EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

Pest Risk Analysis for

Chloridea virescens (Lepidoptera: Noctuidae); tobacco budworm

Early larval instar, lateral view (M. van der Straten, Netherlands Food and Consumer Product Safety Authority, The Netherlands)

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The risk assessment follows EPPO standard PM 5/5(1) *Decision-Support Scheme for an Express Pest Risk Analysis* (available at https://www.eppo.int/RESOURCES/eppo_standards/pm5_pra), as recommended by the Panel on Phytosanitary Measures. Pest risk management (detailed in **Erreur ! Source du renvoi introuvable.**). was conducted according to the EPPO Decision-support scheme for quarantine pests PM 5/3(5). The risk assessment uses the terminology defined in ISPM 5 *Glossary of Phytosanitary Terms* (available at https://www.ippc.int/index.php).

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Based on this PRA, *Chloridea virescens* was added to the EPPO A1 List of pests recommended for regulation as quarantine pests in 2024. Measures for plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures), above-ground fresh cut plant parts intended to be used fresh, fruits, of 'main hosts' and 'likely hosts' (categories 1 & 2) are recommended

Pest Risk Analysis for *Chloridea virescens* (Lepidoptera: Noctuidae); tobacco budworm

PRA area: EPPO region in November 2023
Prepared by: Expert Working Group (EWG) on *Chloridea virescens*
Date: 13-16 November 2023. Further reviewed and amended by EPPO core members and Panel on Phytosanitary Measures (2024-03).

Composition of the Expert Working Group (EWG)

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Comments were provided before the meeting by A. Korycinska (Defra, UK) and G. Schrader (Julius Kühn Institut, Braunschweig, Germany).

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The first draft of the PRA was prepared by the EPPO Secretariat.

Ratings of likelihoods and levels of uncertainties were made during the meeting. These ratings are based on evidence provided in the PRA and on discussions in the group. Each EWG member provided a rating and a level of uncertainty anonymously and proposals were then discussed together in order to reach a final decision. Such a procedure is known as the Delphi technique (Schrader *et al.*, 2010).

Following the EWG, the PRA was further reviewed by the following core members: N. Björklund, J. Boberg, E. Gachet, J.M. Guitian Castrillon, A. MacLeod, C. McGee, R. Potting, D.J. van der Gaag; as well as by the EPPO Secretariat (D. Musolin, M. Suffert, R. Tanner).

The PRA, in particular the section on risk management, was reviewed and amended by the EPPO Panel on Phytosanitary Measures in 2024-03. EPPO Working Party on Phytosanitary Regulation and Council agreed that *Chloridea virescens* should be added to the A1 List of pests recommended for regulation as quarantine pests in 2024.

Summary of the Pest Risk Analysis for *Chloridea virescens*
PRA area: EPPO region at November 2023 (Albania, Algeria, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Guernsey, Hungary, Ireland, Israel, Italy, Jersey, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Montenegro, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Türkiye, Ukraine, United Kingdom, Uzbekistan).
Describe the endangered area: *Chloridea virescens* is more likely to establish from the Mediterranean area through to the Black Sea coast, Caucasus, southwest Russia and Central Asia than in other parts of the EPPO region and especially in areas where the preferred hosts are grown (such as cotton, tobacco, chickpea and tomato). In these areas, there may be several generations per year (up to 5). Economic impact is expected on hosts throughout that area. However, there is an uncertainty on the precise limits of the endangered area related to low soil temperatures in winter, which may limit survival of the pest. *Chloridea virescens* may also establish and cause economic impact indoors throughout the EPPO region.
Main conclusions: *Chloridea virescens* is a polyphagous pest of many field crops (in particular cotton, tobacco and chickpea) as well as of fruits, vegetables and ornamentals. Over 200 hosts are recorded in the literature. The overall likelihood of entry was high with a moderate uncertainty, based on the likelihood of entry on host plants for planting. Entry on asparagus was rated separately as low with a high uncertainty. Other fresh cut plant parts of host plants and host fruits had a moderate likelihood and respectively high and moderate uncertainty. Many host plants of *C. virescens* are present in the EPPO region, in commercial cultivation, gardens, and in nature. Climatic conditions, including soil temperatures in winter, were considered as limiting factors for the establishment of *C. virescens*. The likelihood of establishment outdoors was rated as high with a low uncertainty. The pest is more likely to establish from the Mediterranean through to the Black Sea coast, Caucasus, southwest Russia and Central Asia than in other parts of the EPPO region, and especially in areas where preferred hosts are grown. In part of this area soil temperatures in winter may be too low and limit survival of pupae. Throughout the EPPO region, the likelihood of establishment under protected conditions is assessed to be high with a moderate uncertainty. There may be transient populations outdoors in areas where the pest cannot overwinter. The magnitude of spread was rated as high with a high uncertainty. There is a large trade of host commodities in the region, pupae may also be moved as a contaminant of machinery and of soil, and the pest may disperse by approximately 10 km per generation but there may be movements over longer distances as observed with migratory populations in North America. However, there is a high uncertainty linked to the fact that the pest may not fly at long-distance if it finds suitable hosts, and whether infested commodities will be traded (plants for planting, fruit, above-ground fresh cut plant parts). The magnitude of impact in the current area of distribution was rated as moderate with a moderate uncertainty, focusing on impact in the last ten years, knowing that more impact occurred in the past when no effective control methods were available (especially before transgenic Bt cotton). Economic impact has been reported in some countries during the last ten years. Although the pest is under control in some countries and crops, this is not the case throughout its distribution. The magnitude of impact is lower in some countries like the USA and higher in others such as Peru. Significant impact is expected on many hosts (such as but not limited to: cotton, tobacco, soybean, chickpea, asparagus, tomato), throughout the area of potential establishment, and would be more severe where several generations may occur (up to 5). The pest may also cause damage under protected conditions throughout the EPPO region. The potential impact was rated as high with a high uncertainty, especially in an initial phase until management measures can be fully developed and implemented. Transgenic Bt crops may prove critical to potential impact, but transgenic crops are not authorized for cultivation in many EPPO countries, for example in major cotton producers of the EPPO region or in the EU. There are fewer control options available for organic crops than for conventional crops in the EPPO region, and there may be more impact than in conventional agriculture. Overall, impact may be higher in countries where main hosts are cultivated over large

areas (such as cotton in Uzbekistan or Türkiye). In crops where no management is applied against lepidopteran pests currently, the initial phase until management measures can be fully developed and implemented may take longer. Impact may be different depending on the country, and the speed at which measures can be developed, authorized and implemented.			
Phytosanitary risk for the *endangered area*	**High X**	Moderate ☐	Low ☐
Level of uncertainty of assessment	High ☐	**Moderate X**	Low ☐
Other recommendations: Recommendations for further work are provided in section 18.			

CONTENTS

Pest Risk Analysis for *Chloridea virescens* (Noctuidae)

Stage 1. Initiation

Reason for performing the PRA:
Chloridea virescens (Lepidoptera: Noctuidae - tobacco budworm) occurs in the Americas where it is a polyphagous pest of many field crops (in particular cotton, tobacco and chickpea) as well as of fruits, vegetables and ornamentals. The pest was identified in the EPPO Study on Pest Risks Associated with the Import of Tomato Fruit as a potential threat to tomato crops (EPPO, 2015). Recently, the European Union has established temporary regulation to prevent its introduction into the EU territory, also considering that it had been intercepted on consignments of fruit and vegetables imported from the Americas. *Chloridea virescens* was added to the EPPO Alert List in January 2023 (EPPO, 2023a). In March 2023, the Panel on Phytosanitary Measures (PPM) selected it as a possible priority for PRA, and in June 2023 the Working Party for Phytosanitary Regulations selected it for PRA.

The risk assessment follows EPPO Standard PM 5/5 *Decision-Support Scheme for an Express Pest Risk Analysis* (available at http://archives.eppo.int/EPPOStandards/pra.htm), as recommended by the EPPO Panel on Phytosanitary Measures. Pest risk management (detailed in ANNEX 1) was conducted according to the EPPO Decision-support scheme for quarantine pests PM 5/3(5). The risk assessment uses the terminology defined in ISPM 5 Glossary of Phytosanitary Terms (available at https://www.ippc.int).

PRA area: EPPO region in November 2023 (map at https://www.eppo.int/ABOUT_EPPO/eppo_members)

Note: In this PRA, all elements considered relevant are presented in the text. However, readers wishing a rapid overview of long sections can focus on the bold highlighted text.

Stage 2. Pest risk assessment

1 Taxonomy

Taxonomic classification: Kingdom: Animalia / Phylum: Arthropoda / Subphylum: Hexapoda / Class: Insecta / Order: Lepidoptera / Family: Noctuidae / Subfamily: Heliothinae / Genus: *Chloridea* Duncan (& Westwood), 1841 / Species: *Chloridea virescens* (Fabricius, 1777).

The genus *Chloridea* was reinstated by Pogue (2013). In the literature, the previous name of the pest – *Heliothis virescens* (now synonym) – is often used.

Synonyms: *Heliothis virescens*, *Helicoverpa virescens*, *Noctua virescens* (EPPO, 2023b), *Phalaena rhexiae*, *Xanthia viridescens*, *Xanthia prasina*, *Heliothis spectanda* (Poole *et al.*, 1993).

Poole *et al.* (1993) recognized 13 closely-related species belonging to the '*virescens* species group', all from the Americas and all since transferred to *Chloridea* (Pogue, 2013). *Chloridea virescens* is the most widely distributed and the most common species (Poole *et al.*, 1993).

Within *C. virescens*, Poole *et al.* (1993) identified five geographic populations based on morphology and noted that there may be sibling species. In a DNA barcoding study, Mitchell & Gopurenko (2016) found that *C. virescens* specimens formed 2 separate clusters, and made the hypothesis that the Brazilian populations of *C. virescens* from which sequences were used in their study may have been misidentified or represent a (cryptic) species. However, this has not been confirmed to date. There are strong indications of a differential response of populations of *C. virescens* to sex pheromones by geographic region and host plant (Groot *et al.*, 2009, 2010, 2011; C.A. Blanco, pers. comm.).

All populations are treated as *C. virescens* in this PRA; no distinct species has been described to date.

In experiments, *C. virescens* hybridized with *C. subflexa*, producing fertile F_1 females and sterile F_1 males (Laster *et al.*, 1988; Sheck & Gould, 1996; Oppenheim *et al.*, 2017). *Chloridea virescens* and *C. subflexa* have never been found to hybridize under natural conditions (Oppenheim *et al.*, 2017 citing Teal & Tumlinson 1997).

Common names: (from EPPO Global Database)

English	tobacco budworm
French	noctuelle des bourgeons du tabac, phalène verdoyante
German	Amerikanische Tabakknospeneule, Baumwolleule
Italian	elotide del tabacco
Portuguese	lagarta-da-maçã-do-algodoeiro, lagarta-da-maçã-do-algodão (Brazil)
Spanish	gusano de la yema del tabaco, oruga capullera (Argentina), perforador de la cápsula, gusano tabacalero
Turkish	tutun kapsul kurdu

Chloridea virescens also has local names based on the crops attacked, such as geranium budworm in Colorado (Cranshaw, 2020).

EPPO code: HELIVI

2 Pest overview

2.1 Morphology

Morphological characters of *C. virescens* are summarized in Table 1. Pictures are provided in ANNEX 2.

Table 1. Morphological characters of *C. virescens*

Stage	Description	Size*
Eggs	Spherical with flattened base (Capinera, 2001). Unfertilized eggs are green-whitish, fertilized eggs dark coloured (Zweerus *et al.*, 2021). Develop a reddish-brown band just prior to hatching (NCSU, 2016).	0.5-0.6 mm wide and high (Capinera, 2001; Neunzig, 1964).
Larvae	Five to seven instars, most often five or six (Capinera, 2001; Rodríguez-Espinosa *et al.*, 2018b). Young larvae yellowish or yellowish-green, with a yellowish-brown head capsule. Late larval instars vary in colour (yellow, greenish-yellow, green, pinkish, red or reddish-brown, light brown, greyish). Dorsal and lateral whitish bands, brown head capsule, and many black thorn-like microspines on the body (rough feel). (Capinera, 2001; NCSU, 2016; Cranshaw, 2020; Rodríguez-Espinosa *et al.*, 2018b).	1-4 mm for the first instar (Capinera, 2001; Neunzig, 1964), 2nd 3-8 mm, 3rd 9-15; 4th 18-26, last instar 23-45 mm (Capinera, 2001; Edde, 2018; Neunzig, 1964).
Pupae	Shiny reddish brown, becoming dark brown prior to emergence of the adult (Capinera, 2001).	18 mm long and 5 mm wide (Capinera, 2001).
Adults	Brownish to brownish olive or olive (Capinera, 2001; NCSU, 2016). Three transversal dark bands (dark olive or brown) on the forewings (Capinera, 2001; NCSU, 2016), each often accompanied by a whitish/cream-coloured border (Capinera, 2001). Hind wings whitish with a dark band on the distal margin (Capinera, 2001).	28-38 mm wingspan (Capinera, 2001; Edde, 2018).

* figures may be rounded, precise ranges can be found in publications.

2.2 Life cycle

Number of generations

The number of generations of *C. virescens* in its distribution varies. The literature mentions 1 to 5 generations per year in the field in North America depending on the latitude, 6 generations in Alto Piura (Northwestern Peru), and up to 12 generations per year in the laboratory. In different parts of its distribution, the pest may complete its life cycle all-year round, or generations occur from spring to autumn followed by overwintering of pupae, or generations may develop only during the summer or

there are only migrating adults during the summer. The geographical limits between these areas cannot be clearly specified (see section 2.3).

- Eight generations per year were reported by Manzanarez Jiménez (2020) in the laboratory on artificial diet (from larvae collected in the field on chickpea, kept at 28°C, 80% relative humidity (RH), 14:10 light:dark. When rearing *C. virescens* in the laboratory on artificial diet (described in Blanco *et al.*, 2009a), it was possible to obtain a generation every 26-28 days, i.e. approximately 12 generations per year (C.A. Blanco, pers. comm.).
- Six generations per year in the field is the maximum reported in the literature used in this PRA, in Alto Piura, Northwestern Peru (Benza, 1960). No further information was found for Central and South America.
- In Northern Mexico up to five generations can be found (C.A. Blanco, pers. comm.).
- 'At least five' generations per year have been reported from Louisiana, four from northern Florida and North Carolina (Capinera, 2001).
- Two generations over the summer are reported in Colorado and Nebraska, where the pest is mostly unable to survive the winter (see section 2.3) (Cranshaw, 2020; University of Nebraska, 2023).
- No generations are mentioned from northeastern USA (see section 2.3).

The presence of the pest during the year varies depending on the conditions (e.g climatic conditions, availability and distribution of host plants):
- All year-round: completes its life cycle with generations following each other, no overwintering needed.
- Generations from spring to autumn (complete life cycles) followed by overwintering of pupae.
- Few generations during summer, and the pest is mostly not able to overwinter. It may occasionally be able to overwinter in protected places.
- Only adults during summer, and no generation completed.

In all areas, some individuals may arrive by migration or enter on plant material. Details are provided in section 2.3 in relation to environmental requirements.

Generation time and biological parameters

The generation time reported in the literature used in this PRA ranges from 26 to 77 days.

- Castillo-Valiente & Pesantes (2004) mentioned that *C. virescens* completes its life cycle in 46-77 days according to Valdivieso & Bartra (1983), or 36 days in summer and 78 days in winter according to Wille, 1952.
- In experiments where larvae were fed on various plant substrates (27±0.4°C, 75±10% RH), the shortest generation time was approximately 26 days on artificial diet as well as on lyophilized (freeze dried) host plant tissues of *Cicer arietinum* (chickpea); on fresh tissue of several other hosts, generation times ranged between 30 days on *Geranium dissectum* to 47 days on *Gossypium hirsutum* (cotton) (Blanco *et al.*, 2008a).
- The life cycle in other experiments on various substrates (see ANNEX 3) is in the range 27-55 days.

Biological parameters of *C. virescens* reported in the literature from experiments on various host plants are summarized in ANNEX 3.

Life stages

Adults are active (flying, feeding, mating) at dusk. Adult females produce a sex pheromone and may lay 200-1600 eggs in their lifetime (see Table 2). In experiments, adults were reported to live up to 58 days with food, and 3-5 days without food. Eggs may be laid (normally individually) on any aerial plant parts that provide tender tissue suitable for the development of young larvae, while older larvae may feed on harder plant tissues. Pupation happens in the soil, normally at 2-4 cm deep. Facultative winter and summer diapauses of pupae allow survival through unfavourable periods. As for other Lepidoptera, a proportion of females will not lay eggs, even in suitable conditions, and virgin females may lay eggs, which are not viable and will not hatch.

Adults

- Adults are active in the early evening (Cranshaw, 2020). If disturbed during the day, they fly a short distance to another plant (C.A. Blanco, pers. comm.).
- Strong attraction of *C. virescens* to light is mentioned in Méndez Barceló (2003). Light traps were used in the 1960-70s to trap *C. virescens*, but a switch to pheromone traps was later made (the effectiveness of pheromone traps is discussed in section 2.8).
- *Chloridea virescens* adults feed on the flower nectar of various plants, not necessarily true hosts (Cunningham & Zalucki, 2014; Tingle *et al.*, 1992; Adler, 1987; Jørgensen *et al.*, 2007).
- In experiments, adults emerging from larvae raised on various substrates were observed to live for 6-58 days, more usually 10-25 days (ANNEX 3).
- In the absence of food, adult longevity in two experiments was 3-5 days:
  - 3 days at 25°C, 70% RH, raised from larvae on soybean (Boiça Júnior *et al.*, 2022);
  - 5 days at 27.3-29.5°C, 71-88.5% RH, raised from larvae on tobacco (Mendés-Barceló *et al.*, 2003).
- The pre-oviposition period of females was 'at least 2 days' in laboratory experiments on cotton (Fye & McAda, 1972), and 1-2 days after copulation in the laboratory (C.A. Blanco, pers. comm.).

Females release a sex pheromone (Z11-16:OH - Groot *et al.*, 2018; Foster *et al.*, 2020 – and several lures and traps are commercially available, see sections 2.8 and 12).

- Females lay eggs on blossoms, fruit and terminal growth of plants (Capinera, 2001), individually (Pratissoli *et al.*, 2006). Córdova Vega (2015) mentions that eggs are occasionally laid in groups in the case of high population, but this is not observed by C.A. Blanco (pers. comm.). They choose tender tissue, suitable for the development of early larval stages and avoid unsuitable tissue sites such as bark or branches (C.A. Blanco, pers. comm.). For example, Fitt (1989) mentions that *C. virescens* prefers to lay eggs on young, tender leaves.
- As for other Lepidoptera, a proportion of females will not lay eggs, even in suitable conditions. In addition, virgin females may lay eggs, which are not viable and will not hatch (K. El Fakhouri, C.A. Blanco, pers. comm.). In experiments with laboratory and feral adults, approximately 40 % of the females did not lay fertile eggs (Blanco *et al.*, 2006).
- A female generally lay eggs over a period of one or two weeks (C.A. Blanco, pers. comm.). In experiments on *Asparagus*, the oviposition period of a female lasted 15 days (Carrera & Vergara, 2013). In experiments with an artificial diet, Fye & McAda (1972) observed that 85-98% of the eggs were laid within 15 days after the emergence of the females, but some eggs were laid over a longer period (30-40 days at 20 or 25°C, over 20 days at 30 or 33°C) (Fye & McAda, 1972).
- The numbers of eggs reported in the literature used for this PRA are in Table 2.

Table 2. Number of eggs laid by females of *C. virescens*

Number of eggs	**References**
40-120 eggs per day for females reared on artificial diet	Blanco *et al.*, 2009a
200-500 eggs per female lifetime	Many studies, incl. Fye & McAda, 1972, also citing others; Castillo-Valiente & Pesantes, 2004 on asparagus
for females emerged from larvae raised at 20-25°C and raised on artificial diet, 1000-1600 eggs (during their lifetime) (against 350-500 eggs for females emerged from larvae raised at 30-33°C)	Fye & McAda, 1972
Approximately 700 eggs per female lifetime on asparagus (average; range 350-1020- 25°C, 70% RH) and on tobacco leaves	Asparagus: Carrera & Vergara, 2013, Cruces, 2022 reporting Carrera results Tobacco Méndez Barceló, 2003

Eggs

- Various studies found incubation times in the range of 2-5 days (27-29°C, 71-88 % RH; Méndez Barceló, 2003, Carrera & Vergara, 2013; Manzanarez-Jiménez, 2021; CIAT, 1983).
- In preliminary experiments, hatching of larvae from eggs kept at 3°C (fridge) for several days and then transferred to 22°C was assessed. Emergence of larvae over a period of 5 days was highest for eggs kept 0-4 days at 3°C, was decreased for eggs kept for 5-7 days, minimal after 8 days, and null after 9-10 days (C. Blanco, pers. comm., preliminary results).

Larvae

- Larvae can be found on the plants during the day (C.A. Blanco, pers. comm.). Davidson *et al.* (1992) mention for flower crops that larvae may be inactive during the day or be hidden in flower structures.
- L1 larvae feed on tender tissues, such as the growing points and reproductive structures of tobacco (Fitt, 1989). Around the L2 and L3 stages, larvae may bore into harder plant tissues, such as the flower buds and bolls of cotton (*Gossypium hirsutum*), the seed capsule of velvetleaf (*Abutilon theophrasti*), the pods of chickpea (*Cicer arietinum*), deep into tomato fruits (*Solanum lycopersicon*) (C.A. Blanco, pers. comm.). Because of this, the PRA does not exclude that larvae may attack other fruits with a hard enveloppe.
- Survival of larvae without food is limited to a few days. Boiça Júnior *et al.* (2022) used neonate larvae hatched 'within the previous 12 h' and deprived of food since eclosion, i.e. they had survived during that period. When challenging L1 larvae with insecticide-treated diet, larvae can remain alive for 11 days, although larvae subjected to such detrimental conditions do not recover if moved to untreated diet (C.A. Blanco, pers. comm.). In preliminary experiments, L1 larvae hatched within the previous 24 h were kept individually without food, and exposed to 3°C for different periods. Larvae that were not subject to a period at 3°C died within 5 days. All larvae subject to a period of 1-5 days at 3°C and then transferred to room temperature were dead after 4 days (C. Blanco, pers. comm., preliminary results).
- Cannibalism of *C. virescens* larvae has been observed (Wiseman & McMillian, 1969, Brazzel, 1953).
- The larval stage was recorded to last 11-34 days on average in experiments on various substrates (ANNEX 3), with extremes at 46 days.

Pupae

- Mature larvae burrow into the soil to pupate. Eger *et al.* (1983) found pupae at an average depth of 2.58 cm (range 1-6 cm), and noted that other previous studies reported a range of 3.4-4.4 cm. In extensive studies on pupae in the field (Schneider, 2003), soil samples were collected up to approximately 5 cm depth. Although two summary factsheets (NCSU, 2016; Cranshaw, 2020) mention wider ranges (e.g. 2-6 inches, 5-15 cm), this is not reflected in studies on pupal depth.
- The pupal stage was recorded to last 7.5-22 days in experiments on various substrates (ANNEX 3).
- Emergence of adults is triggered by sufficient temperature and humidity. In Alto Piura in Northwestern Peru on cotton, rainfall was important to allow for emergence, and in one year, pupae of the last generation did not emerge due to insufficient humidity (Benza, 1960).
- Facultative pupal diapauses in winter and summer allow *C. virescens* to survive unfavourable periods.

Overwintering pupal diapause. In Northwestern Peru, overwintering diapause was triggered by absence of rain that prevented emergence of adults (Benza, 1960). Overwintering diapause triggered by low temperatures or short day-length occurs in a part of the distribution of *C. virescens* in North America (see section 2.3). In Sonora, Mexico, *C. virescens* enters diapause under less than 10 h of light and temperatures below 18°C (J. Martínez-Carrillo, pers. comm.). In the related species *Helicoverpa armigera* and *H. zea*, the incidence of winter diapause increases with latitude, but a small proportion of pupae may diapause even in populations breeding continuously in tropical conditions (Fitt, 1989). Similarly, *C. virescens* is present all year-round in parts of its distribution (section 2.3), and part of the population may enter winter diapause (although this is not specified in the literature).

Summer pupal diapause occurs especially in males and is triggered by high temperatures before pupation. In laboratory and insectary experiments, such diapause occurred only when the maximum temperature exceeded 32°C (see section 2.3). Summer diapause confers an advantage to the pest, as the viability of eggs laid by females mated with males that did not enter summer diapause is low. Butler *et al.* (1985) found that, while the duration of pupation in summer when no diapause occurs was 10-15 days, all pupae entering summer diapause emerged during end September-early October, and a few in the following spring. In Coahuila, Mexico, where similar warm temperatures occur, summer diapause of few individuals was observed at 40°C and 13.5 h of light (U. Nava-Camberos, pers. comm.).

2.3 Environmental requirements

In the field, 1-6 generations of *C. virescens* are reported under a wide range of climates, from tropical to oceanic climates.

In this PRA, it is assumed that soil temperatures in the range and durations expressed by Eger *et al.* (1982) (e.g. approximately 15 h at –10°C, 16 days at –6°C, 42 days at –2°C, 52 days at 0°C) are likely to

kill overwintering pupae. However, some pupae in protected places may survive when such temperatures occur in the field. A few frost days (air temperatures) during the winter, even if < –10°C, did not influence the pupae population.
The minimum temperatures for survival of eggs, larvae and adults are not known. Degree-days studies used minimum development thresholds ranging from 12.6 to 13.3°C. In experiments, eggs and L1 larvae without food were able to survive a few days at 3°C (C. Blanco, pers. comm., preliminary results – see section 2.2.).
In part of the range, winter diapause occurs. High soil moisture/rainfall at the start of the diapause have an influence on the survival of pupae, and in areas exposed to sustained soil saturation (e.g. heavy storms or floodings), a high proportion of pupae may not be able to survive.
The pest may develop and reproduce all year-round in greenhouses if hosts are present.
Given its current distribution and summer diapause, the pest can survive periods around 40°C, especially if temperatures above 32°C have occurred during the larval stage that will induce summer diapause. However, temperatures above 30°C throughout the life cycle generally reduce fecundity, longevity and egg viability.

Maximum temperature thresholds for survival and development
The maximum survival temperature in the field is not documented in the literature used for this PRA, but the pest is present in hot areas. High temperature affects different life stages differently. Populations may be greatly diminished if male pupae do not enter summer diapause (this depends at which stage larvae were exposed to high temperatures) due to the very low viability of eggs produced by females mated with undiapaused males or with males diapaused in a late larval stage (Butler *et al.*, 1985, see section 2.2). However, few individuals may still survive and emerge.

At variable temperatures programmed to reflect temperatures in cotton fields in Arizona (over 40°C during part of the day), incompletely pupated individuals were observed at higher temperatures; high temperatures throughout the experiment (30-33°C) reduced fecundity and longevity (Fye & McAda, 1972). In experiments, the percentage of eggs hatching was very low (2-3%) when third to last instar larvae were exposed to fluctuating temperatures of 23.9 to 40.6°C (Butler *et al.*, 1985).

In laboratory and insectary experiments, exposure of larvae to high temperatures during the whole larval stage (either daily 8-h exposure at 43°C, or fluctuating temperatures of 23.9 to 40.6°C) caused summer diapause in over 95% males (and approx. 50% of females). Exposure of pupae to high temperature some days after pupation still caused a limited percentage of males to diapause (Butler *et al.*, 1985).

Minimum temperature thresholds for survival and development
Published data was not available on the minimum temperature for survival of eggs, larvae and adults. Degree days studies used minimum development thresholds ranging from 12.6 to 13.3°C (see ANNEX 4). In a study on devitalization treatments, 100% mortality of eggs and L1 larvae of *C. virescens* was obtained after 12 h at –8°C (Blanco *et al.*, 2018). However, the EWG notes that this temperature is certainly lower than the true minimum temperature for survival of larvae. In preliminary experiments, eggs and L1 larvae without food were able to survive exposure to a few days at 3°C (C.A. Blanco, pers. comm., preliminary results – see section 2.2.).

Relative humidity
Chloridea virescens is present from tropical to arid areas, and relative air humidities are not considered to be a limiting factor overall. Romani (2019) observed the presence of larvae in watermelon fields in the range of relative humidity of 45-75 % (and temperatures of 18.3-33.7°C); the highest populations were observed at 18.3-22°C with 60-70% relative humidity. *C. virescens* continues to be an important pest in areas where the temperatures during the growing season of its hosts range between 9 and 40°C, and relative humidity ranges between 30 and 73% in the Pacific Northwest of Mexico (Sinaloa, Sonora and Baja California) (C.A. Blanco, pers. comm.). The pest thrives in arid areas of the Northern coast of Peru and the Pacific Northwest of Mexico, where crops are grown under irrigation (see also section 9.2). Finally, soil moisture in relation to survival of pupae in winter is dealt with further down.

Presence of the pest during the year depending on environmental conditions
Throughout Nebraska, *C. virescens* can develop year-round in greenhouses (University of Nebraska, 2023), provided hosts are present throughout the year. In Baja California, Mexico, *C. virescens* may oviposit on tomatoes in greenhouses, but only in August-September (C.A. Blanco, pers. comm.).

Outdoors:

- *Generations all-year round*

Winter diapause is not needed (although some individuals may diapause – see below and section 2.2) and there may be generations year-round provided hosts are present. Presence of the pest year-round is reported for coastal conditions in Peru (FAO, 2016; Navarro, 2019), with a higher incidence in spring and summer (FAO, 2016). Hambleton (1944) mentioned presence and damage by *C. virescens* throughout the year in the Cañete Valley (Peru) with active larvae during the winter though most individuals were overwintering pupae. In the Pacific Northwest of Mexico (Sinaloa and Sonora) and Northeastern Mexico (Tamaulipas and Veracruz), *C. virescens* may be present all year round (C.A. Blanco, pers. comm.).

No information was found on the northern and southern limits of the area where *C. virescens* produces generations all-year round, nor on precise conditions conducive to this (temperatures should be sufficient for larval and adult activity, and not trigger diapause). In the north, the limit is somewhere between Central America and southern USA. Florida and California are the only US states with records of adults in all months of the year (http://mothphotographersgroup.msstate.edu/large_map.php?hodges=11071); it is not known if adults are present every year or only in favourable years.

- *Generations over spring-autumn and overwintering*

Winter diapause occurs. In the USA, Capinera (2001) mentions that overwintering is generally successful only in southern states. In these areas, there can also be migrating individuals arriving in spring. In northwestern Mississippi, population dynamics are probably due both to adults migrating in spring and an overwintering population (Hernández & Blanco, 2010, 2019). In southern USA, adults of the first generation emerge from March through May, several generations then develop, and overwintering starts in September-November (Capinera, 2001). In North Carolina the first generation emerges from late April to mid-May (NCSU, 2016). In Mississippi the first generation emerges in April (Laster *et al.* 1987), and the fourth generation can be found on cotton at the end of September (Scheffler *et al.* 2012). In field studies in Arizona with a lower development threshold of 12.8°C, the first emergence in spring (from 1 January) occurred after accumulation of 151 degree-days (Potter *et al.*, 1981).
The parameters mentioned in the literature as being detrimental to the survival of pupae during winter are: high soil humidity, low soil temperatures and tillage.

- In northeastern Mississippi, Schneider (2003) found that both soil saturation and tillage negatively influenced survival. Over the growing seasons 1995-2001, density of (live) pupae was lower in years when soils were saturated by rain storms in late summer and early autumn. The highest densities of (live) pupae were found in 1995 and 1998, when there was no rainfall events exceeding 25.4 mm per 24 h during a period of 8 weeks starting 1 September. *Chloridea virescens* is still able to maintain populations in areas with high rainfalls, in saturated and cold soils.
- Eger *et al.* (1983 citing another Eger *et al.*, 1983) note that survival of pupae held in an insectary in three types of soil during the same two winters was significantly lower at 25% soil moisture than at 10% soil moisture. Nevertheless, soil moisture (combined with appropriate temperatures) is also necessary to trigger emergence of adults (Benza, 1960). In field trials, Eger *et al.* (1983) concluded that moisture may be more important than temperature for the survival of pupae. Over two winters in 1978-1980, survival was highest during the winter with higher soil temperatures (no measurement below –0°C at 2.5 cm depth) and lower humidity (17% instead of 19%).
- Regarding soil temperatures, Cranshaw (2020) notes that overwintering pupae are generally killed if exposed to temperatures below –7°C. Lower temperatures are mentioned in experiments with pre-conditioned diapausing larvae (Eger *et al.*, 1982), where 90% mortality was obtained: after 15 h at –10°C, 547 h (approx. 23 days) at –8°C, 415 h at –6°C (approx. 16 days), 1015 h (approx. 42 days) at –2 °C, 1250 h (approx. 52 days) at 0°C. The mortality of pupae was low at 8° and 10°C (seldomly exceeding the control).
- In field experiments in northeastern Mississippi, Schneider (2003) found that air temperatures did not influence the survival of pupae, not even during the coldest spell (3-5 February 1996, with minimum air temperatures from –13 to –15°C and maximum temperatures not exceeding –6.7°C).

The limit of overwintering survival is generally mentioned as being ‘south of 40°N latitude’ (Hernández & Blanco, 2010). However, the area described in Poole *et al.* (1993) corresponds more to approximately 37°N (‘regularly overwinters …from Florida to Georgia through Texas and as far north as North Carolina, and in Arizona and southern California’). 37°N was retained when illustrating the possible overwintering limit on various maps in this PRA (e.g. section 6). There is no information on the overwintering limit in South America.

There may be a transition area where larvae can survive outdoors in winter, however, no field evidence was found, and this was not considered further in this PRA. In a study using modelling, Hernandez & Blanco (2019) found that the dynamics of *C. virescens* observed from field data in the Mississippi Delta was better explained by larvae of the last generation in a year surviving winter temperatures, than by migration from the South, and concluded that some larvae may be able to survive winter. They report that in laboratory experiments with variable temperatures, some larvae were able to survive artificially-simulated winter temperatures.

- *Few or no generations during summer, and pupae are mostly not able to overwinter, except in protected places*

Cold, freezing temperatures during the winter prevent establishment in the Pacific Northwest (PNW Moths, 2023). However, findings suggest local reproduction during summer of individuals possibly arrived by migration or traded commodities (PNW Moths, 2023, Landolt, 2008).

For northeastern USA, only mentions of individuals (adults) were found in the literature, not of summer generations (Capinera, 2001). In northern USA and southern Canada, populations found during the late summer are believed to be migrants from overwintering sites in the south (Edde, 2018). Adults were reported in New York in July-October (Capinera, 2001; Moth Photographers Group, 2023), Maine in August (Moth Photographers Group, 2023) and Ontario in July (Rockburne & Lafontaine, 1976).

In Nebraska, the first generation emerges in late spring, and the second (and last) in August-early September (University of Nebraska, 2023). The severity of winter determines the number of overwintering pupae and likelihood of a pest outbreak in the following year. In Colorado, damage is worst following mild winters when soil does not freeze deeply (Cranshaw, 2020).

In areas where pupae generally cannot overwinter, they may survive in greenhouses and sheltered locations (Capinera, 2001). Pupae may for example be able to survive:

- in warm/protected soil microclimates, for example around the foundations of heated buildings (Cranshaw, 2020), or structures such as patios or courtyardsthat hold heat (University of Nebraska, 2023).
- potted/container plants stored during winter in protected places, such as garages (Cranshaw, 2020; University of Nebraska, 2023).

2.4 Dispersal capacity

Flight activity allows the pest to find alternative hosts for adult and larval feeding and is important in the seasonal dynamics of the pest. Long-distance flight and migration mostly occur in response to resource shortage at high levels of population and poor local conditions.
This PRA considers that *C. virescens* is highly mobile. Adults can fly approximately 10 km within a generation, but a minority may be able to engage in longer flights (<120 km). Migratory flights (passive) may occur in favourable wind systems, but probably few individuals are involved in such dispersal. Such flights may be longer than active flights but they would not reach 1000 km distance.

Larvae of *C. virescens* crawl and adults fly.

Crawling. No data was found on the crawling distances of larvae, but they are reported to move within plants and between plants to find food.

Flight. Adults of *C. virescens* have a high dispersal capacity by flight (Boiça Júnior *et al.*, 2022), as shown by mark-recapture studies and radar observations (Hendricks *et al.*, 1993; Farrow & Daly, 1987; Schneider 1999; Groot *et al.*, 2011 citing Wolf *et al.*, 1986, Westbrook *et al.*, 1994). Most flight activity is nocturnal (Fitt, 1989 citing others). Adult flights can be separated into the following categories (as used in Farrow & Daly, 1987; Fitt, 1989):

- *Short range*: within or above the host canopy to feed, oviposit, mate, shelter, and confined within habitats over distances of 100-1000 m. Local movements within crops and between alternative crops and wild hosts are important in the seasonal dynamics of the pest (Farrow & Daly, 1987; Fitt, 1989).
- *Long range*: up to 10 m above the canopy, usually downwind, movements between crops, feeding and oviposition sites, and between emergence and oviposition sites (Farrow & Daly, 1987; Fitt, 1989).
  Several authors report that movement (per generation) of *C. virescens* < 10 km are more common, as shown by mark-recapture studies with pheromone traps (Schneider, 1989, 1999), or studies on the variance of populations (Korman *et al.*, 1993). Longer distances have also been reported (see further down).
- *Migratory movement*: above the flight boundary layer with synoptic scale wind systems up to 1-2 km altitude, during several hours, resulting in downwind displacement (Farro & Daly, 1987; Fitt, 1989). *C. virescens* has traditionally been considered as facultative migratory (e.g. Schneider 1989). Passive migratory movements from Mexico northward have been documented (Raulston *et al.*, 1986). Migration occurs in response to poor conditions for reproduction (shortage of nectar sources for adults or of larval hosts), including through weather events (Fitt, 1989 citing others).
- In the northern part of North America, *C. virescens* is believed to disperse northwards annually, reaching for example New England, New York and southern Canada during the late summer (Capinera, 2001).

In mark-recapture studies or captures offshore, long distance movements (from 40 to 160 km) were measured:
- few males released in Mississippi were trapped in a satellite area over 40 km away (Schneider, 1999).
- in southern Texas, in an experiment in which approximately 900 000 males were released in southern Texas, 460 released males were recaptured at various distances, from which more than 30 % were recaptured at more than 51 km, and up to 113 km (presumably dispersed over 4-5 days) (Hendricks *et al.*, 1973).
- in trapping studies of insects offshore (unmarked individuals), one male of *C. virescens* was trapped 74 km offshore in the Gulf of Mexico, and another 160 km offshore (Schneider, 1999 citing Wolf *et al.*, 1986).
- 4 males (out of 18 000) released in Mexico were recaptured 160 km away in the Lower Rio Grande Valley of Texas, and 5 males (out of 44 000) released in Texas were recaptured 130 km to the north (Raulston *et al.* 1982).
- 18 males (unknown initial number) released on St. Croix were recaptured 67 km away on Vieques and 5 males 61 km away on St. Thomas (Schneider, 1999 citing Haile *et al.*, 1975).

Blanco (2012) notes that probably only small numbers of individuals reach areas in the north, and certainly not at distances of 900-1050 km (distances some adults would have to cover from Mexico in order to migrate to Louisiana or Mississippi, and too far for adults to actively migrate every year). Some studies suggested that low numbers of *C. virescens* migrate, while the majority diapauses and survives local conditions, giving rise to local populations (Blanco, 2012 citing Roehrdanz *et al.*, 1994; Hernandez & Blanco, 2010). Blanco *et al.* (2012) conclude that yearly colonization of Mississippi and Louisiana by migrating adults is improbable.

A study on the genetic differentiation of *C. virescens* and *C. subflexa* based on populations in Southeastern USA to Mexico, showed no genetic isolation of *C. virescens* due to geographical or temporal distance, nor differentiation based on host plant association for *C. virescens*, and this homogeneity likely results from the high mobility and generalist feeding behaviour (Groot *et al.*, 2011). Nevertheless, Groot *et al.* (2009) found a significant higher response of *C. virescens* males to females from the same geographical area, than to females from a distant geographical origin.

Evidence of migratory movement exists for related species, in decreasing order of migratory activity: *Heliotis punctigera* > *Helicoverpa zea* > *Chloridea virescens* > *Helicoperva armigera* (Farrow & Daly, 1987; Fitt, 1989).

2.5 Natural enemies

Natural enemies mentioned in several publications are listed in ANNEX 5 as examples. High levels of parasitism by parasitoids have been observed. Effectiveness of the parasitoids varies among crops.

2.6 Nature of the damage, plant parts attacked and location of life stages on the plants

Damage is due to larval feeding. All above-ground plant parts can be attacked, while underground plant parts are never attacked. The plant parts fed on depend on the suitability of plant tissues. L2 and L3 larvae, as well as older larvae, are able to attack harder plant tissues than L1 larvae (see section 2.2). The type of damage on various hosts is reported in Table 3.

Depending on the host (see section 7) and larval stage, larvae may feed on buds, flowers, terminal foliar growth, leaf petioles and stalks, leaves, soft stems and shoots, bolls, capsules, fruit, and pods and their grains (Capinera, 2001 and examples in Table 2). In some hosts, larvae are within plant organs, and therefore hidden/protected (e.g. in geranium flower buds and stems – Cranshaw, 2020; in the internal part of grape bunches – Ventura *et al.*, 2015; in chickpea pods and grain – Alvarez Hernández *et al.*, 2010 citing others, Blanco *et al.* 2009b).

Within a growing season, successive generations of *C. virescens* may pass onto – and damage – different hosts, depending on the availability of suitable plant tissues. The use of alternative hosts is related to the presence of abundant food resources that determine population growth (Ventura *et al.*, 2015 citing Capinera, 2001).

- Wild hosts and weed hosts are of major importance for the populations of the pest, for example during periods when crops are not available (Kogan *et al.*, 1989; Blanco, 2012; Allen *et al.*, 2024). In Southeast USA, the first generation usually infests a wild host, then two generations attack cotton and the fourth generation can be found again on wild hosts (Stadelbacher, 1981; Allen *et al.*, 2024).
- Within a crop, there can be several successive generations if the plants remain appropriate for feeding. Chickpea crops can sustain two generations of the pest (Pérez & Suris, 2012), and Benza (1960) observed 5 generations on cotton. In Northern Mexico, within a year there may be two generations in chickpeas and wild hosts, and up to three on cotton (C.A. Blanco, pers. comm.).
- According to Capinera (2001), for the USA, *C. virescens* attacks mostly field crops such as alfalfa, clover, cotton, flax, soybean, and tobacco, but vegetables are occasionally attacked, especially when cotton or other favored crops are abundant (i.e. understood to be in situations when populations are high); *C. virescens* is also a common pest of flower crops.
- There are numerous examples of host switches within a growing season, for example: geranium to petunias (Davidson *et al.*, 1992), soybean to grapevine (Ventura *et al.*, 2015), cotton to sunflower (Teetes *et al.*, 1970), cotton to soybean (Fidelis *et al.*, 2019).

Field experiments showed that larvae that developed on one host, did not colonize other hosts (e.g. chickpea to cotton), and that mating success from individuals isolated from different hosts was very low (C.A. Blanco, pers. comm.). Similar behaviour is also observed for *Helicoverpa armigera* in Morocco (K. El Fakhouri, pers. comm.).

Table 3. Type of damage by *C. virescens* larvae on several hosts

Host	Plant part attacked, damage	Reference
Gossypium hirsutum cotton	Can attack terminal buds and reproductive organs. Flower buds and bolls are damaged and may drop. Holes can favour entry of pathogens.	Ministero del Ambiente, 2020 Miranda, 2010
Nicotiana tabacum tobacco	Buds, flowers, capsules are attacked. Damage to buds or growing tips, which then produce ragged and distorted leaves. Also chew holes in leaves. Eggs on buds and leaves, larvae usually attack flower buds and ovaries of developing flowers.	Rodríguez-Espinosa *et al.*, 2018a Crop Profile, 1999 Zilnik *et al.*, 2020
Glycine max soybean	All aerial parts may be attacked, incl. leaves, pods, branches. First instars feed on vegetative structures and later instars move to pods.	Boiça Júnior *et al.*, 2022 citing others
Helianthus annuus sunflower	Feed on the back of flower heads and also on seeds; leaves can be almost entirely consumed (referring to several species of Lepidoptera, incl. *C. virescens*). Came from nearby cotton after defoliation of that crop.	Teetes *et al.*, 1970
Linus usitatissum flax	Flower buds and capsules.	Hambleton (1944)
Cicer arietinum chickpea	Females lay eggs on leaves and flowers. When neonate larvae hatch from eggs, they feed on leaves during their first stages. Afterwards, later instars migrate to pods, damaging grains including at the stages of filling and ripening of the pods. Some plants are entirely eaten	Borella Júnior *et al.*, 2022 Alvarez Hernández *et al.*, 2010 citing others Blanco *et al.* 2009b

Host	Plant part attacked, damage	Reference
Phaseolus vulgaris bean	Can feed on all structures. Found on foliage and fruiting structures.	Boiça Júnior *et al.*, 2017 citing others CIAT, 1983
Cajanus cajan pigeon pea	Can feed on leaves, flowers, buds, pods and seeds.	Viteri *et al.*, 2019 citing others; Korytkowski & Torres, 1966
Lablab purpureus Hyacinth bean	Buds, blossoms, seed pods.	Hambleton, 1944
Aspagarus officinalis asparagus	Feed on foliage on main or lateral stems. This normally does not affect growth, but when new shoots appear, larvae attack the apical part or bore into stems, destroying them. Sometimes all new shoots are destroyed. In high infestations, can feed on developed leaves, causing severe defoliation.	Córdova Vega, 2015 citing others
Citrullus lanatus watermelon	Found attacking leaves, flower buds and recently fecundated flowers. Not observed on fruits.	Romani, 2019
Chenopodium quinoa quinoa	First instars feed on leaves and young shoots, and later instars on developing flowers and grains	Cruces, 2022; FAO, 2016
Lactuca sativa lettuce	Can destroy seedlings by feeding on the crown, and can bore into the heads of maturing lettuce.	UC IPM, 2017
Solanum lycopersicum tomato	In observations, first instars (L1 to L3) fed on leaves and flowers, and late instars on fruits, causing 0.5-0.8 mm holes, 2-3 cm from the calyx. Larvae consumed 50-70% of a fruit before moving to another fruit. Larvae can be inside the fruit.	Manzanarez Jiménez, 2021 C.A. Blanco, pers. comm.
*Vaccinium corymbosum** Highbush blueberry	Damages shoots, leaves, inflorescences and fruits. Feed on leaves of the terminal shoot, leading to lower yields. Can also attack flowers, capsules and seeds, and can also affect developed seedlings. Larvae pierce the fruits, and damaged fruits rot and fall.	Narrea *et al.*, 2022 NovAgro-Ag, 2023 citing Rojas, 2016
*Vitis vinifera** Grapevine	On young bunches, bore into buds, blossoms, and small fruits. Bunches were damaged internally as well as berries on the periphery; so the attack was easily observed. There was one to five larvae per bunch.	Ventura *et al.*, 2015
*Malus domestica** apple	Feed on buds, leafs, flower buds, flowers and fruits. Larvae move between fruits.	De Tomás & Peralta, 1994
Flowering plants (incl. *Petunia*, *Pelargonium*/geranium snapdragon etc.)	Usually attack flower buds and ovaries of developing flowers. On geranium, mostly feed inside flower buds and stems, while on petunia mostly feed on leaves and blossoms. Attack the buds of developing flowers, only rarely plant leaves. Emerging larvae tunnel into the stems and developing flower buds. Damaged flowers fail to open, dry up and die. Later instars eat entire flower buds and feed on petals, giving flowers a ragged appearance. Severely affected plants may produce few or no viable flowers. At high densities, larvae of any stage can devour all buds and flowers On geranium, eggs on blossom clusters, larvae often destroy entire clusters, and plants fail to produce flowers	Cranshaw, 2020 University of Nebraska, 2023 Davidson *et al.*, 1992 Hambleton, 1944

* note that published records on some hosts above are limited: for example, only one record for grapevine, records limited to one area of Peru in the 1990s for apple, and records only from Peru for blueberry. See also sections 7 and 12.

2.7 Signs and symptoms

Feeding damage (see section 2.6 and table 3) and frass can be observed on the affected plant parts. However, damage may be confused with that of other lepidopteran pests. For example, damage on tobacco, tomato or cotton is similar to that caused by *H.* zea (Capinera, 2001 citing Neunzig, 1969; Pratissoli et al., 2006, Schefler et al. 2012). Damage generally increases during the growing season, becoming most noticeable in mid to late summer (Cranshaw, 2020).

Depending on the host plant and the organs attacked, signs and symptoms are easier to observe; for example on grapes, attacks were easily observed because of the damaged berries at the periphery of bunches and because of the larger holes than those of other caterpillars in the vineyards (caused by the larger mouthparts of *C. virescens*) (Ventura *et al.*, 2015 including pictures). On cotton, damage of *C. virescens* is more noticeable on terminals. Flower buds (squares) can have larvae on the outside, and damage includes a hole and rarely frass.

Damage to bolls is not easily noticed because these structures are at the bottom of the plant (C.A. Blanco, pers. comm.).

2.8 Detection

Monitoring by inspection of crops is essential for the detection of *C. virescens*. Plants can be inspected for the presence of eggs and larvae, signs and symptoms, and the timing of control appears to be mostly determined by inspecting the crops (see section 12). In some hosts, life stages may be hidden/protected in a plant organ (see section 2.6). On cotton, Miranda (2010) recommends looking for eggs on leaves of the terminal shoot, and larvae in floral structures (buds or bolls) of the middle part of the plant. On flowers of ornamental plants, to detect early stages of an infestation, buds and flowers can be checked regularly for small holes and petal feeding injuries (Cranshaw, 2020).

The following traps are mentioned in the literature to detect infestations and to determine the timing of control (FAO, 2016).

- Sex pheromone lures and traps are available commercially (Blanco *et al.*, 2008a). Large cone-shaped wire traps baited with sex pheromone lures are commonly used to capture adults; smaller bucket traps can also be used but are not very efficient (Capinera, 2001). Narrea *et al.* (2022) recommend for blueberry 10 to 15 pheromone traps per ha. Pheromone traps have not always been reliable to reflect the presence of the pest in the field, nor to reflect population size (eggs and larvae). Their effectiveness may be related to the commercial lures used and their efficiency on different populations (see section 1), and, in order to enhance trapping, different commercial lures should be used in traps (C.A. Blanco, pers. comm.).
- Other traps such as molasses traps, honeydew traps and light traps have been mentioned (NovAgro-Ag, 2023 – blueberry, Narrea *et al.*, 2022), as well as oviposition traps (quinoa, FAO, 2016). However, they are likely less effective. Captures should be identified to species. These publications mention these traps in relation to monitoring populations to determine the need for treatment, not in relation to detection.

Eggs are approximately 0.5 mm (see section 2.1) and are laid individually and are not hidden. First instar larvae are small (1 mm), they may be of the same colour as the plant, or hidden, and they may be difficult to detect. Mature instars measure up to 45 mm. All life stages can be observed without magnification. Eggs and first instar larvae may be more difficult to detect than other stages, nevertheless there are many interceptions of this pest in trade, and detection should be possible.

2.9 Identification

Morphological identification of *C. virescens* is possible but difficult, and requires a Lepidoptera specialist.

- ***Adults*** of *C. virescens* are the easiest life stage for identification. Adults of Heliothinae, including species of the *virescens* group, can be identified based on the pattern of wing veins and male genitalia (Murúa *et al.*, 2016 citing Pogue 2004; Poole *et al.*, 1993; Pogue, 2013). An older morphological study and key of the adults for *H. assulta*, *H. punctigera* and *C. virescens* is available in Kirkpatrick (1961) (cited in Sullivan & Molet, 2007). Poole *et al.* (1993) provide a key for the 13 species of the *virescens* group, and notes that the species are often difficult to differentiate. There may be misidentifications between Heliothinae. Sullivan & Molet (2007) mention that there are over 40 described species of *Helicoverpa* moths (including *Chloridea* – citing Myers *et al.*, 2018), and for example *H. armigera*, *H. assulta*, *H. punctigera* and *C. virescens* can easily be confused. Within the *virescens* group, several specimens of *C. virescens* are currently misidentified in BOLD (at least one as *C. molochitina* and two as *C. subflexa* - Gilligan *et al.*, 2019 citing Mitchell and Gopurenko, 2016).
- ***Eggs*** of *C. virescens* resemble those of *H. zea*, *C. subflexa* and other Heliothinae (Blanco *et al.*, 2019). Blanco *et al.* (2019) developed a fast, relatively easy and inexpensive technique to distinguish *C. virescens* eggs from *H. zea* and *C. subflexa*, based on the presence, number and/or size of aeropyle holes on the primary ribs of eggs near the micropylar rosette.

  Identification using egg color, egg shape and number of ribs in combination with host plant and origin information is almost flawless, but in the Netherlands, because of the large financial implications in the case of rejection, morphological identification is always confirmed using molecular tools (T. van Noort, pers. comm.).

Near-infrared spectroscopy has also been developed to distinguish immature stages of *C. virescens* and *H. zea* (including eggs and young larvae) (Jia *et al.*, 2007). However it is relatively expensive and requires the acquisition of specialized equipment and training of personnel (Blanco *et al.*, 2019).

Development of machine learning methodology to allow distinguishing *C. virescens* and *H. zea* eggs in the field has started (Efromson *et al.*, 2022).

- ***Larvae***. Several publications provide keys or detailed descriptions of the morphological characters that can be used to identify larvae of *C. virescens* and to distinguish them from other species (e.g. Neunzig, 1964; Beardsley, 1982; Passoa, 2014; Gilligan & Passoa, 2014). However, as mentioned in Passoa (2014), molecular methods and rearing immatures to adults increase accuracy. Distinguishing larvae of *C. virescens* from those of other Heliothinae species is challenging (Gilligan *et al.*, 2019; Gilligan & Passoa, 2014). In particular, larvae of *C. virescens* cannot be distinguished from *C. subflexa* by morphological methods. Several species may be associated with the same commodity. For example, *C. subflexa* is also found on *Physalis* fruit.

  See under *eggs* for near-infrared spectroscopy.

- ***Pupae*** cannot be identified based on their morphology. They should be raised to adults for identification.

Molecular methods

In a study on molecular identification of Heliothinae larvae originating from the Americas and intercepted at US ports of entry (Gilligan *et al.*, 2019), rapid real-time PCR assays designed to identify *H. armigera* or *H. zea* were first applied (based on Gilligan *et al.*, 2015 and Perera *et al.*, 2015), and remaining specimens were identified using a standard DNA barcoding protocol (described in Gilligan *et al.*, 2019). Barcode data is available for *C. virescens* (Mitchell & Gopurenko, 2016, Gilligan *et al.*, 2019), but with some misidentifications in BOLD (see under *Adults* above).

In the Netherlands, two RT-PCR protocols (in prep.) are used to identify eggs and larvae of Noctuidae found on imported commodities (T. van Noort, pers. comm.).

In the UK, the identification of intercepted *C. virescens* was done using sequencing (A. Korycinska, pers. comm.).

3 Is the pest a vector?

Yes ☐ No ☒

4 Is a vector needed for pest entry or spread?

Yes ☐ No ☒

5 Regulatory status of the pest

In the EPPO region, *C. virescens* is a regulated pest for Israel. It is temporarily regulated in the EU[1] under Article 30 of Regulation (EU) 2016/2031 until further risk assessment is performed (EPPO, 2023b; EU, 2022a).

Information about the regulatory status of *C. virescens* elsewhere in the world was sought (at 2023-04) from lists of regulated pests on the International Phytosanitary Portal (www.ippc.int) and from a general Internet search. *Chloridea virescens* is regulated at least in Mozambique (Mozambique, 2009), Seychelles (IPPC Secretariat, 2010), Japan (MAFF, 2015), India (India, 2016), Korea Rep. (Korea, 2016), New Zealand

[1] EU (2022a) states that a preliminary risk assessment (citing NVWA, 2020) concluded that the pest fulfills the criteria for a quarantine pest for the EU, but further risk assessment is required.

(Biosecurity New Zealand, 2023) and Western Australia (WA Government, 2023). The information consulted is not exhaustive and *C. virescens* may thus be regulated in more countries. Finally, *Chloridea virescens* is on the list of regulated pests of Mexico (as *Heliothis virescens*; Mexico, 2011), but its presence in Mexico is not in doubt (see e.g. sections 6 and 12).

6 Distribution

***Chloridea virescens* is reported only from the Americas, from southern Canada in the north to Uruguay in the south.**
In the northern part of its distribution, overwintering is limited to sheltered places (see section 2.3) but the pest may form transient populations during the summer.

In the northern part of its distribution where overwintering is not possible, populations or individuals may only be observed during the summer (see section 2.3).

The southern limit in South America based on available records is north of the latitude 34°S, as documented below. It is not known if records correspond to established populations or to cases of migration. No information was found on migration in South America.

- In Argentina, the southernmost record is in Paunero, Cordoba province (Torretta *et al.*, 2009), at a latitude of about 33°S. During surveys with light traps targeting *Helicoverpa* species in Central Argentina (covering Cordoba, Entre Rios and Buenos Aires provinces – spring 2015 and summer 2016) (Balbi, 2019), one specimen of *C. virescens* was identified from the Cordoba province, not from the study itself, but based on specimen collected during previous trappings (Marcos Juarez, Cordoba, latitude of about 32°S). Prevalence at this latitude is presumably very low.
- The pest is present in Uruguay without reported damage to crops (Bentancourt & Scatoni, 1992). Poole *et al.* (1993) map specimen in the South of Uruguay, i.e. approximately 34°S. Prevalence in Uruguay is presumably low.
- In Chile, *C. virescens* was recorded in the areas of Arica and Azapa (Lluta valley, Parra *et al.*, 1986) in the northernmost part of the country (approx. 18°S latitude). Although Santos-Zamorano *et al.* (2017) mention the 'transverse valleys of the Atacama Desert' (which extend further South to ca. 30°S), they refer only to Parra *et al.* (1986), i.e. to findings at about 18°S.

The distribution of *C. virescens* is provided in Table 4 and illustrated in Figure 1.

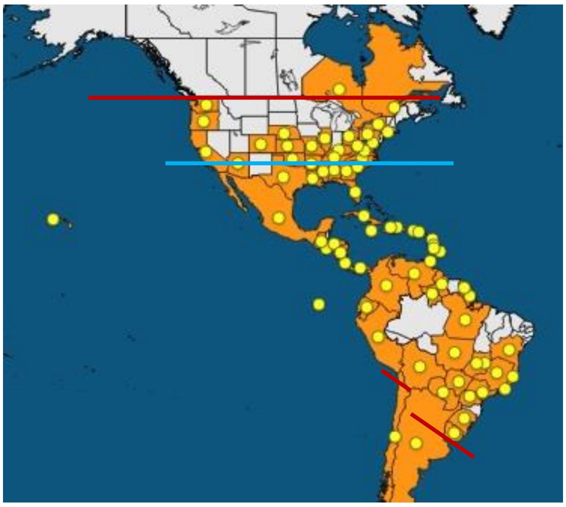

Fig. 1. Distribution of *Chloridea virescens* from EPPO Global Database (EPPO, 2023b)
Red lines: rough northern and southern limits of the current range of *C. virescens;* Blue line: possible northern overwintering limit in North America (approx. 37°N based on Poole et al., 1993; no information for South America (see section 2.3). Between the blue and red lines, transient populations may occur.

Table 4. Distribution of *Chloridea virescens*

Records are from EPPO Global Database (EPPO, 2023b), which provides original references.

	Countries and states with reports of *Chloridea virescens*
North America	Canada: • Ontario • Quebec
	Mexico
	USA: • Alabama • Arizona • Arkansas • California • Colorado • Connecticut • Florida • Georgia • Hawaii • Illinois • Kansas • Kentucky • Louisiana • Maryland • Mississippi • Missouri • Nebraska • New York • North Carolina • Ohio • Oklahoma • Oregon • Pennsylvania • South Carolina • Tennessee • Texas • Virginia • Washington • West Virginia
South America	Argentina: Tucumán, Santiago del Estero (Murúa *et al.*, 2016), Cordoba (Torretta *et al.*, 2009).
	Bolivia
	Brazil: • Amapá • Bahia • Distrito Federal • Espirito Santo • Goias • Mato Grosso • Mato Grosso do Sul • Minas Gerais • Para • Paraná • Rio de Janeiro • Rio Grande do Sul • Roraima • São Paulo
	Chile: Lluta valley, Atacama (Parra *et al.*, 1986)
	Colombia
	Ecuador: • Mainland • Galápagos
	French Guiana
	Guyana
	Paraguay
	Peru
	Uruguay
	Venezuela
Central America and Caribbean	Barbados
	Costa Rica
	Cuba
	Dominican Republic
	El Salvador
	Guadeloupe
	Guatemala
	Haiti
	Honduras
	Jamaica
	Martinique
	Nicaragua
	Panama
	Puerto Rico
	Saint Lucia
	Trinidad and Tobago
	Virgin Islands (US)

Uncertain records. Records below are considered uncertain, and no information confirming the presence of the pest in these countries and territories was found.
In particular, databases or websites (e.g. from citizen science) contain additional observations/unpublished records, for example GBIF (which includes iNaturalist and BugGuide records), Butterflies and Moths, or Moths Photographers Group. These records are not unlikely given the wide distribution range and migratory habits of *C. virescens*, but they are considered uncertain here due to difficulties of identification, and the general uncertainties linked to such observations.

North America

- *Rhode Island (USA).* One larva recorded in Pavulaan (2022). Because of the number of larvae, identification difficulties of larvae and the type of publication, this record is considered uncertain. However, it is not unlikely because Rhode Island is at a latitude the species may reach in summer and it is close to states where the pest has been reported.
- *North Dakota (USA).* CABI CPC (2023) cites CIE (1967), which does not specify this state.
- GBIF (2023): Delaware, District of Columbia, Idaho, Iowa, Maine, Massachusetts, Michigan, Montana, Nevada, New Hampshire, New Jersey, New Mexico, Rhode Island, Utah, Vermont, Wisconsin, as well as Butterflies and moths (2023): Wyoming, Iowa, Indiana. Moth Photographers Group (2023) includes some of these as well.
- *Prairie provinces* (Alberta, Saskatchewan, and Manitoba, Canada). Poole *et al.* (1993) note that the pest probably reaches the southern prairie provinces as well in some years.
- *British Columbia (Canada).* PNW Moths (2023) reports that *C. virescens* occurs sporadically in agricultural areas in southwestern British Columbia. This province is not mentioned in Moth Photographer Group (2023).

South America

- *Belize*. Kogan *et al.* (1989) mention one article existing at the time for this country. This country is not marked in the map of Poole *et al.* (1993).
- *Suriname*. Gilligan & Passoa (2014) mention that *C. virescens* from Suriname can be identified because *C. tergemina* does not occur in this country (citing Poole *et al.*, 1993). GBIF data also include Suriname. However no direct published record was found.
- *Amazonas (Brazil).* CABI CPC (2023) cites CIE (1967), which does not specify this state (for Brazil, CIE (1967) refers to Hambleton, 1944, which does not mention this state either).
- *Brazil*, additional states in GBIF observations: Alagoas, Santa Catarina.
- *Argentina*, additional states in GBIF observations: Misiones, Santa Fe, San Luis, Ciudad de Buenos Aires, Chubut (about 43°S).

Caribbean

- *Grenada, Antigua.* Kogan *et al.* (1989) mention one article existing at the time from these countries.
- *Anguila, Antigua and Barbuda, St. Kitts and Nevis* (indicated with "?" in Gilligan & Passoa, 2014), *St. Maarten.* Gilligan & Passoa (2014) and Gilligan *et al.* (2019) reported interceptions from countries for which no record was found. Due to the uncertainties linked to interceptions (especially the true origin of commodities), these records are uncertain.
- *Antigua and Barbuda, Bahamas, Cayman Islands, Dominica, Grenada, Saint Kitts and Nevis, Saint Vincent and the Grenadines*: CABI CPC (2023) lists these countries based on Poole *et al.* (1993) but it is not possible to see details on the map in Poole *et al.* (1993). Hallman (1980) citing Wolcoot (1933) mentions that all tobacco producing islands in the Caribbean are infested, but it is not clear which islands these are.
- *Bermuda*: CABI CPC cites CIE (1967), which does not specify this country.
- *Bermuda, Grenada* in GBIF data. However, no published record found.

Invalid record

- *Minnesota*: CABI CPC cites Hardee & Bryan (1997), which refers to MS – Mississippi. No reference was found for Minnesota (apart from few GBIF observations from iNaturalist).

7 Host plants and their distribution in the PRA area

***Chloridea virescens* is highly polyphagous on a wide range of cultivated and wild/weed species. The list of plants reported as hosts in the literature (ANNEX 6) includes over 210 species or genera belonging to 36 families, including approximately 100 cultivated plants. The majority of hosts in ANNEX 6 belong to**

the families Fabaceae, Solanaceae and Malvaceae. Preferred host plants include cotton, tobacco, chickpea and tomato.

Analysing the concept of hosts for Heliothinae, Cunningham & Zalucki (2014) recall that females should lay eggs on the plant and a proportion of immature stages should complete development to become reproductive adults. Oviposition on non-hosts may occur, and finding a larva on a plant does not mean that it will be able to complete its development. Few plant species have been tested for the presence of eggs and larval survival through to adulthood. In addition, laboratory-based studies may show larval survival to adult on a plant, but the plant may not be suitable in the field. Regularity of use as host plant under natural conditions and relative abundance of immature stages should also be considered to determine the host plant status; however, this data is rarely available. When larval stages are occasionally found on a particular species in the field, the decision to classify this species as a host is largely subjective, and depends on the frequency with which the event is observed.

In this PRA, it was not possible to establish the true host status of all plants recorded in the literature. Two categories were used for the purpose of determining the plants to which *C. virescens* is most likely to be associated with, and cause damage to. The review focused on finding more information for cultivated plants.

Category 1 - Main hosts. This includes:

- plants mentioned to support populations of the pest in several generations or years, i.e. true hosts.

OR

- plants mentioned as common or preferred hosts, or plants on which impacts have been recorded (including all plants for which damage is mentioned in sections 2.6 and 12). A few plants for which only one publication was found that supports damage or common pest status also fall in this category.

Some wild plants or weeds in the Americas also belong to this category, based on the few publications consulted (no additional information was sought for wild plants and weeds).
Some plants have been reported as hosts throughout the distribution of the pest (such as tobacco, cotton or chickpea), while others may have been reported only in one country or even one area (such as apple, grapevine or blueberry).
Completion of life cycle in experiments was not used as a criterion on its own, but is mentioned in ANNEX 6 as additional information.

Category 2 – Likely hosts. These plants do not fulfil any of the criteria above, i.e. they are not confirmed true hosts; they are not mentioned as common or preferred hosts, or impacts have not been recorded. However, they are still reported as hosts in the literature. Many records in Category 2 are based only on Kogan *et al.* (1989), who note that their host checklist did not include every plant species on which eggs were recorded, nor species regarded as very poor hosts, i.e. they had already screened some plants out. Nevertheless, there is still an uncertainty on what was covered, and hosts only supported by Kogan *et al.* (1989) were kept in category 2.

Hosts are summarized in Table 5 below. A detailed host list is provided in ANNEX 6. Both tables attempt to identify hosts that are present in the EPPO region (cultivated or not).

Association with new plants has commonly been reported for *C. virescens*. A few examples among many:

- In Colombia and other countries, the pest was not found on cotton during the first years of commercial cropping, but later *C. virescens* became the main pest of this crop (Hallman, 1980, Blanco *et al.* 2016).
- More recently attacks on *Vitis vinifera* (Ventura *et al.*, 2015) and *Vaccinium corymbosum* (Narrea *et al.*, 2022) were observed, only in Brazil and Peru respectively.
- The host list includes many plants that are not native to the Americas, such as *Abutilon theophrasti*, *Geranium dissectum*, *Lespedeza cuneata*, *Lonicera japonica* (see ANNEX 6).

Table 5. Summary of hosts

This table was extracted from ANNEX 6.

Highlighted in orange: present in the PRA area

C and bold = cultivated or possibly cultivated in the PRA area

N = present and not cultivated in the PRA area

Empty = no evidence of presence in the PRA area

Host scientific name	Family	Cat.	EPPO
Abelmoschus esculentus	**Malvaceae**	**1**	**C**
Abutilon theophrasti	**Malvaceae**	**1**	**C**
Abutilon trisulcatum	Malvaceae	1	
Acalypha persimilis	Euphorbiaceae	1	
Aeschynomene ciliata	Fabaceae	1	
Ageratum	**Asteraceae**	**1**	**C**
Antirrhinum	**Plantaginaceae**	**1**	**C**
Antirrhinum majus	**Plantaginaceae**	**1**	**C**
Arachis hypogaea	**Fabaceae**	**1**	**C**
Asparagus officinalis	**Asparagaceae**	**1**	**C**
Cajanus cajan	**Fabaceae**	**1**	**C**
Calendula officinalis	**Asteraceae**	**1**	**C**
Chenopodium quinoa	**Amaranthaceae**	**1**	**C**
Chrysanthemum	**Asteraceae**	**1**	**C**
Cicer arietinum	**Fabaceae**	**1**	**C**
Citrullus lanatus	**Cucurbitaceae**	**1**	**C**
Cleome spinosa	**Cleomaceae**	**1**	**C**
Coronilla varia	Fabaceae	1	N
Croptilon divaricatum	Asteraceae	1	
Croton hirtus	Euphorbiaceae	1	
Desmodium obtusum	Fabaceae	1	
Desmodium tortuosum	Fabaceae	1	
Gardenia	**Rubiaceae**	**1**	**C**
Geranium carolinianum	Geraniaceae	1	
Geranium dissectum	Geraniaceae	1	N
Glycine max	**Fabaceae**	**1**	**C**
Gossypium hirsutum	**Malvaceae**	**1**	**C**
Helianthus annuus	**Asteraceae**	**1**	**C**
Jacquemontia tamnifolia	**Convolvulaceae**	**1**	**C**
Lablab purpureus	**Fabaceae**	**1**	**C**
Lactuca sativa	**Asteraceae**	**1**	**C**
Lagascea mollis	Asteraceae	1	
Lespedeza cuneata	**Fabaceae**	**1**	**C**
Linum usitatissimum	**Linaceae**	**1**	**C**
Lonicera japonica	**Caprifoliaceae**	**1**	**C**
Malus domestica	**Rosaceae**	**1**	**C**
Medicago arabica	Fabaceae	1	N
Medicago lupulina	**Fabaceae**	**1**	**C**
Medicago sativa	**Fabaceae**	**1**	**C**
Melochia pyramidata	Malvaceae	1	
Nicotiana repanda	Solanaceae	1	
Nicotiana tabacum	**Solanaceae**	**1**	**C**
Nuttallanthus canadensis	Plantaginaceae	1	
Origanum vulgare	**Lamiaceae**	**1**	**C**
Paulownia tomentosa	**Paulowniaceae**	**1**	**C**
Pelargonium hortorum	**Geraniaceae**	**1**	**C**
Pelargonium peltatum	**Geraniaceae**	**1**	**C**
Petunia	**Solanaceae**	**1**	**C**
Petunia integrifolia	**Solanaceae**	**1**	**C**
Phaseolus vulgaris	**Fabaceae**	**1**	**C**
Portulaca oleracea	**Portulacaceae**	**1**	**C**
Proboscidea louisianica	Martyniaceae	1	N
Rosa	**Rosaceae**	**1**	**C**

Host scientific name	Family	Cat.	EPPO
Ruellia runyonii	Acanthaceae	1	
Sesamum indicum	**Pedaliaceae**	**1**	**C**
Solanum lycopersicum	**Solanaceae**	**1**	**C**
Trifolium incarnatum	**Fabaceae**	**1**	**C**
Trifolium repens	**Fabaceae**	**1**	**C**
Trifolium resupinatum	**Fabaceae**	**1**	**C**
Vaccinium corymbosum	**Ericaceae**	**1**	**C**
Verbena	**Verbenaceae**	**1**	**C**
Verbena neomexicana	Verbenaceae	1	
Vitis vinifera	**Vitaceae**	**1**	**C**
Xerochrysum bracteatum	**Asteraceae**	**1**	**C**
Zinnia	**Asteraceae**	**1**	**C**
Abutilon viscosum	Malvaceae	2	
Acalypha	**Euphorbiaceae**	**2**	**C**
Acalypha alopecuroides	Euphorbiaceae	2	
Acalypha infesta	Euphorbiaceae	2	
Acanthospermum hispidum	**Asteraceae**	**2**	**C**
Aeschynomene americana	Fabaceae	2	
Aeschynomene rudis	Fabaceae	2	
Alcea rosea	**Malvaceae**	**2**	**C**
Brassica carinata	**Brassicacee**	**2**	**C**
Brassica oleracea	**Brassicaceae**	**2**	**C**
Brassica oleracea var. capitata	Brassicaceae	2	
Brassica oleracea var. viridis	**Brassicaceae**	**2**	**C**
Calopogonium mucunoides	Fabaceae	2	
Camonea umbellata	Convolvulaceae	2	
Caperonia palustris	Euphorbiaceae	2	
Capsicum annuum	**Solanaceae**	**2**	**C**
Carya illinoinensis	**Juglandaceae**	**2**	**C**
Castilleja indivisa	Orobanchaceae	2	
Cenchrus americanus	**Poaceae**	**2**	**C**
Chamaecrista nictitans	Fabaceae	2	
Chamaecrista nictitans subsp. patellaria	Fabaceae	2	
Chamaecrista rotundifolia	Fabaceae	2	
Cichorium intybus	**Asteraceae**	**2**	**C**
Corchorus orinocensis	Malvaceae	2	
Cordia globosa	Boraginaceae	2	
Crotalaria	**Fabaceae**	**2**	**C**
Crotalaria pallida	Fabaceae	2	
Crotalaria retusa	**Fabaceae**	**2**	**C**
Ctenodon brasilianus	Fabaceae	2	
Cucumis melo	**Cucurbitaceae**	**2**	**C**
Cucurbita maxima	**Cucurbitaceae**	**2**	**C**
Cucurbita pepo	**Cucurbitaceae**	**2**	**C**
Cydonia oblonga	**Rosaceae**	**2**	**C**
Dalea pogonathera	Fabaceae	2	
Desmodium canescens	**Fabaceae**	**2**	**C**
Desmodium incanum	Fabaceae	2	
Desmodium scorpiurus	Fabaceae	2	
Desmodium strictum	Fabaceae	2	

Host scientific name	Family	Cat.	EPPO
Distimake cissoides	Convolvulaceae	2	
Eirmocephala brachiata	Asteraceae	2	
Erigeron canadensis	Asteraceae	2	N
Funastrum clausum	Apocynaceae	2	
Galactia tenuiflora	Fabaceae	2	
Galinsoga quadriradiata	Asteraceae	2	N
Geranium maculatum	**Geraniaceae**	**2**	**C**
Heliotropium indicum	Boraginaceae	2	
Heterotheca subaxillaris	Asteraceae	2	
Hibiscus	**Malvaceae**	**2**	**C**
Hibiscus moscheutos	**Malvaceae**	**2**	**C**
Hibiscus rosa-sinensis	**Malvaceae**	**2**	**C**
Hyptis suaveolens	Lamiaceae	2	
Indigofera hirsuta	**Fabaceae**	**2**	**C**
Indigofera suffruticosa	Fabaceae	2	
Ipomoea cordatotriloba	**Convolvulaceae**	**2**	**C**
Ipomoea hederaceae	**Convolvulaceae**	**2**	**C**
Ipomoea nil	**Convolvulaceae**	**2**	**C**
Ipomoea purpurea	**Convolvulaceae**	**2**	**C**
Ipomoea triloba	Convolvulaceae	2	
Jacquemontia	Convolvulaceae	2	
Lathyrus hirsutus	Fabaceae	2	N
Lathyrus odoratus	**Fabaceae**	**2**	**C**
Lens culinaris	**Fabaceae**	**2**	**C**
Leonotis nepetifolia	**Lamiaceae**	**2**	**C**
Lespedeza bicolor	**Fabaceae**	**2**	**C**
Lupinus	**Fabaceae**	**2**	**C**
Lupinus rexensis	**Fabaceae**	**2**	**C**
Malachra alceifolia	**Malvaceae**	**2**	**C**
Malva neglecta	Malvaceae	2	N
Malva parviflora	Malvaceae	2	N
Malvastrum americanum	Malvaceae	2	
Malvastrum coromandelianum	Malvaceae	2	
Medicago polymorpha	Fabaceae	2	N
Melilotus albus	**Fabaceae**	**2**	**C**
Mimosa comporum	Fabaceae	2	
Mimosa diplotricha	Fabaceae	2	
Mimosa pigra	Fabaceae	2	
Mimosa somnians	Fabaceae	2	
Mucuna deeringiana	**Fabaceae**	**2**	**C**
Nicandra physalodes	**Solanaceae**	**2**	**C**
Nicotiana alata	**Solanaceae**	**2**	**C**
Nicotiana debneyi	Solanaceae	2	
Nicotiana glutinosa	**Solanaceae**	**2**	**C**
Nicotiana kawakamii	Solanaceae	2	
Nicotiana paniculata	Solanaceae	2	
Nicotiana rustica	**Solanaceae**	**2**	**C**
Nicotiana x sanderi	Solanaceae	2	
Nuttallanthus texanus	Plantaginaceae	2	
Passiflora foetida	**Passifloraceae**	**2**	**C**
Pavonia	**Malvaceae**	**2**	**C**
Penstemon laevigatus	Plantaginaceae	2	
Persicaria pensylvanica	Polygonaceae	2	
Phaseolus lunatus	**Fabaceae**	**2**	**C**
Physalis	**Solanaceae**	**2**	**C**
Physalis angulata	**Solanaceae**	**2**	**C**
Physalis heterophylla	Solanaceae	2	
Physalis lagascea	Solanaceae	2	
***Physalis peruviana* (1)**	**Solanaceae**	**2**	**C**

Host scientific name	Family	Cat.	EPPO
Physalis pubescens	**Solanaceae**	**2**	**C**
Physalis viscosa	**Solanaceae**	**2**	**C**
Pisum sativum	**Fabaceae**	**2**	**C**
Priva lappulacea	*Verbenaceae*	2	
Pseudelephantopus spicatus	Asteraceae	2	
Pyrrhopappus carolinianus	Asteraceae	2	
Rhexia alifanus	Melastomataceae	2	
Rhexia mariana	Melastomataceae	2	
Rhexia nashii	Melastomataceae	2	
Rhynchosia edulis	Fabaceae	2	
Rhynchosia minima	Fabaceae	2	
Ricinus communis	**Euphorbiaceae**	**2**	**C**
Ruellia ciliatiflora	Acanthaceae	2	
Rumex crispus	Polygonaceae	2	N
Salvia misella	Lamiaceae	2	
Salvia occidentalis	Lamiaceae	2	
Salvia officinalis	**Lamiaceae**	**2**	**C**
Scoparia dulcis	Plantaginaceae	2	
Senna occidentalis	Fabaceae	2	
Senna reticulata	Fabaceae	2	
Senna tora	Fabaceae	2	
Setaria italica	**Poaceae**	**2**	**C**
Sicyos angulatus	Cucurbitaceae	2	N
Sida abutilifolia	Malvaceae	2	
Sida acuta	Malvaceae	2	N
Sida cordifolia	Malvaceae	2	N
Sida glomerata	Malvaceae	2	
Sida glutinosa	Malvaceae	2	
Sida rhombifolia	Malvaceae	2	N
Sida spinosa	Malvaceae	2	N
Sida urens	Malvaceae	2	
Sidastrum paniculatum	Malvaceae	2	
Solanum carolinense	Solanaceae	2	N
Solanum hirtum	Solanaceae	2	
Solanum melongena	**Solanaceae**	**2**	**C**
Solanum rostratum	Solanaceae	2	
Solanum sessiliflorum	**Solanaceae**	**2**	**C**
Solanum sisymbriifolium	**Solanaceae**	**2**	**C**
Solanum torvum	**Solanaceae**	**2**	**C**
Solanum tuberosum	**Solanaceae**	**2**	**C**
Stilias caroliniana (2)		2	
Strelitzia reginae	**Strelitziaceae**	**2**	**C**
Stylosanthes guianensis	Fabaceae	2	
Tridax procumbens	Asteraceae	2	N
Trifolium pratense	**Fabaceae**	**2**	**C**
Trixis cacalioides	Asteraceae	2	
Trixis inula	Asteraceae	2	
Turnera ulmifolia	**Passifloraceae**	**2**	**C**
Vernonanthura brasiliana	Asteraceae	2	
Vicia villosa	Fabaceae	2	N
Vigna unguiculata subsp. unguiculata	**Fabaceae**	**2**	**C**
Waltheria americana	Malvaceae	2	
Xanthium orientale	Asteraceae	2	

(1) only from interceptions in the Netherlands. See Annex 6.

(2) The EPPO Secretariat was not able to find which species this name relates to.

8 Pathways for entry

Chloridea virescens is known to move with plant products in trade, as shown by interceptions (Netherlands -NVWA, 2020; UK - A. Korycinska, pers. comm.; USA - Gilligan & Passoa, 2014; Gilligan *et al.*, 2019). Interceptions on specific commodities are detailed in relevant pathways in section 8.1.

In the study on Heliothinae larvae originating from the Americas and intercepted at US ports of entry in 2014-2016 (Gilligan *et al.*, 2019), *C. virescens* was the most commonly intercepted species, originating from every country in the study except Guatemala, with a total of 107 interceptions and 137 individuals. The two articles summarizing US interceptions (Gilligan & Passoa, 2014; Gilligan *et al.*, 2019) do not mention commodities. The list of plants on which interceptions were made is provided in ANNEX 7. Some plant species in that list have not been included in the host list of this PRA because no references were found in the literature; these species are mentioned as uncertain hosts below the table in ANNEX 7.

These interceptions show that *C. virescens* can move in trade, but the trade flows in the EPPO region may be different from the ones in the USA.

The pest is associated with different hosts in different parts of its distribution, at different times of the year, and it is not possible to know at what period a commodity arising from a specific host is likely to be infested from a specific origin.

Similarly, plants grown close to a preferred host are less likely to be infested if the preferred host is at a suitable development stage, and more likely to be infested if they offer tender plant tissue when the preferred host is not suitable anymore, or at high levels of population, but this cannot be analysed in detail in the pathways.

These elements were not repeated under individual pathways.

The following pathways for entry of *C. virescens* are discussed in detail in this PRA in section 8.1:

- Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material (Table 6)
- Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material (Table 7)
- Host fruit and associated packaging material (Table 8)

The following pathways are discussed in section 8.1, but not considered in detail:

- Non-host plants for planting, above-ground cut fresh plant parts and fruit, and associated packaging material
- Soil and other growing media (on its own)
- Contaminant of soil attached to used machinery and equipment.

Regarding hitchhiking, contamination of packaging associated to commodities, of non-host plants and of used machinery and equipment are covered under several pathways above. No other case of hitchhiking was identified.

The following pathways are considered very unlikely and are discussed in section 8.2:

- Host forage and associated packaging material
- Seeds, bulbs, corms, tubers, rhizomes for planting, pollen, tissue cultures (hosts and non-hosts)
- Bare-rooted plants (hosts and non hosts)
- Underground plant parts (hosts and non-hosts)
- Stored products/dried plant parts (hosts and non-hosts)
- Manufactured/processed commodities (other than wood) made of hosts or non-hosts
- Wood (round wood, sawn wood, wood chips, processing wood residues, hogwood), bark, wood packaging material, furniture and articles made of wood (hosts and non-hosts)
- Natural spread

8.1 Pathways investigated

Information on import prohibitions and phytosanitary measures is not provided for all countries of the PRA area.

Data on trade was extracted from UN Comtrade (herafter ‘Comtrade’) for HS6 customs codes, i.e. for the whole EPPO region, and from Eurostat for categories HS8 that are not detailed in Comtrade, i.e. only for the EU.

8.1.1 Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material

Table 6. Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material

Pathway	**Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)**
Coverage	• Plants for planting of hosts, in pots or similar containers, or as cuttings. Herbs traded in small pots with growing medium are covered (even if intended to be sold for consumption). • All commercial trade is covered, including Internet trade by private persons (although there is no specific data on the latter). • This pathway also covers associated packaging material. • Bare-rooted plants, seeds, bulbs, corms, tubers, rhizomes, tissue cultures, pollen, are unlikely pathways (see section 8.2). • This pathway also includes travellers carrying in their luggage plants for planting from areas where the pest occurs. However, no data is available for such plants, which are therefore not assessed separately.
Plants concerned	Main hosts and likely hosts (categories 1 and 2 - see section 7 and ANNEX 6). Non-cultivated hosts are covered in this pathway only as weeds that may contaminate host plants for planting. Host weeds contaminating non-host plants for planting are covered in a separate pathway. Hosts for which no data was found on their presence in the EPPO region (see ANNEX 6) are unlikely to be traded as plants for planting. However, trade patterns change, and it cannot be excluded that some of them may be traded in the future.
Pathway prohibited in the PRA area?	Partly, at least in some EPPO countries. In the EU, import of some host plants intended for planting, other than fruit or seeds, is prohibited in relation to other quarantine organisms according to Annex VI of Regulation (EU) 2019/2072 (EU, 2019). These prohibitions cover countries where *C. virescens* occurs for: - Solanaceae other than seeds - *Rosa* other than dormant plants free from leaves, flowers and fruits - *Vitis* other than fruits These prohibitions also apply in Türkiye (N. Üstün, pers. comm.). In the EU, in addition, the following are prohibited: plants for planting (other than seeds) of the family Poaceae other than plants of ornamental perennial grasses of the subfamilies Bambusoideae and Panicoideae, and of the genera *Buchloe*, *Bouteloua*, *Calamagrostis*, *Cortaderia*, *Glyceria*, *Hakonechloa*, *Hystrix*, *Molinia*, *Phalaris*, *Shibataea*, *Spartina*, *Stipa* and *Uniola*. The EWG had no information on the requirements of other non-EU EPPO countries.
Pathway subject to a plant health inspection at import?	Yes, at least in some EPPO countries. For example, in the EU, plants for planting other than seeds from third countries should be accompanied with a phytosanitary certificate and should be inspected at import (EU, 2019; EU, 2022b). The growing medium associated with plants for planting is subject to specific requirements to ensure that it is free from quarantine pests and potential quarantine pests confirmed by PRA, and is also subject to inspection. Plants for planting of specific species/genera are also covered by various pest-specific phytosanitary requirements (EU, 2019). Similar requirements apply in Türkiye. These requirements are likely to reduce the likelihood of association of the pest with the commodity as they imply inspection before export and at import, which increases the likelihood of detection. However, *C. virescens* is not a quarantine pest in most EPPO countries (except Israel), and presence

Pathway	Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)
	of the pest on an intercepted commodity may not result in its rejection. In the EU, the current temporary regulation (EC, 2022) implies that, upon finding in a consignment, member states should take measures to prevent entry, establishment and spread into the EU (Article 30 of Regulation (EU) 2016/2031).
Pest already intercepted?	No known interception on this pathway. A large number of interceptions are reported from the USA (see section 8 and ANNEX 7) Some might have been on plants for planting, but there is no information on the commodity.
Most likely stages that may be associated	Eggs and larvae may be associated with plants for planting, including cuttings, if fresh tender tissue (leaves, buds, flowers, fruit or stems) are available. They may also be associated with host weeds present in the containers of rooted host plants. Larvae are unlikely to be present on some types of plants for planting (such as cuttings without leaves). Pupae may be associated to growing medium in which the plants are grown. For dormant plants (e.g. *Vitis*, rose), only pupae may be associated, in the growing medium. For plants originating from locations where overwintering occurs, only pupae would be associated to plants with growing medium in winter if the plants were grown outdoors. However, other life stages could be present if the plants were produced in protected conditions. The packaging may carry pupae if mature larvae pupate during storage or transport, or larvae of any stage if those leave the plants. Adults are unlikely to remain associated to commodities through packing (will fly away). Adults can mostly be associated to consignments if they emerge during storage or transport.
Important factors for association with the pathway	This pathway includes a large number of ornamental hosts. *Chloridea virescens* is expected to have a closer association with hosts in category 1. The pest is present all year-round in some areas, such as in coastal Peru and probably a large part of its tropical distribution. In areas where the commodities concerned are produced in protected conditions, the pest may also be associated. Within the USA, the trade of ornamental plants for planting is thought to be one way for *C. virescens* to reach northern USA in summer (the pest is thought to have been carried into Oregon from California on ornamental petunias and in one case geranium; Landolt, 2008). No information was sought on whether measures are applied at origin to prevent the association with plants for planting, however sites with high populations of lepidopteran pests, especially Heliothinae, would presumably be treated to ensure the quality of the final product and avoid losing plants, hence lowering the likelihood of association. Heavy infestations would be more visible, as well as damage caused by mature larvae. Since standards for export of plants for planting are generally high, large populations are not expected: infested plants or damaged plants would be removed during quality checks. However, low levels of infestation with younger life stages (including eggs) may not be noticed during production, especially on plants with dense shoots or when the pest feeds inside plant organs such as in flowers. The pest would be more easily detected on cuttings and very young plants than on larger and bushy plants for planting. Plants for planting transported by passengers may come from local production, gardens or the wild, where the pest may not be controlled. Travellers may not notice infestations if eggs or young larvae are present.

Pathway	Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)
	For plants imported into the EU, growing medium associated with plants for planting is subject to specific requirements to ensure that it is free from quarantine pests (and potential quarantine pests), and is also subject to inspection. Plants for planting are generally inspected at entry. Detection would depend on the intensity of inspection. The prevalence of the pest is expected to be low and at young stages. Eggs and young larvae would be less detectable, depending on the host and plant part, but inspectors are able to detect these stages on some commodities, as shown by interceptions in the Netherlands and the UK. As larvae develop, damage and larvae would become more visible. Pupae in growing medium may also be detected. Detection at arrival in travellers' luggage would depend on luggage inspection, which is currently not done on a regular basis in many EPPO countries. However, if it is done, it would be easier to detect on the fewer items present in luggage (compared to the number of plants in a consignment). To date, in the Netherlands, a major trade hub for plants in the EPPO region, *C. virescens* has only been intercepted on fruits and vegetables (see relevant pathways), although plants for planting are also inspected to detect quarantine Noctuidae (T. van Noort, pers. comm.). Emergency measures are in place against *C. virescens* since 18 November 2016, but already in 2010 it was decided to take emergency measures in case of an interception on plants for planting (DJ van der Gaag, pers. comm.). Noctuids from the Americas intercepted on commodities, as far as possible, are identified to genus or species level in order to be able to safely exclude the possibility of dealing with a quarantine organism (T. van Noort, pers. comm.).
Survival during transport and storage	Pupae in consignments are expected to survive, also if plants are transported cooled. If larvae leave the host plant (e.g. crawl to the packaging), their survival would be limited to a few days if they do not manage to crawl back onto a suitable host (see section 2.2). Temperature in the consignments may affect the survival and further development of egg, larvae and emerging adults. Eggs and larvae are expected to survive transport and storage at temperatures below (but close to) the lower threshold for development (assumed to be 12.6°C – see section 2.3). In the Netherlands, rearing of eggs/larvae intercepted on *Physalis* has sometimes been done successfully; the optimal carrying temperature of *Physalis* is 9-10°C and it may be stored at 5-10°C (https://www.cargohandbook.com/Physalis) (see pathway fruit). Such rearing was occasionally successful on asparagus vegetables (stored and transported at 0-2°C, and in any case <5°C) (see details under Table 7). Applying these elements to plants for planting: • At temperatures above approximately 10°C, all life stages are expected to survive, but development may stop temporarily when the temperature is below the development threshold. Some commodities are transported not cooled, such as tropical ornamental hosts such as *Strelitzia regina* (likely host), as well as non-acclimated potted plants (e.g. *Asparagus* 18-21°C, *Hibiscus* 18-24°C - https://www.cargohandbook.com/Flowering_potted_plants). Foliage plants are best shipped at 15-18°C, with 85% to 90% RH, and lowest at 10-13°C (which may lead to some chilling injury on the plants) (https://www.cargohandbook.com/Foliage_plants). This is also the case of some flowering potted plants (if acclimated) (e.g. 10-15°C for *Hibiscus* https://www.cargohandbook.com/Flowering_potted_plants). • At lower temperatures, the survival and viability of eggs and larvae is likely to be reduced and development is also likely to stop. For example, acclimated flowering potted plants may be transported chilled or at low temperature (e.g. 2-5°C for rose - https://www.cargohandbook.com/Flowering_potted_plants). Cuttings may be transported at fairly low temperatures (e.g. 3-4°C) (EPPO draft PRA on *Tetranychus mexicanus*). A short duration of transport (by plane versus ship) would be more favourable to survival and viability of all life stages. In experiments, air transportation was shown to have a limited effect on the survival of larvae and pupae of *C. virescens* (C.A. Blanco, pers. comm. – preliminary results).

Pathway	Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)
	If adults emerge during transport (i.e. not under cool transport), they need to find nectar to feed on (i.e. only in the case of flowering), otherwise they would die within a few days. In all cases, *C. virescens* is unlikely to reproduce during storage and transport (as early life stages are more likely to remain associated, they would not complete development to adult).
Trade	Trade data were extracted for 2018-2022 for rose plants for planting as well as for several broad categories that may contain hosts. - For rose plants for planting (HS6 codes), data were extracted from UN Comtrade and cover imports into all EPPO countries; - For live outdoor plants[2], indoor rooted cuttings and young plants (excl. cacti), indoor flowering plants with buds or flowers (excl. cacti), live indoor plants and cacti (excl. the categories just above) (HS8 codes), data are not available in Comtrade; data were extracted from Eurostat and cover imports into EU countries. For broad categories, there is an uncertainty on which hosts are imported, and non-EU countries may also import such plants. Trade data and a more complete summary are provided in ANNEX 8. Overall, the data available show trade of these commodities from 5-17 countries where the pest is present (depending on the commodity) to 9-23 EPPO countries (depending on the commodity) during the period 2018-2022. The most traded broad category was *live indoor plants and cacti (excl. the other two categories of indoor plants below)* (approx. 22000 t in 2022) from 17 countries where the pest is present into 23 EPPO countries over the whole period. There were also significant imports of *indoor rooted cuttings and young plants (excl. cacti)* (approx. 9300 t in 2022) from 17 countries where the pest is present into 18 EPPO countries over the period. Imports of *live outdoor plants* were moderate (approx. 900 t in 2022) from 16 countries where the pest occurs into 16 EPPO countries over the period. There were also moderate imports of rose plants for planting (approx. 88000 plants in 2022) from 5 countries where the pest is present into 7 EU countries and 2 EPPO non-EU countries (Jordan and Russia) over the whole period. Finally, there were minor imports of *indoor flowering plants with buds or flowers (excl. cacti)* from 8 countries where the pest occurs into 13 EPPO countries (approx. 1400 kg).
Transfer to a host	The pest is already on a suitable host. In nurseries, infested plants for planting are likely to be grouped close to other suitable hosts to which *C. virescens* could transfer. If maintained in protected environments (glasshouses/polytunnels), conditions are likely to be suitable for the pest. Outdoors, temperatures may not be favourable to transfer in all parts of the EPPO region, nor at all seasons (see section 2.3).
Likelihood of entry and uncertainty	**High likelihood with moderate uncertainty** *Uncertainty:* • Host species that are traded as plants for planting • Whether the standard for trading of plants for planting is the same from all origins to EPPO countries • Whether and how low temperatures (e.g. <10°C) will affect survival of life stages • Type (air vs. ship), duration, frequency and temperature of transport of the commodities concerned • Association of the pest in production of plants for planting of its hosts and absence of interception

[2] excl. bulbs, tubers, tuberous roots, corms, crowns and rhizomes, incl. chicory plants and roots, unrooted cuttings, slips, rhododendrons, azaleas, roses, mushroom spawn, pineapple plants, vegetable and strawberry plants, trees, shrubs and bushes

8.1.2 Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material

Table 7. Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material

Pathway	**Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material**
Coverage	This pathway covers all commodities composed of above-ground fresh cut plant parts that include leaves, buds, stems, flowers, and are intended to remain fresh until the final use (consumption or industrial processing) i.e.: - cut flowers, cut foliage, cut branches (for ornamental purposes) - leaf vegetables, and other leaves (incl. herbs) - other green plant parts (incl. stem vegetables, such as *Asparagus*). It also covers associated packaging material. Fruit on their own are covered in separate pathways.
Plants concerned	Main hosts and likely hosts (categories 1 and 2 - see section 7 and ANNEX 6). Host plants below were considered relevant for this pathway (these lists are not complete, there may be others in ANNEX 6). - cut flowers, cut foliage, cut branches: *Rosa*, *Chrysanthemum*, *Gardenia*, *Helianthus annuus*, *Pelargonium*, *Petunia*, possibly *Vitis vinifera*? Likely hosts: *Strelitzia reginae*. Some other ornamentals on the host list may also be traded as cut flowers. - leaf vegetables and other leaves: *Lactuca sativa*, *Origanum vulgare*, *Portulaca oleracea*, *Vitis* leaves for consumption. Likely hosts: *Brassica oleracea* and related vars, *Salvia officinalis*. Note that it is not known if all leaves used as herb or for medicinal purposes would be traded fresh, or fresh enough to allow survival of the pest. No information was found on whether herbs would be traded as fresh cut foliage from the Americas (or as small potted plants). - other green plant parts: *Asparagus officinalis* (only green – white asparagus is underground and would not be infested) This pathway also covers plants whose parts are reported as being consumed mostly locally at origin (travellers may carry such plant parts, and it is not excluded that there is a small commercial production): *Lablab purpureus*. Note on *Cichorium intybus* (likely host): the only record at origin related to the wild plant, not to crops.
Pathway prohibited in the PRA area?	Probably not for most commodities. There is one prohibition in the EU: plants of *Vitis* (Annex VI of Commission Implementing Regulation 2019/2072), including cut branches, leaves etc.
Pathway subject to a plant health inspection at import?	Partly, at least in some EPPO countries In the EU, a phytosanitary certificate is required for certain above-ground fresh cut plant parts under Annex XI of Commission Implementing Regulation 2019/2072 (EU, 2019), such as under Part A *Pelargonium*, *Rosa*; under Part B, cut flowers, cut foliage, leafy vegetables, asparagus. A proportion of consignments are inspected (EU, 2022b), but not all depending on the commodity (e.g. minimum 5% *Rosa* consignments from Colombia, EU, 2022b; 1% for commodities in Part B).
Pest already intercepted?	Yes. In the Netherlands, intercepted, multiple times on green *Asparagus officinalis* from Peru (NVWA, 2020; T. van Noort, pers. comm.). Details on these interceptions are provided in relevant parts of this table. In the UK, 2 separate interceptions in October 2023 on *Asparagus* from Peru (first interception 1 egg, second 5 eggs) (A. Korycinska, pers. comm.).

Pathway	Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material
	In the EU, 5 interceptions on *Asparagus officinalis* from Mexico (Europhyt, 2024 – 06 & 07-2021, 06 & 07-2022, 06-2023). In addition, interceptions in the USA on species for which cut fresh plant parts are commonly traded but there is no information on the commodity.
Most likely stages that may be associated	Eggs and larvae may be associated with this commodity if fresh tender tissues (leaves, buds, stems, flowers, fruits) are available. They are less likely to be associated with cut branches, as very few woody hosts are reported, and unlikely to be associated with cut branches without leaves. The packaging may carry pupae if mature larvae pupate during storage or transport, or larvae of any stage if those leave the plant parts. Adults are unlikely to remain associated to commodities through packing (will fly away). Adults can be associated mostly if they emerge during storage or transport.
Important factors for association with the pathway	This pathway includes a large number of ornamental hosts. *Chloridea virescens* is expected to have a closer association with hosts in category 1. The pest is present all year-round in some areas, such as in coastal Peru and probably a large part of its tropical distribution. In areas where the commodities concerned are produced in protected conditions, the pest may also be associated. There is a known association of eggs with green *Asparagus* from Peru due to several interceptions, but with a low number of eggs in each interception. In the Netherlands, only eggs were intercepted (113 interceptions with 1-6 eggs found) (T. van Noort, pers. comm.); similarly in the UK, only eggs were intercepted (1 and 5 eggs in 2 interceptions) (A. Korycinska, pers. comm.). *Asparagus* spears grow fast and are not outside the soil for long, which explains why mostly eggs are found (T. van Noort, pers. comm.). A high density of plants in protected conditions may be favourable to association of the pest with the plants. Some ornamental commodities exported to the EPPO region are probably grown in greenhouses (e.g. 90% of the cut flower production in the state of Mexico is in greenhouse – Anonymous, 2008; in Colombia, there is a production of cut flowers in greenhouses/tunnels - Villagran & Bojacá, 2020). If the plant parts originate from commercial facilities, operations at harvest and post-harvest (such as washing/sorting) may limit the association of different life stages. For asparagus, EFSA (2023) provides information on practices in Peru in relation to imports into the EU (for *Elasmopalpus lignosellus*): • ‘Pest management involves use of unspecified pesticides applied to the soil and management of irrigation.’ • ‘Asparagus spears are harvested by hand, spears seen to be infested are rejected in the field.’ • ‘Asparagus is cleaned, graded and packed at origin. Packs are from 250 g to 500 g.’ • ‘Producers exporting to the EU aim to comply with export procedures designed by the NPPO of Peru. Samples of 300 spears are taken from each shipment at the packing house to ensure pest freedom.’ The tolerance for Noctuidae on spears of asparagus is 0% to the EU, and 4 % to the UK (NAHS, 2022). No information was sought for other cut plant parts, however sites with high populations of lepidopteran pests will presumably be treated to ensure the quality and yield of the final product, hence lowering the likelihood of association. Heavy infestations will be more visible, as well as damage caused by mature larvae. The plant parts may not be marketable (especially cut flowers), and therefore highly infested commodities will be removed during quality checks. However, low levels of infestation with younger life stages (including eggs) may not be noticed during production especially on plants with dense shoots or many leaves, or when the pest feeds inside plant organs such as in flowers and buds.

Pathway	Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material
	Detection of *C. virescens* in commercial consignments at entry would depend on the intensity of inspection. The prevalence of the pest is expected to be low and at young stages. Therefore, eggs and young larvae would be less detectable, depending on the host and plant part, but inspectors are able to detect them on some commodities, as shown by interceptions in the Netherlands and the UK. As larvae grow, damage and larvae would become more visible. Cut plant parts transported by passengers may come from local production, gardens or the natural environment, where the pest may not be controlled. Travellers may not notice infestations if eggs or young larvae are present. Detection at arrival in travellers' luggage would depend on luggage inspection, which is currently not done on a regular basis in many EPPO countries. However, if it is done, it would be easier to detect on the fewer items present in luggage. In the Netherlands, noctuids from the Americas intercepted on commodities are, as far as possible, identified to either genus or species level (T. van Noort, pers. comm.). The pest has to date not been intercepted on cut fresh plant parts other than green asparagus from Peru.
Survival during transport and storage	Pupae associated to the packaging are expected to survive, also if commodities are transported cooled. Because of their short shelf lifes these commodities are usually transported by plane (short transport time) (see also Table 6). Temperature in the consignments may affect the survival and further development of egg, larvae and emerging adults. Most commodities concerned are likely to be transported under cool conditions to keep them fresh and because they have a short shelf-life. Eggs and larvae are expected to survive transport and storage at temperatures below (but close to) the lower threshold for the development (assumed to be 12.6°C – see section 2.3). In the Netherlands, rearing of eggs/larvae intercepted on *Physalis* has sometimes been done successfully; the optimal carrying temperature of *Physalis* is 9-10°C and it may be stored at 5-10°C (https://www.cargohandbook.com/Physalis) (see pathway fruit). Such rearing was only occasionally successful on asparagus (stored and transported at 0-2°C, and in any case <5°C) (details below). Transposing these elements to all cut plant parts: • At temperatures above approximately 10°C, life stages are expected to survive, but development may stop temporarily when temperature is below the development threshold. For example, some sensitive flowers and green foliage (amongst hosts: bird-of-paradise *Strelitzia regina*) are stored and transported above 10°C (https://www.cargohandbook.com/Cut_flowers_and_florist_plants/greens). • At lower temperatures, the survival and viability of eggs and larvae is likely to be reduced, and development is also likely to stop. For example, asparagus is highly perishable and cooled immediately after harvest to 0-2°C, which is also the optimal carrying temperature (in any case <5°C) (https://www.cargohandbook.com/Asparagus). Asparagus imported from Peru into the EU is shipped by plane in chilled containers (temperature ranges 0.5°C-2.2°C) (EFSA, 2023). In the Netherlands, eggs found on asparagus were successfully raised to adulthood in a number of occasions in the past (success rate and number of attempts unknown) (T. van Noort, pers. comm.). Similarly to asparagus, the optimal carrying temperature of lettuces is 0°C (max. 5°C). • Cut flowers may be transported at various temperatures. The optimal carrying temperature of most cut flowers including roses is 0-1°C in https://www.cargohandbook.com. Anonymous (2008) for Mexico notes that cut flowers for export are refrigerated and kept in cold storage. According to https://www.carrier.com/truck-trailer/en/uk/solutions/flowers/, flowers are stored in a cold room at 2-4°C for one night immediately after cutting, and it is then recommended to keep the flowers around 4-6°C until they are sold. • No information was found on the transport temperatures of herbs. If adults emerge during transport (i.e. not under cool transport), they should find nectar to feed on (i.e. only in the case of cut flowers), otherwise they would die within a few days. In all cases, *C. virescens* is unlikely to reproduce during storage and transport (as early life stages are more likely to remain associated, they would not complete development to adults).
Trade	Trade data were extracted for 2018-2022 for several cut flowers and vegetables.

Pathway	Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material
	- For rose cut flowers and chrysanthemum cut flowers (HS6 codes), data were extracted from UN Comtrade and cover imports into all EPPO countries. - For other cut flowers (excl. roses, carnations, orchids, gladioli, ranunculi, chrysanthemums and lilies), as well as asparagus and lettuce (HS8 codes), data are not available in Comtrade; data were extracted from Eurostat and cover imports into EU countries. Trade data and a more complete summary are provided in ANNEX 9. Overall, the data available show trade of these commodities from 9-19 countries where the pest is present (depending on the commodity) to 7-43 EPPO countries (depending on the commodity) during the period 2018-2022. Cut roses and asparagus were the most traded commodities (approx. 30000 t each in total in 2022), respectively from 13 and 15 countries where the pest occurs to 43 and 35 EPPO countries over the whole period. There were also significant imports of chrysanthemum cut flowers (over 9500 t in 2022) and other cut flowers (approx. 12000 t in 2022), respectively from 9 and 13 countries where the pest occurs to respectively 30 and 17 EPPO countries. Imports of lettuce were minor (approx. 340 t in total in 2022). For asparagus, EFSA (2023) mentions that imports from Peru take place every month of the year, although import volumes are not constant throughout the year. Consignments of asparagus to the EU weigh 800-3200 kg, and are composed of boxes of packs weighing 5-20 kg (EFSA, 2023). Finally, some host commodities may be transported by travellers in their luggage, e.g. specific food or medicinal uses for which fresh material is difficult to find in the EPPO region (especially leaf vegetables and herbs). However, there is no data.
Transfer to a host	For transfer to occur, the pest has to develop to the adult stage, find a mate and the female find a suitable host. There should be at least a male and a female at the same time and place for mating. The pest should arrive at a time suitable for survival and reproduction. In addition, even if mating occurs, females may not lay eggs or eggs may not hatch (see section 2). The shelf life of these commodities is usually short, and even shorter for asparagus or leaf vegetable, and they are unlikely to support the whole development of larvae (the larval stage takes 11-34 days on various hosts in favourable conditions – see section 2.2). Cut plant parts are mostly used indoors (for decoration, consumption or processing) where there may not be other suitable plants to transfer to. Even if the temperature is suitable for the pest, the material will progressively degrade, and will become unsuitable. In a probabilistic assessment of the likelihood of escape of the lepidopteran pest *Copitarsia decolora* from imported asparagus through waste (also associated as eggs), Gould et al. (2006) found that escape from waste was more likely to occur at importers' sites than at later stages, and was negligeable from consumers. Leaf vegetables may be kept cooled until consumption. NVWA (2020) considered that *Asparagus* will be kept indoors and refrigerated prior to consumption resulting in a small window of opportunity to complete the insect's life cycle on this product. The low temperature makes this unlikely. Cut flowers will be kept at room temperature. The pest may be destroyed during processing or discarded in waste bins. If infested commodities or infested waste is discarded outdoors (e.g. in compost), the pest would need to complete its development to adult. If larvae find suitable host material in the waste, they may be able to complete development. However survival to adult stage is less likely if only eggs or young larvae are associated with imported material. In interceptions in the EPPO region, only few eggs were found. The pest has a wide host range, and if mature larvae or pupae arrive at a time of the year when they can survive outdoors, they may be able to develop and find a host. However, those life stages are less likely to be associated with above-ground fresh plant parts.

Pathway	Above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material
Likelihood of entry and uncertainty	The EWG rated separately asparagus and other above-ground fresh plant parts. **Asparagus: Low likelihood, high uncertainty** *Uncertainty* • Frequency with which infested asparagus are discarded outdoors. • Prevalence of eggs in the waste. Capacity of larvae to develop on waste. • Proportion of eggs leading to an adult, of adults finding a mate, and of females laying eggs. • Whether and how low temperatures (e.g. <10°C) will affect survival of life stages • Whether consignments will arrive at a suitable time for survival and reproduction of the pest **Other above-ground fresh cut plant parts of hosts: Moderate likelihood, high uncertainty** The EWG highlighted that there is larger trade of cut flowers than of asparagus. Transfer is more likely than from asparagus because larvae may be present (instead of eggs), some commodities being transported at higher temperatures (e.g. tropical cut flowers). Cut flowers will more often be discarded outdoors and may be able to find suitable material to complete development. Detection on cut flowers or on some leaf vegetables would be more difficult than on asparagus due to the presence of leaves, flowers, buds. *Uncertainty* is higher than for asparagus • Lack evidence of association with the pathway (do not know if some US interceptions relate to these commodities) • Whether host cut plant parts are traded from areas where the pest occurs, and whether the pest is associated with the host in specific areas, and at times when the host cut plant parts are traded • Cut flowers may be more treated at origin because not edible • Frequency with which infested cut plant parts are discarded outdoors. • . • Prevalence of eggs and larvae in the waste. • Proportion of eggs leading to an adult, of adults finding a mate and of females laying eggs. • Whether and how low temperatures (e.g. <10°C) will affect survival of life stages • Whether consignments will arrive at a suitable time for survival and reproduction of the pest

8.1.3 Host fruit and associated packaging material

Table 8. Host fruit and associated packaging material

Pathway	**Host fruit and associated packaging material**
Coverage	This pathway includes fresh fruit in the botanical sense with or without green parts (leaves and peduncles) associated, as well as nuts and pods. It also covers packaging used for packing fruit. The pathway focuses on commercial trade, but fruit carried by travellers are also covered. Travellers from where the pest occurs may carry fruit. Airline luggage is a known pathway for entry of alien insect species in the USA (Liebhold *et al.*, 2006). Passengers may bring fruit to eat during their journey, and have leftovers at arrival (EPPO 2020a - PRA on *Gymnandrosoma aurantianum*).
Plants concerned	Main hosts and likely hosts (categories 1 and 2 - see section 7 and ANNEX 6). It is not excluded that *C. virescens* may be associated with other fruits. The following hosts have edible fruits that may be traded fresh: - 'Fleshy fruits': *Solanum lycopersicum*, *Vaccinium corymbosum*, *Vitis vinifera, Citrullus lanatus.* Likely hosts: *Capsicum annuum, Cucumis melo, Cucurbita maxima, Cucurbita pepo*, *Physalis angulata*, *Physalis peruviana*, *Physalis pubescens, Physalis viscosa*, *Solanum melongena*, - Pods (unshelled or shelled): *Abelmoschus esculentus* (pods are never shelled), *Cajanus cajan, Cicer arietinum, Glycine max* (i.e. 'Edamame'), *Phaseolus vulgaris, Vigna unguiculata* subsp. *unguiculata*. Likely hosts: *Mucuna deeringiana, Phaseolus lunatus, Pisum sativum*. For *Cicer arietinum*, although harvest is reported to take place when most plants are yellow and pods are mature (https://albertapulse.com/chickpea-harvesting-storage/), interceptions are reported in the USA (although there is an uncertainty on the commodity concerned) and there is a market for fresh green pods in Mexico (C.A. Blanco, pers. comm.) and it was therefore kept. -This pathway also covers plants whose fruit are reported as being consumed mostly locally at origin (travellers may carry such fruits, and it is not excluded that there is a small commercial production): *Passiflora foetida*, *Sesamum indicum* (if in capsules, for the purpose of having fresh seeds e.g. for tahini), *Lablab purpureus, Solanum sisymbriifolium, Solanum sessiliflorum, Solanum torvum*. The analysis of edible fruits was made based on a general search and may have missed some hosts in ANNEX 6. The fruit of some hosts is either not traded as such, or not traded in a form that may carry the pest, or not traded fresh, and is therefore not relevant for this pathway: • Pods of some Fabaceae hosts (e.g. *Medicago*, *Trifolium*, *Melilotus*) would not be traded as such. • *Carya illinoiensis* nuts (likely host) are traded without the outer green envelope. • *Ricinus communis* fruits are only imported into the EPPO region after some sort of processing (for instance as castor oil) (EPPO, 2013). • *Arachis hypogea* fruit is underground. Fruit that is only traded dry is dealt with under stored products/dried plant parts (section 8.2).
Pathway prohibited in the PRA area?	No

Pathway	Host fruit and associated packaging material
Pathway subject to a plant health inspection at import?	Partly, at least in some EPPO countries In the EU, a phytosanitary certificate is required for all fruit (including for fruit transported by passengers in luggage) on the host list (see Table 5, section 7) under Annex XI of Commission Implementing Regulation 2019/2072 (EU, 2019), such as in Part A Solanaceae, *Passiflora*, *Malus*, *Vaccinium, Vitis*; in Part B, oleaginous fruits, fresh, not broken, melons, fresh or chilled. A proportion of consignments are inspected (EU, 2022b), but not all depending on the commodity (e.g. minimum 10% *Vaccinium* consignments from Peru, EU, 2022b; 1% for commodities in Part B).
Pest already intercepted?	Yes, in the Netherlands, in 2014-2024, 3 interceptions on *Abelmoschus esculentus* (okra) from Mexico and the Dominican Republic, 5 interceptions on *Physalis* (species not specified) from Colombia and 5 on *Physalis peruviana* from Colombia (NVWA, 2020; T. van Noort, pers. comm.). In addition, interception in the USA on species for which the fruit is commonly traded but there is no information on the commodity.
Most likely stages that may be associated	Eggs and young larvae may be associated with host fruit that is tender enough. Later larval stages can also be associated with tender fruit, but also with harder fruit and pods (see Larvae in section 2.2) (even if no such records exist in the literature for e.g. cucurbits). In Peru, in a record on *Citrullus lanatus*, only leaves, buds and flowers were attacked (section 2.6). Eggs and larvae may also be associated with the green parts attached to the fruit (although no information on this was found in the literature used in this PRA), and on *Physalis*, larvae were found on the fruit wrapped in the enlarged calyx. On fresh leguminous pods, eggs may be associated to the outer shell, and larvae may be on the outer shell or inside, feeding on grain (as reported for *Cicer arietinum*). The packaging may carry pupae if mature larvae pupate during storage or transport, or larvae of any stage if those leave the fruit. Adults are unlikely to remain associated to commodities through packing (will fly away). Adults can be associated only if they emerge during storage or transport.
Important factors for association with the pathway	*Chloridea virescens* is expected to have a higher probability of association with hosts in category 1 than in category 2. The pest is present all year-round in some areas, such as in coastal Peru and probably a large part of its tropical distribution. In areas where the commodities concerned are produced in protected conditions, the pest may also be associated. ‘ Because eggs are laid singly and due to the cannibalistic habits of larval stages (section 2.2), it is not expected that there would be many individuals per fruit. In interceptions on *Physalis* spp. and *Physalis peruviana* in the Netherlands, eggs and larvae (up to mature larvae) were found. On *Physalis peruviana*, larvae were found feeding on the fruit. On *Abelmoschus esculentus* (3 interceptions), in two cases young larvae, in one case a mature larva were found. (T. van Noort, pers. comm.). In the literature, references mentioning association with non-leguminous fruit in the field were found for tomato, sweet pepper, grapevine (incl. berries –) and *V. corymbosum*. Association with fruit appears to happen mostly in the vicinity of infested crops of preferred hosts nearby, when those become unsuitable for the pest. There are several publications from different areas for tomato, and from Peru for blueberry. There is only one record from Parana, Brazil on *V. vinifera*, close to soybean fields. Interceptions in the EPPO region also show an association, at least with *Abelmoschus esculentus* and *Physalis peruviana.*

Pathway	Host fruit and associated packaging material
	For leguminous fruit, *C. virescens* is more likely to be associated with pods traded whole (unshelled) than with shelled grain (e.g. peas or beans). Some larvae may not have entered the pod, and some larvae inside pods would be removed or damaged during the shelling process. Some pods are never shelled (such as *A. esculentus*). A high density of plants in protected conditions may be favourable to association of the pest with the plants. Some fruit such as tomato may be produced in greenhouses. If the fruit originates from commercial facilities, operations at harvest and post-harvest (such as washing) may limit the association of different life stages. Some fruit provide structures that may hide the pest (for example *Physalis* may be exported with or without calyx around the fruit, grape bunches). No information was sought on whether measures are applied at origin to prevent the association with cut plant parts, however sites with high populations of lepidopteran pests especially Heliothinae would presumably be treated to ensure the quality and yield of the final product, hence lowering the likelihood of association. In addition, infested fruit would not be marketable, and would be removed during quality checks. However, low levels of infestation with younger life stages may not be noticed (e.g. on leguminous pods, and as shown by interceptions on *A. esculentus* and *Physalis*). Fruit collected by hand may be discarded if visibly infested. Fruit subject to limited handling, because it degrades their quality (such a blueberries and grapes), may be more likely to retain eggs or larvae unnoticed. Fruit transported by passengers may come from local production, gardens or the wild, where the pest may not be controlled. Travellers may not notice infestations if eggs or young larvae are present. Detection of *C. virescens* in commercial consignments may be difficult but would depend on the intensity of inspection. The prevalence of the pest is expected to be low and at young stages. Eggs and young larvae would be less detectable, depending on the host and plant part (e.g. where the pest can be hidden under a floral structure (e.g. *Physalis*) or green parts associated with the fruit or inside the fruit e.g. peppers and tomatoes), but inspectors are able to detect them on some commodities, as shown by interceptions in the Netherlands and the UK. As larvae grow, damage and larvae would become more visible, as well as in the case of high levels of infestation. The pest may be more detectable on fruit which is packed and exported in small containers (e.g. *Physalis* or blueberry). Detection at arrival in travellers' luggage would depend on luggage inspection, which is currently not done on a regular basis in many EPPO countries. However, if it is done, it would be easier to detect on the fewer fruit present in luggage. In the Netherlands, noctuids from the Americas intercepted on commodities are identified to either genus or species level. The pest has to date only been intercepted on *Abelmoschus esculentus* from Mexico and the Dominican Republic, and *Physalis* (species not specified) and *Physalis peruviana* from Colombia (T. van Noort, pers. comm.).
Survival during transport and storage	Pupae in consignments are expected to survive, also if fruit is transported cooled. The survival of any larva on the packaging would be limited to a few days if they do not crawl back to a suitable substrate (see section 2.2). Larvae could feed on the fruit until a late stage. Temperature in the consignments may affect the survival and further development of eggs, larvae and emerging adults. Fruit in international trade is commonly transported under controlled conditions (lower temperature and/or controlled atmosphere), however, this depends on the fruit species. Eggs and larvae are expected to survive transport and storage at temperatures below (but close to) the lower threshold for the development (assumed to be 12.6°C – see section 2.3). In the case of import in the Netherlands, *Physalis* (predominantly traded is *P. peruviana*) is shipped both by plane and ship and

Pathway	Host fruit and associated packaging material
	is not (extremely) cooled (unlike *Asparagus* – see Table 7). This is also the case of *Abelmoschus esculentus*, which is transported only by plane. Rearing of eggs/larvae from *Physalis* intercepted in the Netherlands has sometimes been done, and was successful (T. van Noort, pers. comm.). This shows that they have survived storage and transport conditions, while rearing from asparagus vegetables was occasionally successful. Transposing these elements to other fruit: • At temperatures above approximately 10°C, life stages are expected to survive, but development may stop temporarily when temperature is below the development threshold. For example the optimal carrying temperature of tomatoes is 8-15°C depending on ripeness (https://www.cargohandbook.com/Tomatoes), and of *Carica papaya* (uncertain host) 7-10°C. In travellers' luggage, travel time by plane is unlikely to affect survival, and the fruit would not be transported in cool conditions. • At lower temperatures, the survival and viability of eggs and larvae is likely to be reduced and development is also likely to stop. For example, the optimal carrying temperature of grapes is -1°C to 0°C, and of blueberries 0°C, of peas 0-1°C (https://www.cargohandbook.com). The optimal carrying temperature of beans is 0-7.5°C depending on the type. A short duration of transport (by plane versus ship) would be more favourable to survival and viability of the life stages (see also Table 6) If adults emerge during transport (i.e. not under cool transport), they would not find nectar to feed on, and would die within a few days. In all cases, *C. virescens* is unlikely to reproduce during storage and transport (as early life stages are more likely to remain associated, they would not complete development to adult).
Trade	Trade data from UN Comtrade were extracted for 2018-2022 for grapes, tomato, peas, beans and other leguminous fruit (HS6 codes – for peas, beans and other leguminous, fresh or chilled), and cover imports into all EPPO countries. Trade data and a more complete summary are provided in ANNEX 10. Data were not extracted for other host species, including pepper, aubergine or cucurbits. The data show a trade from many countries where the pest is present (17-18 depending on commodities) to a large number of EPPO countries (20-44 depending on commodities) during the period 2018-2022. Grapes was the most traded commodity (approx. 218000 t in 2022, incl. 111000 t from Peru), to 44 EPPO countries over the whole period. There were also moderate imports of peas (approx. 4700 t in 2022) and tomatoes (approx. 1900 t in 2022) into respectively 27 and 20 EPPO countries over the period. Lesser quantities of beans (approx. 800 t in 2022) and other leguminous fruit (approx. 170 t in 2022) were imported into respectively 27 and 22 EPPO countries over the period. Travellers may carry host fruit, especially fruits that are difficult to obtain in the EPPO region. However, there is no data.
Transfer to a host	For transfer to occur, the pest has to develop to the adult stage, find a mate and the female should be able to find a suitable host. There should be at least a male and a female. The pest should arrive at a time suitable for survival and reproduction. The shelf life of fruit is usually short, but the pest may be able to develop on the fruit itself until a late stage. The highest likelihood would be if mature larvae arrive in packing or storage facilities in the EPPO region that are close to growing host plants, and adults emerge and mate at suitable time and conditions to exit the facility and find a host. Some fruit, such as tomato, may be imported and repacked in production areas which would favour transfer. Imported fruit will be stored before sale. *Physalis* and *Abelmoschus* might be outdoors at open markets or shop displays for a limited amount of time giving mature larvae time to escape and pupate in the open (NVWA, 2020) and this would apply to other fruit.

Pathway	Host fruit and associated packaging material
	If leguminous fruit is transformed to be processed (e.g. peas or beans), a large number of infested pod envelopes may be discarded. Part of the fruit (*Physalis* 'leaves', grape bunches) or infested fruit may also be discarded outdoors. If the pods are shelled to be consumed (e.g. some *P. vulgaris*) or infested fruit is discarded, transfer in gardens may happen, if host plants are present. Because of a wide host range, if larvae arrive at the right season, they may be able to develop and find a host. If infested commodities or infested waste is discarded outdoors, the pest would need to complete its development to adult. If larvae find suitable host material in the waste, they may be able to complete development.
Likelihood of entry and uncertainty	**Moderate likelihood with moderate uncertainty** The EWG considered that the likelihood of entry was higher than for above-ground fresh cut plant parts of hosts because of interceptions of mature larvae on okra and *Physalis*, which make transfer more likely. In addition, fruits would be less treated than some other non edible commodities, leading to a higher association. *Uncertainty* • Current association with the fruit of some species (e.g. grape - reported once in one area, apple – reported in only one area, only in the past) • Whether the host fruit is traded from areas where the pest occurs and whether the pest is associated with this host in specific areas • Frequency with which infested fruit are discarded outdoors. • Prevalence of eggs and/or mature larvae in the waste. • Proportion of eggs leading to an adult, of adults finding a mate, and of females not laying eggs. • Whether and how low temperatures (e.g. <10°C) will affect survival of life stages • Type (air vs. ship), duration, frequency and temperature of transport of the commodities concerned • Whether consignments will arrive at a time suitable for survival and reproduction of the pest.

8.1.4 Non-host plants for planting, above-ground cut fresh plant parts and fruit, and associated packaging material

Association with the pathway, survival during transport and storage, and transfer to a host plant are less likely for life stages on non-host plants than on hosts. Consequently, the overall likelihood of entry on commodities of non-host plants is also lower. The same arguments apply to plants for planting, fresh cut plant parts and fruit. However, it is noted that there have been interceptions on non-hosts (but these may in fact be unreported hosts) (see ANNEX 7).

Association:

- Females would not prefer these plants for laying eggs, and there would be fewer individuals on non-host plants than on host plants.
- Growing medium associated with non-host plants for planting is less likely to carry pupae (unless growing medium contaminated by pupae has been used).
- Larvae may not remain associated to non-host plants, as they could leave non-host plants to find a host. In particular, there would not be late larval instars.
- The pest may only survive during a limited time on the non-host, is unlikely to complete its development to the adult stage, i.e. there would not be populations on non-hosts during production after import.
- The pest may be associated with host weeds contaminating non-host plants for planting, but it is not expected that many weeds (incl. host weeds) would be associated with containers of plants for planting.

Survival in storage and transport

- Survival would be shorter than on hosts. Adults can survive 3-5 days without food. The duration of survival of larvae is not known.

Transfer

- If larvae have survived transport on a plant/plant part that does not allow its development, transfer would require crawling to a suitable host.
- As there may be low numbers of larvae and, following transport, in weak conditions, the probability that a larva finds a suitable host is considered very low. Similar considerations apply to cut plant parts and to fruit.

8.1.5 Overall rating of the likelihood of entry taking the worst-case scenario from the individual pathways considered

Rating of the overall likelihood of entry	*Very low* ☐	*Low* ☐	*Moderate* ☐	***High*** X	*Very high* ☐
Rating of uncertainty			*Low* ☐	***Moderate*** X	*High* ☐

8.2 Pathways with a very low likelihood of entry

Host forage and associated packaging material

Several host plants may be used as forage (animal feed), such as *Glycine max*, *Medicago*, *Pisum sativum*, *Trifolium*, *Saccharum officinarum* or *Vigna unguiculata* subsp. *unguiculata*. Forage in the form of fresh cut plant parts that include leaves (incl. silage and hay) is not intended to remain fresh until use, unlike above-ground plant parts in section 8.1. Eggs and larvae may be associated with leaves, and with pods of leguminous forage hosts. It is expected that larvae will leave plant material when it is dried to produce hay, or made into silage (EPPO, 2017 - PRA on *Prodiplosis longifila*), or may be killed during the process of making silage. Even if some material is fresh at harvest and packing, it will progressively dry and will eventually be unsuitable for the development of larvae through transport, storage and before it is used at destination. For silage, compaction, storage in airtight conditions (in a silo or an air-tight bag), and fermentation will most probably kill the pest. If adults emerge during transport, they may not be able to emerge from the bulk of the commodity and if they do, will not find food in the consignment. There is a large international trade of animal feed in the form of pellets, but the trade as forage containing leaves or pods is presumably small, if it exists. Forage is intended to be eaten by animals. The only transfer possibility would be that adults emerge at destination from pupae produced during or after transport, before the commodity is fed to animals, and are able to reach a host. This is very unlikely.

Uncertainty: Low.

Soil and other growing media (on its own)

This pathway covers soil/growing medium as a commodity. Soil/growing medium associated with other pathways is covered under those (e.g. plants for planting). Pupae may be associated with soil or other growing medium used to grow host plants. The import of soil and growing media is usually regulated in EPPO countries (e.g. soil and growing media as such from all third countries other than Switzerland, cannot be imported into the EU according to Annex VI point 19 and 20 of Commission Implementing Regulation (EU) 2019/2072) (EU, 2019). If soil or growing media in which infested plants were previously grown is imported, it may be a pathway for entry of the pest. However, this is considered very unlikely for growing media for professional use. Data is lacking to fully assess and rate this pathway. This pathway is relevant for spread within the EPPO region (section 11).

Uncertainty: Moderate.

Seed, bulbs, corms, tubers, rhizomes for planting, pollen, tissue cultures (hosts and non-hosts)

Chloridea virescens is normally not associated with seeds, except for leguminous hosts. Seed crops would be subject to more scrutiny than grain crops. Export of infested seed is less likely since, prior to export, infested seed is more likely to be detected than infested grain, and thus is prevented from being exported. Seeds are traded dry and life stages would not survive. For others above, *Chloridea virescens* is not associated with such plant parts.

Uncertainty: low

Bare-rooted plants (hosts and non hosts)

Most hosts of *C. virescens* would not be traded in this form. If they were, for *C. virescens* to be present, leaves, buds or fruits should be associated, which is unlikely. Bare-rooted plants are dormant, and leaves, if still present, would not remain fresh for a period sufficient to sustain the larvae. The amount of soil associated with such plants is small and pupae would be removed with the soil. Although theoretically pupae could remain blocked between roots, they are large and noticeable.

Uncertainty: low

Underground plant parts (hosts and non-hosts).

Hosts include species whose bulbs, tubers or rhizomes are used for consumption. Pupae may be associated with soil, and soil with these commodities. However, plant parts would be harvested and undergo a cleaning process, and pupae would be removed during harvest or cleaned away with most of the soil. It is expected that only small amounts of soil would accompany these underground plant parts. Several host plants may be traded in this form without green parts attached (e.g. *Arachis hypogea, Solanum tuberosum, Helianthus tuberosus* (uncertain host)).

If green parts are attached, eggs and larvae may be associated. The only such plant in this PRA is carrot *Daucus carota*, with an interception in the USA (commodity not specified). However, *D. carota* is an uncertain host, and this pathway was not considered further.

Uncertainty: low.

Stored products/dried plant parts (hosts and non-hosts)

C. virescens would not survive in stored products or dried plant parts. This includes for example dried tobacco leaves; *Gossypium* fibres and dry seeds for animal feed, dried *Gossypium* branches for decoration, *Vitis* raisins, dried Fabaceae beans and peas with or without pods; fruit that is traded dry. Some host fruit would only be traded dry, such as *Sesamum indicum, Chenopodium quinoa, Lens culinaris*.

Uncertainty: low.

Contaminant of soil attached to used machinery and equipment.

Pupae may contaminate soil and growing medium attached to used machinery and equipment. However, pupae are normally at 2 cm deep or more, and this would require the presence of large amounts of soil. If there is any movement of used machinery from the countries where the pest occurs into the EPPO region (this was not checked), phytosanitary procedures such as decontamination are likely applied. In addition, this pathway is now covered by an International Standard for Phytosanitary Measures (ISPM 41) (FAO, 2017). Data is lacking to fully assess and rate this pathway. This pathway is relevant for spread within the EPPO region (section 11).

Uncertainty: low.

Manufactured/processed commodities (other than wood) made of hosts or non-hosts

The processes involved will destroy live stages (e.g. grain of *Sorghum*, *Glycine max* meal or oil, *Arachis hypogaea* foods).

Uncertainty: low.

Wood (round wood, sawn wood, wood chips, processing wood residues, hogwood), bark, wood packaging material, furniture and articles made of wood (hosts and non hosts)

There are a few tree species amongst likely hosts. Larvae of *C. virescens* may become associated with the bark by crawling. However, bark and wood would not sustain survival.

Uncertainty: low.

Natural spread

Chloridea virescens is present only in the Americas. Migrations of several hundred of kilometres are hypothesized in the Americas, favoured by weather events. However, the pest is unlikely to enter the EPPO region through natural spread from the Americas. This pathway is relevant for spread, should the pest be introduced into the EPPO region (see section 11).

Uncertainty: low.

9 Likelihood of establishment outdoors in the PRA area

9.1 Host plants

Many host plants of *C. virescens* are present in the EPPO region, in commercial cultivation, gardens, and in nature. Elements on commercial cultivation of several main hosts in the EPPO region are detailed in ANNEX 11. An overview of the presence of hosts in the EPPO region is also provided in Table 5 (section 7) and in ANNEX 6.

Overall, Türkiye and countries in the Middle East, Caucasus, southwest Russia, Central Asia, and Mediterranean Basin include a wide diversity of cultivated hosts, including the main hosts cotton, tobacco, soybean, chickpea, asparagus, tomato and grapevine. Several preferred hosts are mostly concentrated in these areas such as cotton, chickpea, as well as sesame and okra on smaller areas.

Many species of main hosts are distributed over a large part of the EPPO region, such as: soybean, tobacco, alfalfa, asparagus, grapevine, sunflower, tomato, *Vaccinium corymbosum*, as well as lettuce and *Phaseolus vulgaris*. Many ornamental hosts are also cultivated throughout the region such as *Rosa*, *Chrysanthemum*, *Gardenia* and *Petunia*. Flax is mainly grown in the northern part of the region (from UK in the West and eastwards to Russia). Some hosts are probably grown more locally and on a small scale, such as *Cajanus cajan*, *Chenopodium quinoa* and *Arachis hypogaea* (no detailed data was sought).

In countries in Table 9, crops for which data was extracted from FAO Stat (ANNEX 11) cover an area >1 million ha, mainly of field crops, sunflower and soybean, but also, in some countries, of cotton, grapevine and tomato.

Table 9. Countries with > 1 million ha of the hosts considered
Total area calculated based on data extracted for cotton, tobacco, soybean, sunflower, asparagus, tomato, grapevine, blueberries, okra.

country	Total area (ha) for the hosts considered	Crops contributing to >90% of total area
Russia	12 823 995	Sunflower, soybean
Ukraine	8 099 696	Sunflower, soybean
Türkiye	2 005 353	Sunflower, cotton, grapevine, tomato
France	1 739 447	Grapevine, sunflower, soybean
Spain	1 702 134	Grapevine, sunflower
Romania	1 446 800	Sunflower, grapes, soybean
Italy	1 229 120	Grapevine, soybean, sunflower, tomato
Uzbekistan	1 216 417	Cotton, grapevine
Kazakhstan	1 206 844	Sunflower, soybean, cotton

The major host, cotton, is produced in 11 countries, among which Uzbekistan and Türkiye are major producers, and to a lesser extent Kazakhstan and Azerbaijan (ANNEX 11). Cotton areas in Uzbekistan and Türkiye are illustrated in Fig. 2.

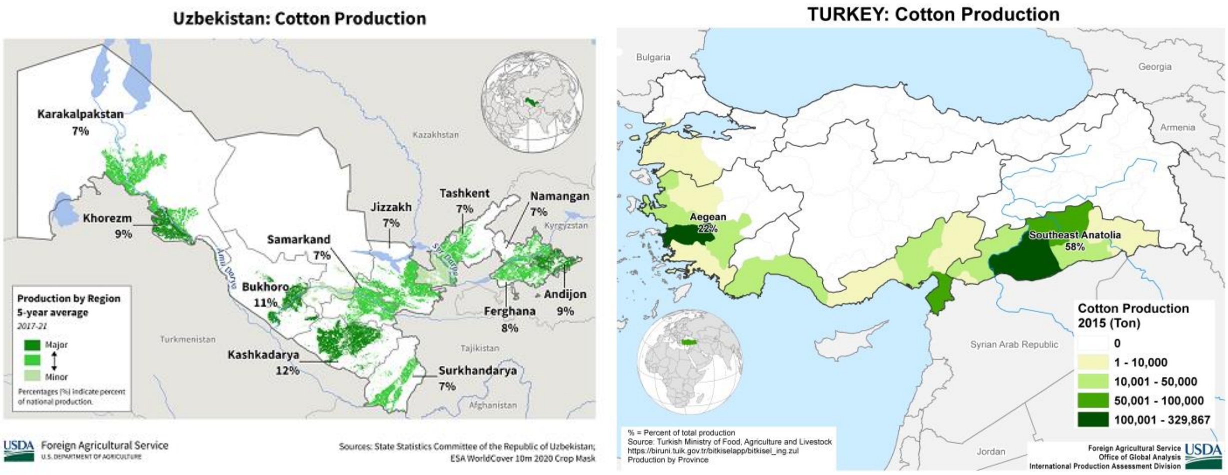

Fig. 2. Maps of cotton-growing areas in Uzbekistan and Türkiye (IPAD, 2023)

The northernmost part of the EPPO region (UK, Scandinavia, Baltic countries, northern Russia) has a more limited presence of hosts in commercial cultivation. Hosts may also be grown in gardens.

Finally, several wild and weed hosts are native to the EPPO region and widespread, such as *Coronilla varia*, *Geranium dissectum*, *Medicago arabica*, *M. lupulina*, *Trifolium incarnatum* and *T. repens*.

9.2 Climatic suitability

Chloridea virescens is reported from a wide range of climates in the Americas. Diapause in winter and summer allow the pest to survive in cold and hot areas. The pest is present in dry and humid areas, and low or high relative humidity is not considered a limiting factor in this PRA except in very dry conditions.

Plant hardiness was not taken into account in the assessment because soil temperature is a more important parameter, for which data was analysed.

9.2.1 Temperature of the soil

The temperature of the soil will influence survival of pupae during winter. According to experimental data in section 2.3, pupae may die if exposed for approximately 15 h at –10°C, 16 days at – 6°C, 42 days at – 2°C, and 52 days at 0°C. This temperature would have to be reached at 5 cm depth from the surface (see section 2.2, pupae).

The datasets on soil temperatures at 0-5 cm available through the Soil Temp project (Lembrechts *et al.*, 2022; van den Hoogen, 2022) were used to produce a map for the minimum soil temperature of the coldest month (Fig. 3). Soil temperatures were modelled using data from actual loggers over varying date periods in various geographical locations, and transformations were carried out using CHELSEA global microclimate air temperatures (1979-2013). There is some uncertainty over the transformations, but it is assumed that the modelled soil temperatures are also for the date range 1979-2013. The map does not represent measurements at all locations, and is therefore subject to uncertainty, but reflect the best dataset currently available. The EWG also looked at a similar map for the mean of the coldest quarter (3 months), but there was too much uncertainty over how it was calculated, and it did not add substantially to the minimum soil temperature (though it represented a longer time period).

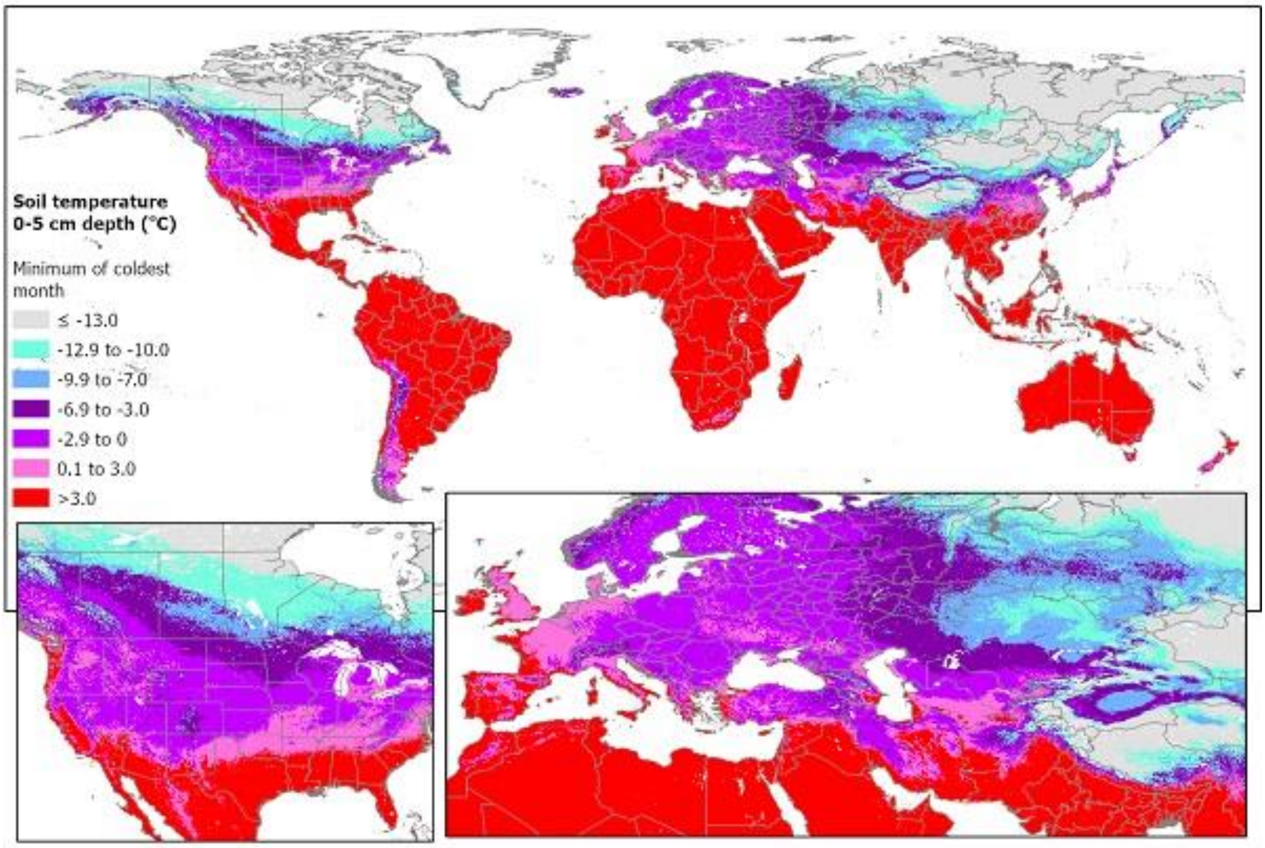

Fig 3. Minimum soil temperature at 0-5 cm depth (°C) of the coldest month for, map prepared by A. Korycinska (DEFRA, UK) from datasets of the Soil Temp project (Lembrechts *et al.*, 2022; van den Hoogen, 2022). The minimum soil temperature is understood to be the minimum of the monthly minimum temperatures (which are 5% percentile, not the extreme lowest value).

The mapping does not fully reflect the data on mortality of pupae (see section 2.3). It shows, in areas where overwintering is not possible in North America, temperatures that should allow survival of pupae. However, as mentioned in the literature, other factors are likely important for survival of pupae (see section 2.3). Based on the map, the EWG considered that:

- For southeastern USA, minimum soil temperatures at 0-5 cm >3°C illustrate well the area where overwintering is known to occur. Consequently, in the EPPO region, areas that present similar soil temperatures are likely suitable for survival of pupae , i.e. broadly parts of Western and southern Europe, North Africa, the Near East, and parts of Türkiye, Caucasus and Central Asia (red area on the map).
- Some parts of Russia (East of the Ural) and parts of Kazakhstan experience minimum soil temperatures < –3°C and so it seems likely substantial periods with soil temperatures below –3°C, and survival of pupae is very unlikely in these areas, in line with biological data.
- Finally, minimum soil temperatures between –3°C and 3°C in the USA correspond to areas where the pest is not known to overwinter. Soil temperatures around 0°C lead to mortality of pupae after extended period (see section 2.3). The available data does not allow concluding on the survival of pupae in areas

with the range of minimum soil temperatures –3°C to 3°C in the EPPO region. This range covers part of the cotton-growing areas of Uzbekistan and Türkiye (see Fig. 2).

In areas where pupae cannot overwinter, *C. virescens* may be able to form transient populations during summer (from migrating individuals or infested commodities). Limited numbers of pupae may survive outdoors in sheltered places (see section 2.3), but this would lead to limited numbers of individuals in the following year, and is unlikely to lead to stable presence of populations over several years (and to establishment).

Chloridea virescens maintains populations in areas with high rainfalls and soil humidity in southeastern USA (see section 2.3). Soil humidity would be limiting for establishment only in the case of sustained saturation, such as with heavy storms or flooding.

9.2.2 Köppen-Geiger climate types

The distribution of Köppen-Geiger climate types associated with *C. virescens* distribution was mapped for the recent climate (1980-2016) along with a projection for the EPPO region for the years 2071-2100 under the worst-case climate change scenario RCP8.5 (Representative Concentration Pathway: high emission scenario of CO_2 with little measures to reduce the emission).

Distribution records from various publications were used (coordinates mentioned in the articles, or estimated based on specific locations mentioned in the articles). To increase the number of locations, distribution records from GBIF (2023) were used (except records from collection), with uncertainties as explained in section 6. A file with locations mapped is available at: https://upload.eppo.int/download/1795oc9f8bdff8 .

A map of all climate types under which the pest is reported and their presence in the EPPO region is presented as Map 1 in ANNEX 11, and an interactive map can be downloaded at: https://upload.eppo.int/download/1784o1f23eaf64.

Favourable climate types
Chloridea virescens is present in the following climate types that are also present in the EPPO region. In the USA, only part of the areas with these climate types is suitable for overwintering, and in other parts of the areas with these climate types, generations may be produced in summer. The same situation will likely occur in the EPPO region.

- warm temperate fully humid type, with hot summers (Cfa)
- warm temperate summer-dry type, with hot or warm summers (Csa & Csb)
- cold and hot arid steppe climates (Bsk and Bsh)
- cold arid desert climate (Bwk)
- hot arid desert climate type (Bwh). In Peru to northern Chile, this climate type is present throughout coastal areas and coastal valleys, which are cultivated intensively under irrigation, and where C. *virescens* is an economic pest (e.g. Ica, La Libertad and Lambayaque regions - Córdova Vega, 2015). Bwh is also present in parts of Mexico and USA where crops are grown under irrigation. Provided that irrigation is in place, this climate type is suitable to *C. virescens*. In the EPPO region, Bwh occurs in North Africa and the Middle East. In a large part of this area, it is true deserts that are not cultivated (e.g. Sahara). However, there are some cultivation areas under this climate, such as Dakhla city in Morocco where tomato and blueberry crops are being established (K. El Fakhouri, pers. comm.).

These seven climate types delimit an area where conditions likely favour establishment in the EPPO region, i.e. Portugal, Spain, Italy, Greece, parts of North Africa, the Mediterranean coast, Türkiye, the Black Sea coast, Caucasus, and parts of southwest Russia and Central Asia (Fig. 4; an interactive map can be downloaded at https://upload.eppo.int/download/1785o165f93174). There is an uncertainty on whether the pest can overwinter (and establish) throughout these areas or may only be able to produce few generations in summer (in which case there could be transient populations outdoors if the pest enters). Under arid climates, only irrigated areas would be suitable for establishment. *Chloridea virescens* may not be able to establish in areas where soil temperatures are too low in winter (e.g. parts of Central Asia and Türkiye).

Under a scenario of climate change (2071-2100 under the RCP8.5 scenario), climates under which *C. virescens* is established in its distribution would be more widespread in the EPPO region, including in Western Europe to the Baltic and Eastern Europe (see map 2 in ANNEX 12 or interactive maps mentioned above).

Finally, the equatorial climate types (Af, Am, Aw) cover a large part of the distribution of the pest but are not present in the EPPO region. Similarly there are some records under the warm temperate climates with dry winters and hot summers (Cwa - 1 record in GBIF) or warm summers (Cwb), which are not present in the EPPO region.

Uncertainty on the occurrence of the pest under some climate types present in the EPPO region
In the EPPO region, the warm temperate fully humid climate type with warm summers (Cfb) is the dominant climate type in Western Europe (east to Western Germany), and the warm temperate fully humid climate type with cool summers (Cfc) has a limited distribution in some mountain ranges (based on layered map from MacLeod & Korycinska, 2019). In the Americas, Cfb and Cfc occur only in small areas. In GBIF, there are 2 citizen-science records under Cfb, in Buenos Aires (Argentina), which are not confirmed records in the literature. There are no known records under Cfc. There is an uncertainty on the suitability of these areas for establishment, but transient populations may be possible in summer.

Climate types under which *C. virescens* was recorded and could maintain transient populations for part of the year outdoors in the EPPO region under current climatic conditions
The pest has been recorded under several climate types that are not suitable for survival outdoors in winter. In the EPPO region, these areas may support transient populations annually:

- *Snow, fully humid with hot or warm summers (*Dfb – only 1 GBIF record from Eastern USA; Dfa *),* corresponding to northern USA and southern Canada, which in EPPO occurs from Germany eastwards.
- *Snow, summer dry with warm summer (*Dsb – only 2 GBIF records from Western USA), which in the EPPO region occurs in limited parts (mountains) in Türkiye and Central Asia.

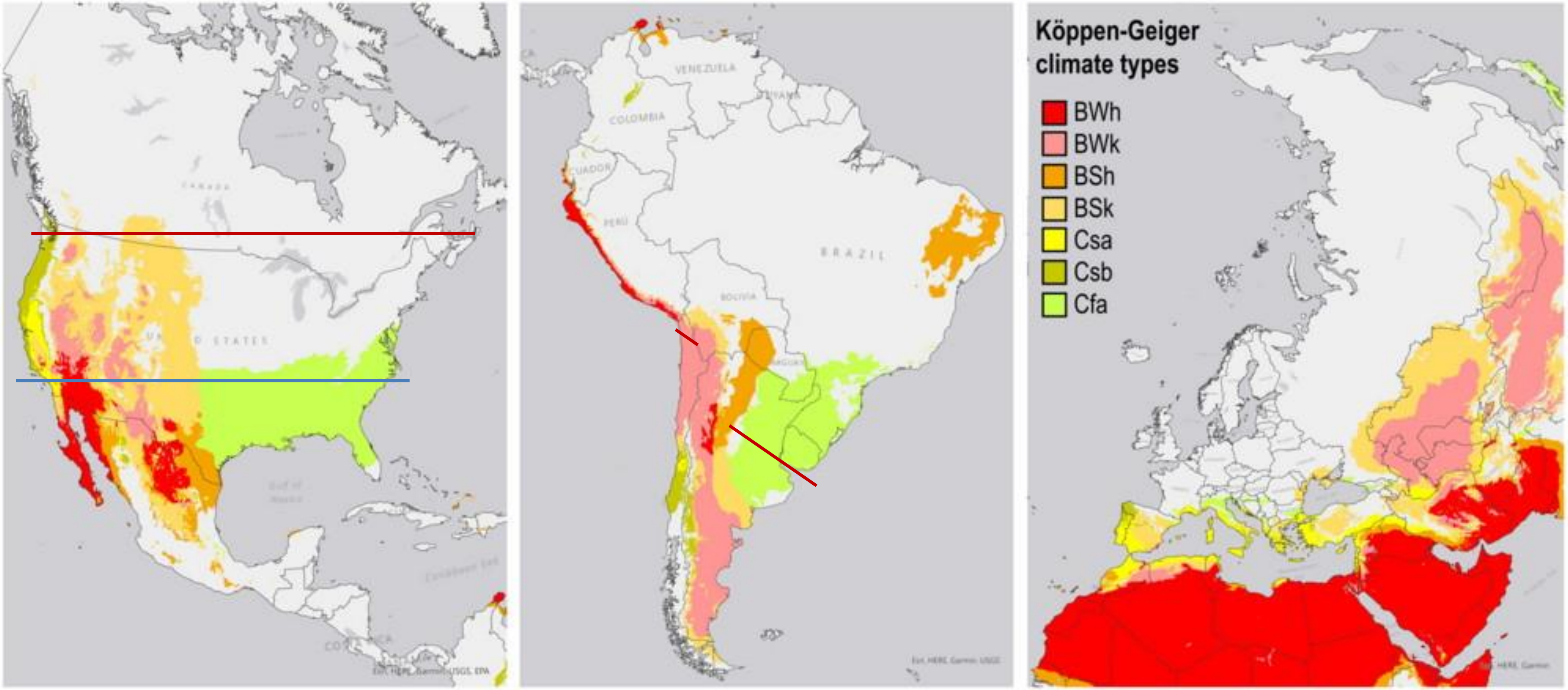

Fig. 4. Seven climate types associated with *C. virescens* (left and middle map) which delimit an area where conditions likely favour establishment in the EPPO region (right map).
Red lines: rough northern and southern limits of the current range of *C. virescens*
Blue line: possible northern limit of overwintering in North America (approximately 37°N based on Poole et al., 1993).
Distribution in the recent climate (1980-2016). The data for the Köppen-Geiger types were derived from Beck *et al.* (2018) at a resolution of 0.083° (about 10 km at the equator). The country borders on the map were sourced from GADM (2020). Map prepared by J. Tuomola (Ruokavirasto, Finland).

9.2.3 Temperature accumulation and number of generations

A map showing the potential number of generations was produced using the following parameters (selected data from ANNEX 4):

- minimum development threshold: 12.6°C, maximum development threshold 33.3°C (as in Hartstack *et al.* 1976).
- the mean GDD for a generation was chosen as 550 GDD.
- daily temperature data with a spatial resolution of 300 arc-seconds from 1987 to 2016.

A static map is presented as Fig. 5, and an interactive map can be downloaded at: https://upload.eppo.int/download/1786odc445dc83 .

The map reflects reasonably the number of annual generations reported in southeastern USA (4 or 5 generations) and northwestern USA (1 or 2 generations). No more than 6 generations in the field are reported in the literature, and the map indicates higher number of generations in parts of the distribution range. This may be due to limiting factors, like availability of hosts during the season.

Based on this map, in the EPPO region:

- There may be 1 to 5 generations per year in the areas considered suitable for establishment (those represented in Fig. 4 above), with 4 or 5 generations maximum in the southern part of the Iberic Peninsula, part of the Mediterranean coast, Black Sea Coast and in Central Asia.
- The pest would be unable to complete a generation in Ireland, most of the UK (except limited areas in the south-east), Scandinavia, Estonia, northern Russia, and Latvia.
- *Chloridea virescens* may develop 1 or 2 generations during the summer in other areas.

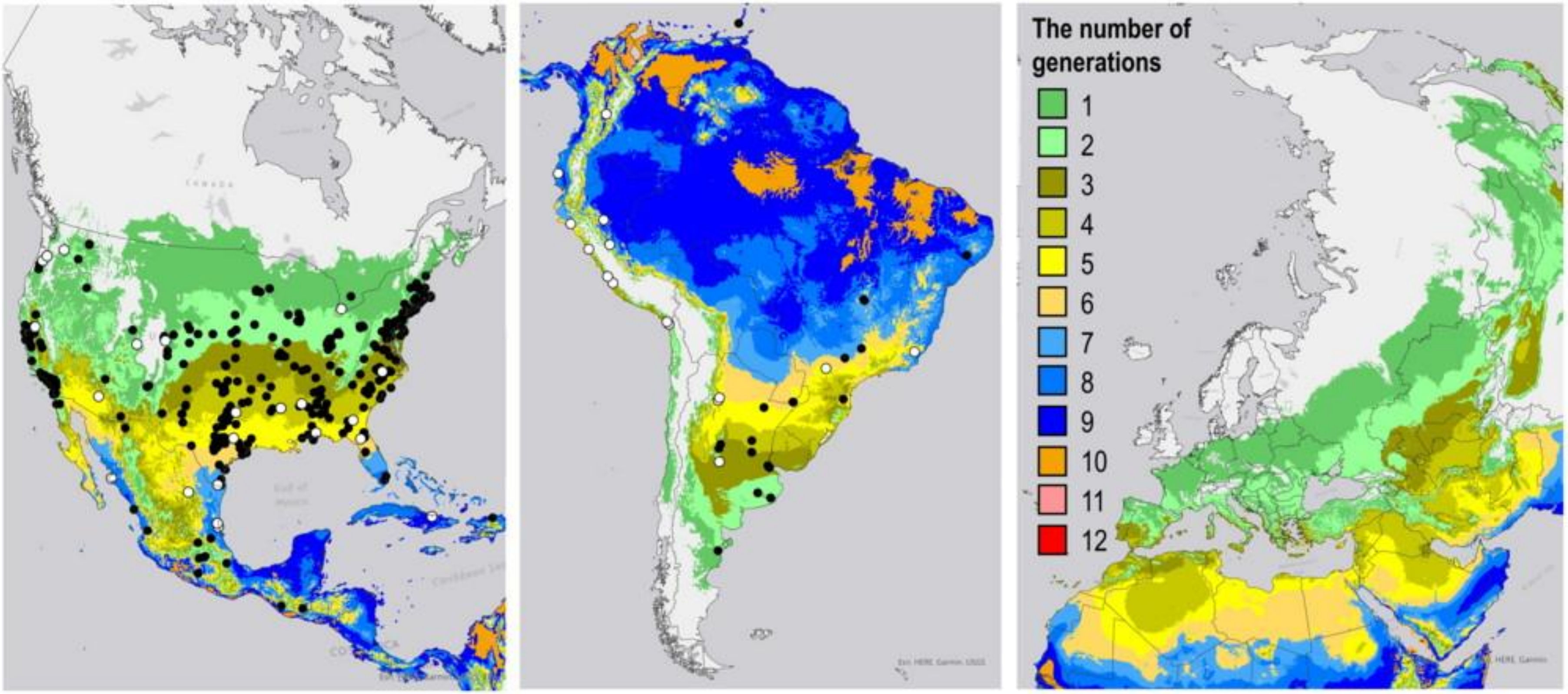

Fig. 5. Number of generations based on temperature accumulation

These maps provide an estimate of the potential number of generations that *C. virescens* could complete in a year (left: North America to Central America and Caribbean; centre: South America; right: EPPO region). Maps were prepared by J. Tuomola (Ruokavirasto, Finland).

The estimate is based on the average annual growing degree days (GDD) calculated over two decades, using daily temperature data with a spatial resolution of 300 arc-seconds from 1987 to 2016 (Karger *et al.*, 2017; Karger *et al.*, 2022).

It was assumed that *C. virescens* needs 550 GDD to complete a generation, considering the minimum threshold temperature for development of 12.6°C and the maximum development temperature of 33.3°C. The GDDs were calculated using method 1 McMaster & Wilhelm (1997), with the modification that zero GDD accumulation was recorded when temperatures exceeded the maximum development temperature.

Distribution records of *C. virescens* retrieved from GBIF (2023) [black dots] and various publications (coordinates presented in the publications or estimated based on the information in the publications) [white dots] are displayed on the map. The country borders on the map were sourced from GADM (2020). A file with locations mapped is available at: https://upload.eppo.int/download/1795oc9f8bdff8.

Note that 11-12 generations apply to individual points in South America, which are not visible here but show on the interactive map (https://upload.eppo.int/download/1786odc445dc83).

9.3 Other factors

- Adults can feed on the nectar of various plants and therefore are expected to survive (without food they would survive 3-5 days).
- Fecundity can be high (200-1600 eggs - section 2.2), and is highest on preferred hosts such as cotton, tobacco and chickpea.
- Establishment will be more likely in areas where the pest can produce several generations per year on suitable hosts, as it would favour the build-up of an initial population in the first growing season.
- Natural enemies may occur in the EPPO region, but they are not likely to prevent establishment.
- Tillage will negatively affect survival of pupae during winter, but is unlikely to kill all pupae.

9.4 Conclusion

- Hosts are present throughout the EPPO region, and the climatic suitability will be the limiting factor for establishment outdoors.
- *Chloridea virescens* is more likely to establish from the Mediterranean area through to the Black Sea coast, Caucasus, southern Russia and Central Asia (Fig. 4 above), especially in areas where the preferred hosts are grown (such as cotton, tobacco, chickpea and tomato). In these areas, there may be several generations per year (up to 5). Within this area, there is an uncertainty related to low soil temperatures in winter, which may limit survival of the pest, and therefore limit the area of potential establishment. The pest could establish in arid areas provided that irrigation is used.
- *Chloridea virescens* is unlikely to be able to complete its development (insufficient degree days to complete a generation) in the northern part of the EPPO region: Ireland, most of the UK (except limited areas in the south-east), Scandinavia, Estonia, northern Russia, and Latvia (see Fig. 5). Establishment outdoors is therefore unlikely in these areas. Similarly, some parts of Russia (East of the Ural) and parts of Kazakhstan experience soil temperatures <–3°C for a long period, and establishment is likewise unlikely in these areas.
- Finally in the remaining areas of the EPPO region, including Western and Central Europe, there is an uncertainty on whether the pest could establish (soil temperatures and suitability of other climatic factors), but it could complete 1 or 2 generations at least as transient populations over the summer.
- Throughout the EPPO region, climatic conditions in mountainous areas are likely to be less suitable to the pest.

With climate change (2071-2100 under the scenario RCP8.5 – see above), a larger part of the EPPO region, including the whole of continental Western Europe may present climate types under which *C. virescens* is currently established in the Americas or produces generations over summer.

The likelihood of establishment outdoors was rated for the area where climatic conditions are likely suitable (as represented in Fig. 5 above) with an uncertainty related to soil temperatures. Hosts will not be a limiting factor for establishment within this area. In part of this area, conditions will be suitable to the development of the pest all year-round and there would be several generations which will increase the likelihood of establishment.

In other parts of the EPPO region, the likelihood of establishment is lower with a higher uncertainty (whether it could survive in winter, whether it could switch to new hosts in areas where the preferred hosts are not cultivated). In some areas, there may only be transient populations.

In areas of the EPPO region where climatic conditions are suitable

Rating of the likelihood of establishment outdoors	*Very low* ☐	*Low* ☐	*Moderate* ☐	***High*** X	*Very high* ☐
Rating of uncertainty			***Low*** X	*Moderate* ☐	*High* ☐

10 Likelihood of establishment in protected conditions in the PRA area

Chloridea virescens may survive in protected conditions during winter (Capinera, 2001). Crop consultants in Mexico report that it is a pest on greenhouse tomatoes (C.A. Blanco, pers. comm.). The related species *H. armigera* is a pest in tomato greenhouses in Agadir, Morocco (K. El Fakhouri, pers. comm.). The conditions of protected conditions would be favourable to the pest all year-round provided host plants are present.

The preferred hosts cotton and tobacco are not grown in protected conditions. However, many main hosts of *C. virescens* are grown in glasshouses in the EPPO region, such as *Solanum lycopersicum*, *Lactuca sativa*, *Rosa* and *Chrysanthemum* (NVWA, 2020 for the Netherlands). In the Netherlands, glasshouses are generally concentrated in certain areas and the pest may be able to establish in such glasshouse areas where host plants are present year round.

Under protected conditions, there may be periods of the year without any host. To maintain populations in protected conditions throughout the year, *C. virescens* should find suitable host material (leaves, buds, flowers or fruit) all year round indoors, or be able to establish outdoors and re-enter the greenhouse. Pupae in the soil or growing medium could allow the pest to survive until new plants are established in the greenhouse. However, as part of regular pest management in greenhouses, the pest may be detected and controlled before it can establish. In addition, some growing conditions in greenhouses (e.g. hydroponic systems) may not allow survival of pupae.

In areas where *C. virescens* can establish outdoors, the likelihood of establishment under protected conditions is similar to establishment outdoors, because of possible reintroduction from outside.

In areas where it cannot establish outdoors, establishment is likely only in greenhouses where host plants are present year-round in soil. Plant protection products applied against other pests may have an effect on *C. virescens*, and possibly prevent establishment, but no data is available. The use of plant protection products that are effective against the pest would be limited in organic farming. In greenhouses or greenhouse areas where host plants are only present part of the year, establishment is very unlikely, and only transient populations may occur indoors.

In areas where it cannot establish outdoors, and in greenhouses where host plants are present year-round

Establishment was rated similar as to areas where *C. virescens* can establish outdoors. Establishment was not rated very high, because the pest may be detected and controlled before it can establish.

Rating of the likelihood of establishment in protected conditions	*Very low* ☐	*Low* ☐	*Moderate* ☐	***High*** X	*Very high* ☐
Rating of uncertainty			*Low* ☐	***Moderate*** X	*High* ☐

Uncertainty: it is uncertain how likely it is that the pest is detected and treated in time

11 Spread in the PRA area

Natural spread will occur through flight and wind currents. The pest may disperse by approximately 10 km per generation (section 2.4), and in the EPPO region there may be several generations per year (up to 4 or 5, but in most areas 1 to 3 – see section 9.2). However, the pest is unlikely to spread to such distances in areas where it can find suitable host plant material to accomplish its life cycle during the growing period, at least until populations have build-up.

There may be movements at longer distances (see section 2.4). Mountainous areas or large bodies of water may be an obstacle to the spread between favourable areas. It is not known if the pest would migrate in the EPPO region to the same extend as in North America (it is not documented from all areas where the pest is present, and migration occurs in response to poor conditions). However, weather events may contribute to its dispersal at long distance. If the pest establishes in the south of the EPPO region, it may spread in the summer northwards. Population build-up in the south should be sufficient to induce such migratory behaviour.

Human activities are likely to transport *C. virescens*, in particular the large trade within the EPPO region of:

- host plants for planting,
- above-ground fresh cut plant parts of hosts and
- host fruit.

In part of the EPPO region, there are currently no phytosanitary requirements against other pests that would limit the spread (e.g. with fruit and cut plant parts in the EU).

In addition, pupae may be transported:

- as a contaminant of soil attached to used machinery and equipment,
- with soil on its own.

For the similar species *Helicoverpa armigera*, wind movement has been suggested from southern Europe and North Africa to the UK (Farrow & Daly, 1987 citing others; Fitt, 1989 citing others). There is also some evidence of migration of this species in the Middle East and in China (EFSA, 2014; Feng *et al.*, 2005). *Helicoverpa armigera* has been recorded in northern Europe (e.g. UK, Ireland, Sweden, Finland, Estonia) mostly during the summer, with only few records of completion of one generation in northern Europe (EFSA, 2014 citing others). In the Netherlands, there has been considerable increase in the number of individuals reported since 2021 (Waarneming.nl). Overall, such detections in the north may be due to migration or to transport on commodities. *Chloridea virescens* may have higher capacity of migratory movement than *H. armigera* (see section 2.4).

Climate change may speed up the dispersal of the pest in the future as conditions would become more favourable (see section 9.2.2).

The magnitude of spread was rated as high due to the large trade of host commodities in the region, and the flight capacity of adults (10 km per generation). Note that the magnitude of spread was not rated as very high, because the pest is unlikely to spread at long distances in areas where it can find suitable host plant material.

Rating of the magnitude of spread	*Very low* ☐	*Low* ☐	*Moderate* ☐	***High*** X	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	***High*** X

Uncertainty: if adults find suitable hosts, they may not fly at long distance; whether infested commodities will be traded (plants for planting, fruit, cut plant parts).

12 Impact in the current area of distribution

Chloridea virescens **has been an important pest in a wide variety of crops for the past 200 years in the Americas (Blanco, 2012). It is reported as a pest of many crops such as cotton, tobacco, tomato, soybean, chickpea, bean and alfalfa (Pogue, 2013 citing Graham & Robertson, 1970; Waldvogel & Gould, 1990; Blanco *et al.*, 2007), as well as vegetables and ornamentals. Cotton, tobacco and chickpea are hosts throughout the distribution of the pest and are frequently reported in the literature. However, other hosts are also attacked depending on the location. Currently, IPM programmes are applied and the pest appears to be under control in most crops in some countries (such as USA and Mexico). When *C. virescens* recently became a problem in a new crop (e.g. blueberry in Peru or grapevine in Brazil), suitable combinations of control methods had to be developed in the framework of IPM. As for other noctuid pests, economic damage may not occur every year depending on management applied and weather conditions (K. El Fakhouri, C.A. Blanco, pers. comm.).**

12.1 Impact in different countries

USA

Details on impact were found for tobacco, cotton, flowers and lettuce. The use of transgenic cotton crops since the 1990s has contributed to a general decrease of populations of the pest in wide areas. Currently, damage is occurring mostly on crops such as ornamental plants (C.A. Blanco, pers. comm.).

- On tobacco, *C. virescens* was first reported as a serious pest in the 1800s. It is still a pest, such as 'the most significant pest of tobacco grown for seed' (Crop Profile, 1999; Burrack & Chapman, 2013).
- On cotton, *C. virescens* became a serious pest in the 1930s, although damage and the application of control measures may date back to the 1890s (Blanco, 2012). In the 1950s-1980s, the extensive use of pesticides contributed to *C. virescens* becoming a major pest by eliminating natural enemies and promoting resistance to all available pesticides. As a result, cotton cultivation stopped in very large areas, with huge economic consequences (Reed & Pawar, 1982). «The bollworm complex has been classified at some point as "the nation's most destructive and ecologically disruptive insect pest problem," costing the country over $1 billion dollars for their damage» (Blanco, 2012). In the 1980s, IPM approaches combining the use of pesticides with destruction of early weedy hosts adjacent to crop fields, biological insecticide, as well as in some cases the release of sterile crosses (never in area-wide management) were used, but were not fully effective (Blanco, 2012).
  Since the 1990s, the use of Bt cotton[3] and associated management measures have likely reduced populations on a wide scale (Blanco, 2012). The possible impact of previous control efforts, as well as current infrequent spraying of lepidopteran-active insecticides on cotton may all have contributed to the decline of populations since the end of the 1990s (Blanco, 2012). The use of Bt cotton has in particular been combined with resistance management strategies developed for transgenic crops (Hernandez & Blanco, 2019). The decline of populations took about a decade (C.A. Blanco, pers. comm.).
  High infestations of this pest severely reduce the number of bolls, especially early in the cotton growing season. Failure to control this pest before the development of the sixth internode would impact yields and quality of the fiber. Cotton plants with undetermined growth would produce more bolls in upper internodes but these may not mature at harvest time (C.A. Blanco, pers. comm.).
- In California and some Central USA states (Nebraska, Kansas, Colorado), impact on flowers is reported, especially on petunia, geranium and *Nicotiana* (Davidson *et al.*, 1992, University of Nebraska, 2023, Cloyd, 2016, Cranshaw, 2020). In California, *C. virescens* was recorded on ornamentals much before it was first observed attacking cotton in the early 1970s (Davidson *et al.*, 1992). It can cause considerable damage to geraniums, and can devastate petunias because the plants are often small and are usually planted as annuals. In observations in the field, the proportion of mature flowers per plant damaged by feeding often reached 50% during the summer (Davidson *et al.*, 1992). In Nebraska, the second (and last) generation of *C. virescens* in August and early September is the most damaging; serious damage caused some gardeners to stop growing geraniums or petunias (University of Nebraska, 2023). The pest is also reported to feed on rose, snapdragon, verbena and other flowering plants (Davidson *et al.*, 2012, University of Nebraska, 2023, Cranshaw, 2020, Cloyd, 2016). In Colorado, *C. virescens* can be a severe pest of many garden flowers in some years (Cranshaw, 2020).
- In California southern desert, *C. virescens* is a pest of lettuce and management is recommended in UC IPM (2017). Control in the heads of maturing lettuce is difficult.
- The population dynamics of *C. virescens* are poorly understood. For example, in Maryland this pest used to be of concern on tobacco in the 1980s and 1990s. The tobacco area has greatly diminished in Maryland and large experimental plots established in 2020-2023 with different *C. virescens* hosts (e.g., chickpea, cotton, okra, tomato and tobacco) have not been infested by the pest (C.A Blanco, pers. comm.).

Mexico

- In the past, *C. virescens* could cause 100% economic losses on cotton. On tobacco, losses can be over 1900 USD per hectare. It is the pest with the greatest impact on chickpea in Mexico and the Americas (Manzanarez Jiménez, 2020).
- In the 1950s, *C. virescens* was causing severe damage to cotton (Loera-Gallardo *et al.*, 2008). Before Bt cotton became available in northeastern Mexico, cotton cultivation became almost unfeasible in 1994-

[3] first expressing Cry1Ac proteins, later others such as Cry1Fa, Cry1Ab, Cry2Aba and Vip3A. The next generation of Bt cotton (Bollgard® 3) containing a Vip3A gene is now on the market (Sullivan & Molet, 2007 citing others).

1995 due to insecticide resistance. After a couple of years of limited pyrethroids application and use of Bt cotton, the susceptibility of *C. virescens* to most insecticides (incl. pyrethroids), returned, allowing control (Terán-Vargas *et al.* 2005, Blanco, 2012).

- In Sinaloa, the economic threshold for damage of *C. virescens* on tomato is 8.5 % (Manzanarez-Jiménez *et al.*, 2021).

Peru

- Historically, *C. virescens* was a major pest of cotton in the 1930s (Reed & Pawar, 1982). In the Cañete Valley (Pacific coast, central Peru), *C. virescens* was initially present at levels that caused insignificant damage, but switch from sugarcane to cotton production increased damage. In the 1950s, widespread resistance to plant protection products occurred, and in 1956, nearly 50% of the cotton crop was lost despite an average of 15 chemical sprays. Following 7 years of a new programme (near-complete abandonment of synthetic pesticides, changes in cultural practices, and increased use of biological control), *C. virescens* was not a major problem of cotton anymore (Walsh *et al.*, 2022). However, it is still reported as an economic pest (Ministero del Ambiente, 2020).
- In recent literature, *C. virescens* is reported as an economic pest of asparagus, quinoa, and blueberry, and management recommendations are made (FAO, 2016; Navarro, 2019; Narrea *et al.*, 2022; NovAgro-Ag, 2023 citing Rojas, 2016).
    - On asparagus, the first infestations were observed in the early 1990s, and it rapidly became a key pest of this crop. In some areas of Lima, Ancash and La Libertad regions, it is the main pest problem on asparagus (Sánchez & Vergara, 1996).
    - *Chloridea virescens* is one of the most important pests of blueberries and cause yield reduction (Narrea *et al.*, 2022). Damage can reach 40% of blueberry plants, and up to 25-30 pesticides applications were applied per year (pest present all year round) (Navarro, 2019).
    - On quinoa, feeding on leaves is mostly not economically relevant, but feeding on grains affects production; harvested grains are usually contaminated with frass (Cruces, 2022 citing Carrera *et al.*, 2016).
- There are older reports of damage and management on other crops:
    - *Chloridea virescens* was one of the main pests of *Cajanus cajan* (Korytkowski & Torres, 1966).
    - On apple, economic damage occurred in 1993 in the Mala valley (Cañete province), with over 50% of fruits damaged and 30-80% of leaves eaten in some periods of the year and areas. Large numbers of chemical treatments were applied and some orchards had to be abandoned. The pest was present without causing economic damage in previous years (De Tomás & Peralta, 1994). In subsequent years, research was made with plant traps (chickpea) as control measure (Alba, 2004; De la Cruz Abarca, 2008). According to De la Cruz Abarca (2008), the period of time in which the pest had an importance for apple crops was relatively short, and the plant traps proposed had no time to be completely adopted.
- Given interceptions on asparagus from Peru (section 8.1.2), there must be an economic impact on exports, incl. due to rejection, delays on identification, increase of inspection intensity.

Brazil

- Outbreaks of *C. virescens* were first observed in the late 1930s (Hambleton, 1944), and it was reported for many years as a pest of cotton (Ventura *et al.*, 2015 citing McCaffery 1998). Attacks can lead to loss of fiber and seeds and recommendations for its control on cotton are still made (Miranda, 2010). Blanco *et al.* (2016) mention that it is a pest of non-Bt cotton in Brazil.
- Later, the pest started attacking soybean (Ventura *et al.*, 2015 citing McCaffery 1998). Significant yield losses have been reported in important soybean-producing regions (Boiça Júnior *et al.*, 2022). In Roraima, it is not a major lepidopteran pest of soybean, but its importance could increase because cotton-growing is starting (similarly to observations in other parts of Brazil that it can be a pest of soybean especially in areas close to cotton) (Fidelis *et al.*, 2019).
- *Chloridea virescens* is a major pest of chickpea (Borella Júnior *et al.*, 2022), and of bean (Boiça Júnior *et al.*, 2017).
- On tomato, during attacks in fields in the state of Espírito Santo, 10% of tomato fruit were damaged, showing holes of different sizes in the pulp of the fruits with diameters of two or more centimetres, depending on the state of development of the larvae (Pratissoli *et al.*, 2006).

- On grapevine, the first finding occurred in the state of Parana, where the pest was found in several vineyards in several municipalities (up to 20 km from each other) (Ventura *et al.*, 2015). The presence of larvae, damage, and frass rendered the grape bunches worthless for the fresh market, and control measures were applied (Ventura *et al.*, 2015). However, only one published record was found and it is not known if this situation occurred again.

Cuba. *Chloridea virescens* is reported as the key pest of tobacco (Rodríguez-Espinosa *et al.*, 2018a). It is also the main pest of chickpea in Cuba, and can cause large losses at the stages of filling and ripening of the pods, attacking the grains or eating them totally and therefore making them unusable for human consumption (Alvarez Hernández *et al.*, 2010 citing others).

Dominican Republic. *Chloridea virescens* is one of the pests affecting grain of pigeon pea (*Cajanus cajan*) (Guzmán *et al.*, 2018).

Puerto Rico. *Chloridea virescens* is a pest of *Cajanus cajan*. The quantity and quality of green pods/seeds may be reduced drastically (up to 100%) in severe infestations (Viteri *et al.*, 2019 citing others). It is a pest of non-Bt cotton in Puerto Rico (Blanco *et al.*, 2016).

Nicaragua. *Chloridea virescens* is listed amongst pests of tobacco (Jiménez Martínez & Rodríguez Flores, 2014).

Argentina. *Chloridea virescens* is (or was) a key pest of tobacco in northeastern Argentina (Delgado & Fedre, 2003). In Santiago del Estero and Cordoba provinces, the pest appears to be present at a very low prevalence (Murúa *et al.*, 2016, Torretta *et al.*, 2009).

Bolivia. *Chloridea virescens* was one of the most injurious pests of cotton in 1970-71 in the region of Santa Cruz (Candia, 1971). No recent information was found.

Colombia. *C. virescens* was rarely found on tobacco (Hallman, 1980). On cotton, it was initially not a pest in the first years after the crop was introduced, but became a major pest afterwards (Hallman, 1980), and it could cause 100 % losses on cotton (Bachini, 1966). Blanco *et al.* (2016) mentions that it is a pest of non-Bt cotton in Colombia.

Chile. In the transverse valley of the Atacama desert, feeding activity of *C. virescens* larvae is a serious problem for some horticultural crops (Santos-Zamorano *et al.*, 2017 citing Klein-Koch & Waterhouse 2000). In the same area at the border with Peru, it causes problems on blueberry and asparagus (G.I. Silva Aguayo, pers. comm.). The pest is reported to be associated with a number of other crops by Koch & Waterhouse (2000), but no specific data on impact or recent information were found.

Uruguay. *Chloridea virescens* is not of major interest (Bentancourt & Scatoni, 1992). No recent information was found.

Ecuador. In a survey, few individuals of *C. virescens* were observed per cotton boll (0.5) and damage was not significant. *C. virescens* has been reported attacking cotton in the flowering stage (Zambrano *et al.*, 2021).

No information was found for other countries where the pest is present.

Environmental impact is not reported in the literature.

12.2 Control methods

Effective control of *C. virescens* in commercial crops currently relies on IPM. Strategies aim at reducing populations, including pro-actively managing the pest year-round (Sullivan & Molet, 2007 citing others), and are applied in the crops and on wild hosts. Control strategies take account of the fact that infestations originate from weeds and from neighbouring fields with susceptible crops (FAO, 2016 on quinoa).

The different types of control methods that are combined in IPM strategies are listed below. For an overview of combinations for individual crops, see the publications cited. The types of control methods are broadly similar to those recommended against the noctuid *S. frugiperda* in IPPC Secretariat (2021), which also provides an analysis of their advantages and disadvantages.

Plants are inspected to determine the need for treatments. For example:

- On cotton, inspecting plants to detect eggs on the leaves and larvae in floral structures (terminal buds and bolls) of the upper and middle part of the plant (Miranda, 2010).
- In gardens, monitoring flowerbuds for tunneling by the first generation of *C. virescens* in early summer, and continuing monitoring throughout the summer (University of Nebraska, 2023).
- On lettuce, recently-emerged seedlings can be inspected to detect eggs and to determine if they are parasitized, hatched, or about to hatch. Above a threshold of eggs and caterpillars, insecticides should be applied after eggs have hatched. At least 25 plants should be checked in each quadrant of a 40-80-acre field twice a week. In fields where the crop is heading, 5 plants in each quadrant should be monitored. Recommended thresholds are: between lettuce thinning and heading, more than one larva for each two plants on average; once heads form, one larva in every 25 plants on average (UC IPM, 2017).
- In tobacco fields, foliar application targeting *C. virescens* larvae were made at a threshold of 10% of plants infested with ≥1 *C. virescens* (Zilnik *et al.* 2020). A threshold for chemical control in tobacco was mentioned as prior to tobacco buttoning when there are five or more larvae per 50 plants (after the button stage, *C. virescens* rarely causes economic damage to tobacco) (Crop Profile, 1999).
- In *Cajanus cajan* (pigeon pea), Viteri *et al.* (2019) showed that incidences over 5% due to life stages of *C. virescens* caused yield reductions over 70% in the control compared to the best treatments (e.g. β-cyfluthrin and chlorantraniliprole) which serve as an initial action threshold to control tobacco budworm in the field.

Use of resistant or tolerant host varieties

Transgenic cultivars

Transgenic cultivars expressing the Cry toxins from *Bacillus thuringiensis* are extensively used in the Americas against Lepidopteran pests such as *C. virescens*, for example cotton and soybean. This has been a key to bringing *C. virescens* under control in cotton crops (Blanco, 2012), and allowed resuming cropping in the USA following severe attacks by *C. virescens*. Bt cotton has proved 95% effective in controlling *C. virescens* in the cotton-growing region of Mexico (Traxler & Godoy-Savila, 2004; Nava-Camberos *et al.* 2019). Control of *C. virescens* on Bollgard® cotton is greater than 99.9% (Blanco *et al.* 2008b, 2009c). Transgenic cotton expressing Cry1Ac was introduced in the 1986 (Walsh *et al.*, 2022). More recently, 'pyramided' varieties producing both Cry1Ac and Cry1F have been released (Gahan *et al.*, 2005). In Brazil, Cry1Ac soybean continues to provide high control of several lepidopteran pests including *C. virescens* (Horikoshi *et al.*, 2021). For *C. virescens*, unlike for *Helicoverpa zea*, no Cry1Ac resistance has yet been detected in the field (Blanco *et al.* 2009c; Walsh *et al.* 2022). In the laboratory, tolerance to Cry endotoxins has been selected for (Gould *et al.* 1995, Walsh *et al.*, 2022; Gahan *et al.*, 2005; Jurat-Fuentes *et al.*, 2003). The use of Bt crops is accompanied by strategies to avoid the development of resistance (Walsh *et al.*, 2022; Blanco *et al.*, 2008a, citing others). From the literature, the use of transgenic cultivars generally seems to still provide a good protection.

Conventional resistant or tolerant cultivars

Development of resistant varieties for noctuid pests is difficult due to polyphagy, mobility and high fecundity, and selection mostly focuses on tolerance and antixenosis (K. El Fakhouri, pers. comm.). No information was found on the commercial use of conventional tolerant or resistant varieties. Some experimental data was found regarding the resistance or tolerance of cultivars. Two commercial soybean cultivars (IAC 100 and M 7110 IPRO) showed antibiosis resistance to *C. virescens* (Almeida *et al.* 2017; Boiça Júnior *et al.*, 2022 citing Eduardo *et al.*, 2020).

For chickpea, Borella Júnior *et al.* (2022) found that the cultivars (Jamu 96 and BRS Aleppo) with different resistance mechanisms (antixenosis and antibiotic), which had different resistance levels and mechanisms to *C. virescens*, could be used in IPM programmes to control this pest. The resistant chickpea cultivars expressed a higher trichome density in their leaves and higher contents of oxalic and malic acids.

Some variation in susceptibility to *C. virescens* has been observed among petunia cultivars, and some geranium species are less frequently damaged, such as ivy geranium (*Pelargonium peltatum*) compared to zonal types (*Pelargonium* x *hortorum*) (Cranshaw, 2020).

Cultural control

Cultural practices aim at avoiding infestations by the pest (FAO, 2016 - quinoa) and reducing adult populations (and therefore the number of eggs and larvae) (NovAgro-Ag, 2023 - blueberry). In Brazil, no insecticide is registered against *C. virescens* on chickpea, and other control methods are applied in the framework of IPM strategies (Borella Júnior *et al.*, 2022 citing others).

The following cultural control methods are mentioned in the literature:

- elimination of wild hosts in fallow fields and margin areas surrounding cotton fields aiming to reduce the first generation of the year (Blanco, 2012 - cotton), and keeping crops free from weeds (FAO, 2016 - quinoa). Herbicides or mowing can be used (Capinera, 2001), as well as geomembranes established before planting to prevent weeds from sprouting, as well as management of alternative hosts in the environment or field edges (Narrea *et al.*, 2022[4] - blueberry).
- deep tillage (FAO, 2016 - quinoa). For tobacco, fall and winter deep plowing exposes the pest to natural enemies and harsh weather conditions (Crop Profile, 1999).
- crop rotation (FAO, 2016 - quinoa).
- best cropping practices including to limit plant stress: correct fertilization program (NovAgro-Ag, 2023 – blueberry; Crop Profile, 1999 - tobacco), use of windbreakers, management of planting density, weed management (Narrea *et al.*, 2022 - blueberry), pre-sowing irrigation (FAO, 2016 - quinoa)
- use of nets to prevent entry of *C. virescens* (effective to reduces by 80% the entry of Lepidoptera) (Narrea *et al.*, 2022 – blueberry; Cango *et al.* 2021).
- destruction of crop remains to suppress populations in the off-season (Miranda, 2010 - cotton).
- taking account of neighbouring crops to adjust management (Narrea *et al.*, 2022 - blueberry).

IPPC Secretariat (2021) for *S. frugiperda* also mention planting time adjustments, companion cropping and intercropping, and habitat management practices (probably for small growers). No mention of these was found for *C. virescens* in the literature used.

Trap crops are not used against *C. virescens*. The use of trap crops for the highly polyphagous species *H. zea* has not been effective to date (Cunningham & Zalucki, 2014).

For garden owners, mostly cultural control is recommended in central or northern locations in the USA, sometimes combined with the use of plant protection products:

- Manual removal of larvae or removal of the entire flower head (University of Nebraska, 2023). In small flower plantings, this is the most practical control (Cranshaw, 2020).
- If potted host plants are kept inside in winter, soil can be removed to eliminate pupae and plants be repotted before taking them inside (Cranshaw, 2020; University of Nebraska, 2023). Old soil in outdoor containers with a history of *C. virescens* should be removed (University of Nebraska, 2023).

Plant protection products

Chemical and microbial plant protection products are mentioned. IPPC Secretariat (2021) for *S. frugiperda* also mentions botanical products (such as neem), but this is not named for *C. virescens* in the literature used.

Foliar insecticides were commonly used in crops, but this led to destruction of beneficial organisms and resistance (Capinera, 2001; Blanco, 2012). Current recommendations in commercial crops mostly mention 'low-impact insecticides' (FAO, 2016), biological insecticides or mixtures. However chemical plant protection products are still recommended in some countries or particular settings.

[4] Narrea *et al.* (2022) proposed an IPM programme against *C. virescens* on blueberry for Peru, combining methods that are already in use. These are mentioned in this section, even if it is not always clear if they are currently used against *C. virescens* or other pests.

Bacillus thuringiensis and nuclear polyhedrosis virus foliar sprays were used over wild hosts in IPM strategies for cotton (Blanco, 2012) as well as in field crops (Capinera, 2001). *Bacillus thuringiensis* var. *kurstaki* can be used in blueberry crops (alone or in combination with *Bacillus thuringiensis* var. *aizawai*, or mixed with emamectin benzoate or abamectin - NovAgro-Ag, 2023), in flower gardens on plants for which larvae feed on leaves and blossoms, such as petunias (Cranshaw, 2020), or on lettuce (UC IPM, 2017). *Bacillus thuringiensis* subsp. *kurstaki* strain VBTS-2546 + *Bacillus thuringiensis* subsp. *aizawai* strain ABTS-1857 are approved in the USA against lepidopteran pests on various crops (EPA, 2022). Nuclear polyhedrosis virus can also be used in blueberry (Narrea *et al.*, 2022). A mix of *Chrysodeixis includens* Nucleopolyhedrovirus isolate #460 (17.1%) with *Helicoverpa zea* Nucleopolyhedrovirus strain ABANPV-U (17.1%) is approved in the USA against *C. virescens* (EPA, 2021).

Table 10 lists active substances mentioned for different crops in recent publications.

Table 10. Active substances recommended against *C. virescens* on some crops in recent publications

Active substances	Country and crop	References
Lambda-cyhalothrin, thiamethoxam*	Ecuador on cotton	Zambrano *et al.* (2021)
Acephate*, carbaryl*, endosulfan*, methomyl*	USA on tobacco	Crop Profile (1999)
bifenthrin*	Brazil on grapes	Ventura *et al.* (2015)
emamectin benzoate# or chitin synthesis inhibitors	Peru on blueberry (only 'as the last resort')	Narrea *et al.* (2022)
emamectin benzoate# or abamectin	Peru on blueberry (in combination with *Bacillus thuringiensis*)	NovAgro-Ag (2023)
chlorantraniliprole, spinosad, indoxacarb*, emamectin benzoate#, zeta-cypermethrin*, permethrin*	California in IPM lettuce. they note that spinosad has negative effects on beneficial syrphid flies and parasitoids	UC IPM (2017)
permethrin*, cyfluthrin*, bifenthrin*	Nebraska on flower crops for garden owners, difficult for plants on which caterpillars are in flowerbuds and stems, such as geraniums, but is possible for others, such as petunias	University of Nebraska (2023)
spinosad, cyfluthrin*, cypermethrin, lambda-cyhalothrin, permethrin*	Colorado on flower crops for garden owners. Insecticides cannot be applied when bees are active	Cranshaw (2020)
Pyrethroids authorized for homeowner uses are e.g. permethrin*, lambda cyhalothrin, bifenthrin*	North Carolina on rose (no negative effect on pollinators: residue on the outside of sepals, and bees/butterflies feed on petals and anthers)	NCSU (2016)
Flubendiamide	North Carolina on tobacco	Hannah and Chapman (2013)
deltamethrin, indoxacarb*, spinosad, spinetoram, cypermethrin, methomyl*, chlorantraniliprole, lambda-cyhalothrin, thiodicarb*, lufenuron*	Colombia (currently used, no details on crops)	ICA (2009), J. Rodriguez, pers. comm.

* not approved in the EU (EC, 2023); # in the EU, under the name emamectin

Release of sterile males

In the USA, release of sterile males resulting from the cross between *C. virescens* and *H. subflexa* was used in cotton, prior to the use of Bt cotton (Blanco, 2012). This technique helped in limiting populations. This technique is no longer used (C.A. Blanco, pers. comm.).

Augmentative biological control, i.e. mass-production and release of biological control agents

The egg parasitoid *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae) can be effective in vegetable crops. Other important parasitoids are *Cardiochiles nigriceps* in vegetables and *Cotesia marginiventris* in other crops (both Hymenoptera: Braconidae) (Capinera, 2001). Release of *Trichogramma* sp. is advised when eggs of *C. virescens* are detected in the field (FAO, 2016 - quinoa).

Conservation biological control, i.e. preservation of populations of natural enemies

Control methods should not destroy populations of natural enemies (Blanco, 2012, Miranda, 2010). In areas of cotton growing with low pest infestations, natural enemies can keep populations of *C. virescens* under the threshold for economic damage (Miranda, 2010).

IPPC Secretariat (2021) for *S. frugiperda* also mentions habitat management practices for the purpose of promoting beneficial organisms; this was not mentioned for *C. virescens* in the literature used.

The rating of the magnitude of impact in the current area of distribution was done focusing on impact in the last ten years, which corresponds to more current control methods, knowing that more impact occurred in the past. Economic impact has been reported in some countries. Although the pest is under control in some countries and crops, this is not the case throughout its distribution. The magnitude of impact is lower in some countries like the USA and higher in others such as Peru.

Rating of the magnitude of impact in the current area of distribution	*Very low* ☐	*Low* ☐	***Moderate*** X	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	***Moderate*** X	*High* ☐

Uncertainty. No recent information from many countries where the pest occurs. Whether the low number of reports on some crops reflect occasional attacks, misidentification or lack of science output.

13 Potential impact in the PRA area

Will impacts be largely the same as in the current area of distribution? Yes / **No**

The main hosts grown in the area of potential establishment include cotton, tobacco, soybean, chickpea, asparagus and tomato, as well as a wide variety of other hosts.

The two main differences between impacts in the current area of distribution and the EPPO region are:

- Transgenic Bt host crops are currently not used in the EPPO region, while experience in the current area of distribution shows that they proved critical to reducing impact. Where Bt crops are not used, *C. virescens* may initially have severe impact before such crops can be authorized or other control methods are put in place, for example on major hosts such as cotton, or soybean. Nevertheless, impact will likely not be as high as in the 1930s-70s in the Americas, because new generation plant protection products are available, which may be less favourable to resistance development, and IPM practices can be implemented. In many EPPO countries, authorisation of transgenic crops may not be possible at all:
  - Bt cotton is not approved in Türkiye, Uzbekistan, Turkmenistan and Tajikistan, which have a substantial cotton production. Cotton is an important production and export commodity for Türkiye and Uzbekistan (Tokel *et al.*, 2021), and *C. virescens* may have a major economic impact. The pest may also have impact on the limited cotton production of other EPPO countries (see section 9.1).
  - There are no Bt host crops authorized for cultivation in the EU (only some cotton and soybean cultivars for imports as food, feed or products containing them; https://joint-research-centre.ec.europa.eu/scientific-activities-z/gmos_en; https://webgate.ec.europa.eu/dyna2/gm-register/) nor in Morocco (K. El Fakhouri, pers. comm.).
- There are relatively fewer control options available for organic crops than for conventional crops in the EPPO region, and there may therefore be relatively more impact in organic crops than in conventional agriculture in the EPPO region.

In the EPPO region, economic losses in the field can be expected in areas where the pest can establish outdoors. Impact will be more severe where preferred crops are cultivated, on which the pest may develop high populations, and where hosts are cultivated over large areas. From such infestations, large populations may develop and other hosts may be infested during the growing season. The pest may have impact on a wide range of hosts. However it is not possible to assess if some hosts, especially those for which there is only one or few records, will be affected (e.g. grapevine, blueberry, apple), and whether plants that are closely related to known hosts may also be attacked.

Impact will be more severe in the parts of the EPPO region that are more suitable to *C. virescens* and where several generations per year may occur. If the pest is established on a wider scale in the EPPO region, local overwintering populations may be replenished by migrating individuals, as observed for *H. armigera* (EFSA, 2014).

In areas where the pest cannot establish outdoors, establishment indoors and subsequent yield losses might still occur but such a situation would be easier to control. There may also be outbreaks outdoors in those areas due to transient populations during the summer. Such outbreaks may be severe in years where weather conditions are favourable to the pest, as observed for *H. armigera* in part of Europe (EFSA, 2014).

Over the wide range of hosts, *C. virescens* may increase the need for pest treatments in crops that may not be treated at the moment. The availability of control methods will influence potential impact.

There may be limited numbers of insecticides authorized to control *C. virescens*. Nevertheless, a number of chemical plant protection products recommended in the Americas against *C. virescens* are still approved in the EU for specific uses (as marked in Table 10 in section 12.2), and some active substances that have been used in the EU against *H. armigera* are also still approved[5]. However, development of resistance to plant protection products, such as observed for *C. virescens* in the past in its distribution, may complicate control and increase impacts.

Several strains of *Bacillus thuringiensis* (incl. of var. *kurstaki* and of var. *aizawai*) are also approved (EC., 2023), and both *B. thuringiensis* and nucleopolyhedrovirus are used in the EU against *H. armigera* (EFSA, 2014). Entomopathogenic fungi such as *Beauveria bassiana* are also used against many lepidopteran insects (including *Helicoverpa armigera*) (K. El Fakhouri, pers. comm.). In Türkiye against *H. armigera*, *B. bassiana* is used in cotton and *Bacillus thuringiensis* var. *kurstaki* in tomato (Tagem, 2017; Tagem, 2022).

The accurate timing of insecticide applications relies on monitoring of the crop. Traps with pheromones of different commercial companies are available, but such traps are of limited use for decisions on treatment. Crop scouting is more labour intensive, but a proven and reliable method to help farmers make timely, informed and economical field crop decisions.

Pest management methods already applied against Lepidoptera, especially *H. armigera*, may have an influence on the potential impact in the EPPO region, such as treatments, but *C. virescens* could have serious impact (J.M. Durán, pers. comm.).

- In crops in which noctuids (or other Lepidoptera) currently are not pests, and therefore no management against them is applied (e.g.: asparagus in Spain).
- In crops in which there is not much availability of plant protection products, and they depend on exceptional authorizations (e.g.: chickpea in Spain), which are not always granted. In Morocco, there are no approved insecticides for chickpea.
- If introduced populations had acquired (in the area of origin) resistance to the insecticides used in the EPPO region.

In Türkiye, *H. armigera* attacks tomato, pepper, eggplant, ornamentals, cotton, maize, tobacco and okra (N. Üstün, pers. comm.). On cotton (Tagem, 2017), IPM is implemented against various pests, incl. *H. armigera*.

Finally, some parasitoids are already used commercially or officially in several EPPO countries, such as *Cotesia marginiventris* indoors against Lepidoptera, and are detailed in EPPO Standard PM 6/3 (EPPO, 2022a). *Trichogramma pretiosum* and *Cardiochiles nigriceps*, which are used against *C. virescens* (see section 12.2), are not in EPPO Standard PM 6/3. However, several *Trichogramma* species have been used against Lepidoptera (*T. cacoeciae*, *T. cordubensis*, *T. dendrolimi*, *T. evanescens*, *T. pintoi*) and *T. brassicae* against *Ostrinia nubilalis* on maize (EPPO, 2022a). Against *H. armigera* in the EU, several parasitoids and predators have been used, which may also be useful against *C. virescens* (EFSA, 2014 citing others):

[5] Active substances that have been used in the EU against *H. armigera* (quoted from EFSA, 2014), currently still approved in the EU, except if marked with * (EC, 2023): benzoylureas (e.g. lufenuron*), oxadiazines (e.g. indoxacarb*), pyrethroids (e.g. bifenthrin*, cypermethrin, deltamethrin, etofenprox, lambda-cyhalothrin), pyrazoles, spinosyns, carbamates (e.g. methomyl*), organophosphates (e.g. chlorpyrifos*), semicarbazones (e.g. metaflumizone), moulting hormone agonists (e.g. methoxyfenozide), and other compounds derived from bacteria (e.g. abamectin), fungi (e.g. emamectin) and plants (e.g. azadirachtin).

predators *Orius* spp., *Nabis* spp., *Chrysoperla carnea*, *Macrolophus caliginosus* and *Dicyphus tamanini*, and parasitoids *Trichogramma* sp., *Cotesia kazak*, *Hyposoter didymator* and *Telenomus* spp.

Deep plowing of the fields before planting and after harvest is already recommended on some crops against other pests (e.g. on chickpea – K. El Fakhouri, pers. comm.) and will reduce populations of *C. virescens* pupae in the soil. Other cultural practices used in the Americas are also commonly used in the EPPO region against other pests (see section 12.2).

C. virescens may have consequences for export, including between EPPO countries (NVWA, 2020).

Introduction of the pest may have socio-economic impact in rural communities with limited access or financial means to acquire suitable agrochemicals. Social impact may occur if cropping of some hosts has to be temporarily abandoned following the introduction of the pest, similarly to what happened in several American countries for cotton, until IPM strategies can be put in place.

Consequently, impact may be high, especially in an initial phase until management measures can be fully developed and implemented. Such impact may be greater in countries where main hosts are cultivated over large areas (such as cotton in Uzbekistan or Türkiye). In crops where no management is applied against Lepidoptera currently, this initial phase may take longer. Impact may be different depending on the country, and the speed at which measures can be developed, authorized and implemented.

Rating of the magnitude of impact in the area of potential establishment	*Very low* ☐	*Low* ☐	*Moderate* ☐	***High*** X	*Very high* ☐
Rating of uncertainty			*Low* ☐	***Moderate*** X	*High* ☐

Uncertainty. unpredictability of whether some hosts will be impacted in the EPPO region (e.g. blueberry, grapevine, apple), and whether other plants will be attacked; efficacy of pest management that can be put in place in the absence of Bt crops

14 Identification of the endangered area

Chloridea virescens is more likely to establish from the Mediterranean area through to the Black Sea coast, Caucasus, southwest Russia and Central Asia, especially in areas where the preferred hosts (incl. cotton, tobacco, chickpea and tomato) are grown. In these areas, there may be several generations per year (up to 5). Economic impact is expected on hosts throughout that area. However, there is an uncertainty on the precise limits of the endangered area related to low soil temperatures in winter, which may limit survival of the pest. *Chloridea virescens* may also establish and cause damage indoors throughout the EPPO region.

15 Overall assessment of risk

Summary of ratings**:**

	Likelihood	**Uncertainty**
Entry (overall)	**High**	**Moderate**
Host plants for planting (except bare-rooted plants, seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures) and associated packaging material	High	Moderate
Asparagus and associated packaging material	Low	High
Other above-ground fresh cut plant parts of hosts, intended to be used fresh, and associated packaging material	Moderate	High
Host fruit and associated packaging material	Moderate	Moderate
Establishment outdoors for the area where climatic conditions are suitable	**High**	**Low**
Establishment in protected conditions		
- in areas where it can establish outdoors	High	Moderate
- in areas where it cannot establish outdoors, in greenhouses where host plants are present year-round	High	Moderate

	Likelihood	Uncertainty
Magnitude of spread	**High**	**High**
Magnitude of impact in the current area of distribution	**Moderate**	**Moderate**
Magnitude of potential impact in the PRA area	**High**	**Moderate**

Chloridea virescens is a polyphagous pest of many field crops (in particular cotton, tobacco and chickpea) as well as of fruits, vegetables and ornamentals. Over 200 hosts are recorded in the literature. The overall likelihood of entry was high with a moderate uncertainty, based on the likelihood of entry on host plants for planting. Entry on asparagus was rated as low with a high uncertainty. Other fresh cut plant parts of host plants and host fruits had a moderate likelihood and respectively high and moderate uncertainty.

Many host plants of *C. virescens* are present in the EPPO region, in commercial cultivation, gardens, and in nature. Climatic conditions, including soil temperatures in winter, were considered as limiting factors for the establishment of *C. virescens*. The likelihood of establishment outdoors was rated as high with a low uncertainty. The pest is more likely to establish from the Mediterranean through to the Black Sea coast, Caucasus, southwest Russia and Central Asia than in other parts of the EPPO region and especially in areas where preferred hosts are grown (such as cotton, tobacco, chickpea and tomato). In part of this area soil temperatures in winter may be too low and limit survival of pupae. Throughout the EPPO region, the likelihood of establishment under protected conditions is assessed to be high with a moderate uncertainty. There may be transient populations outdoors in areas where the pest cannot overwinter.

The magnitude of spread was rated as high with a high uncertainty. There is a large trade of host commodities in the region, pupae may also be moved as a contaminant of machinery and of soil, and the pest may disperse by approximately 10 km per generation but there may be movements over longer distances as observed with migratory populations in North America. However, there is a high uncertainty linked to the fact that the pest may not fly long distance if it finds suitable hosts, and whether infested commodities will be traded (plants for planting, fruit, above-ground fresh cut plant parts).

The magnitude of impact in the current area of distribution was rated as moderate with a moderate uncertainty, focusing on impact in the last ten years, knowing that more impact occurred in the past when no effective control methods were available (especially before transgenic Bt cotton). Economic impact has been reported in some countries during the last ten years. Although the pest is under control in some countries and crops, this is not the case throughout its distribution. The magnitude of impact is lower in some countries like the USA and higher in others such as Peru.

Significant impact is expected on many hosts (such as but not limited to: cotton, tobacco, soybean, chickpea, asparagus, tomato), throughout the area of potential establishment, and would be more severe where several generations may occur (up to 5). The pest may also cause damage under protected conditions throughout the EPPO region. The potential impact was rated as high with a high uncertainty, especially in an initial phase until management measures can be fully developed and implemented. Transgenic Bt crops may prove critical to potential impact, but transgenic crops are not authorized for cultivation in many EPPO countries, for example in major cotton producers of the EPPO region or in the EU. There are fewer control options available for organic crops than for conventional crops in the EPPO region, and there may be more impact than in conventional agriculture. Overall, impact may be higher in countries where main hosts are cultivated over large areas (such as cotton in Uzbekistan or Türkiye). In crops where no management is applied against lepidopteran pests currently, the initial phase until management measures can be fully developed and implemented may take longer. Impact may be different depending on the country, and the speed at which measures can be developed, authorized and implemented.

The phytosanitary risk for the endangered area (based on a three-level scale) was assessed to be high with a moderate uncertainty.

Based on all the information in this PRA, the EWG identified management options for *C. virescens*.

The EWG noted that climate change may increase the area of potential establishment and spread as environmental conditions would become more favourable to *C. virescens*.

Stage 3. Pest risk management

16 Phytosanitary measures

16.1 Measures on individual pathways to prevent entry

Considering the likelihoods of entry and uncertainties, the EWG recommended that measures should be recommended for several pathways. Measures were studied for the pathways host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures), above-ground fresh cut plant parts of hosts intended to be used fresh, as well as host fruits (see ANNEX 1).

The EWG recommended that measures should be applied to hosts in categories 1 and 2.

EPPO countries should consider whether specific requirements are necessary in relation to travellers and Internet trade (covered as entry pathways in section 8).

Pathway	Measures identified for the exporting country
Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Pest free area (PFA) (ISPM 4, ISPM 29) (see requirements below) OR Pest-free production site for the specified pest, established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* + Stored and transported in conditions preventing infestation, i.e. outside of the flight period of *C. virescens*, or not in/through areas infested with the pests, or closed (with new or cleaned packaging). OR Plants without soil or growing media attached (or the growing medium has been changed), and without leaves, flowers, buds and fruits + Stored and transported using new or cleaned packaging. OR Post-entry quarantine (in the framework of a bilateral agreement)
Above-ground fresh cut plant parts of hosts intended to be used fresh	Pest free area (PFA) (ISPM 4, ISPM 29) (see requirements below) OR Pest-free production site for the specified pest, established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* + Stored and transported using new or cleaned packaging. OR Systems approach combining all four of the following indents: - No signs of *C. virescens* observed at the place/site[1] of production during the last 3 months prior to export, and - Treatment(s) (treatment of the crop at the place/site of production) at appropriate time(s) to ensure freedom from the specified pest, and - Inspection of the lot prior to export and absence of the specified pest, and - Stored and transported using new or cleaned packaging.

	OR Irradiation treatment (ISPM 18) with a dose of minimum 150 Gy [2] + Stored and transported with new or cleaned packaging. OR Import for processing or direct consumption at specific time of the year (in the framework of a bilateral agreement)
Host fruits	Pest free area (PFA) (ISPM 4, ISPM 29) (see requirements below) OR Pest-free production site for the specified pest, established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* + Stored and transported with new or cleaned packaging. OR Systems approach combining all four of the following indents: - No signs of *C. virescens* observed at the place/site[1] of production during the last 3 months prior to export, and - Treatment(s) (treatment of crop at the place/site of production) at appropriate time(s) to ensure freedom from the specified pest, and - Inspection of the lot prior to export and absence of the specified pest, and - Stored and transported using new or cleaned packaging. OR Irradiation treatment (ISPM 18) with a dose of minimum 150 Gy [2] + Stored and transported with new or cleaned packaging. OR Import for processing or direct consumption at specific time of the year (in the framework of a bilateral agreement)

[1] *The choice between pest free place of production and pest free production site is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements.*
[2] *Other treatments such as cold treatments, chemical treatments, fumigation treatments, or controlled atmosphere treatments may be appropriate for some commodities, but no specific schedule for* C. virescens *was found.*

Requirements for establishing a PFA:
Because of the migratory behaviour of *C. virescens*, PFA may be very difficult to apply in the current range of its distribution, i.e. the parts of the Americas between the red lines in Fig. 1. Outside this area:

- To establish and maintain the PFA (ISPM 4, ISPM 29), a general surveillance in the area in the three years prior to establishment of the PFA and continued every year at suitable periods may be sufficient.
- In specific cases, specific surveys should also be carried out in the zone between the PFA and known infestation to demonstrate pest freedom. The surveys to establish and maintain the PFA should be targeted for the pest and should be based on appropriate combination of trapping, and visual examination of host plants.
- There should be restrictions on the movement of host material (originating from areas where the pest is known to be present) into the PFA, and into the area surrounding the PFA, especially the area between the PFA and the closest area of known infestation.

16.2 Eradication and containment

Early detection would be essential for the eradication and containment of *C. virescens* but is complicated by:

- The wide host range including weeds, and the need for monitoring many plant species at many seasons. Traps exist but are not fully effective. There are strong indications of a differential response of populations of *C. virescens* to sex pheromones by geographic region and host plant (Groot *et al.* (2009, 2010, 2011; C.A. Blanco, pers. comm.).
- Possible confusion with other similar lepidopteran pests, requiring identification, possibly with molecular methods.
- The dispersal capacity of adults, as the pest may already have spread.

If the pest is detected, thorough inspection and intensive trapping with multiple commercial lures should be performed to delimitate infested areas. A suitable buffer zone should be established. The EWG was not able to determine a size of buffer zone, which should depend on the host presence in the vicinity, environmental conditions in the area, and any factor that may reduce spread (e.g. natural barriers, presence of non-host plants).

Eradication may be possible in limited settings, such as early detection of immature life stages in a greenhouse. Destruction of infested plants and appropriate treatment of growing media should be performed. Intensive monitoring of the site and its surroundings, and chemical and biocidal treatments should be used. There should be restrictions on the movement of plants and plant products. Public information and outreach campaigns may help an earlier reporting and better implementation of measures.

In areas where the pest can establish outdoors, eradication would be extremely difficult or impossible once adults are produced and spread from an initial outbreak. In the case of the noctuid *S. frugiperda*, which presents similar characteristics (incl. a high mobility, possibly higher than for *C. virescens*), targeted eradication attempts in several countries have been unsuccessful, and significant populations have established in over 70 countries in which the pest was detected (IPPC Secretariat, 2021). More information on eradication of several species of Noctuidae are available through the database Gerda (2024).

17 Uncertainty

The EWG used the categories of main sources of uncertainties (under development) discussed by the Panel on Phytosanitary Measures in October 2023:

- *Key uncertainties*: likely to significantly affect the overall conclusions (including overall risk and overall uncertainty) of the PRA (i.e. the determination of whether the pest has the characteristics of a quarantine pest, and the pathways that should be managed).
- *Other main uncertainties*: not likely to affect the overall conclusions of the PRA but likely to impact conclusions of individual part(s) of the risk assessment or risk management.

Key uncertainties	**Other main uncertainties**
Likelihood of transfer for above ground cut fresh plant parts and fruit	Capacity of survival and development in suboptimal conditions (temperature, hosts)
	Effectiveness of pre- and post-import inspection
	Potential impact in the EPPO region on some crops, including blueberry, grapevine, apple
	Efficacy of pest management that can be put in place in the absence of Bt crops
	Whether the pest could establish in a large part of the EPPO region
	Limited knowledge of current prohibitions or phytosanitary inspections in some EPPO countries
	Taxonomy and differentiation of populations by geographic region or host plant (see section 1)
	Host range (hosts reported once, likely hosts, hosts reported in some countries but never reported in others,

	whether other species could be attacked, whether there has been misidentifications; whether some US interceptions relate to hosts).

18 Remarks

The EWG noted that the following work would address some main sources of uncertainty in the PRA :

- improved efficacy of pheromone trapping including trap design, lures and trapping protocols in different host crops (placement and density)
- biotype characterization (in relation to host plants, distribution)
- host range studies
- improved identification methods to allow identification regardless of in which life stage a specimen is in, including for rapid decision at inspection
- basic biology (e.g. survival and development at low temperatures)
- alternative treatments of consignments for cut plant parts and fruit

Data on import of plants for planting (species, quantities, origins) would be useful to better identify pathways and reduce the uncertainty related to the likelihoods of entry.

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ANNEX 1. Evaluation of possible phytosanitary measures for the main identified pathways, using EPPO Standard PM 5/3

The table below summarizes the consideration of possible measures for the pathways 'host plants for planting', 'above-ground cut fresh plant parts', and 'fruit' (based on EPPO Standard PM 5/3).

When a measure is considered appropriate, it is noted "yes", or "yes, in combination" if it should be combined with other measures in a systems approach. "No" indicate that a measure is not considered appropriate. A short justification is included.

Option	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Above-ground fresh cut plant parts of hosts	Host fruit
Existing measures in the PRA area	Partly	No	Partly
Options at the place of production			
Visual inspection at place of production	**Yes, in combination*** **Detection by inspection is not completely effective. All life stages can be observed, but early life stages and low levels of infestation may not be detected. In some crops, larvae or eggs may be hidden.** **Repeated visual inspection at suitable times over the whole growing period would allow detecting the pest. The feasibility and reliability of visual inspection would depend on the size and type of plants.** **In relation to systems approach, the EWG noted that inspection during the last 3 months prior to export would be appropriate.** **Pheromone trapping is not reliable.**	Yes, in combination* As for plants for planting.	Yes, in combination* As for plants for planting.
Testing at place of production	Not relevant	Not relevant	Not relevant
Treatment of crop	Yes, in combination* **Biological and chemical plant protection products are available. However, they may not be completely effective. Treatments of the crops should be repeated at appropriate times. Life stages may be protected from the treatment. Reinfestation from weeds and**	Yes, in combination* As for plants for planting. However, treatment options for products for human consumption may be more limited, especially just before harvest.	Yes, in combination* As for plants for planting. However, treatment options for products for human consumption may be more limited, especially just before harvest.

Option	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Above-ground fresh cut plant parts of hosts	Host fruit
	surrounding crops may also occur. **Cultural control methods should also be applied, including on weeds and in the vicinity of fields.**		
Resistant cultivars	No, no resistant cultivars exist. Bt crops are less likely to be infested. However, cotton is not likely to be traded as plants for planting, and this option is therefore not retained here.	No, no resistant cultivars exist.	No, no resistant cultivars exist There is no Bt variety for edamame (fresh soybean pods) (C.A. Blanco, pers. comm.)
Growing under complete physical isolation	Yes **Plants for planting could be grown under protected conditions with sufficient measures to exclude the pest, following EPPO Standard PM 5/8(1) *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'* (EPPO, 2016).**	Yes As for plants for planting.	Yes As for plants for planting.
Specified age of plant, growth stage or time of year of harvest	No, **it is not possible to define at what period a commodity will be infested** **Plants for planting exported in winter from places where the pest cannot survive outdoors would not carry the pest (provided the growing medium is removed). However, it is not possible to specify the areas concerned.**	No As for plants for planting	No As for plants for planting
Produced in a certification scheme	No	No	No
Pest freedom of the crop	**In EPPO Standard PM 5/3, 'pest freedom of the crop' is recommended for pests having a 'very low' rate of natural spread.** Several options related to pest freedom of the crop are reviewed in this table under: - Treatment of crop - Resistant cultivars - Growing under complete physical isolation	As for plants for planting	As for plants for planting

Option	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Above-ground fresh cut plant parts of hosts	Host fruit
	- Specified age of plant, growth stage or time of year of harvest - Produced in a certification scheme.		
Pest free production site	**Yes if grown under physical isolation, see above.** **No in other conditions**	Yes if grown under physical isolation, see above.	Yes if grown under physical isolation, see above.
Pest free place of production	As for pest free production site. As recommended by the Panel on Phytosanitary Measures, the choice between PFPP and PFPS is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements	As for pest free production site	As for pest free production site
Pest free area	Yes **Because of the migratory behaviour of *C. virescens*, PFA may be very difficult to apply in the current range of its distribution, i.e. the parts of the Americas between the red lines in Fig. 1. Outside this area:** • **To establish and maintain the PFA (ISPM 4, ISPM 29), a general surveillance in the area in the three years prior to establishment of the PFA and continued every year at suitable periods may be sufficient.** • **In specific cases, specific surveys should also be carried out in the zone between the PFA and known infestation to demonstrate pest freedom. The surveys to establish and maintain the PFA should be targeted for the pest and should be based on appropriate combination of trapping, and visual examination of host plants.** • **There should be restrictions on the movement of host material (originating from areas where the pest is known to be present) into the PFA, and into the area surrounding the PFA, especially the area**	Yes, as for plants for planting	Yes, as for plants for planting

Option	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Above-ground fresh cut plant parts of hosts	Host fruit
	between the PFA and the closest area of known infestation.		
Options after harvest, at pre-clearance or during transport			
Visual inspection of consignment	Yes, in combination* **The pest is relatively easy to detect. However, detection by visual inspection is not completely effective (see Visual inspection at place of production). The intensity of inspection should be adapted to the host. However, on some host species, early life stages and low level of infestation may be more difficult to detect.** Examples when the pest is more difficult to detect: bushy plants, life stage hidden in flower organs, etc.	Yes, in combination* As for plants for planting Examples: pest hidden within structures, e.g. lettuce, flowers	Yes, in combination* As for plants for planting Examples: pest inside the pods
Testing of commodity	Not relevant	Not relevant	Not relevant
Treatment of the consignment	Yes, in combination* Chemical and biological plant protection products are available, and especially early larval instars are sensitive to a broad range of insecticides. However, insecticides may not be completely effective, particularly if life stages other than early larvae are present. On some plants, life stages may be hidden.	Yes (for irradiation) Yes, in combination (for other treatments). ***Irradiation*. No schedule is approved internationally under the IPPC. However, Hallman (2016) found that 150 Gy (actual measured dose distribution was 145–166 Gy) led to no emerging normal-looking adults of *C. virescens* and *H. zea*. They concluded that a dose of approximately 150 Gy is sufficient as a phytosanitary treatment against these species, and note that this confirms that the generic dose treatment of 250 Gy is adequate to control eggs and larvae of Lepidoptera that infest fresh commodities.** **No other treatment was found. Cold treatments, chemical treatments, fumigation treatments or controlled atmosphere treatments may be appropriate for some**	Yes. As for above-ground fresh cut plant parts of hosts. Treatments such as cold treatment and phosphine fumigation can be used as post-harvest treatment of certain fresh fruits e.g. table grapes or blueberries, against some pests (Walse *et al.* 2020). The same publication also mentions that ethyl formate fumigation is being researched, However, no schedule was found for *C. virescens*. Fumigation with methyl bromide has been used for various pests and fruit (Wales *et al.*, 2020), but decision was made in EPPO not to recommend such treatment.

Option	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Above-ground fresh cut plant parts of hosts	Host fruit
		commodities, but no specific schedule fully effective on *C. virescens* was found.	
Pest only on certain parts of plant/plant product, which can be removed	Yes, if there are no leaves, flowers, buds and fruit on a plant, and no growing medium is associated (or the growing medium has been changed), the pest is not likely to be associated	No, the plant parts traded as such can be infested.	No. Eggs and larvae may be on fruit and on associated parts (e.g. calyxes) For pods, shelling may limit the presence of the pest, but there may be larvae in grain Yes, in combination*. *Physalis:* removing the calyx would not eliminate completely the pest but would make sure the life stages are visible. Washing could ensure absence of the pest when the pest is only on the surface of fruit, such as *Physalis.* However, it is not known whether washing is possible for physalis.
Prevention of infestation by packing/handling method	Yes, in combination* Precautions should be taken to make sure that the commodities are not re-infested. Packing should prevent reinfestation during storage and transport New or cleaned packaging should be used at origin, and packaging should be destroyed or safely disposed of at import	**Yes, in combination*** **New or cleaned packaging should be used at origin, and packaging should be destroyed or safely disposed of at import** **No otherwise: the pest would not reinfest cut plant parts (female would not be attracted to such plant parts to lay eggs).**	Yes, in combination*. As for above-ground fresh plant parts of hosts.
Options that can be implemented after entry of consignments			
Post-entry quarantine	Yes, in the framework of a bilateral agreement.	No, not relevant for above-ground fresh plant parts of hosts	No, not relevant for host fruit
Limited distribution of consignments in time	No It is not possible to define precisely the areas and times where/when the pest is not likely to establish, and it may also establish under protected conditions	**Yes** **Import for processing or direct consumption at specific time of the year (in the framework of a bilateral agreement).** **Eggs and larvae are associated, and the**	Yes Import for processing or direct consumption at specific time of the year (in the framework of a bilateral agreement).

Option	Host plants for planting (except seeds, bulbs, corms, rhizomes, tubers, pollen, tissue cultures)	Above-ground fresh cut plant parts of hosts	Host fruit
and/or space or limited use		**specific period of the year should prevent association with the commodity (e.g. eggs or larvae on plants/fruits) [season in the country of origin] or to prevent transfer (in part of the EPPO region, if life stages are imported in winter, transfer is unlikely) [season in the country of destination]. The bilateral agreement should also consider the production conditions of the commodity (indoors/outdoors). The measure would be less feasible from areas where the pest occurs all-year round. No Separation of trade and production flows in importing countries lower the likelihood of transfer, however it would be difficult to implement because the pest is polyphagous**	Yes, in combination* Separation of trade and production flows in importing countries lower the likelihood of transfer
Surveillance and eradication in the importing country	No Detecting the pest at an early stage to enable eradication would not be feasible.	As for plants for planting	As for plants for planting

*The individual measures identified above as 'Yes in combination' were:

Host plants for planting	**Above-ground fresh cut plant parts of hosts**	**Host fruits**
Visual inspection at the place of production	Visual inspection at the place of production	Visual inspection at the place of production
Treatment of the crop at the place of production	Treatment of the crop at the place of production	Treatment of the crop at the place of production
Visual inspection of consignment	Visual inspection of consignment	Visual inspection of consignment
Treatment of the consignment		

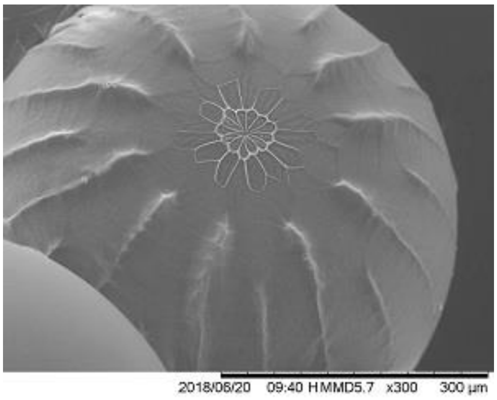
Possible combinations:
The EWG considered that the following measures could be combined to achieve a suitable level of protection:

For above-ground fresh cut plant parts of hosts, and host fruit:
- No signs of *C. virescens* observed at the place/site of production during the last 3 months prior to export, and
- Treatment(s) (treatment of the crop at the place/site of production) at appropriate time(s) to ensure freedom from the specified pest, and
- Inspection of the lot prior to export and absence of the specified pest
- Stored and transported using new or cleaned packaging.

For plants for planting, no combination was found that sufficiently mitigates the risk.

ANNEX 2. Illustrative pictures of *Chloridea virescens*

Eggs on cotton leaf (U. Nava, Universidad Juárez del Estado de Durango, Mexico)

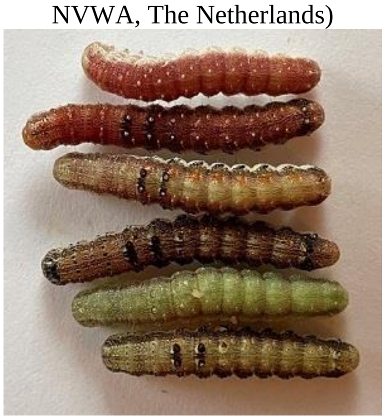


Egg - electronic microscopy (C.A. Blanco, University of New Mexico, USA)

L1-L5 larval stages (C.A. Blanco, University of New Mexico, USA)

Early larval instar, lateral view (M. van der Straten, NVWA, The Netherlands)

L4 larva, lateral view (M. van der Straten, NVWA, The Netherlands)



L5 larvae, colour variation (C.A. Blanco, University of New Mexico, USA)

Pupae (C.A. Blanco, University of New Mexico, USA & A. Rosario, USDA, USA)

Adult (C.A. Blanco, University of New Mexico, USA)


Larva feeding in cotton boll (J. Rodriguez Chalarca, Alliance Bioversity International, Colombia)


Larva feeding on cotton boll (U. Nava, Universidad Juárez del Estado de Durango, Mexico)


Larva feeding on chickpea (C. García Gutiérrez, Instituto Politécnico Nacional, Mexico)


Larva feeding on asparagus in an experiment (C.A. Blanco, University of New Mexico, USA)


Larva feeding on tomato in an experiment (C.A. Blanco, University of New Mexico, USA)

ANNEX 3. Biological parameters of *Chloridea virescens* from the literature

Studies do not include the same parameters, hence empty cells in the table.

Reference	**Rodríguez Espinosa *et al.*, 2018a**	**Rodríguez Espinosa *et al.*, 2018b**			**Castillo-Valiente & Pesantes, 2004***	**Boiça Júnior *et al.*, 2022^**	**Fye & McAda, 1972**				**Carrera & Vergara, 2013**	**CIAT, 1983**	**Manzanarez Jiménez, 2021**	**Manzanarez Jiménez, 2020**	**Alvarez Hernández *et al.*, 2010**	
Temperature Relative humidity	24°C 82%	24°C 82 %			25°C 75%	25°C 70%	20°C >50%	25°C >50%	30°C >50%	33°C >50%	25°C 70%	24°C not specified	23.5±4.5 °C <70% and photoperiod 10:14	28 C ±1 C, 80±5% RH, photoperiod 14 light:10 dark	leaves	fruit
Raised on	*N. tabacum*	*N. tabacum*	*C. cajan*	*Rosa*	*Asparagus*	Soybean	'lima bean medium'				*Asparagus*	Bean	Tomato	Artif. diet	Chickpea	
Larva (days)	18-21 days#	22	14.5	21.5	22	17-23	34	17	20	11	33 (23-46**)	19	22.5	22.5	28	14.5
pre-pupa (days)	1.6-2 #				2										1.5	1
pupa (days)	11-12 #				13	13	22	13	11	10	13.5 ♀ - 15 ♂	5	9	9	11	11
Longevity (days)	13 ♀ 10 ♂ (max. ≈ 15)				10.5-11.5*	3 (no food)	25 ♂ & ♀ (max 45)	20 ♂ & ♀ (max 36)	15♂ 17♀ (max 30)	12♂ 16♀ (max 26)	41.5-58.5**		7.5	6.7		
Duration of life cycle (days)	44-50 ♀ 40-42 ♂ #	35	27	32	50-55*						51 ♂ 49 ♀		41		40 (larva to adult emergence)	25 (larva to adult emergence)

^ Boiça Júnior *et al.* (2022): for larvae, different figures relate to different cultivars and plant part (leaf, leaf + uncut pod, cut pod, leaf + cut pod)
# Rodríguez-Espinosa *et al.* (2018a): these two figures are averages for two populations of the pest (longevity was similar for both populations)
* Castillo-Valiente & Pesantes (2004): figures were approximated from diagrams (figures are not specified in the text). Longevity: different figures is range for different cultivars.
** results obtained by Carrera (2013, thesis) presented by Cruces (2022) (relate to the same study but are not detailed in Carrera & Vergara (2013), and Carrera (2013) was not available).

ANNEX 4. Degree days data from various studies

The table below summarizes degree-days data available from various studies.

Reference	Type	Min. dev. thresh.	Max. dev. thresh.	DD calculations
Tingle & Mitchell, 1988	Field study, Tobacco fields, Florida	12.6°C (as calculated by others. Citing Hartstack *et al.*, 1973, Hoog & Calderon, 1981).	None	In average over 3 years, 512 DD between the first and second peaks of adults (476-559), 550 DD between 2 larval peaks (496-604), 554 (498-586) between two peaks of damage, and between the second and third peaks, 583 DD for adults (531-622). **→ 550 GDD, range 476-622 GDD**
Delgado & Fedre 2003	Calculation of number of generations for northern Argentina on tobacco, based on other studies (marked with #)	12.9ºC (average of values in the studies marked with # below)	32.1ºC (average of studies, marked with # below)	1150 GDD in Jujuy and Tucuman allowed the development of 2 generations, while 900 GDD in Salta did not allow completion of the second generation.
Hartstack et al 1976#	Field study, College Station, Texas	12.6ºC	33.3ºC (intermediate cut-off)	Adult to adult: 485 GDD
Potter *et al.* 1981#	Field study, Tucson, Arizona	12.8ºC	30ºC (horizontal cut-off)	First spring emergence (from 1 January): 151 DD; 95% at approx. 329 DD.
Butler & Hamilton, 1979#	Laboratory study, on germinated wheat grain	13.3ºC	33ºC	Egg to adult: 413 DD
Butler *et al.*, 1979#	Laboratory study on germinated wheat grain and cotton	13.3ºC	33ºC	Larva: wheat: 210.6 DD, cotton 300.2 DD
Hernandez & Blanco (2019)	model to understand the dynamics of populations	12.8ºC	-	375.4 DD for 50% from L1 emergence to adult emergence.

ANNEX 5. Natural enemies of *Chloridea virescens*

The list below was extracted from few publications and is not exhaustive.

Type/taxonomy	Species	References
PREDATORS		
Spiders		Capinera, 2001
Hymenoptera		
Vespidae	*Polistes* spp., wasps	Capinera, 2001
Hemiptera		
Berytidae	*Jalysus wickkhami*	Crop Profile, 1999
Lygaeidae	*Geocoris punctipes* (Say), *Geocoris* ssp.	Capinera, 2001, Miranda, 2010
Nabidae	*Nabis* spp.	Capinera, 2001
	Tropiconabis ssp.	Miranda, 2010
Anthocoridae	*Orius* spp.	Capinera, 2001, Miranda, 2010
PARASITOIDS		
Hymenoptera		
Trichogrammatidae	*Trichogramma pretiosum* Riley	Capinera, 2001, Kogan *et al*., 1989
	Trichogramma minutum Riley	Kogan *et al*., 1989
Braconidae	*Cardiochiles nigriceps* Viereck	Capinera, 2001, Kogan *et al*., 1989, NCSU, 2016
	Cotesia marginiventris (Cresson)	Capinera, 2001, Kogan *et al*., 1989
	Microplitis croceipes (Cresson)	Kogan *et al*., 1989
	Meteorus autographae Muesebeck	Capinera, 2001
Ichneumonidae	*Campoletis flavicincta* (Ashmead), *C. perdistinctus* (Viereck), *C. sonorensis* (Cameron)	Capinera, 2001, Kogan *et al*., 1989, Crop Profile, 1999, NCSU, 2016
	Netelia sayi (Cushman)	Capinera, 2001
	Pristomerus spinator (Fabricius)	Capinera, 2001, Kogan *et al*., 1989
	Hyposoter annulipes Cr.	Kogan *et al*., 1989
	Sinophorus eruficinctus (Walkley)	Kogan *et al*., 1989
Scelionidae	*Telenomus* sp.	Kogan *et al*., 1989
Chalcodidae	*Spilochalcis side* (Walker)	Kogan *et al*., 1989
Diptera		
Muscidae	*Muscina assimilis* (Fallen)	Kogan *et al*., 1989
Tachinidae	*Archytas marmoratus* (Townsend)	Capinera, 2001, Kogan *et al*., 1989
	Chaetogaedia monticola (Bigot)	Kogan *et al*., 1989
	Eucelatoria australis Townsend, *E. bryani, E. heliothis* Sabrosky, E. *rubentis* (Coquillet)	Kogan *et al*., 1989
	Euphorocera peruviana (Townsend)	Kogan *et al*., 1989
	Lespesia aletiae (Riley), *Lespesia (=Achaetoneura) archippivora* (Riley)	Kogan *et al*., 1989
	Metaplagia occidentalis Coq. V	Kogan *et al*., 1989
	Myiosturmia mixta	Kogan *et al*., 1989
	Spogosia claripennis (Macq.), *S. floridensis* (Tns.), *S. peruviana* (Tns.)	Kogan *et al*., 1989
	Winthemia rufopicta (Bigot), *W. sinuata* Reinhard*, Winthemia* spp.	Kogan *et al*., 1989, Crop Profile, 1999
	Zygostrumia spp.	Crop Profile, 1999

ANNEX 6. Host plants

Two categories were used for the purpose of determining the plants to which *C. virescens* is most likely to be associated with, and cause damage to. More details on the categories can be found in section 7.

Category 1 - Main hosts. This includes:

- plants mentioned to support populations of the pest in several generations or years, i.e. true hosts.

OR

- plants mentioned as common or preferred hosts, or plants on which impacts have been recorded (including all plants for which damage is mentioned in section 2.6 and 12). A few plants for which only one publication was found that supports damage or common pest status also fall in this category.

Category 2 – Likely hosts. These plants do not fulfil any of the criteria above, i.e. they are not true hosts; they are not mentioned as common or preferred hosts, or impacts have not been recorded.

Green: Category 1
Orange: present or possibly present in the PRA area and:
- **bold & C**: cultivated or possibly cultivated in the PRA area
- N: not cultivated in the PRA area

Presence in the PRA area: some details in section 9.1 and ANNEX 11
Origins/native: mostly from Plants of the world online (https://powo.science.kew.org)
Potential commodities: forms the plant may be traded in. This was added to the first draft of the PRA for the purpose of understanding pathways. It is not exhaustive and has not been updated.
For ornamentals, it is not excluded that they may be traded as plants for planting with roots or cuttings, although some species are more likely to be traded as seeds.

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Abelmoschus esculentus	**Malvaceae**	**1**	**ABMES**	**Okra** **Yes, cultivated, probably limited to the warmest part of the region:** **- as ornamental, seeds available in the EU http://www.rareplants.es/shop/product.asp?P_ID=11785** **- as vegetable e.g. Middle East Ghawi *et al.* (1994)** **- or other uses (Camciuc *et al.*, 1998).**	**C**		**Blanco *et al.* (2019 citing Chamberlin and Tenhet, 1926)** **Kogan *et al.*, 1989** **Reporting findings ‚in some numbers‘ by Wilson 1923 in okra pods and tobacco seed pods in the Virgin isl. (Hambleton, 1944)** **As okra 'Vegetables, especially … are readily infested ' (NCSU, 2016)** **'became abundant on okra only after tobacco was removed from the cropping system' (Martin *et al.*, 1976)** **Three generations observed on the plant, present from June to October (Snow & Brazzel, 1965)**	**Pfp with roots?** **Fruit** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Abutilon theophrasti	**Malvaceae**	**1**	**ABUTH**	**Yes, wild/weed and cultivated as ornamental. Origin C Asia & Asia, introduced to Mediterranean, W & N Europe, Siberia, Russian Far East (EPPO, 2023b).**	**C**	**weed at origin, Capinera, 2001**	**Kogan *et al.*, 1989** **Sudbrink 1991** **Annual larval densities respectively 4 and 5 times higher in *A. theophrasti* and chickpea than in cotton, and peak larval densities leading to 1 adult for every 13, 22 and 55 larvae on chickpea, cotton and velvetleaf, respectively (Blanco *et al.*, 2007)** **Larvae consistently recovered from … (Edde, 2018)** **Observed in the field** on the plant (Blanco *et al.*, 2008a) Collected during a period of the year (Sudbrink, 1991)	**Pfp with roots** **seeds?**
Abutilon trisulcatum	Malvaceae	1	ABUTR	No evidence found through general Internet search. Origin: Mex., C. Am.		Wild/weed at origin (Capinera, 2001)	Kogan *et al.*, 1989 'In southern Texas, cotton is the principal host, but such weeds as wild tobacco,*Nicotania repanda*; vervain, *Verbena neomexicana*; ruellia, *Ruellia runyonii*; and mallow, *Abutilon trisulcatum*, are important hosts early or late in the year' (Capinera, 2001)	
Abutilon viscosum	Malvaceae	2	ABUVS	No evidence found through general Internet search. Origin: tropical subtropical America		Wild at origin	(as Bastardia viscosa) Kogan *et al.*, 1989	
Acalypha	**Euphorbiaceae**	**2**	**ACCSS**	**Possibly cultivated, some species available as ornamentals, probably for protected conditions only (tropical plants), e.g. *A. hispida*, A. *wilkesiana***	**C**		**Kogan *et al.*, 1989 Blanco *et al.*, 2019**	**Pfp with roots?** **seeds**
Acalypha alopecuroides	Euphorbiaceae	2	ACCAL	No evidence found through general Internet search. Origin: Mexico to Peru, Caribbean		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Acalypha infesta	Euphorbiaceae	2	ACCIF	No evidence found through general Internet search. Origin: Mexico, SW. Colombia to W. Bolivia		Wild at origin (web search)	Kogan *et al.*, 1989 One observation of larvae observed feeding on blossoms and terminal growth (Hambleton, 1944)	
Acalypha persimilis	Euphorbiaceae	1	ACCOS	No evidence found through general Internet search. Origin: N C America, weed		Wild at origin	As *ostryaefolia.* Sudbrink & Grant, 1995 As *ostryifolia.* In studies for H. zea, mix of H. zea and C. virescens larvae collected from this plant (Allen *et al.*, 2023). As *ostryifolia.*Natural refuge for C. virescens (Allen *et al.*, 2024)	
Acanthospermum hispidum	**Asteraceae**	**2**	**ACNHI**	**Yes, possibly cultivated and wild** **Introduced to Russian Far East (EPPO, 2023b - Cultivated as an ornamental and used medicinally)**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Pfp with roots?** **seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				Few records of entry in Europe over time, incl. as contaminant of soybean grain, 'reluctant to flower' in W Europe https://alienplantsbelgium.myspecies.info/content/acanthospermum-hispidum Origin: C S Am.				
Aeschynomene americana	Fabaceae	2	AESAM	No evidence found through general Internet search. Origin C Am., introduced to many tropical areas		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Aeschynomene ciliata	Fabaceae	1	AESCI	No evidence found through general Internet search. Origin Mexico to trop Am, Caribbean		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 Hallman *et al.*, 1980 abundant in this host. "It was found on the host whenever the insect was present in the area. (although less population in March and September	
Aeschynomene rudis	Fabaceae	2	AESRU	No evidence found through general Internet search. Origin S Am, weed in N Am		(weed/wild at origin – Hallman, 1980- as A. poss. rudis)	Kogan *et al.*, 1989	
Ageratum	**Asteraceae**	**1**	**AGESS**	**Possibly cultivated as ornamental. *Ageratum conysioides* available as seeds The main species in cultivation is *A. houstonianum* (see below)**	**C**		**Kogan *et al.*, 1989** **'common pest of geranium and other flower crops such as…' (Capinera, 2001)** **'… are also infested' (NCSU, 2016)** **Larvae consistently recovered from several species in the genus (Edde, 2018)** **Hambleton (1944), partially injured** ***A. houstonianum* seems to be the main cultivated *Ageratum***	**Pfp with roots? Seeds**
Alcea rosea	**Malvaceae**	**2**	**ALGRO**	**common hollyhock** **Yes, as garden ornamental** **Asian origin**	**C**		**(as Althaea rosea) Kogan *et al.*, 1989**	
Antirrhinum	**Plantaginaceae**	**1**	**ATHSS**	**Yes, wild and cultivated. A. majus appears to be the main ornamental species in the genus. Large number of native species and hybrids in the EPPO region https://powo.science.kew.org/**	**C**	**Many other species than majus in N Am. https://bsapubs.onlinelibrary.wiley.com/doi**	**Kogan *et al.*, 1989** **As snapdragon 'common pest of geranium and other flower crops such as…' (Capinera, 2001)** **Rose, snapdragons, verbena and many other flowers are occasionally damaged' (Cranshaw, 2020, Colorado)** **Larvae consistently recovered from several species in the genus (Edde, 2018)**	**Pfp with roots? Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
						/full/10.3732/ajb.91.6.918		
Antirrhinum majus	Plantaginaceae	1	ATHMM	common snapdragon Yes, cultivated as garden ornamental	C		Hambleton (1944) 'frequently injure buds, flowers, and seeds pods of snapdragons during the winter months in Cañete and Lima´ Kogan *et al.*, 1989 Some records for the genus probably refer to this species, which seems to be the main cultivated Ageratum. However, no confirmation was found (consequently, cat. 2)	Pfp with roots? Seeds
Arachis hypogaea	Fabaceae	1	ARHHY	Peanut Yes, cultivated for edible seeds in some Southern countries (EPPO, 2023c)	C		Blanco *et al.*, 2019 citing Martin *et al.* (1976) Other hosts such as the weed Desmodium, and crops such as peanuts and quince. (De Tomás & Peralta 1994) Kogan *et al.*, 1989 Hallman, 1980 found on the host whenever the insect was present in the area Causes damage to this crop in the department of Tolima, Colombia (Hallman, 1980) small numbers found on cabbage, collards, peanuts, white clover, and tomatoes (Martin *et al.*, 1976)	Unlikely to be traded as plants for planting other than seeds? Seeds, stored products
Asparagus officinalis	Asparagaceae	1	ASPOF	Asparagus Yes, cultivated as vegetable, in many EPPO countries (EPPO, 2017 - PRA on Prodiplosis longifila)	C		Reported as a pest of asparagus in Peru. Data on the life cycle with total development (Carrera & Vergara, 2013) One of the main pests of asparagus in Peru (Córdova Vega, 2015) Life cycle studied over three generations, from individuals collected from asparagus fields (Castillo-Valiente & Pesantes, 2004) Núñez Sacarías de Dioses & Pereyra Colchado (2021) Different life stages collected. Photos of eggs and first larval instar	Fresh cut plant parts Unlikely as pfp with roots? Rhizomes?
Brassica carinata	Brassicaceae	2	BRSCA	Yes, cultivation as oilseed crop in Europe (e.g. Spain, Italy, Greece, UK – Seepaul *et al.*, 2021) biomass/biofuel in Spain (https://nutrinews.com/en/brassica-carinata-a-new-resource-to-feed-animals/)	C		2 larvae found on this plant during surveys on pests of the crop (Baldwin *et al.*, 2021)	Unlikely pfp

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Brassica oleracea	Brassicaceae	2	BRSOX	Cabbages. Yes, cultivated as vegetables, throughout the EPPO region	C		As 'cabbage'. 'sometimes attacks vegetables such as… especially when cotton or other favored crops are abundant' (Capinera, 2001) As 'cabbage .'Vegetables, especially … are readily infested ' (NCSU, 2016) Larvae consistently recovered from … (Edde, 2018) small numbers found on cabbage, collards, peanuts, white clover, and tomatoes (Martin *et al.*, 1976)	Pfp with roots? Fresh cut plant parts (leaf vegetable) Seeds
Brassica oleracea var. *capitata*	Brassicaceae	2	BRSOL	Cabbage see above			Kogan *et al.*, 1989	Pfp with roots? Fresh cut plant parts (leaf vegetable) seeds
Brassica oleracea var. *viridis*	Brassicaceae	2	BRSOA	Yes, probably cultivated	C		(as *Brassica oleracea* var. *acephala*) Kogan *et al.*, 1989 As collards 'Vegetables, especially … are readily infested ' (NCSU, 2016) small numbers found on cabbage, collards, peanuts, white clover, and tomatoes (Martin *et al.*, 1976)	Pfp with roots? Fresh cut plant parts (leaf vegetable) seeds
Cajanus cajan	Fabaceae	1	CAJCA	Pigeon pea Yes, present in Türkiye and black sea area according to https://www.europlusmed.org/cdm_dataportal/taxon/38455060-f00f-4d47-9896-9889d877dc84 Investigated for growing in Türkiye (Internet search) Limited availability as plants or seeds on the Internet. Possibly not cultivated commercially. https://www.icrisat.org/what-we-do/crops/PigeonPea/PigeonPea.htm	C		Kogan *et al.*, 1989 (as C. cajan and as C. indicus, which is syn.) Blanco *et al.*, 2019 In the West Indies, more common on C. cajan than on cotton (Hambleton, 1944 citing Wolcott 1933) 'sometimes attacks vegetables such as… especially when cotton or other favored crops are abundant' (Capinera, 2001) Important pest in Peru, supporting higher egg numbers than nearby cotton (Korytkowski & Torres, 1966). attacks in Peru, Hambleton (1944) In experiments, sustaining complete life cycle (Rodríguez-Espinosa *et al.*, 2018b) Important pest of this crop in Puerto Rico and the tropics (Viteri *et al.*, 2019) Feeds on C. cajan in Barbados (Tucker *et al.*, 1952)	Unlikely as Pfp with roots? Fruit (pods, shelled or not) stored product (dried)? Seeds
Calendula officinalis	Asteraceae	1	CLDOF	common marigold Yes, cultivated as garden ornamental	C		Hambleton (1944) 'larvae feed on the buds and open blossoms of this ornamental from August to January in Cañete and Lima.'	Pfp with roots? Seeds

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				Possibly grown commercially as oil crop https://journals.sagepub.com/doi/10.5367/000000000101293040 or for medicinal purposes			**Kogan *et al.*, 1989**	
Calopogonium mucunoides	Fabaceae	2	CLOMU	No evidence found through general Internet search. Origin tropical Am		(weed/wild at origin – Hallman, 1980)	Hallman, 1980 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Camonea umbellata	Convolvulaceae	2	MRRUM	No evidence found through general Internet search. Origin tropical Am		(weed/wild at origin – Hallman, 1980)	(as Merremia umbellata)Kogan *et al.*, 1989	
Caperonia palustris	Euphorbiaceae	2	CNPPA	No evidence found through general Internet search. Origin tropical Am		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Capsicum annuum	**Solanaceae**	**2**	**CPSAN**	**Sweet pepper** **Yes, widely cultivated for fruit under protected conditions and outdoors**	**C**		**Blanco *et al.*, 2019 citing Graham and Robertson (1970)** **As pepper: 'sometimes attacks vegetables such as… especially when cotton or other favored crops are abundant' (Capinera, 2001)**	**Pfp with roots?** **Fruit** **Seeds**
Carya illinoinensis	**Juglandaceae**	**2**	**CYAIL**	**Yes, cultivated, including commercial, in a very limited part of the region (e.g. NE Italy, Türkiye mainly Antalya). Available as ornamental/fruit plant in nurseries (EPPO, 2023c citing others)**	**C**		**Blanco *et al.*, 2019 citing Payne & Polles (1974)**	**Pfp with roots?** **Fruit (nuts)** **Seeds**
Castilleja indivisa	Orobanchaceae	2	CSLIN	No evidence found through general Internet search. Origin Central & SE. U.S.A. to NE. Mexico		Wild at origin (web search)	As Castilleta Blanco *et al.*, 2019Kogan *et al.*, 1989	
Cenchrus americanus	**Poaceae**	**2**	**PESGL**	**Pearl millet** **Yes, at least cultivated:** **- introduced / cultivated in Algeria, Israel, Libya and Morocco (Verloove, 2012)** **- in recent years, ornamental cultivars marketed for garden use. Introduced in some Mediterranean and Black Sea countries, Russia, Russian Far East, Central Asia etc. (EPPO, 2023b)** **- introduced in Central Asia and Middle East [not specified if in the wild or cultivated] https://powo.science.kew.org/taxon/77105978-1** **Not clear if cultivated for grain in EPPO. In the world, cultivated as cereal grain, forage crop, ornamental**	**C**		**(as Pennisetum glaucum)Blanco *et al.*, 2019 citing Martin *et al.* (1976)**	**Pfp with roots?** **Grain?, seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				https://plants.ces.ncsu.edu/plants/cenchrus-americanus/ **Origin: Africa**				
Chamaecrista nictitans	Fabaceae	2	CASNI	No evidence found through general Internet search. Origin tropical Am		(weed at origin – Hallman, 1980)	(as Cassia patellaria) Hallman, 1980	
Chamaecrista nictitans subsp. *patellaria*	Fabaceae	2	CASPA	No evidence found through general Internet search. Origin tropical Am			Cassia patellaria Kogan *et al.*, 1989	
Chamaecrista rotundifolia	Fabaceae	2	CASRO	No evidence found through general Internet search. Origin Mex. to tropical Am.		Wild at origin (web search)	(as Cassia rotundifolia) Kogan *et al.*, 1989	
Chenopodium quinoa	**Amaranthaceae**	**1**	**CHEQU**	**Yes, possibly limited cultivation, also at higher latitudes, e.g. The Netherlands (WUR, 2023)** **In Spain (mainly in Andalusia). 1600 ha approx. (¿Es rentable el cultivo de quinoa en España? - Agroptima).**	**C**		**Part of the pest complex of quinoa in lowland Peru. feed on the developing grains Cruces, 2022** **First instar larvae feed on leaves and young shoots, and later larval instars on developing flowers and grains (Cruces, 2022; FAO, 2016)** **Pest in Peru, management recommendations made (FAO, 2016)**	**Unlikely as plants with roots** **Grain, seeds**
Chrysanthemum	**Asteraceae**	**1**	**CHYSS**	**Yes, cultivated as ornamental** **There is ambiguity as to whether the references mean the scientific name *Chrysanthemum* or also include chrysanthemums such as *Dendranthema***	**C**		**Kogan *et al.*, 1989** **'common pest of geranium and other flower crops such as…' (Capinera, 2001)** **Larvae consistently recovered from … (Edde, 2018)**	**Pfp with roots** **Cut flowers** **seeds**
Cicer arietinum	**Fabaceae**	**1**	**CIEAR**	**Chickpea** **Yes, commercial cultivation for grain, mostly in the warmer parts of the EPPO region** **Mediterranean area (Global Bean Project, 2023)** **In Europe, incl. Spain, Italy, Bulgaria and Greece (INCREASE, 2021)**	**C**		**Blanco et al 2008** **Blanco *et al.*, 2019** **Hambleton, 1944** **Kogan et al., 1989** **Main pest of chickpea, life cycle completed (Pérez & Suris, 2012)** **The main pest of chickpea in Cuba. Different larval stages observed, which infers that this insect develops complete generations on chickpea (Alvarez Hernandez *et al.*, 2010 citing Fichetti *et al.*, 2009).** **Major pest of chickpea in Brazil (Borella Júnior *et al.*, 2022)** **Life cycle completed. Annual larval densities respectively 4 and 5 times higher in A. theophrasti and chickpea than in cotton, and peak larval**	**Unlikely as Pfp with roots?** **Fruit (pods, shelled or not)** **stored product (dried beans)?** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							densities leading to 1 adult for every 13, 22 and 55 larvae on chickpea, cotton and velvetleaf, respectively (Blanco *et al.*, 2007) **Capability for high densities in the field, generation after generation and year after year (Blanco et al. 2008 citing Blanco *et al.*, 2007)** **Larvae consistently recovered from … (Edde, 2018)** **Severe problems when they are grown in succession cropping systems (Murúa *et al.*, 2016 cited in Borella Júnior *et al.*, 2022)**	
Cichorium intybus	**Asteraceae**	**2**	**CICIN**	**Yes, wild/weed in the EPPO region, native and widely naturalised** **Also cultivated: some varieties of *C. intybus* are cultivated for roots or for green heads (radicchio, winter chicory, chicory)** **https://plantura.garden/uk/flowers-perennials/chicory/chicory-overview** **Native from Central Europe**	**C**	**Wild at origin**	**Kogan *et al.*, 1989,** **Sudbrink 1991 (1 larva found on this plant in a survey)** **This record related to the wild plant, and not to vegetable varieties.**	**Pfp with roots?** **Cut fresh plant parts (heads)** **Seeds, roots**
Citrullus lanatus	**Cucurbitaceae**	**1**	**CITLA**	**Watermelon** **Yes, cultivated for fruit in the warmer parts of the EPPO region**	**C**		**(as Citrullus vulgaris) Kogan *et al.*, 1989** **In Villacurí (Ica region, Peru), one of the main pests that were most frequently recorded in watermelon crops (with Prodiplosis longifila, Bemisia tabaci, Thrips tabaci) (Romani, 2019)**	**Pfp with roots?** **Fruit?** **Seeds**
Cleome spinosa	**Cleomaceae**	**1**	**CLESP**	**Spider flower** **Yes, cultivated as garden ornamental, available as seeds or plants**	**C**	**Wild at origin**	**Blanco *et al.*, 2019** **Kogan *et al.*, 1989** **Continuous populations on this species from June to October, with distinct generation (Snow & Brazzel, 1965)**	**Pfp with roots?** **Seeds**
Corchorus orinocensis	Malvaceae	2	CRGOR	No evidence found through general Internet search. Origin Mex. to tropical Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Cordia globosa	Boraginaceae	2	CRHGL	No evidence found through general Internet search. Origin: Americas		(weed at origin – Hallman, 1980)	Kogan *et al.*, 1989, Hallman, 1980 (=Varronia bullata subsp. humilis)	
Coronilla varia	Fabaceae	1	CZRVA	Yes, wild, native to Europe and Asia [GD: Europe, Black Sea, Caucasus, Siberia, Russian Far East (introduced), Central Asia]	N	Wild at origin	Sudbrink & Grant, 1995 Collected during a period of the year (Sudbrink, 1991)	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Croptilon divaricatum	Asteraceae	1	CZVDI	No evidence found through general Internet search. Origin: North America		Wild/weed at origin	(as Haplopappus divaricatus) Blanco *et al.*, 2019 Kogan *et al.*, 1989 Supported early and late larval instars, one generation, but serves as important food plant late in the season (Snow & Brazzel, 1965)	
Crotalaria	**Fabaceae**	**2**	**CVTSS**	**C. juncea cultivated, recently introduced crop in the south of Spain with the aim to improve the quality of the soil.** **seeds available for e.g. green manure: https://www.sunnhemp.eu/** **'Potential as a biomass feedstock for advanced biofuels in Southern Europe'** **https://www.sciencedirect.com/science/article/pii/S096195342100012X**	**C**		**Kogan *et al.*, 1989**	**Unlikely as pfp with roots?** **Seeds**
Crotalaria pallida	Fabaceae	2	CVTPL	No evidence found through general Internet search. Origin: old world tropics/subtropics, green manure		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Crotalaria retusa	**Fabaceae**	**2**	**CVTRE**	**Possibly cultivated (seeds available from the Internet). Invasive** **Tropical**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Croton hirtus	Euphorbiaceae	1	CVNHI	No evidence found through general Internet search. Origin. Mex to S Am tropical		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984) abundant in this host. found on the host whenever the insect was present in the area (although less population in March and September)	
Ctenodon brasilianus	Fabaceae	2	CDKBR	No evidence found through general Internet search. Origin. Mex to S Am tropical		Wild/weed at origin	(as Aeschynomene brasiliana) Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Cucumis melo	**Cucurbitaceae**	**2**	**CUMME**	**Melon** **Yes, cultivated for fruit under protected conditions and outdoors**	**C**		**Kogan *et al.*, 1989** **'sometimes attacks vegetables such as… especially when cotton or other favored crops areabundant' (Capinera, 2001)**	**Pfp with roots?** **Fruit** **Seeds**
Cucurbita maxima	**Cucurbitaceae**	**2**	**CUUMA**	**Giant Pumpkin** **Yes, cultivated for fruit**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots?** **Fruit** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Cucurbita pepo	**Cucurbitaceae**	**2**	**CUUPE**	**Pumpkin, squash** **Yes, cultivated for fruit**	**C**		**Blanco *et al.*, 2019 citing Graham and Robertson (1970)** **As squash. 'sometimes attacks vegetables such as… especially when cotton or other favored crops areabundant' (Capinera, 2001)** **As squash. One attack in a field alongside a cotton field (Hambletoin, 1944)**	**Pfp with roots?** **Fruit** **Seeds**
Cydonia oblonga	**Rosaceae**	**2**	**CYDOB**	**Quince** **Yes, cultivated for fruit**	**C**		**De Tomás & Peralta (1994). Other crops such as "maní" and "membrillero". The pest shows preference by the later [*C.oblonga*] for oviposition in the shoots. In them, there were observed eggs and first instars of larvae.**	
Dalea pogonathera	Fabaceae	2	DLEPO	No evidence found through general Internet search. S USA to Mexico		Wild/weed at origin	Kogan *et al.*, 1989	
Desmodium	Fabaceae	-	DEDSS	No evidence found through general Internet search. Origin: native range of this genus is Tropics & Subtropics to N. Am.		(weed at origin, Capinera, 2001)	Blanco *et al.*, 2019; Kogan *et al.*, 1989; De Tomás & Peralta, 1994. *Desmodium* spp. are its preferred food plants (Edde, 2018) In Georgia, 'developed principally on toadflax during April and May for 1 to 2 generations, followed by 1 generation on deergrass during June and July and 2 to 3 generations on beggarweed during July through October (Capinera, 2001)	
Desmodium canescens	**Fabaceae**	**2**	**DEDCN**	**Possibly cultivated, available as seeds.** **Origin. USA to Mex.**	**C**	**Wild/weed at origin**	**(as Meibomia canescens)Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Desmodium incanum	Fabaceae	2	DEDCA	No evidence found through general Internet search. Origin: tropical/subtrop. Am.		Wild/weed at origin	(as D. canum) Kogan *et al.*, 1989	
Desmodium obtusum	Fabaceae	1	DEDOB	No evidence found through general Internet search. Origin: Central & E. U.S.A., Cuba		Wild/weed at origin	(as Desmodium rigidum)Kogan *et al.*, 1989 (as D. rigidum) two generations utilised this plant in one season, primary host of great importance in late season (Snow & Brazzel, 1965)	
Desmodium scorpiurus	Fabaceae	2	DEDSC	No evidence found through general Internet search. Origin: Tropical & Subtropical America. cultivated in other places, tropical		weed/wild at origin – Hallman, 1980)	(as scorpiorum)Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Desmodium strictum	Fabaceae	2	DEDSR	No evidence found through general Internet search. Origin: E USA		Wild/weed at origin	(as Meibomia stricta)Kogan *et al.*, 1989	
Desmodium tortuosum	Fabaceae	1	DEDTO	No evidence found through general Internet search. Origin: Mexico to trop. Am.		(weed/wild at origin – Hallman, 1980)	(as Desmodium purpureum)Kogan *et al.*, 1989 The most important non-cultivated host of *C. virescens* in Tolima, Colombia. Immature stages present on the	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							plants through most of the study period (1976-79). Preferred host after cotton (Hallman, 1980, 1985)	
Distimake cissoides	Convolvulaceae	2	MRRCI	No evidence found through general Internet search. Origin: Mexico to trop. Am.		(weed/wild at origin – Hallman, 1980)	(as Merremia cissoides)Kogan *et al.*, 1989	
Eirmocephala brachiata	Asteraceae	2	EIHBR	No evidence found through general Internet search. Origin: tropical S Am		(weed at origin-canal– Hallman, 1980)	(as Vernonia brachiata)Kogan *et al.*, 1989	
Erigeron canadensis	Asteraceae	2	ERICA	Yes, as weed/wild, introduced and widely naturalised. Invasive weed in Eurasia Origin: N Am.	N	Wild/weed at origin	Kogan *et al.*, 1989	
Galactia tenuiflora	Fabaceae	2	GACTE	No evidence found through general Internet search. Origin: pantropical		(weed/wild at origin – Hallman, 1980)	(as G. striata)Kogan *et al.*, 1989	
Galinsoga quadriradiata	Asteraceae	2	GASCI	Yes, as weed/wild, introduced. Established Europe to Russia https://www.nobanis.org/globalassets/speciesinfo/g/galinsoga-quadriradiata-/galinsoga-quadriradiata.pdf Origin: C and S Am.	N	Wild at origin	As Galinsoga cilliata Sudbrink & Grant, 1995	
Gardenia	**Rubiaceae**	**1**	**GADSS**	**Yes, cultivated as ornamentals, e.g. G. jasminoides, G. taitensis**	**C**		**'common pest of geranium and other flower crops such as…' (Capinera, 2001)**	**Pfp with roots** **Cut flowers** **Seeds**
Geranium	**Geraniaceae**	**-**	**GERSS**	**Yes, wild species and some species cultivated as ornamentals** **There is an ambiguity in the US literature when the common name geranium is used as it sometimes refer to the garden geranium *Pelargonium* x *hortorum.* However, Edde used the Latin name.**	**C**		**Blanco *et al.*, 2019 citing Snow *et al.* (1966)** **Kogan *et al.*, 1989** **Larvae consistently recovered from *Geranium* (Edde, 2018)** **Several varieties of *Geranium* spp. frequently injured by virescens larvae, large quantities of eggs on blossom clusters, larvae can destroy entire clusters, causing flowering failure (Hambleton, 1944)**	**Pfp with roots?** **Cut flowers?** **Seeds**
Geranium carolinianum	Geraniaceae	1	GERCA	No evidence found through general Internet search. Origin N. Am.		(weed at origin – Blanco *et al.*, 2008a)	Kogan *et al.*, 1989 Blanco et al 2008 Observed in the field on the plant, and in experiments the plant supports life cycle (Blanco *et al.*, 2008a) Pair, 1994: larval populations on Lonicera japonica occurring at the same time as those on Trifolium incarnatum and Geranium carolinianum	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Geranium dissectum	Geraniaceae	1	GERDI	cranesbill Yes, not cultivated. Weed/wild, native Europe to W. & Central Asia, N. Africa	N	(weed at origin, Capinera, 2001) (weed at origin – Blanco *et al.*, 2008a)	Kogan *et al.*, 1989 Observed in the field on the plant, and in experiments the plant supports life cycle (Blanco *et al.*, 2008a) In Mississippi, cranesbill was identified as the key early season host plant (Capinera, 2001) Larvae reported on this plant (Landolt, 2008 citing Stadelbacher, 1979)	
Geranium maculatum	**Geraniaceae**	**2**	**GERMA**	**wild geranium** **Yes, cultivated as ornamental** **Origin: Canada to USA**	**C**		**Larvae reported on this plant (Landolt, 2008 citing Tietz, 1972)**	**Pfp with roots** **Cut flowers?** **Seeds**
Glycine max	**Fabaceae**	**1**	**GLXMA**	**soybean** **Yes. Cultivated for food and fodder in Southern EPPO countries (EPPO, 2023c)**	**C**		**Blanco *et al.*, 2019 citing Hillhouse and Pitre (1976)** **Hallman,** 1980 abundant in this host, found on the host whenever the insect was present in the area **Major pest of this crop, large number of publications related to this pest on the crop (Kogan *et al.*, 1989)** **'principally a field crop pest attacking crops such as' (Capinera, 2001)** **often infested, causing significant yield losses in important soybean-producing regions (Eduardo *et al.*, 2020)** **Cause severe economic loss (Edde, 2018)** **Mentioned amongst principal crop hosts (Fitt, 1989)** **IPM (Fidelis *et al.*, 2019)**	**Unlikely as Pfp with roots?** **Fruit (pods) ('edamame')** **Grain, stored product, seeds**
Gossypium hirsutum	**Malvaceae**	**1**	**GOSHI**	**cotton** **Yes. Main Gossypium sp. cultivated as fiber crop (EPPO, 2023c).**	**C**		**Blanco *et al.*, 2008** **As cotton. Major pest of this crop, large number of publications related to this pest on the crop (Kogan *et al.*, 1989)** **Major pest of cotton (Blanco, 2012)** **As cotton Causes damage to this crop in the department of Tolima, Colombia (Hallman, 1980)** **As cotton Mentioned amongst principal crop hosts (Fitt, 1989)** **Annual larval densities respectively 4 and 5 times higher in *A. theophrasti* and chickpea than in cotton, and peak larval densities leading to 1 adult for every 13, 22 and 55 larvae on chickpea, cotton and velvetleaf, respectively (Blanco *et al.*, 2007)** **Miranda 2010. Pest of cotton in Brazil**	**Unlikely as plants for planting with roots.** **Seeds, stored product (fibers)**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							No other Gossypium spp. found to be host in the literature used, but no specific search made [although Gossypium as genus mentioned in Blanco *et al.*, 2019 citing Scheffler *et al.* (2012), and Edde (2018) as causing severe economic loss	
Helianthus	**Asteraceae**	**-**	**HELSS**	**See *H. annuus*. Also *H. tuberosus* (Jerusalem artichoke) as root vegetable and as ornamental**	**C**	**(weed at origin, Capinera, 2001)**	**Blanco *et al.*, 2019 citing Harding (1976)** **Cause severe economic loss (Edde, 2018)**	**Pfp with roots?** **Seeds, underground plant parts (tubers)**
Helianthus annuus	**Asteraceae**	**1**	**HELAN**	**Sunflower** **Yes, cultivated for grain and as ornamental (JKI, 2020). By products are also used for animal feeding (https://www.feedipedia.org/node/732).**	**C**		**Kogan *et al.*, 1989** **As sunflower. Mentioned amongst main crop hosts (Fitt, 1989)** **In a test plot of cultivated sunflower in Texas in October 1969, larvae of C. virescens (the most abundant) [and other Lepidoptera] were found feeding on the backs of the flower heads and some on the seeds; the leaves had been almost entirely consumed. Investigations indicated that the larvae of *C. virescens* and *P. includens* came from an adjacent field of cotton after the crop had been defoliated. (Teetes *et al.*, 1970)**	**Pfp with roots?** **Seeds, grain, cut flowers?**
Heliotropium indicum	Boraginaceae	2	HEOIN	No evidence found through general Internet search. Origin: S Am.		Wild at origin (introduced from Asia)	Kogan *et al.*, 1989 Hallman, 1980 reported as a host in the literature of Colombia, but not observed as a host by Hallman 1980, despite being frequently observed. However, experimental host.	
Heterotheca subaxillaris	Asteraceae	2	HTTSU	No evidence found through general Internet search. Origin: USA to Belize		Wild at origin	Kogan *et al.*, 1989	
Hibiscus	**Malvaceae**	**2**	**HIBSS**	**See *H. moscheutos* and *H. rosa-sinensis*. Many other species grown as ornamentals, such as. H. syriacus, H. lasiocarpus**	**C**		**Cause severe economic loss (Edde, 2018)**	
Hibiscus moscheutos	**Malvaceae**	**2**	**HIBMO**	**Yes, cultivated as ornamental**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Hibiscus rosa-sinensis	**Malvaceae**	**2**	**HIBRS**	**Yes, cultivated as ornamental**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Hyptis suaveolens	Lamiaceae	2	HPYSU	No evidence found through general Internet search. Origin: trop Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Indigofera hirsuta	**Fabaceae**	**2**	**INDHI**	**Possibly cultivated as ornamental, probably limited, available as seeds** **Origin: tropics & subtropics**	**C**	**Wild, green manure, forage at origin**	**Kogan *et al.*, 1989** Eggs and larvae found on the plant in Colombia (Hallman, 1984)	**Pfp with roots?** **Seeds**
Indigofera suffruticosa	Fabaceae	2	INDAN	No evidence found through general Internet search. Origin: trop. & subtrop. Am.		(weed/wild at origin – Hallman, 1980)	(as Indigofera anil)Kogan *et al.*, 1989	
Ipomoea	Convolvulaceae	-	IPOSS	Not searched. see individual species		(weed at origin, Capinera, 2001) (weed at origin – Blanco *et al.*, 2008a)	Blanco et al 2008 (Ipomoea sp.) Observed in the field on the plant (Blanco *et al.*, 2008a) Kogan *et al.*, 1989 Genus reported as host from several regions (Sudbrink, 1991)	
Ipomoea cordatotriloba	**Convolvulacea e**	**2**	**IPOTC**	**Possibly cultivated as ornamental, probably limited, available at least as seeds** **Origin. NE Mex. SE USA**	**C**		**(as I. commutata)Kogan *et al.*, 1989(as I. trichocarpa)Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Ipomoea hederaceae	**Convolvulacea e**	**2**	**IPOHE**	**Possibly cultivated as ornamental, probably limited, available at least as seeds** **Origin Mexico**	**C**	**Wild/ornamental at origin**	**Sudbrink 1991**	**Pfp with roots?** **Seeds**
Ipomoea nil	**Convolvulacea e**	**2**	**IPONI**	**Yes, cultivated as ornamental** **Origin. trop. & subtrop. America**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Ipomoea purpurea	**Convolvulacea e**	**2**	**PHBPU**	**Yes, cultivated as ornamental** **Origin trop. & subtrop. America**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Ipomoea triloba	Convolvulaceae	2	IPOTR	No evidence found through general Internet search. Origin: Mexico to Brazil, Caribbean		(weed/wild at origin– Hallman, 1980)	Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Jacquemontia	Convolvulaceae	2	IAQSS				Kogan *et al.*, 1989	
Jacquemontia tamnifolia	**Convolvulacea e**	**1**	**IAQTA**	**Possibly cultivated as ornamental, probably limited. Seeds available for sale from a few sites**	**C**	**(weed at origin, Capinera, 2001) (weed/wild at**	**Blanco *et al.*, 2019 citing Kogan *et al.* (1989)** **Kogan *et al.*, 1989** **Hallman, 1980 abundant in this host. "… found on the host whenever the insect was present in the area »**	**Pfp with roots?** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
						origin – Hallman, 1980)	Although occasionally found on several hosts, the most important ones seem to be cotton, crimson clover, Jacquemontia tamnifolia and tobacco (Brazzel, 1953)	
Lablab purpureus	**Fabaceae**	**1**	**DOLLA**	**Hyacinth bean Possibly limited cultivation, for pods, in gardens? (tropical plant)**	**C**		**(as Dolichos lablab)Blanco *et al.*, 2019 citing Gross *et al.* (1975) Kogan *et al.*, 1989 In Peru, buds, blossoms and seed pods attractive during winter. Small plantings frequently found infested, 'often to such extent that practically no crop is produced' (Hambleton, 1944)**	**Unlikely as Pfp with roots? Fruit (pods, shelled or not) stored product (dried beans)? Seeds**
Lactuca sativa	**Asteraceae**	**1**	**LACSA**	**Lettuce Yes, widely cultivated as leaf vegetable throughout the region**	**C**		**As lettuce. 'sometimes attacks vegetables such as… especially when cotton or other favored crops are abundant' (Capinera, 2001) As lettuce. 'can be found in lettuce in California's southern desert', management guidelines provided. larvae can destroy seedlings and bore in heads of maturing lettuce (UC IPM, 2017)**	**Unlikely as pfp with roots? Seeds, fresh cut plant parts (leaf vegetable)**
Lagascea mollis	Asteraceae	1	LAGMO	No evidence found through general Internet search. Origin: Mex. to trop. Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1980, 1984) abundant in this host. "Found on the host whenever the insect was present in the area"	
Lathyrus hirsutus	Fabaceae	2	LTHHI	Yes, wild/weed. Native to Eurasia, N Africa	N		Blanco *et al.*, 2019 citing Kogan *et al.* (1989)	
Lathyrus odoratus	**Fabaceae**	**2**	**LTHOD**	**Yes, cultivated as ornamental Origin: Europe**	**C**		**Kogan *et al.*, 1989 Larvae consistently recovered from … (Edde, 2018) Hambleton (1944) one small planting with numerous eggs, later only slight injury to blossoms**	**Pfp with roots? Seeds**
Lens culinaris	**Fabaceae**	**2**	**LENCU**	**Lentil Yes, cultivated for grain**	**C**		**Kogan *et al.*, 1989**	**Unlikely as pfp with roots? Fruit (only without pod) Grain, seeds**
Leonotis nepetifolia	**Lamiaceae**	**2**	**LEONA**	**Possibly cultivated as ornamental, probably limited, available at least as seeds Origin: Africa, India**	**C**	**(weed/wild at origin – Hallman, 1980)**	**(as nepetaefolia)Kogan *et al.*, 1989**	**Pfp with roots? Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Lespedeza bicolor	**Fabaceae**	**2**	**LESBI**	**Yes, as cultivated ornamental Origin: Siberia to Japan**	**C**	**(weed at origin, Capinera, 2001)**	**Kogan *et al.*, 1989**	**Pfp with roots? Seeds**
Lespedeza cuneata	**Fabaceae**	**1**	**LESCU**	**Possibly cultivated as ornamental, probably limited, available at least as seeds EPPO A1 List Origin: Asia**	**C**		**Blanco *et al.*, 2019 citing Kogan 1989 served as a host for one generation of both species early in the season when other hosts were not available (Snow & Brazzel, 1965) [name Lespedeza sericea (Thunb.) Benth.with authorities does not exist. Are two homonyms, but assumed to be the N Am plant, juncea]**	**Pfp with roots? Seeds**
Linum usitatissimum	**Linaceae**	**1**	**LIUUT**	**Flax Yes, cultivated for fiber and seeds in part of the region. Kazakhstan is a major producer worldwide (Stavropoulos *et al.*, 2023)**	**C**		**Ventura *et al.* (2015) First record damaging table grape bunches Kogan *et al.*, 1989 Hambleton (1944) blossom buds and capsules occasionally attacked in Peru (winter crop) 'principally a field crop pest attacking crops such as' (Capinera, 2001)**	**Unlikely as pfp with roots? Seeds, fiber?**
Lonicera japonica	**Caprifoliaceae**	**1**	**LONJA**	**Yes, as ornamental. Invasive in Mediterranean area http://especes-exotiques-envahissantes.fr/espece/lonicera-japonica/ Origin: China to temperate E Asia**	**C**	**(weed at origin, Capinera, 2001)**	**Capinera, 2001 Pair, 1994: important early and late season host of *C.virescens*. Larvae shown to be capable of developing on flowers in the laboratory.**	**Pfp with roots? Seeds**
Lupinus	**Fabaceae**	**2**	**LUPSS**	**Yes, especially polyphyllus as ornamental (and invasive)**	**C**	**(weed at origin, Capinera, 2001)**	**Blanco *et al.*, 2019 citing Kogan *et al.* (1989) Kogan *et al.*, 1989**	**Pfp with roots? Seeds**
Lupinus rexensis	**Fabaceae**	**2**	**LUPTX**	**Possibly as ornamental, probably limited, available at least as seeds Origin: Texas to Mexico**	**C**	**Wild at origin**	**As rexensis Kogan *et al.*, 1989**	**Pfp with roots? Seeds**
Malachra alceifolia	**Malvaceae**	**2**	**MAAAL**	**Possibly as ornamental, probably limited, available at least as seeds Origin: Mex. to trop. Am.**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Pfp with roots? Seeds**
Malus domestica	**Rosaceae**	**1**	**MABSD**	**Apple Yes, for fruit, commercial, gardens, wild**	**C**		**De Tomás & Peralta, 1994. Economic damage since 1993 in orchards of Mala valley, Canete province, Peru**	
Malva neglecta	Malvaceae	2	MALNE	Yes, not cultivated. wild (roadside, ruderal, disturbed ground)	N	Weed at origin	Sudbrink & Grant, 1995	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				Origin: Canary Isl. Morocco, Eurasia				
Malva parviflora	Malvaceae	2	MALPA	Yes, not cultivated. wild (native Eurasia, N Af)	N		Kogan *et al.*, 1989	
Malvastrum americanum	Malvaceae	2	MAVAM	No evidence found through general Internet search. Origin: trop & subtrop. Am.		(weed/wild at origin – Hallman, 1980)	(as M. spicatum)Kogan *et al.*, 1989	
Malvastrum coromandelianum	Malvaceae	2	MAVCO	No evidence found through general Internet search. Origin: New World		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Medicago arabica	Fabaceae	1	MEDAB	Yes, no evidence found that cultivated. Native from Eurasia, North Africa. https://www.knowyourweeds.com/da/weeds/Medicago_arabica	N	(weed at origin – Blanco *et al.*, 2008a)	Observed in the field on the plant, and in experiments the plant supports life cycle (Blanco *et al.*, 2008a)	Pfp with roots? Seeds
Medicago lupulina	**Fabaceae**	**1**	**MEDLU**	**Black medick** **Yes, wild, native from Europe, Asia, Africa, weed/wild** **Also cultivated as forage (e.g. https://www.scandinavianseed.se/produkt/mellangroda_humlelusern/; https://www.feedipedia.org/node/277)**	**C**	**(weed at origin, Capinera, 2001) Wild at origin Sudbrink & Grant 1995**	**Kogan *et al.*, 1989, Sudbrink & Grant, 1995** **2 generations developed on this plant in one season (Snow & Brazzel, 1965)** **Collected during a period of the year (Sudbrink, 1991)**	
Medicago polymorpha	Fabaceae	2	MEDPO	toothed medick Yes, wild (native Mediterranean Basin)	N		(as M. hispida)Kogan *et al.*, 1989	
Medicago sativa	**Fabaceae**	**1**	**MEDSA**	**Lucerne/alfalfa** **Yes, wild (native and naturalised) and cultivated as forage**	**C**		**Blanco *et al.*, 2019 citing Kogan *et al.* (1989) 'principally a field crop pest attacking crops such as' (Capinera, 2001)** **Kogan *et al.*, 1989** **Larvae consistently recovered from … (Edde, 2018)** **In Chile, reported associated with this crop (Koch & Waterhouse, 2000).**	**Unlikely as pfp with roots?** **fresh cut plant parts (forage)** **Seeds,**
Melilotus albus	**Fabaceae**	**2**	**MEUAL**	**honey clover** **Yes, wild (native to Eurasia), also garden ornamental and fodder crop**	**C**		**Kogan *et al.*, 1989**	**Unlikely as pfp with roots?** **fresh cut plant parts (forage)?** **Seeds,**
Melochia pyramidata	Malvaceae	1	MEOPY	No evidence found through general Internet search. Origin: trop & subtrop. Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984). Halman (1980) abundant in this host,	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							found on the host whenever the insect was present in the area	
Mimosa comporum	Fabaceae	2	-	Name not found		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Mimosa diplotricha	Fabaceae	2	MIMIN	No evidence found through general Internet search. Origin: trop & subtrop. Am. Invasive in trop. areas		(weed/wild at origin – Hallman, 1980)	(as M. invisa)Kogan *et al.*, 1989	
Mimosa pigra	Fabaceae	2	MIMPI	No evidence found through general Internet search. Origin: trop & subtrop. Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Mimosa somnians	Fabaceae	2	MIMSO	No evidence found through general Internet search. Origin: Mexico to S trop. Am, Trinidad		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Mucuna deeringiana	**Fabaceae**	**2**	**MUCDE**	**Tropical bean** **Possibly, limited in gardens?, available at least as seeds**	**C**		**(as Stizolobium deeringianum)Kogan *et al.*, 1989**	**Unlikely as Pfp with roots?** **Fruit (pods, shelled or not)?** **stored product (dried beans)?** **Seeds**
Nicandra physalodes	**Solanaceae**	**2**	**NICPH**	**Yes, cultivated as ornamental**	**C**		**Kogan *et al.*, 1989** **As. N. physaloides. Several green fruits containing larvae (Hambleton, 1944)**	**Pfp with roots?** **Seeds**
Nicotiana	Solanaceae	-	NIOSS	See under the different species			Blanco *et al.*, 2019 citing Chamberlin and Tenhet (1926) 'Petunia and Nicotiana [ornamentals] are other common hosts' (Cranshaw, 2020). Mentioned amongst flower crops commonly damaged by the pest (University of Nebraska, 2023, Cloyd, 2016, Cranshaw, 2020)	
Nicotiana alata	**Solanaceae**	**2**	**NIOAL**	**Yes, cultivated as ornamental**	**C**		**Jackson *et al.*, 1996** **Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Nicotiana debneyi	Solanaceae	2	NIODE	No evidence found through general Internet search. Origin: AU			Jackson *et al.*, 1996	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Nicotiana glutinosa	**Solanaceae**	**2**	**NIOGT**	**Used in tobacco hybrids** **Yes, cultivated as ornamental**	**C**		**Jackson *et al.*, 1996**	**Pfp with roots?** **Seeds**
Nicotiana kawakamii	Solanaceae	2	NIOKA	Trap crop for *C. virescens?*			Jackson *et al.*, 1996	Pfp with roots? Seeds
Nicotiana paniculata	Solanaceae	2	NIOPA	No evidence found through general Internet search. Origin: W Peru			Kogan *et al.*, 1989 Blossom buds with eggs and L1 larvae on several plants (Hambleton, 1944)	
Nicotiana repanda	Solanaceae	1	NIORE	No evidence found through general Internet search. Origin: Texas to Mex., Cuba, tropical		(weed at origin, Capinera, 2001)	Kogan *et al.*, 1989 'In southern Texas, cotton is the principal host, but such weeds as wild tobacco,*Nicotania repanda*; vervain, *Verbena neomexicana*; ruellia, *Ruellia runyonii*; and mallow, *Aubitilon trisulcatum*, are important hosts early or late in the year' (Capinera, 2001)	
Nicotiana rustica	**Solanaceae**	**2**	**NIORU**	**Yes, cultivated as ornamental**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**
Nicotiana tabacum	**Solanaceae**	**1**	**NIOTA**	**Tobacco** **Cultivated, and has often escaped from cultivation, in Asia and Europe.** **https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.36326**	**C**		**Reporting findings ‚in some numbers' by Wilson 1923 in okra pods and tobacco seed pods in the Virgin isl. (Hambleton, 1944)** **Jackson *et al.*, 1996** **Major pest of this crop, large number of publications related to this pest on the crop (Kogan *et al.*, 1989)** **'principally a field crop pest attacking crops such as' (Capinera, 2001)** **very damaging on tobacco (Edde, 2018)** **as tobacco Mentioned amongst principal crop hosts (Fitt, 1989)** **Hallman, 1980** **In experiments, sustaining complete life cycle (Rodríguez-Espinosa *et al.*, 2018b)**	**Pfp with roots?** **Seeds, fresh or dried cut plant parts**
Nicotiana x sanderi	Solanaceae	2	NIOSA	N. alata × N. forgetiana No evidence found through general Internet search.			Jackson *et al.*, 1996	
Nuttallanthus canadensis	Plantaginaceae	1	LINCA	No evidence found through general Internet search. Origin: Canada to S Am, Caribbean		(weed at origin, Capinera, 2001)	(as Linaria canadensis)Kogan *et al.*, 1989 Blanco *et al.*, 2019 citing Kogan *et al.* (1989) In Georgia, 'developed principally on toadflax during April and May for 1 to 2 generations, followed by 1	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							generation on deergrass during June and July and 2 to 3 generations on beggarweed during July through October (Capinera, 2001)	
Nuttallanthus texanus	Plantaginaceae	2	LINTX	No evidence found through general Internet search. Origin: Canada to Mexico			(as Linaria canadensis var. texana)Kogan *et al.*, 1989	
Origanum vulgare	**Lamiaceae**	**1**	**ORIVU**	**Yes, cultivated as herb, also wild (native to the Mediterranean region, but widely naturalised elsewhere in the temperate Northern Hemisphere)**	**C**		**Flores Mego 2021, larvae on leaves, the third most abundant pest, present in all fields sampled (16), Tacna area (southern Peru)**	**Pfp with roots cut fresh plant parts (herb) Seeds**
Passiflora foetida	**Passifloraceae**	**2**	**PAQFO**	**Possibly cultivated as ornamental, but limited. Available as seeds from few sites**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Pfp with roots? Seeds**
Paulownia tomentosa	**Paulowniaceae**	**1**	**PAZTO**	**Yes, as cultivated ornamental tree (native from China), ornamental plantation (EPPO, 2014), wood, ornamental, and considered invasive in some EPPO countries (EPPO, 2018)**	**C**		**Observed in the field on the plant, and in experiments lyophilized extracts of the plant support life cycle (Blanco *et al.*, 2008a) Terminals and flower buds of *P.tomentosa* serve for the full development of *C. virescens* (C.A Blanco, personal observation in Mississippi, USA).**	**Pfp with roots? cut branches? other uses?? Seeds**
Pavonia	**Malvaceae**	**2**	**PVASS**	**Yes, several species cultivated as ornamentals (e.g. P. hastata, P. multiflora)**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Pfp with roots? Seeds**
Pelargonium hortorum	**Geraniaceae**	**1**	**PELZO**	**Garden geranium Yes, cultivated as ornamental**	**C**		**Landolt, 2008 Pacific Northwest. 1 larva found on the plant and raised to adult, also collection specimens As geranium & P x hortorum, commonly attacked in Colorado. Geranium is a particularly common host, hence the regional name "geranium budworm" (Cranshaw, 2020) 'common pest of geranium and other flower crops such as…' (Capinera, 2001) Geranium often infested throughout the growing season (NCSU, 2016) As geranium (cultivated geranium mostly P. hortorum, so recorded under that name): Pest in California. eggs deposited on the plant, all stages can be found (Davidson *et al.*, 1992)**	**Pfp with roots Cut flowers Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							As geranium, mentioned amongst flower crops commonly damaged by the pest (University of Nebraska, 2023, Cloyd, 2016, Cranshaw, 2020)	
Pelargonium peltatum	**Geraniaceae**	**1**	**PELPE**	**Cascading geranium** **Yes, cultivated as ornamental**	**C**		**Much less damaged than P. x hortorum (Cranshaw, 2020)**	
Penstemon laevigatus	Plantaginaceae	2	PEELA	No evidence found through general Internet search. Origin: E USA		(weed at origin, Capinera, 2001)	Kogan *et al.*, 1989	
Persicaria pensylvanica	Polygonaceae	2	POLPY	No evidence found through general Internet search. Origin: N. America, Cuba to Hispaniola			(as Polygonum pennsylvanicum)Blanco *et al.*, 2019 Kogan *et al.*, 1989 Sudbrink 1991	
Petunia	**Solanaceae**	**1**	**PEUSS**	**Yes, cultivated as ornamental**	**C**		**Hambleton (1944), partially injured** **Kogan *et al.*, 1989** **'common pest of geranium and other flower crops such as…' (Capinera, 2001)** **often infested throughout the growing season (NCSU, 2016)** **Eggs and larvae developing, pest in California (Davidson *et al.*, 1992)** **Mentioned amongst flower crops commonly damaged by the pest (University of Nebraska, 2023, Cloyd, 2016, Cranshaw, 2020)**	**Pfp with roots** **Cut flowers** **Seeds**
Petunia integrifolia	**Solanaceae**	**1**	**PEUIN**	**Yes, probably not cultivated (not very appropriate for cultivation, link below). Limited presence as introduced exotic associated with grain/birdseeds (https://alienplantsbelgium.myspecies.info/content/petunia-integrifolia)**	**C**		**As P. violacea Landolt, 2008, numerous larvae. Numerous larvae on petunia (*P. violacea*) over 2 months in 2007. Larvae were on well-established plants late in the season, suggesting local reproduction during the warmer months.**	
Phaseolus lunatus	**Fabaceae**	**2**	**PHSLU**	**Lima bean** **Yes, cultivated for beans. At least in the Mediterranean (commercial cultivars and traditional crops mentioned in Martínez-Nieto *et al.*, 2020). Probably limited.**	**C**		**In Chile, reported associated with this crop (Koch & Waterhouse, 2000).**	**Unlikely as Pfp with roots?** **Fruit (pods, shelled or not)** **stored product (dried beans)?** **Seeds**
Phaseolus vulgaris	**Fabaceae**	**1**	**PHSVX**	**Yes: widely cultivated as a crop plant (EPPO, 2020b**	**C**		**Blanco *et al.*, 2019 citing Graham and Robertson (1970 Kogan *et al.*, 1989)**	**Unlikely as Pfp with roots?**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				- PRA Naupactus xanthographus, cultivated commercially and grown in gardens. Mostly grown outdoors, although seed crops may be grown in protected conditions, and some fruit production may also be conducted in protected conditions Crop residues can be used as fodder (https://www.feedipedia.org/node/266)			As beans, pest CIAT (1983) In Chile, reported associated with this crop (Koch & Waterhouse, 2000).	Fruit (pods, shelled or not) stored product (dried beans)? Seeds
Physalis	**Solanaceae**	**2**	**PHYSS**	Yes. *P. peruviana* is probably the most widely cultivated species. Cultivated as garden plant, seeds available. No data on commercial cultivation in PRA area, although some websites mention an interest in commercial cultivation in Europe (EPPO, 2012).	C		Capinera, 2001	Pfp with roots? Fruit? Seeds
Physalis angulata	**Solanaceae**	**2**	**PHYAN**	Yes, cultivated for as ornamental and for fruit, at least in gardens Assessed for commercial cultivation: https://www.jstor.org/stable/26613287 Also weed/invasive? In Türkiye one of the most commonly distributed weeds in summer crops; in Greece, wherever found, in very high densities (cited in https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.40711)	C	(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	Pfp with roots? Fruit? Seeds
Physalis heterophylla	Solanaceae	2	PHYHE	No evidence found through general Internet search. Origin: E Canada to USA			Kogan *et al.*, 1989	
Physalis lagascea	Solanaceae	2	PHYLG	No evidence found through general Internet search. Origin: Mex. to S Am, Cuba		(weed/wild at origin – Hallman, 1980)	(as P. lagascae-glabrescens)Kogan *et al.*, 1989	
Physalis peruviana	**Solanaceae**	**2**	**PHYPE**	Yes, some commercial cultivation in Türkiye in greenhouse (Gümrükcü *et al.*, 2016), possibly in other countries in the south, also widely as garden plant	C		NVWA, 2020: interception on this plant, details available: life stages. See section 8.	
Physalis pubescens	**Solanaceae**	**2**	**PHYPU**	Yes, cultivated as garden plant for ornamental/fruit, probably limited At least assessed for commercial cultivation: https://www.jstor.org/stable/26613287	C		(as P. turbinata)Kogan *et al.*, 1989 Considered as a non-host in Sheck & Gould 1993 (experiments)	Pfp with roots? Fruit? seeds

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				Origin: trop. and subtrop. Am.				
Physalis viscosa	**Solanaceae**	**2**	**PHYVI**	**Yes, cultivated as garden plant for ornamental/fruit, probably limited** **Origin: Mex. to S. Am.**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots?** **Fruit?** **Seeds**
Pisum sativum	**Fabaceae**	**2**	**PIBSX**	**Pea** **Yes, widely cultivated (EPPO, 2022b) cultivated commercially (for food and feed) and grown in gardens. Mostly grown outdoors, although seed crops may be grown in protected conditions, and some fruit production may also be conducted in protected conditions**	**C**		**Kogan *et al.*, 1989** **As pea 'sometimes attacks vegetables such as… especially when cotton or other favored crops areabundant' (Capinera, 2001)** **Larvae consistently recovered from … (Edde, 2018)**	**Unlikely as Pfp with roots?** **Fruit (pods, shelled or not)** **stored product (dried)** **Seeds**
Portulaca oleracea	**Portulacaceae**	**1**	**POROL**	**Yes. wild, weed, also cultivated as leaf vegetable (EPPO, 2023c)**	**C**		**Kogan *et al.*, 1989** **Hallman, 1980: reported as a host in the literature of Colombia, but not observed as a host by Hallman 1980, despite the plant being frequently observed. However, experimental host.**	**Unlikely as pfp with roots?** **Fresh cut plant parts (leaf vegetable)** **Seeds**
Priva lappulacea	*Verbenaceae*	2	PRVLP	No evidence found through general Internet search. Origin: trop. S. Am., Florida, Texas		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 (misspelled Priya) Hallman, 1980 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Proboscidea louisianica	Martyniaceae	1	PROLO	Yes, introduced to parts of Europe (https://seedidguide.idseed.org/fact_sheets/proboscidea-louisianica/)	N	Weed/wild	C. virescens "can survive and reproduce on this plant » Laster, 1995	
Pseudelephantopus spicatus	Asteraceae	2	PSESP	No evidence found through general Internet search. Origin: trop. S. Am., Florida, Texas		(weed at origin - canal – Hallman, 1980)	Kogan *et al.*, 1989	
Pyrrhopappus carolinianus	Asteraceae	2	PYHCA	No evidence found through general Internet search. Origin: USA to Mexico		Weed/wild	Kogan *et al.*, 1989	
Rhexia	Melastomataceae	-	RHXSS	No evidence found through general Internet search. Origin: E. Canada to Central & E. USA, Cuba to Puerto Rico.		(weed at origin, Capinera, 2001)	Kogan *et al.*, 1989 In Georgia, 'developed principally on toadflax during April and May for 1 to 2 generations, followed by 1 generation on deergrass during June and July and 2 to 3 generations on beggarweed during July through October (Capinera, 2001)	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Rhexia alifanus	Melastomataceae	2	RHXAL	No evidence found through general Internet search. Origin. SE USA		Weed/wild	Kogan *et al.*, 1989	
Rhexia mariana	Melastomataceae	2	RHXMA	No evidence found through general Internet search. Origin. C & SE USA		Weed/wild	Kogan *et al.*, 1989	
Rhexia nashii	Melastomataceae	2	RHXNA	No evidence found through general Internet search. Origin. SE USA		Weed/wild	Kogan *et al.*, 1989	
Rhynchosia edulis	Fabaceae	2	RHNED	No evidence found through general Internet search. Origin: Arizona to S Am.		(weed/wild at origin – Hallman, 1980)	(as apoloensis)Kogan *et al.*, 1989	
Rhynchosia minima	Fabaceae	2	RHNMI	No evidence found through general Internet search. Origin: tropics and subtropics		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Ricinus communis	**Euphorbiaceae**	**2**	**RIICO**	**Yes. Cultivated as oil crop and grown as ornamental**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**Other plant parts? Seeds** **Unlikely as plts for planting with roots?**
Rosa	**Rosaceae**	**1**	**ROSSS**	**Yes. Some species in the wild. Native or exotic species also widely cultivated as ornamentals, major cut flower plant**	**C**		**Hambleton (1944) eggs on buds of a large white tea rose, larvae in flowers** **Kogan *et al.*, 1989** **often infested throughout the growing season (NCSU, 2016)** **Rose, snapdragons, verbena and many other flowers are occasionally damaged' (Cranshaw, 2020)** **In experiments, sustaining complete life cycle (Rodríguez-Espinosa *et al.*, 2018b)** **Larvae feed on this plant (Tucker, 1952)**	**Pfp with roots? cuttings** **Cut flowers**
Ruellia ciliatiflora	Acanthaceae	2	RUELO	No evidence found through general Internet search. Origin: USA to S Am.		(weed at origin, Hallman, 1980)	(as R. lorentziana)Kogan *et al.*, 1989, Hallman, 1980	
Ruellia runyonii	Acanthaceae	1	RUERU	No evidence found through general Internet search. Origin: USA to S Am.		(weed at origin, Capinera, 2001)	Blanco *et al.*, 2019 citing Kogan *et al.* (1989) 'In southern Texas, cotton is the principal host, but such weeds as wild tobacco,*Nicotania repanda*; vervain, *Verbena neomexicana*; ruellia, *Ruellia runyonii*; and mallow, *Abutilon trisulcatum*, are important hosts early or late in the year' (Capinera, 2001)	
Rumex crispus	Polygonaceae	2	RUMCR	Yes, wild/weed. Native to Europe and Western Asia	N		Kogan *et al.*, 1989	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Salvia misella	Lamiaceae	2	SALMS	No evidence found through general Internet search. Origin: S Florida to S Am., trop.			(as S. riparia)Kogan *et al.*, 1989	
Salvia occidentalis	Lamiaceae	2	SALOC	No evidence found through general Internet search. Origin: S Florida to S Am., trop.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Salvia officinalis	**Lamiaceae**	**2**	**SALOF**	**Yes, wild and cultivated for culinary and medicinal purposes (mostly in gardens?)** **native to the Mediterranean, naturalized in many other areas**	**C**		**Kogan *et al.*, 1989** **One half-grown larva found feeding on foliage (Hambleton, 1944)**	**Pfp with roots** **Cut fresh plant parts (herb)** **Seeds**
Funastrum clausum	Apocynaceae	2	FUSCL	No evidence found through general Internet search. Origin: trop. and subtrop. America		(weed at origin – canal Hallman, 1980)	Kogan *et al.*, 1989	
Scoparia dulcis	Plantaginaceae	2	SCFDU	No evidence found through general Internet search. Origin Trop. and subtrop.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Senna occidentalis	Fabaceae	2	CASOC	No evidence found of establishment. Rare and ephemeral in Belgium, and other records in Europe according to https://alienplantsbelgium.myspecies.info/content/senna-occidentalis Origin: trop. and subtrop. Am.		weed at origin – Hallman, 1980)	(as Cassia occidentalis) Kogan *et al.*, 1989	
Senna reticulata	Fabaceae	2	CASRE	No evidence found through general Internet search. Origin S. Mexico to S. Tropical America, Trinidad		(weed at origin-canal – Hallman, 1980)	Cassia reticulata Kogan *et al.*, 1989	
Senna tora	Fabaceae	2	CASTO	No evidence found through general Internet search. Origin: C. America		(weed at origin – Hallman, 1980)	(as Cassia tora) Kogan *et al.*, 1989	
Sesamum indicum	**Pedaliaceae**	**1**	**SEGIN**	**Sesame** **Yes, cultivated as oil seed crop and for grain, e.g. in Türkiye (Ercan *et al.*, 2004). Small volumes of seeds produced in Greece and Italy (CBI, 2022).**	**C**		**Kogan *et al.*, 1989** **Causes damage to this crop in the department of Tolima, Colombia (Hallman, 1980)** **Feeds on flower buds and capsules, normally does not necessitate treatment**	**Pfp with roots?** **Fresh seeds,** **Stored products (dried)** **Seeds**
Setaria italica	**Poaceae**	**2**	**SETIT**	**Foxtail millet** **Yes, cultivated as ornamental** **General search on the Internet shows it was cultivated for food in old times, but does not seem to be the case now. It is also cultivated as a**	**C**		**Blanco *et al.*, 2019 citing Kogan *et al.* (1989) Kogan *et al.*, 1989**	**Pfp with roots?** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				forage plant (https://www.feedipedia.org/node/382)				
Sicyos angulatus	Cucurbitaceae	2	SIYAN	Yes, not cultivated. large part of Europe to Russia (EPPO, 2023b) In Belgium, increasing, usually ephemeral alien, usually grain contaminant. rapidly spreading and aggressive weed, in agricultural fields (e.g. maize fields) in S Europe https://alienplantsbelgium.myspecies.info/content/sicyos-angulatus Established population found in Georgia in 2012, expanding Origin: E. Canada to Central & E. U.S.A	N		Kogan *et al.*, 1989	
Sida abutilifolia	Malvaceae	2	SIDAB	No evidence found through general Internet search. Origin: subtrop. trop. Am.		(weed/wild at origin – Hallman, 1980)	(as S. procumbens)Kogan *et al.*, 1989	
Sida acuta	Malvaceae	2	SIDAC	Yes, probably not cultivated. Introduced in Mediterranean (eastern) (EPPO, 2023b) Very rare in Israel https://flora.org.il/en/plantshttps://flora.org.il/en/plants/SIDACU Not searched further	N	(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Sida cordifolia	Malvaceae	2	SIDCO	Yes, probably not cultivated (although medicinal plant elsewhere in the world), probably limited. found in a field in NL https://alienplantsbelgium.myspecies.info/content/sida Origin: tropics, subtropics	N	(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989 Eggs and larvae found on the plant in Colombia (Hallman, 1984)	
Sida glomerata	Malvaceae	2	SIDGL	No evidence found through general Internet search. Origin: trop. Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Sida glutinosa	Malvaceae	2	SIDGT	No evidence found through general Internet search. Origin: trop. SW. Mexico to Ecuador, Caribbean, Central & E. Brazil to Paraguay		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Sida rhombifolia	Malvaceae	2	SIDRH	Yes, probably not cultivated, probably limited. In Belgium, soybean alien associated with soybean grain imports close to harbours, also found as weed in lily field in NL	N	(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
				(https://alienplantsbelgium.myspecies.info/content/sida-rhombifolia) Origin tropical, subtropical				
Sida spinosa	Malvaceae	2	SIDSP	Yes, probably not cultivated, probably limited. in Belgium ephemeral, associated with grain imports https://alienplantsbelgium.myspecies.info/content/sida-spinosa Greece (EPPO, 2009) Origin tropics and subtropics	N	(weed at origin, Capinera, 2001)	Sudbrink 1991 Blanco *et al.*, 2019 citing Kogan *et al.* (1989) Kogan *et al.*, 1989	
Sida urens	Malvaceae	2	SIDUR	No evidence found through general Internet search. Origin: trop. Am.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Sidastrum paniculatum	Malvaceae	2	SIDPA	No evidence found through general Internet search. Origin: trop. Am.			(as Sida paniculata)Kogan *et al.*, 1989	
Solanum carolinense	Solanaceae	2	SOLCA	Yes, not cultivated. introduced to Europe (invasive), regulated pest Israel, Jordan (EPPO, 2023b) Origin: E Canada to Mexico, temperate	N	Wild at origin	Kogan *et al.*, 1989	
Solanum hirtum	Solanaceae	2	SOLHT	No evidence found through general Internet search. Origin: Mexico to Trinidad-Tobago and Ecuador.		(weed/wild at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Solanum lycopersicum	**Solanaceae**	**1**	**LYPES**	**Tomato** **Yes, widely cultivated for fruit, outdoors and indoors**	**C**		**(as Lycopersicon esculentum Blanco *et al.*, 2019 citing Brazzel (1953), Kogan *et al.*, 1989** **Major pest of this crop, large number of publications related to this pest on the crop (Kogan *et al.*, 1989)** **'sometimes attacks vegetables such as… especially when cotton or other favored crops areabundant' (Capinera, 2001)** **Reared from tomato (Tucker, 1952)** **Attacks on fruit, eggs and larvae found, raised to adults. Damage by first to mature instar larvae (Pratissoli *et al.*, 2006).** **'Vegetables, especially … are readily infested ' (NCSU, 2016)** **Cause severe economic loss (Edde, 2018)** **Mentioned amongst principal crop hosts (Fitt, 1989)** **In addition, substantial numbers of eggs and a few larvae were found on tomatoes in field cages (Martin *et al.*, 1976)**	**Pfp with roots ?** **Fruit** **Seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
							In cage tests and field studies conducted in Florida and which did not include cotton, tobacco was more highly preferred than other field crops and vegetables, but cabbage, collards, okra, and tomato were attacked (Capinera, 2001 citing Martin *et al.*, 1976). In Chile, reported associated with this crop (Koch & Waterhouse, 2000).	
Solanum melongena	**Solanaceae**	**2**	**SOLME**	**Aubergine/eggplant Yes, cultivated for fruit**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots ? Fruit Seeds**
Solanum rostratum	Solanaceae	2	SOLRS	No evidence found through general Internet search. Origin: C & S USA to Mexico		Wild at origin	Kogan *et al.*, 1989	
Solanum sessiliflorum	**Solanaceae**	**2**	**SOLTP**	**Possibly cultivated as ornamental, probably limited. Seeds available for sale from a few sites Tropical. Origin: C & S America**	**C**		**Anteparra *et al.*, 2012. found feeding on flower buds and buds**	**Pfp with roots ? Fruit ? Seeds**
Solanum sisymbriifolium	**Solanaceae**	**2**	**SOLSI**	**Yes, cultivated. Introduced (Sth American origin). As been used as trap crop against potato cyst nematode, as intercrop (NL PRA on Leucinodes orbonalis) and as ornamental https://www.eppo.int/ACTIVITIES/plant_quarantine/alert_list_plants/solanum_sisymbriifolium potentially invasive. EPPO Alert List**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots ? Fruit ? Seeds**
Solanum torvum	**Solanaceae**	**2**	**SOLTO**	**Yes, probably limited. Used as rootstock for Solanaceae, 23 individuals found in a stream in Calabria, S Italy https://link.springer.com/article/10.1007/s10722-019-00822-5o evidence found through general Internet search. Origin. tropical Am.**	**C**		**Kogan *et al.*, 1989**	**Pfp with roots ? Fruit ? Seeds**
Solanum tuberosum	**Solanaceae**	**2**	**SOLTU**	**Potato Yes, widely cultivated for tubers**	**C**		**Larvae consistently recovered from … (Edde, 2018)**	**Seed potatoes, ware potatoes**
Stilias caroliniana		2	-	Name not found			Kogan *et al.*, 1989	
Strelitzia reginae	**Strelitziaceae**	**2**	**STZRE**	**Yes, cultivated as ornamental, probably mostly indoors Origin S Africa**	**C**		**Larvae consistently recovered from … (Edde, 2018)**	**Pfp with roots ? Cut flowers**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
								Seeds
Stylosanthes guianensis	Fabaceae	2	STYGN	No evidence found through general Internet search. Origin: Mex. to trop. Am. Also cultivated in tropical areas			(as S. gracilis Kogan *et al.*, 1989	
Tridax procumbens	Asteraceae	2	TRQPR	Yes, not cultivated, Introduced at least to Russia (EPPO, 2023b) Origin: Mex. to trop. Am.	N	(weed at origin – Hallman, 1980)	Kogan *et al.*, 1989	
Trifolium	**Fabaceae**	**-**	**TRFSS**	**Yes, some major species are hosts. Others are present such as T. aureum, T. campestre, T. medium (both wild)**	**C**		**Blanco *et al.*, 2019 citing Kogan *et al.* (1989)** **Ventura *et al.* (2015)** **'principally a field crop pest attacking crops such as' (Capinera, 2001)** **As white clover. small numbers found on cabbage, collards, peanuts, white clover, and tomatoes (Martin *et al.*, 1976)** **Larvae consistently recovered from … (Edde, 2018)** **Genus reported as host from several regions (Sudbrink, 1991)**	**Fresh cut plant parts (forage)** **Unlikely as plants for planting with roots ?** **seeds**
Trifolium incarnatum	**Fabaceae**	**1**	**TRFIN**	**Yes, wild and cultivated as ornamental, as forage/hay and silage, nitrogen-fixing cover (native to parts of Europe** **https://alienplantsbelgium.myspecies.info/content/trifolium-incarnatum** **https://www.feedipedia.org/node/247** **Young-Mathews, 2013**	**C**		**Kogan *et al.*, 1989** **Although occasionally found on several hosts, the most important ones seem to be cotton, crimson clover, Jacquemontia tamnifolia and tobacco.** **Amongst many plant species sampled, second highest number of larvae collected on this plant (after cotton) (Brazzel, 1953)** **In studies for H. zea, mix of H. zea and C. virescens larvae collected from this plant (Allen *et al.*, 2023)** **Pair, 1994: larval populations on Lonicera japonica occurring at the same time as those on Trifolium incarnatum and Geranium carolinianum**	**Fresh cut plant parts ? (forage)** **Unlikely as plants for planting with roots ?** **seeds**
Trifolium pratense	**Fabaceae**	**2**	**TRFPR**	**Yes, wild and cultivated as fodder crop, ornamental** **Native to Europe and W Asia, NW Africa** **https://www.feedipedia.org/node/246**	**C**		**Kogan *et al.*, 1989**	**Fresh cut plant parts? (forage)** **Unlikely as plants for planting with roots ?** **seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Trifolium repens	**Fabaceae**	**1**	**TRFRE**	**Yes, wild and cultivated as ornamental, forage native to N Africa, W Asia, Europe, Caucasus, Central Asia).** **https://www.feedipedia.org/node/245**	**C**	**(weed at origin – Blanco *et al.*, 2008a)**	**Kogan *et al.*, 1989** **Source of the first generation in Washington county, Mississippi (Blanco *et al.*, 2008a)** **In experiments, the previously reported plant hosts Trifolium repens, Geranium were the best hosts for the development, but C. virescens was not found on these plants during the 2-years surveys in Mississippi (Blanco *et al.*, 2008a).**	**Fresh cut plant parts? (forage)** **Unlikely as plants for planting with roots ?** **seeds**
Trifolium resupinatum	**Fabaceae**	**1**	**TRFRS**	**Yes, wild and cultivated as forage/hay native to C and S Europa, Mediterranean, SW Asia. Wild and cultivated as forage** **https://www.feedipedia.org/node/244**	**C**		**Kogan *et al.*, 1989** **adequate host, capable of supporting large populations, important early spring host (Snow & Brazzel, 1965)**	**Fresh cut plant parts? (forage)** **Unlikely as plants for planting with roots ?** **seeds**
Trixis cacalioides	Asteraceae	2	Not in GD	No evidence found through general Internet search. Origin: Bolivia to S Am.			New host record. Santos-Zamorano *et al.*, 2017. larvae collected from the plants and raised to adult	
Trixis inula	Asteraceae	2	Not in GD	No evidence found through general Internet search. Origin: TX to Venezuela, Caribbean, tropical		(weed at origin-canal – Hallman, 1980)	(as Trixis radialis)Kogan *et al.*, 1989	
Turnera ulmifolia	**Passifloraceae**	**2**	**TURUL**	**Possibly as ornamental, probably limited (seeds available from few sites)** **Origin: Mex., C Am., Caribbean, tropical**	**C**	**(weed/wild at origin – Hallman, 1980)**	**Kogan *et al.*, 1989**	**pfp with roots ?** **seeds**
Vaccinium corymbosum	**Ericaceae**	**1**	**VACCO**	**Highbush blueberry** **Yes, cultivated in Europe for fruit production (EPPO, 2021 - PRA on Orgyia leucostigma), also in North Africa (e.g. Morocco https://blueberriesconsulting.com/en/agroberries-se-instala-en-marruecos/)**	**C**		**important pest of blueberry in Peru (Narrea, 2022)** **Larvae feed on leaves of the terminal shoot, flowers, capsules, seeds, developed seedlings fruit (NovAgro-Ag, 2023 citing Rojas, 2016)** **Pest in La libertad, Peru (Navarro, 2019)**	**Pfp with roots** **Cuttings** **Fruit**
Verbena	**Verbenaceae**	**1**	**VEBSS**	**Yes, other species as wild (native) and ornamentals, such as Verbena officinalis (both), V. bonariensis.**	**C**		**Blanco *et al.*, 2019 citing Graham and Robertson (1970)** **'common pest of geranium and other flower crops such as…' (Capinera, 2001)** **Rose, snapdragons, verbena and many other flowers are occasionally damaged' (Cranshaw, 2020)** **Hambleton (1944), partially injured**	**Pfp with roots** **seeds**

Host scientific name	Family	Cat.	EPPO code	common name (only for some cultivated plants) Presence in the PRA area / cultivated C or not N		Notes on Americas	Comments	Potential commodities
Verbena neomexicana	Verbenaceae	1	VEBNE	No evidence found through general Internet search. Origin: California.		(weed at origin, Capinera, 2001)	Kogan *et al.*, 1989 'In southern Texas, cotton is the principal host, but such weeds as wild tobacco,*Nicotania repanda*; vervain, *Verbena neomexicana*; ruellia, *Ruellia runyonii*; and mallow, *Aubitilontrisulcatum*, are important hosts early or late in the year' (Capinera, 2001	
Vernonanthura brasiliana	Asteraceae	2	VENSA	Native to Brazil. Not found available online		(weed at origin-canal – Hallman, 1980)	(as Vernonia brasiliana)Kogan *et al.*, 1989	
Vicia villosa	Fabaceae	2	VICVI	Yes, wild (native to Eurasia)	N		Kogan *et al.*, 1989 Blanco *et al.*, 2019 citing Kogan *et al.* (1989)	
Vigna unguiculata subsp. unguiculata	**Fabaceae**	**2**	**VIGSC**	**Cowpea** **Yes, minor cultivation in Southern Europe (Lazaridi & Bebeli, 2023). Cultivated in areas of Southern Europe such as Greece, Italy, Spain, Cyprus, Croatia, Portugal and Serbia, Bosnia and Herzegovina, and North Macedonia, less widespread in Central Europe. also Slovenia and Hungary.** **Possibly Middle East, North Africa (https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1439-0434.1976.tb03213.x)**	**C**		**(as Vigna sinensis)Kogan *et al.*, 1989** **Hallman, 1980 reported as a host in the literature of Colombia, but not observed as a host by Hallman 1980, despite being frequently observed. However, experimental host.**	**Unlikely as Pfp with roots?** **Fruit (pods, shelled or not)** **stored product (dried)? Seeds**
Vitis vinifera	**Vitaceae**	**1**	**VITVI**	**Grapes** **Yes. Widely cultivated for fruit (EPPO, 2023c)**	**C**		**Ventura *et al.* (2015). causing damage to bunches**	**Pfp with roots, cuttings, fruit**
Waltheria americana	Malvaceae	2	WALAM	No evidence found through general Internet search. Origin: tropical and subtrop. Am.		(weed/wild at origin – Hallman, 1980)	(as Waltheria indica)Kogan *et al.*, 1989	
Xanthium orientale	Asteraceae	2	XANOR			Wild at origin	(as X. pensylvanicum)Blanco *et al.*, 2019 citing Kogan *et al.* (1989) Kogan *et al.*, 1989	
Xerochrysum bracteatum	**Asteraceae**	**1**	**HECBR**	**Strawflower** **Yes, as ornamental (& cut flower)**	**C**		**(as Helichrysum bracteatum)Kogan *et al.*, 1989** **As strawflower 'common pest of geranium and other flower crops such as…' (Capinera, 2001)** **As Helichrysum bracteatum Hambleton (1944). Damaged from September to January, larvae in terminal growths, often killing them**	**Pfp with roots, cut flowers** **seed**
Zinnia	**Asteraceae**	**1**	**ZIISS**	**Zinnias** **Yes, cultivated as ornamentals (e.g. *Z. peruviana*, *Z. elegans*)**	**C**		**'common pest of geranium and other flower crops such as…' (Capinera, 2001)**	**Pfp with roots cut flowers?** **seed**

Uncertain hosts

- *Zea mays*. Two articles from Mexico (Alvarado-Canche *et al.*, 2019, Sanchez-Vega *et al.*, 2019) report *C. virescens* in the field on maize and huitlacoche (corn smut, i.e. *Ustilago maydis* growing on maize ears). However, morphological and molecular identification in these papers are not well described.. In addition, Alvarado-Canche *et al.* (2019) report more individuals of *C. virescens* than *H. zea* on transgenic maize, but *C. virescens*, unlike *H. zea*, is known to be very sensitive to Cry1Ab and Cry1F, and only report of Bt resistance in *C. virescens* was from a laboratory-induced resistant strain (see section 12.1). Finally, a third paper, Bortolotto *et al.* (2022), conducted experiments to determine the biological parameters of *C. virescens* raised on maize cobs, but this does not demonstrate that maize is a host. Experts from Mexico and the USA indicated that they were not aware of maize as host (C.A. Blanco, pers. comm.). Therefore maize is considered an uncertain/doubtful host in this PRA.
- *Gossypium* species other than *G. hirsutum*, such as *G. barbadense* and *G. raimondii*. For Peru, Ministerio del Ambiente (2020) mentions that those species are present in addition to *G. hirsutum* – and *G. barbadense* is more widely cultivated than *G. hirsutum* - but no direct confirmation of their host status was found.
- *Sorghum bicolor*. Ventura *et al.*, 2015 citing (Fitt 1989) notes that, in general, *C. virescens* larvae prefer plant structures with higher levels of nitrogen, including *S. bicolor* heads. However, Fitt (1989) mentions that *S. bicolor* is not attacked by *C. virescens*. No other record was found.
- *Acacia, Achillea, Allium fistulosum, Anigozanthos, Apium graveolens, Aster, Benincasa hispida, Brunia, Campanula, Carica papaya, Daucus carota, Delphinium, Eryngium foetidum, Fragaria, Hydrangea, Lagenaria siceraria, Limonium, Mentha, Moluccella, Ocimum basilicum, Ocimum, Opuntia, Pithecellobium dulce, Saccharum officinarum, Sechium edule, Thymus vulgaris, Tulipa:* interceptions of *C. virescens* are reported from the USA on these species (Gilligan & Passoa, 2014 or Gilligan *et al.*, 2019). Among those, NVWA (2020) notes the pest feeding on *Allium, Apium, Aster*, *Carica papaya*, *Citrus*, *Tulipa* (citing Gilligan & Passoa, 2014). No other reference was found for these plants in the literature and they were not considered as hosts in this PRA.
- *Brassica campestris*, *Origanum majorana*, *Physalis philadelphica, Vicia faba, Zea mays*. Interceptions of *C. virescens* are reported from the USA on these species or genera (Gilligan & Passoa, 2014 or Gilligan *et al.*, 2019). Although they are not as such on the host list, other species of the genus are.
- *Pinus radiata*. Reported associated with this species in Chile (Koch & Waterhouse, 2000), but considered doubtful, or only incidental finding.
- 'mallow', 'marigold' bird of paradise' (Capinera, 2001): ambiguous common names, which may correspond to different species (in order: Malvaceae / Asteraceae / *Strelitzia* or *Raggiana*).

ANNEX 7. Interceptions in the USA

Extracted from Gilligan & Passoa (2014) and Gilligan *et al.* (2019).

Article: 2014 = Gilligan & Passoa (2014); 2019 = Gilligan *et al.* (2019); or both.
Latin name: plants marked with* are not on the host list, and those with # belong to genera for which there is at least one species on the host list. Number of specimens sequenced (between brackets) are from Gilligan *et al.* (2019).

article	Latin name
2014	*Abelmoschus esculentus*
2014	*Abelmoschus* sp.#
2014	*Acacia* sp.*
2014	*Achillea* sp.*
2014	*Allium fistulosum**
2014	*Anigozanthos* sp.*
both	*Antirrhinum majus* (4)
2014	*Antirrhinum* sp.
2014	*Apium graveolens**
2014	*Aster* sp.*
2019	*Benincasa hispida* (1)*
2014	*Brassica campestris**#
2014	*Brassica* sp.*#
2014	*Brunia* sp.*
both	*Cajanus cajan* (30)
2014	*Campanula* sp.*
2014	*Capsicum annuum*
both	*Capsicum* sp. (2)*#
2014	*Carica papaya**
2014	*Chrysanthemum* sp.
both	*Cicer arietinum* (20)
2014	*Cicer* sp.*#
2014	*Citrus* sp.*
2014	*Cucurbita* sp.*#
2019	*Daucus carota* (1)*
2014	*Delphinium* sp.*
2019	*Eryngium foetidum* (1)*
2014	*Fabaceae*
2014	*Fragaria* sp.*
both	*Helianthus annuus* (1)
2019	*Helianthus* sp. (1)
2014	*Hydrangea* sp.*
2014	*Lablab purpureus*
2014	*Lablab* sp.*#
2014	*Lactuca* sp.*#
2014	*Lagenaria siceraria**
2014	*Limonium* sp.*
2014	*Mentha* sp.*
2014	*Moluccella* sp.*
both	*Ocimum basilicum* (2)*
2014	*Ocimum* sp.*
2014	*Opuntia* sp.*
Both	*Origanum majorana* (1)*#
2014	*Origanum* sp.*#
2014	*Origanum vulgare*
both	*Phaseolus lunatus* (1)
2014	*Phaseolus* sp.*#
2014	*Phaseolus vulgaris*
both	*Physalis philadelphica* (5)*#
2014	*Physalis pubescens*
both	*Physalis* sp.(2)*#
both	*Pisum sativum* (40)
both	*Pisum sativum* var. *macrocarpon* (6)
both	*Pisum* sp.(16)*#
2014	*Pithecellobium dulce**
2014	*Saccharum officinarum**
both	*Salvia officinalis* (1)
2019	*Sechium edule* (1)*
2014	*Solanaceae*
2014	*Solanum lycopersicum*
2014	*Solanum melongena*
2014	*Thymus vulgaris**
2014	*Tulipa* sp.*
2014	*Vicia faba**#
2014	*Vigna unguiculata*
both	*Zea mays* (1)*
2014	Zingiberaceae

ANNEX 8. Trade data and summary analysis – plants for planting

Trade data were extracted for 2018-2022.

- For rose plants for planting (HS6 codes), data were extracted from UN Comtrade and cover imports into all EPPO countries;
- For several broad categories that may contain hosts (HS8 codes) (live outdoor plants (excl. bulbs, tubers, tuberous roots, corms, crowns and rhizomes, incl. chicory plants and roots, unrooted cuttings, slips, rhododendrons, azaleas, roses, mushroom spawn, pineapple plants, vegetable and strawberry plants, trees, shrubs and bushes); indoor rooted cuttings and young plants (excl. cacti); indoor flowering plants with buds or flowers (excl. cacti); live indoor plants and cacti (excl. the categories just above), data are not available in Comtrade; data were extracted from Eurostat and cover imports into EU countries. For broad categories, there is an uncertainty on which hosts are imported, and non-EU countries may also import such plants.

- Table 1. *Rose plants for planting (UN Comtrade; 060240 - Roses, whether or not grafted)* were imported from 5 countries where the pest is present to 7 EU countries and 2 EPPO non-EU countries (Jordan and Russia), with Colombia and Ecuador being by far the largest exporters. In 2022, approx. 88000 rose plants were imported in total, incl. approx. 50000 from Colombia to Germany, and approx. 36000 from Ecuador to Spain, Germany, Jordan and Finland. Other imports were minor (4 plants from Canada and 44 from Peru).
- Table 2. *Live outdoor plants (Eurostat; 06029050 - Live outdoor plants, incl. their roots (excl. bulbs, tubers, tuberous roots, corms, crowns and rhizomes, incl. chicory plants and roots, unrooted cuttings, slips, rhododendrons, azaleas, roses, mushroom spawn, pineapple plants, vegetable and strawberry plants, trees, shrubs and bushes)* were imported from 17 countries where the pest is present into16 EU countries, including between 100 and 400 t in different years from Argentina, Brazil, Chile, Costa Rica, Honduras, Paraguay and the USA. In 2022, the largest volumes were approx. 260 t from Chile, 210 t from Argentina, 190 t from Costa Rica and 145 t from Paraguay.
- Table 3. *Indoor rooted cuttings and young plants (excl. cacti) (Eurostat; 06029070)* were imported from 17 countries where the pest is present into 18 EU countries. In 2022, the largest quantities were imported from Costa Rica (approx. 5400 t corresponding to approx. 13.5 million units), Guatemala (approx. 2100 t corresponding to approx. 10 million units) and Honduras (approx. 1100 t corresponding to approx. 21 million units). There were also imports over 10 t from El Salvador (approx. 400 t), USA (approx. 200 t), Colombia (approx. 15 t), Ecuador (approx. 13 t), and quantities below 10 t from several other countries.
- Table 4. *Indoor flowering plants with buds or flowers (excl. cacti)* (Eurostat; 06029091) were imported in minor quantities from 8 countries where the pest is present into 13 EU countries. In 2022 such plants were imported only from Guatemala and the USA (approx. 700 kg for each, corresponding respectively to 23500 and 2500 units) and Brazil (approx. 60 kg corresponding to 1000 plants). The largest quantities over the whole period were about 100 t from Paraguay in 2019 (corresponding to 19 units).
- Table 5. *Live indoor plants and cacti (excl. the two categories above) (Eurostat; 06029099)* were imported from 16 countries where the pest is present into 23 EU countries. In 2022, the largest quantities were imported from Costa Rica (approx. 8000 t corresponding to approx. 2 million units), Honduras (approx. 6000 t corresponding to ca 4.3 million units), Guatemala (approx. 4900 t corresponding to approx. 6.1 million units), El Salvador (approx. 2550 t corresponding to 1.6 million units), Mexico (approx. 145 t corresponding to 85000 units), Brazil (approx. 150 t corresponding to approx. 100000 units, USA (approx. 340 t corresponding to approx. 50000 units), and quantities below 10 t from several other countries.

Table 1. 060240 Roses, whether or not grafted

From UN Comtrade, import quantity in in number of units. Countries and years without data were deleted

	Estonia		Finland			France	Germany				Ireland	Jordan			Luxembourg		Russia	Spain		
	2018	2019	2018	2019	2022	2019	2018	2019	2020	2022	2022	2019	2020	2022	2021	2022	2019	2018	2019	2022
Barbados						22														
Canada			1132	26				800			4									
Colombia										51831										
Ecuador	98755	37180			64	295	72111		1225	10500		2833	1398	5993			384	5600	20000	20000
Peru															16	44				
total	**98755**	**37180**	**1132**	**26**	**64**	**317**	**72111**	**800**	**1225**	**62331**	**4**	**2833**	**1398**	**5993**	**16**	**44**	**384**	**5600**	**20000**	**20000**

Same data with quantities in kg

	Estonia		Finland			France	Germany				Ireland	Jordan			Luxembourg		Russia	Spain		
	2018	2019	2018	2019	2022	2019	2018	2019	2020	2022	2022	2019	2020	2022	2021	2022	2019	2018	2019	2022
Barbados						11														
Canada			11	25				765			9									
Colombia										2306										
Ecuador	6747	1939			12	5	57216		44	446		312	670	2598			165	369	243	189
Peru															27	54				

Table 2. 06029050 Live outdoor plants, incl. their roots (excl. bulbs, tubers, tuberous roots, corms, crowns and rhizomes, incl. chicory plants and roots, unrooted cuttings, slips, rhododendrons, azaleas, roses, mushroom spawn, pineapple plants, vegetable and strawberry plants, trees, shrubs and bushes)

From Eurostat, import quantity in 100 kg. Countries and years without data were deleted

		BE	CZ	DE	DK	ES	FI	FR	GB	HU	IE	IT	LV	NL	PL	PT	SK	EUtotal
AR	2018											241,00						241
AR	2019											715,50						715,5
AR	2021					330,40												330,4
AR	2022					1072,20						1065,00						2137,2
BO	2022													0,05				0,05
BR	2018					2838,04												2838,04
BR	2019					2510,21												2510,21
BR	2020													0,01				0,01
BR	2021											0,66						0,66
BR	2022	0,60						0,36						1,62		0,22		2,8
CA	2018			9,91		4,95												14,86
CA	2019							0,20			0,05		0,14					0,39
CA	2020							0,03					0,34					0,37
CA	2021			11,34							0,02							11,36
CA	2022	0,02	0,00											0,15		0,04		0,21
CL	2018					7,65												7,65
CL	2019	0,35										245,00				0,11		245,46
CL	2020			6,33								978,14		41,03				1025,5
CL	2021											2760,00		82,17				2842,17
CL	2022											2500,00		84,42				2584,42
CO	2019													2,26				2,26
CO	2020													7,31				7,31
CO	2021					1,46		1,34						13,00				15,8
CO	2022							0,12						49,17				49,29
CR	2018					3059,06									1,54			3060,6
CR	2019					2235,03								229,98	1,91			2466,92
CR	2020			628,53		2128,42						9,50			1,89			2768,34
CR	2021			206,00		4041,58								0,59				4248,17
CR	2022					1873,01						23,50		0,04				1896,55
DO	2018							6,73										6,73
DO	2020							0,04										0,04
EC	2018	262,42																262,42
GT	2018			26,19		641,83		4,83	18,17									691,02
GT	2019			12,80		449,40		0,67	18,19					244,83		1,12		727,01
GT	2020			7,42		393,01						8,36		0,01				408,8
GT	2021					3,25						10,56		4,50		0,40		18,71
GT	2022					225,92						31,81		0,16				257,89
HN	2018					342,42												342,42
HN	2019					858,22												858,22
HN	2020					990,61										200,00		1190,61
HN	2021					110,52												110,52
MX	2018	254,50								73,40		87,90						415,8
MX	2019	237,00																237
MX	2020									99,90		40,00						139,9
MX	2021									184,00								184
MX	2022	296,00				185,00				154,95		3,00		0,11				639,06
PE	2019					0,42												0,42
PE	2020					0,26												0,26
PY	2019											644,00						644
PY	2021											881,10						881,1
PY	2022					1068,80						381,60						1450,4
SV	2018					0,30												0,3
US	2018	0,03		3,67		15,02	0,05	115,22	0,26	1,30	0,08			1752,44	0,03			1888,1
US	2019	4,25		2,93		1,49	0,04	43,38	3,56		0,29	0,20		2337,94	0,30	0,18		2394,56
US	2020	0,05	0,08	10,25	0,05			10,22		0,14	0,15	0,10	0,08	1317,60	0,26		0,21	1339,19
US	2021		0,05	1,08		0,00		86,73		0,07	0,04			518,32	0,21			606,5
US	2022	0,65	0,05	3,13	0,34	2,25	0,04	20,27		0,01	0,02	0,00	0,01	115,52	18,85	0,01	0,09	161,24

Table 3. 06029070 Indoor rooted cuttings and young plants (excl. cacti)

From Eurostat, import quantity in 100 kg. Countries and years without data were deleted

		AT	BE	CZ	DE	DK	ES	FI	FR	GB	HU	IE	IT	LV	NL	PL	PT	SE	SK	
AR	2022														0,07					0,07
BR	2018														656,62					656,62
BR	2019														247,66					247,66
BR	2020				1,06										53,75					54,81
BR	2021				0,25										59,19					59,44
BR	2022														76,68		0,09			76,77
CA	2018														2,76					2,76
CA	2019														0,06	0,02				0,08
CA	2020														0,25					0,25
CA	2021	0,01			0,42															0,43
CA	2022														0,67					0,67
CL	2018														447,94					447,94
CL	2019														499,94					499,94
CL	2020														273,69					273,69
CL	2021														196,07					196,07
CL	2022														94,23					94,23
CO	2018				16,33		0,40						0,36		224,29					241,38
CO	2019				23,89		0,45						8,24		451,95					484,53
CO	2020				8,77		11,60						0,45		190,49					211,31
CO	2021						122,70						0,83		76,08					199,61
CO	2022				7,39		50,50						0,30		98,33					156,52
CR	2018		9010,08			2850,75				0,78					4776,38					16637,99
CR	2019		9534,54			1959,90				168,54					5103,65					16766,63
CR	2020		9186,20			1631,95	28,92								4630,22					15477,29
CR	2021		10546,31			1470,90	2,50								5658,12					17677,83
CR	2022		7937,02			1023,70	48,90						29,77		44701,64					53741,03
DO	2018														335,16					335,16
DO	2019														154,14					154,14
DO	2020														70,54					70,54
DO	2022														0,08					0,08
EC	2018				3,85	108,60									0,19					112,64
EC	2019			0,52	9,16															9,68
EC	2020				98,37															98,37
EC	2021				183,05										11,62					194,67
EC	2022				127,30		0,05								1,03			0,04		128,42
GT	2018		173,13		27,91	1225,00				0,55					5155,32					6581,91
GT	2019		0,02		29,30	2097,00									4977,51					7103,83
GT	2020				24,20	2021,00									5447,03					7492,23
GT	2021					2041,99									6009,84					8051,83
GT	2022				28,31	865,00									20412,39					21305,7
HN	2018					4440,00									539,28					4979,28
HN	2019					5411,00									724,87					6135,87
HN	2020					4512,00									555,94					5067,94
HN	2021					5160,00									593,71					5753,71
HN	2022					3960,00									7428,91					11388,91
MX	2018									0,15										0,15
NI	2022														0,06					0,06
PA	2019					585,00														585
PE	2020				1,09															1,09
PE	2021				4,09			0,00										0,01		4,1
PE	2022						0,11													0,11
SV	2018		55,34												319,72					375,06
SV	2019														209,18					209,18
SV	2020														100,22					100,22
SV	2021														123,25					123,25
SV	2022														4021,63					4021,63
US	2018				3,39			0,02		1,03	0,10				198,27			0,07		202,88
US	2019				4,48	60,78			1,84	1,65	0,05				331,14	0,02				399,96
US	2020		0,01		4,44				0,48			0,08			109,57	0,40				114,98
US	2021		0,09	0,02	3,67				0,00			0,00			248,78			0,02	0,10	252,68
US	2022	0,05	0,67	0,00	0,43			0,00	0,30					0,01	2128,64	0,01		0,13		2130,24
UY	2018																	0,12		0,12
UY	2019																			0
UY	2020																			0
UY	2021																			0

From Eurostat, import quantity in 'supplementary quantity' (units). Countries and years without data were deleted

		AT	BE	CZ	DE	DK	ES	FI	FR	GB	HU	IE	IT	LV	NL	PL	PT	SE	SK	EUtotal
AR	2022														1200					1200
BR	2018														1876030					1876030
BR	2019														707537					707537
BR	2020				4496										153546					158042
BR	2021				315										169147					169462
BR	2022														416363		512			416875
CA	2018														7895					7895
CA	2019														150	34				184
CA	2020														720					720
CA	2021	1			2154															2155
CA	2022														1880					1880

CL	2018														1279773					1279773
CL	2019														1428392					1428392
CL	2020														781936					781936
CL	2021														560193					560193
CL	2022														663197					663197
CO	2018				38849		1500						6550		640715					687614
CO	2019				48689		1600						94459		1291037					1435785
CO	2020				18464		78585						8850		544170					650069
CO	2021						745100						17830		217363					980293
CO	2022				31336		326560						6960		291368					656224
CR	2018		1610218			183908				45108					13644466					15483700
CR	2019		1765632			208113				66365					14578662					16618772
CR	2020		1630735			133251	80650								13225587					15070223
CR	2021		1947640			127998	8500								16162026					18246164
CR	2022		1618938			114699	2000						26823		11615545					13378005
DO	2018														957370					957370
DO	2019														440230					440230
DO	2020														201400					201400
DO	2022														500					500
EC	2018				970	9933									525					11428
EC	2019			358	4616															4974
EC	2020				38458															38458
EC	2021				62423										33109					95532
EC	2022				77161		86								2953			10		80210
GT	2018		10906232		169810	130173				27200					14727703					25961118
GT	2019		62500		200800	156076									14219045					14638421
GT	2020				221595	149006									15561458					15932059
GT	2021					123634									17168332					17291966
GT	2022				223100	100893									9565679					9889672
HN	2018					169360									1540385					1709745
HN	2019					190299									2070790					2261089
HN	2020					163451									1588102					1751553
HN	2021					163140									1696033					1859173
HN	2022					124985									21225476					21350461
MX	2018									20100										20100
NI	2022														8800					8800
PA	2019					48305														48305
PE	2020				914															914
PE	2021				22513			4										5		22522
PE	2022						150													150
SV	2018		8716057												913440					9629497
SV	2019														597641					597641
SV	2020														286447					286447
SV	2021														352214					352214
SV	2022														678699					678699
US	2018				8356			3		16026	1500				566221			42		592148
US	2019				8330	19500			8592	20706	22				945724	1				1002875
US	2020		75		11279				1512			520			311274	823				325483
US	2021		22	7	12650				2			22			709665			1	638	723007
US	2022	2	1244	4	1171			1	864					6	188690	8		28		192018
UY	2018																	42		42

Table 4. 06029091 Indoor flowering plants with buds or flowers (excl. cacti)

From Eurostat, import quantity in 100 kg. Countries and years without data were deleted

		BE	DE	ES	FI	FR	HU	IE	IT	NL	PL	PT	SE	SI	
BR	2021				0,01										0,01
BR	2022											0,61			0,61
CO	2019														0
CO	2021		2,01												2,01
CR	2020	30,00													30
EC	2019		2,61												2,61
EC	2021		2,00							8,00					10
EC	2018					1,90									1,9
GT	2019	0,74							4,00		0,64				5,38
GT	2020	1,10							2,20						3,3
GT	2021	0,61	6,71						2,93						10,25
GT	2022		3,39						3,50						6,89
GT	2018								5,36		0,72				6,08
PE	2019								0,12						0,12
PE	2021		3,00												3
PY	2019			985,90											985,9
US	2019	0,01				38,25	0,01	0,00		22,80					61,07
US	2020		0,30	0,02	0,01	0,03				23,20					23,56
US	2021						0,13	0,03		24,00					24,16
US	2022							0,00		7,30			0,00	0,00	7,3
US	2018			0,02				0,00	0,34	25,36					25,72

From Eurostat, import quantity in 'supplementary quantity' (units). Countries and years without data were deleted

		BE	DE	ES	FI	FR	HU	IE	IT	NL	PL	PT	SE	SI	EUtotal
BR	2021				4										4
BR	2022											1140			1140
CO	2021		4503												4503
CR	2020	2220													2220
EC	2018					2630									2630
EC	2019		798												798
EC	2021		632							1000					1632
GT	2018								39272		9270				48542
GT	2019	8600							44370		4960				57930
GT	2020	10600							17435						28035
GT	2021	10600	1342						16924						28866
GT	2022		676						22765						23441
PE	2019								546						546
PE	2021		5400												5400
PY	2019			19											19
US	2018			5				0	6360	3170					9535
US	2019	1				6663	10	37		2850					9561
US	2020		140	12	3	1				2900					3056
US	2021						7	48		3000					3055
US	2022							9		2670			1	1	2681

Table 5. 06029099 Live indoor plants and cacti (excl. rooted cuttings, young plants and flowering plants with buds or flowers)

From Eurostat, import quantity in 100 kg. Countries and years without data were deleted

		AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	HU	IE	IT	LU	MT	NL	PL	PT	SE	SI	SK	EUtotal
BO	2020																		0,03						0,03
BO	2021																		24,10						24,1
BO	2022																		1,78						1,78
BR	2018		125,00				0,80					17,25				5,62			180,75						329,42
BR	2019						1,10									4,44			0,72						6,26
BR	2020		0,05													4,86			926,59						931,5
BR	2021											0,13							4625,85			0,01			4625,99
BR	2022											0,00							1503,86						1503,86
CA	2018							3,00					0,05												3,05
CA	2019							2,50											1,80		16,55				20,85
CA	2020																		0,02		13,05	0,01			13,08
CA	2021											0,03			0,00				0,64		2,04	0,01	0,01		2,73
CA	2022		0,06					0,21	0,00			0,02			0,03				3,67		0,03	0,02			4,04
CL	2018															3,20			130,35						133,55
CL	2022																		299,47						299,47
CO	2018									2,25		0,50				0,05									2,8
CO	2019		0,64									1,60				0,15									2,39
CO	2020	2,70	0,01				15,42					0,50													18,63
CO	2021	1,43					6,69									0,20			1,58						9,9
CO	2022	1,74					0,75																		2,49
CR	2018						624,49			74,29			13,57			393,82			188464,35						189570,5
CR	2019						192,88	102,60		56,57			16,86			577,72			215215,83						216162,5
CR	2020							22,07		340,63						300,62			228935,06						229598,4
CR	2021		0,23							3853,85						321,80			267151,39						271327,3
CR	2022		665,05				192,00			4399,97						147,66			74001,03		124,00				79529,71
DO	2018																		514,19						514,19
DO	2019																		5706,38						5706,38
DO	2020											9,20							4995,72						5004,92
EC	2018		32,43							6,02												0,11			38,56
EC	2019						1,30			2,73															4,03
EC	2020		1,65				1,45												1,10						4,2
EC	2021		1,62				11,96												2,87		0,05			0,01	16,51

EC	2022		0,24		0,08	0,20	16,84																		17,36
GT	2018	0,62	0,31				69,43			17,70						321,62			29459,34						29869,02
GT	2019		0,46				44,11			11,16						597,93			48750,84						49404,5
GT	2020						49,23			0,85						291,75			58848,78						59190,61
GT	2021						48,67			4,47						62,34			91044,79						91160,27
GT	2022						53,85			1,76						310,50			48588,06						48954,17
HN	2018									22,50									14454,63						14477,13
HN	2019															120,00			19557,56						19677,56
HN	2020									420,00									21700,24						22120,24
HN	2021									2959,07						240,00			41933,57						45132,64
HN	2022							840,00		2725,28									55995,33						59560,61
MX	2018						50,00									74,30			105,46						229,76
MX	2019						1,20												1208,33						1209,53
MX	2020						1,73			0,01									1,89		26,50				30,13
MX	2021											0,13				370,00			378,41						748,54
MX	2022		4,00									0,13				185,00			1260,36						1449,49
NI	2022																		741,60						741,6
PA	2019																		2,70						2,7
PA	2022																		1,07						1,07
PE	2018						2,70																		2,7
PE	2019						3,00			76,30															79,3
PE	2020						0,27																		0,27
PE	2021						9,76												1,10						10,86
PE	2022						2,55																		2,55
SV	2018																		5135,34						5135,34
SV	2019																		6263,98						6263,98
SV	2020																		8637,61						8637,61
SV	2021																		9143,71						9143,71
SV	2022																		25452,78						25452,78
US	2018		2295,11				8,53			8,41		2,95	0,10			0,25			154,54			0,02			2469,91
US	2019		2295,00				0,71			2,71		5,22	0,25	0,05	0,00				685,08	0,92	0,08				2990,02
US	2020		1215,18			0,02	0,34				0,15	0,18		0,04	0,15	0,55	0,01		49,26			0,10			1265,98
US	2021	0,01	1080,31	0,05			3,46				0,00	1,91		0,01	0,08	0,03	0,11		240,65			0,01			1326,63
US	2022	0,00	2835,15				10,60	0,02				1,93		0,00	0,04	0,23		0,04	563,22		0,00	0,52	0,06		3411,81

From Eurostat, import quantity in 'supplementary quantity' (units). Countries and years without data were deleted

		AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	HU	IE	IT	LU	MT	NL	PL	PT	SE	SI	SK	EUtotal
BO	2020																		2						2
BO	2021																		1606						1606
BO	2022																		119						119
BR	2018		343				2250					34500				93720			12050						142863
BR	2019						2260									83968			48						86276
BR	2020		1													90780			61772						152553
BR	2021											1							308388			1			308390
BR	2022											5							100749						100754
CA	2018							1692					12												1704
CA	2019							450											120		35336				35906
CA	2020																		1		41500	30			41531
CA	2021											3			1				42		6500	1	1		6548
CA	2022		52					83	1			5			22				278		925	4			1370
CL	2018															319			8689						9008
CL	2022																		19965						19965
CO	2018									18180		2831				320									21331
CO	2019		673									4703				250									5626
CO	2020	3000	2				26646					2190													31838
CO	2021	2000					11100									203			105						13408
CO	2022	2900					2343																		5243
CR	2018						32500			9574			291325			101824			12564119						12999342
CR	2019						12050	15948		167890			372300			245077			14347541						15160806
CR	2020							692		417970						41645			15262150						15722457
CR	2021		41							1027414						155882			17809840						18993177
CR	2022		24652				784207			1201894						146601			17237444		40000				19434798
DO	2018																		34279						34279
DO	2019																		380425						380425
DO	2020											92							333048						333140
EC	2018		99							20325												60			20484
EC	2019						403			12250															12653
EC	2020		1898				652												73						2623
EC	2021		1391				5448												191		6			12	7048
EC	2022		91		8	223	7382																		7704
GT	2018	520	2750				475520			193370						1372199			1963937						4008296
GT	2019		2850				435615			66320						2023816			3250028						5778629
GT	2020						455747			7250						893945			3923222						5280164
GT	2021						405870			17082						1638555			6069598						8131105
GT	2022						223350			10000						221347			5679277						6133974
HN	2018									800									963631						964431
HN	2019															2500			1303821						1306321
HN	2020									78000									1446666						1524666
HN	2021									320475						10045			2795545						3126065
HN	2022							26600		294941									3990998						4312539
MX	2018						10000									255			7028						17283
MX	2019						1846												80554						82400
MX	2020						1100			2									126		2650				3878
MX	2021											14				835			25225						26074

		AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	HU	IE	IT	LU	MT	NL	PL	PT	SE	SI	SK	EUtotal
MX	2022		120									116				772			84024						85032
NI	2022																		70978						70978
PA	2019																		180						180
PA	2022																		71						71
PE	2018						3889																		3889
PE	2019						4760			15200															19960
PE	2020						168																		168
PE	2021						8328												73						8401
PE	2022						5896																		5896
SV	2018																		342352						342352
SV	2019																		417592						417592
SV	2020																		575838						575838
SV	2021																		609580						609580
SV	2022																		1628893						1628893
US	2018		756				9465			21498		6857	28			31			10301			23			48959
US	2019		575				5276			120		6557	531	1008	5				45671	200	1				59944
US	2020		1486			36	277				4398	91		200	36	7900	1		3283			10			17718
US	2021	1	4488	150			271				1	1140		78	62	26	15		15974			10			22216
US	2022	1	1360				2853	41				2139		5	58	172		110	41463		25	424	86		48737

ANNEX 9. Trade data and summary analysis – above-ground fresh cut plant parts

Trade data were extracted for 2018-2022.

- For rose cut flowers and chrysanthemum cut flowers (HS6 codes), data were extracted from UN Comtrade and cover imports into all EPPO countries.
- For other cut flowers (excl. roses, carnations, orchids, gladioli, ranunculi, chrysanthemums and lilies), as well as asparagus and lettuce (HS8 codes), data are not available in Comtrade; data were extracted from Eurostat and cover imports into EU countries.

Cut flowers

- Table 1. *Rose cut flowers (UN comtrade; 060311 Fresh cut roses and buds, of a kind suitable for bouquets or for ornamental purposes)* were imported from 13 countries where the pest is present into 43 EPPO countries, with the largest quantities by far from Ecuador (approx. 53000 t in 2021, approx. 26000 t in 2022) and Colombia (approx. 8000 t in 2021, approx. 5000 t in 2022). In 2022, there were also minor imports from other countries: approx. 4 t from Costa Rica and 3 t from Panama, and quantities from the remaining countries were below 500 kg. The UK, the Russian Federation, Belarus and Ukraine were major non-EU importers in the period 2018-2021 (data not recorded for 2022).
- Table 2. *Chrysanthemum cut flowers (UN comtrade; 060314 Fresh cut chrysanthemums and buds, of a kind suitable for bouquets or for ornamental purposes)* were imported from 9 countries where the pest is present into 30 EPPO countries, especially from Colombia and to a lesser extent Ecuador. In 2022, approx. 9600 t were imported from Colombia (incl. 8800 t into the UK), approx. 120 t from Ecuador, and minor quantities from other countries.
- Table 3. O*ther cut flowers (Eurostat; 06031970 fresh cut flowers and buds, of a kind suitable for bouquets or for ornamental purposes (excl. roses, carnations, orchids, gladioli, ranunculi, chrysanthemums and lilies)* were imported from 13 countries where the pest is present into 17 EU countries. In 2022, approx. 6700 t from Ecuador (corresponding to approx. 165 million units), approx. 4900 t from Colombia (corresponding to approx. 47 million units), 320 t from Chile (corresponding to approx. 5 million units), approx. 100 t from Costa Rica, approx. 85 t from Peru, approx. 25 t from Guatemala, approx. 20 t from Brazil and 12 t from Mexico, with smaller quantities from other countries. This category would in particular include *Strelitzia*.
  In Mexico, based on data in Anonymous (2008), the main cut flower was gladiolus (not a host), but amongst hosts in 2006 were chrysanthemum (2400 ha), rose (1100 ha), African marigold (*Tagetes erecta*) (1200 ha), bird of paradise (210 ha) and sunflower (140 ha).

Vegetables

- Table 4. *Asparagus (UN comtrade; 070920 Fresh or chilled asparagus)* were imported from 15 countries where the pest is present into 35 EPPO countries. The largest imports were overall from Peru, Mexico, and to a lesser extent Ecuador. In 2022, approx. 22000 t from Peru, approx. 7000 from Mexico, approx. 80 from Ecuador, and smaller quantities from other countries. Of these, only green asparagus may carry the pest.
- Table 5 & 6. *Lettuce (UN Comtrade; 070511 Fresh or chilled cabbage lettuce and 070519 Fresh or chilled lettuce (excl. cabbage lettuce))* Imports of cabbage lettuce and other lettuces were recorded from 19 countries where the pest is present, into respectively 12 EPPO countries (only non-EU country, Serbia) and 19 EPPO countries (non-EU countries: Belarus, Montenegro, Kazakhstan, Switzerland). Imports are irregular (not all years). In 2022, the largest quantities for lettuces other than cabbage lettuce were approx.1900 t from Peru, 215 t from Brazil, approx. 80 t from El Salvador, approx. 50 t from Honduras and 2.5 t from the Dominican Republic. Other countries had similar exports in previous years, such as approx. 290 t from Paraguay in 2019, approx. 230 t from Colombia in 2020, approx. 28 t from Canada in 2021, approx. 14 t from Haiti in 2019, approx. 10 t from Costa Rica in 2020. Other quantities were minor. For cabbage lettuce, the largest quantity over the period was approx. 150 t from Paraguay in 2019. In 2022 minor quantities were imported only from Colombia (approx. 2.5 t) and Ecuador (approx. 1.2 t), and smaller quantities from other countries.

Table 1. 060311 Fresh cut roses and buds, of a kind suitable for bouquets or for ornamental purposes

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Brazil		Canada				Chile			Colombia					Costa Rica					Ecuador				
	2018	2019	19	20	21	22	19	21	22	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Austria											100									56060	63054	140980	81151	102
Azerbaijan							1206			26988	24824	7709	10568	22124						286632	241962	87850	137535	135737
Belarus								12		1226495	1404162	1399623	491977							16718017	19423497	19514966	2857096	
Belgium													8520	9050						310	95	219		
Bosnia Her.										17751	7522	24449	36255	47989	169	5				71665	81163	58345	70165	72453
Bulgaria																				53594	57417	29265	6352	
Cyprus										200	60	158		186						1190	2511	5578	12046	3612
Czech Rep.										490996	383021	391343	446062	425203	3300					467599	480011	573281	774138	861436
Denmark																					150		61	
Estonia										1579	677		205	505						719	9533	122	6669	7811
Finland										347				46						7987	1895	8016	11377	974
France					1	1				141409	174948	23781	45295	46527						602475	671557	9031	12764	8388
Georgia											6437	3208		1105						76034	82947	77184	78389	179660
Germany										35994	39557	7100	1777	1005						1022050	919452	480835	575247	550319
Greece																				8809	9979	2800		
Hungary																					220			
Ireland										4478	1535	149	2270	6651						4	349			1489
Italy										27626	46725	24301	75382	77106						563602	275956	43197	29940	115864
Jordan														202								1931		
Kazakhstan										323728	401995	388347	455573	398797						2928949	3121720	2048569	2838922	3298376
Kyrgyzstan										1120				7						34573	34926	32593	57951	157763
Luxembourg									21	160	32									1006	20			3720
Malta											90										242			
Montenegro										47	19138	17974	23796	40340						1870	1666	465	995	7828
Morocco											286	1006	526	1975									230	170
Netherlands	8330	983								1108960	1157760	1143810	2197760	1294470						7136350	7815820	8164080	15214100	14960500
NorthMacedonia										313	3	117	731	315			35			50586	52813	35444	53203	49352
Norway										5785	6437	6092	4765	4367						3804	1493	716	9	17
Poland										71546	51117	153925	2406	351490	398			567		8000	77042	165965	171779	192451
Portugal	1804	1478								47671	54581	14278		32488						11672	3540	360		
Rep.of Moldova									2	61823	26903	15419	12804	13705						120936	165143	132994	195697	201905
Romania										16440	4333	4407	2346							47906	13923	5649	4353	8143
RussianFederation										1101615	641585	314909	1162328				1			9887968	7123940	4971877	23128594	
Serbia									18	44	21	931	2117	3126			1			15300	12932	10400	25386	11358
Slovakia			269							51375	54183	67411	60983	47433		3969	6977		4110	26473	34363	19486	25607	32130
Slovenia				14						13769	12694	19784	28367	37781						21044	18151	15530	17095	14608
Spain										1623076	1565825	1331604	1845381	1968948						4566429	4670595	2990246	3888810	4035224
Sweden										619	1632	1071	1000							16016	13000	9000	34	
Switzerland										36	1742	1431	440	1974			191			1111560	1051347	886995	1032398	957938
Türkiye										41		18		1						38	1096			162
Ukraine										449172	530731	723532	360850	59765						2006224	2562561	2081508	1042135	123303
United Kingdom										394876	443163	321445	1051735							160735	223533	102071	313431	
Uzbekistan													42							288	169	534		73
Total	**10134**	**2461**	**269**	**14**	**1**	**1**	**1206**	**12**	**41**	**7246079**	**7063820**	**6409332**	**8332261**	**4894682**	**3867**	**3974**	**7205**	**567**	**4110**	**48094474**	**49321782**	**42708082**	**52663658**	**25992865**

	El Salvador	Guatemala			Guyana	Mexico					Nicaragua			Panama			Peru			
	2022	2018	2019	2020	2022	2018	2019	2020	2021	2022	2018	2019	2021	2018	2021	2022	2018	2019	2021	2022
Belarus						59	6913	3218									9	23		
Bosnia Herzegovina			6				30													
France														301						
Luxembourg	19																		12	191
Montenegro		1900		2																
Netherlands			72													2090		424		
Poland		221				52								6						
Russian Federation															699					
Slovakia											424	105	291							
Spain		12							507	425										
Ukraine		3														1093				
United Kingdom		4758		8750																
Uzbekistan					85															
Total	**19**	**6894**	**78**	**8752**	**85**	**111**	**6943**	**3218**	**507**	**425**	**424**	**105**	**291**	**307**	**699**	**3183**	**9**	**447**	**12**	**191**

Table 2. 060314 Fresh cut chrysanthemums and buds, of a kind suitable for bouquets or for ornamental purposes

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina	Brazil		Chile			Colombia					Costa Rica				Ecuador					ElSalvador	Mexico	Panama
	2022	2019	2022	2018	2021	2022	2018	2019	2020	2021	2022	2018	2019	2021	2022	2018	2019	2020	2021	2022	2021	2022	2018
Azerbaijan	2			42	20	17	808	6	14	15	29	277		7		102			72	277	2		
Belarus							5271	7052	17915	4865						12860	29770	49073	5050				
Bosnia Herz.							42									34		6					
Czech Rep.							17335	11280	9913	13158	18065			12	62					837			
Estonia																				43			
France							25288	30809	16913	43116	54386					1130	1068	179	1071	2210			86
Georgia											5					103	381	45	130	1647			
Germany							44									764	1091	1797	2289	3314			
Ireland							2	8	87	5131	38504												
Italy											117									218			
Kazakhstan							1906	855	1731	3371	9847					1308	1006	1096	1231	3541			
Kyrgyzstan							557				103					1914	1984	709	194	651			
Luxembourg			6																				
Malta																	22						
Montenegro																45	29		69			101	
Netherlands							45224	35159	162006	156177	343173					869	1170	2503	2989	18187			
North Macedonia											66												
Norway							140	338	222							79	50	58	32	44			
Poland							23				20									7			
Moldova										34	20					362	513	455	315	2585			
Romania							280	87	147	17													
Russia		3					137500	25198	18560	24509				2		263963	18918	26210	53698				
Serbia											9									77			
Slovakia													1921			16							
Slovenia							68	14	14	5													
Spain							89997	129610	188581	232009	310747				326	82318	72126	55063	73179	81940			
Switzerland									54										83	21			
Türkiye														28									
Ukraine							105	41		2356	2383					410	151	342	634	2135			
UK							5252382	5232620	5457362	8071893	8824993					3652	3001	2523	79381				
Total	2	3	6	42	20	17	5576972	5473076	5873518	8556656	9602467	277	1921	49	388	369928	131279	140059	220417	117733	2	101	86

Table 3. 06031970 Fresh cut flowers and buds, of a kind suitable for bouquets or for ornamental purposes (excl. roses, carnations, orchids, gladioli, ranunculi, chrysanthemums and lilies)

From Eurostat, import quantity in 100 kg. Countries and years without data were deleted

		BE	BG	CY	DE	DK	ES	FR	GB	GR	IE	IT	LU	MT	NL	PT	RO	SE	EUtotal
AR	2019														83,58				83,58
AR	2020														31,65				31,65
AR	2021														24,36				24,36
AR	2022														68,68				68,68
BR	2018														152,66				152,66
BR	2019														130,15				130,15
BR	2020														115,63				115,63
BR	2021														90,71				90,71
BR	2022														205,54				205,54
CA	2022							0,25											0,25
CL	2018						0,03								402,05				402,08
CL	2019														546,57				546,57
CL	2020														362,74				362,74
CL	2021	3,13													652,63				655,76
CL	2022														3174,39				3174,39
CO	2018	36,15		5,30	125,11		5975,06	980,83	1739,70		2,39	392,80			29858,17	0,37	14,75		39130,63
CO	2019			37,43	133,64		7613,94	1052,58	2279,45		1,66	830,12	1,80		27296,10		5,76		39252,48
CO	2020	80,54		4,72	70,92		5470,27	424,95			1,22	137,49			31344,38		4,33		37538,82
CO	2021	15,52		24,73	57,13	0,17	8676,09	258,15			26,28	1258,34			29820,42		1,54		40138,37
CO	2022			27,66	12,72	0,32	10570,61	295,88			94,16	1917,11			36077,58				48996,04
CR	2018						11,98	47,68	191,19						515,03				765,88
CR	2019				0,96		9,10	17,54	108,06						441,45				577,11
CR	2020	10,55			2,40		3,41	8,97							177,43				202,76
CR	2021						1,25	0,95							188,94				191,14
CR	2022	535,81					6,62	18,45							436,86				997,74
EC	2018	1,32	4,77	5,10	1074,07		7101,62	167,67	1268,70	0,42	131,15	849,73	4,21		82838,96	14,21	6,65	0,40	93468,98
EC	2019	153,94		1,30	910,23		8481,74	231,26	1390,50	1,02	104,05	348,54	1,17	0,43	79958,71		0,63	0,12	91583,64
EC	2020	721,41			410,01		4756,67	77,70			15,09	15,64	0,16		64289,09		0,14		70285,91
EC	2021	546,26			437,27	0,15	8049,46	32,24				237,80			85070,07		0,63		94373,88
EC	2022				378,22		9900,47	34,78				163,06			56377,43				66853,96
GT	2018				5,06		0,06								111,24				116,36
GT	2019				2,65		0,68								59,58				62,91
GT	2020														314,61				314,61
GT	2021														130,95				130,95
GT	2022						0,10								237,12				237,22
MX	2018														26,48				26,48
MX	2019														3,08				3,08
MX	2021	59,20					0,03								69,13				128,36
MX	2022						0,15								115,21				115,36
PA	2018														3,31				3,31
PE	2018														965,81				965,81
PE	2019				4,29		0,08								1752,70				1757,07

PE	2020				11,94		0,05								1404,18				1416,17
PE	2021						0,12								886,10				886,22
PE	2022				3,20		0,05								856,86				860,11
SV	2018														0,00				0
US	2018				0,08		0,08	3,07							30,46				33,69
US	2019				2,00		0,22				0,03				0,38				2,63
US	2020				1,32						0,00				11,31				12,63
US	2021				9,90			0,07			0,12				28,33				38,42
US	2022				2,33		0,14	0,84			0,07				22,04				25,42

From Eurostat, import quantity in 'supplementary quantity' (units). Countries and years without data were deleted

		BE	BG	CY	DE	DK	ES	FR	GB	GR	IE	IT	LU	MT	NL	PT	RO	SE	EUtotal
AR	2019														144108				144108
AR	2020														54575				54575
AR	2021														42000				42000
AR	2022														116759				116759
BR	2018														263167				263167
BR	2019														224347				224347
BR	2020														199326				199326
BR	2021														156441				156441
BR	2022														351587				351587
CA	2022							338											338
CL	2018						30								693139				693169
CL	2019														942346				942346
CL	2020														625469				625469
CL	2021	35													11221				11256
CL	2022														5393609				5393609
CO	2018	90550		4726	256035		8873614	2242143	3010790		2792	327607			51477878	750	29145		66316030
CO	2019			22444	148923		11506572	2486376	3507578		4160	750629	578		47058988		9140		65495388
CO	2020	197829		2826	121015		9937045	1000011			1460	149164			54040181		9390		65458921
CO	2021	7		13698	62638	160	14720454	598760			65067	1091393			51411458		4240		67967875
CO	2022			16404	30012	761	179276	5080			221216	1553966			45339211				47345926
CR	2018						10588	19711	60450						887956				978705
CR	2019				384		6995	11267	56905						761103				836654
CR	2020	5379			5		3090	5779							305965				320218
CR	2021						2740	304							325776				328820
CR	2022	1					3989	8365							749890				762245
EC	2018	6	5720	8714	2586005		15942953	364368	3129294	420	17904	1298572	5396		142819642	24036	9747	1860	166214637
EC	2019	2434		2100	2212634		19530807	476093	3498508	840	241260	562049	580	370	137851664		1570	400	164381309
EC	2020	45019			1022019		11372177	187159			34900	39670	100		110835172		240		123536456
EC	2021	2215			11172	240	18996496	68043				540630			146661563		4950		166285309
EC	2022				725854		24105118	49728				366600			139343938				164591238
GT	2018				24275		75								191789				216139
GT	2019				18300		3470								102755				124525
GT	2020														542424				542424
GT	2021														225756				225756
GT	2022						120								2642				2762
MX	2018														45660				45660
MX	2019														5317				5317
MX	2021	1184					30								119184				120398
MX	2022						240								195850				196090
PA	2018														5699				5699
PE	2018														1665082				1665082
PE	2019				9375		100								3021871				3031346
PE	2020				20796		100								2420977				2441873
PE	2021						180								17719				17899
PE	2022				10970		60								1457067				1468097
SV	2018														1				1
US	2018				231		50	5140							533				5954
US	2019				4997		214				3				664				5878
US	2020				3656						543				19498				23697
US	2021				25645			3			1476				48850				75974
US	2022				5932		53	887			448				37464				44784

Table 4. 070920 Fresh or chilled asparagus

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Brazil					Chile					Ecuador					Mexico					Peru				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Albania																								9317	
Austria	5639	3942	640	5		2874	62					576	277	89		34628	59571	14323	162540		266364	143630	73788	125149	
Azerbaijan																		40			135	150		205	442
Belarus																235		6633	1257		1775	775	596	1694	
Belgium									30							408124	330977	316375	617292	551821	1726002	1855829	1506785	1899944	1826159
Bosnia Herzegovina											10				17	144	122	26	143	116	669	559	339	370	1199
Czech Rep.						45237					59	10	66	36		7078	5472	9446	10829	5894	36227	38236	47669	42516	51286
Denmark																	16216	13025				22730	2		
Estonia													11			1330	769	8000	27465	17128	22597	33866	16188	23093	30681
Finland																94074	463	18088	72690	43759	80747	89121	100028	65510	107340
France						23					2941	5789				96251	30619	30030	154357	2676	1505259	1432630	498577	625841	545487
Germany		198	219	918	285	163	6615	33		3871	8241	3441	3330	924	49	742109	571862	434442	1255155	1197410	3761121	3287160	1628947	3226256	2277367
Greece																					35465	2879			5640
Ireland	250											224				148338	188347	178396	412172	391275	433133	632265	676465	255825	373923
Italy																136433	181331	133391	415921	222842	550601	445913	42620	13499	19913
Jordan													157			855	592	634	3150	135	6133	5155	6130	18868	10497
Kazakhstan																	35	50	124	157	3952	3084	2575	2871	4651
Luxembourg													134		1	18215	18	14868	2647	2014	51105	68620	38037	68611	58954
Montenegro											287	303	81	53	178	139	263	329	847	979	4701	7715	2873	6856	7404
Morocco						5							481	124		1876	2681	560	5238	1082	29405	23292	34824	36912	51676
Netherlands		3125	3135	1000		2184						52282	231350	66784	20816		121214	153021	621958	570697	6659500	6050540	5784050	7250870	5664960
North Macedonia														25		241	296	61	320	437	2395	2439	2339	3320	3580
Norway			810				1071				245	787	2618	2306	1406	165465	138870	119429	182305	191912	630921	677861	521160	618623	609537
Poland		25							30		29	411	872	413		23976	154189	63981	165265	88301	116699	160021	175621	204588	169675
Portugal																							5000		
Moldova		11										20	40	60		460	788	1207	1749	4399	3043	5075	5203	7182	8117
Russian Fed.													7024	5850		26847	26170	17880	167241		284803	318500	219201	248358	
Serbia											13	112	61			1377	1217	1204	1129	2046	6937	6522	4871	7144	6259
Slovakia																	30	440	818	4196	20148	29534	7930	10443	5985
Slovenia						3						64	185	124	7	4841	1370	722	5042	2668	8815	8483	9009	7622	6560
Spain								10000		1020	111313	140392	171457	179057	55490	3227108	1658080	1416889	2642448	3197326	9742118	10964017	7987466	9564907	9540396
Switzerland		49		14						1		144	134	201	632	1218231	1126657	606857	1170364	718442	935943	734053	467736	581160	631788
Türkiye																6580	11833	13355		11350	62505	71365	64995		103042
Ukraine													1414	45		8578	17496	22131	40177	6203	61272	78730	68871	75374	33373
UK						720		29078	2500			3000				2362445	3375568	3857121	4184340		9322537	8880138	7787253	9014860	
Total	**5889**	**7350**	**4804**	**1937**	**285**	**51209**	**7748**	**39111**	**2560**	**4892**	**123138**	**207554**	**419691**	**256092**	**78597**	**8735977**	**8023116**	**7452953**	**12324983**	**7235265**	**36373028**	**36080887**	**27787149**	**34017787**	**22155891**

	Argentina			Canada		Colombia					Costa Rica			Dominican Rep.			El Salvador			Guatemala			Honduras				Nicaragua	Uruguay
	2018	2019	2022	2021	2022	2018	2019	2020	2021	2022	2018	2020	2021	2019	2020	2022	2019	2020	2022	2018	2020	2021	2018	2019	2020	2022	2018	2018
Austria							25						31							6								
Czech Rep.	210992					1878											4	1765	13202				2304					
Finland								2055																				
France											160															3		39
Germany			2033					19		7070			7776															
Ireland				1																4983		40						
Luxembourg					2														9									
Netherlands	1570				2500	4737			1080	1						26												
Norway		240																		600			5400					
Moldova										221																		
Slovakia																			5206									
Slovenia		49				14	6					85																
Switzerland											10			16	1250								165					
UK																					18256	16130		17955	33507		6300	
Total	**212562**	**289**	**2033**	**1**	**2502**	**6629**	**31**	**2074**	**1080**	**7292**	**170**	**85**	**7807**	**16**	**1250**	**26**	**4**	**1765**	**18417**	**5589**	**18256**	**16170**	**7869**	**17955**	**33507**	**3**	**6300**	**39**

Table 5. 070511 Fresh or chilled cabbage lettuce

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina	Brazil			Canada			Chile			Colombia		Costa Rica	Ecuador			El Salvador		Guatemala			Mexico	Panama	Paraguay		Peru			
	2020	2019	2021	2022	2018	2019	2022	2018	2021	2022	2020	2022	2020	2019	2021	2022	2021	2022	2018	2019	2020	2018	2021	2018	2019	2018	2020	2021	2022
Austria		168						53																		614			
Belarus																								9372	154771				
Czech Rep.								300		300																			
France						1316																							
Germany				960								2640																	
Ireland			375					620							250								375						
Luxembourg			8	1			3		9	10					6		9	3										189	369
Netherlands									292																				
Poland																			12	27	52						1120		
Serbia																						2							
Slovenia					266								392																
Switzerland	4										83			5520	1086	1200											3		
Total	**4**	**168**	**383**	**961**	**266**	**1316**	**3**	**973**	**301**	**310**	**83**	**2640**	**392**	**5520**	**1342**	**1200**	**9**	**3**	**12**	**27**	**52**	**2**	**375**	**9372**	**154771**	**614**	**1123**	**189**	**369**

Table 6. 070519 Fresh or chilled lettuce (excl. cabbage lettuce)

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Brazil					Canada					Chile					Colombia				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Austria	52	153						20												
Belgium																	180	84		
Czech Rep.	560											40								
Finland						1														
France	284	67					1702								1					
Germany		772	14316	1455	21348						560			1125		97		20128	205	
Ireland														25						
Kazakhstan					19															56
Luxembourg				27,86	27					3				8	14,8					
Montenegro																36				
Netherlands	54			470	6				86				20		14					1
Poland		5																		
Slovenia				1,9							100				33					
Spain			180															2520		
United Kingdom							14865	23931	27584											
Total	**950**	**996**	**14496**	**1954**	**214005**	**1**	**16567**	**23951**	**27670**	**3**	**660**	**40**	**20**	**1157**	**62,8**	**133**	**180**	**22732**	**205**	**57**

	Costa Rica			Cuba	Dominican Rep.		Ecuador					El Salvador			Guatemala		
	2019	2020	2022	2019	2018	2022	2018	2019	2020	2021	2022	2020	2021	2022	2018	2019	2021
Austria								55									
Czech Rep.	60											2171		34857			
France		4216		6	494	2408									7		
Germany			938				110	404	28								
Ireland											4						
Luxembourg						1				4	8		10	21			
Montenegro																2	
Netherlands											11						
Slovakia														44797			
Slovenia																	29
Spain	1850	5800						150									
United Kingdom											900						
Total	**1910**	**10016**	**938**	**6**	**494**	**2409**	**110**	**609**	**28**	**4**	**923**	**2171**	**10**	**79675**	**7**	**2**	**29**

	Haiti	Honduras				Jamaica	Mexico		Paraguay		Peru					Uruguay
	2019	2019	2020	2021	2022	2019	2019	2021	2018	2019	2018	2019	2020	2021	2022	2022
Austria	13631										324	498	11			
Belarus									39151	287843						
Estonia																444
France						180										
Germany		266	624	5596	50000		388						626	224	186483	
Ireland											116652	39507	34096			
Luxembourg														215	413	
Montenegro		3						2								
Slovenia											9			35		
Spain											3000	1980				
Switzerland							10							16		
Total	13631	269	624	5596	50000	180	398	2	39151	287843	119985	41985	34733	490	1868962	444

ANNEX 10. Trade data and summary analysis – fruit

Trade data were extracted for 2018-2022.
- For grapes, tomato, peas, beans and other leguminous fruit (HS6 codes – for peas, beans and other leguminous, fresh or chilled), data were extracted from UN Comtrade and cover imports into all EPPO countries.
- For sweet corn (HS8 codes), data are not available in Comtrade; data were extracted from Eurostat and cover imports into EU countries.

- Table 1. *Tomatoes* (UN comtrade; 070200 Fresh or chilled tomatoes) were imported from 18 countries where the pest is present into 20 EPPO countries (incl. non-EU countries such as Belarus, Kazakhstan, Norway Serbia, Switzerland and Ukraine). The largest imports were overall from the Dominican Republic (over 1000 t), and over the whole period quantities over 100 t were also imported from Costa Rica, El Salvador, Colombia, Mexico and Peru. In 2022, approx. 1150 t from the Dominican Republic, approx. 290 t from El Salvador, approx. 230 t from Costa Rica, approx. 190 t from Colombia, approx. 36 t from Peru, approx. 33 t from Brazil, approx. 22 t from Ecuador, 1-4 t from each Nicaragua, Haiti, Argentina, Mexico, and< 1 t from other countries.
- Table 2. *Grapes (UN comtrade; 080610 grapes fresh)* were imported from 17 countries where the pest is present into 44 EPPO countries. Overall, there were large quantities and regular imports from Peru, Chile and Brazil, and to a lesser extend from Argentina, Costa Rica, Ecuador and Guatemala. In 2022, approx. 111000 t from Peru, 77000 t from Chile, 30000 t from Brazil, 640 t from Argentina, 450 t from Ecuador, 95 t from Mexico, 70 t from Colombia and Jamaica, 60 t from Costa Rica and Guatemala, approx. 20 t from El Salvador, and quantities <10 t from other countries.
- Table 3. *Peas (UN comtrade; 070810 vegetables, leguminous, peas (Pisum sativum), shelled or unshelled, fresh or chilled*), were imported from 17 countries where the pest is present into 27 EPPO countries. Overall, there were regular moderate imports from Guatemala and Peru. In 2022, approx. 2800 t from Guatemala, 1900 t from Peru, 36 t from Canada, 11 t from Costa Rica and imports from all other countries were <10 t.
- Table 4. *Beans (incl. Phaseolus and Vigna) (UN Comtrade; 070820 vegetables, leguminous; beans (Vigna spp., Phaseolus spp.) , shelled or unshelled, fresh or chilled)* were also imported from 17 countries where the pest is present into 27 EPPO countries. Overall, there were small regular imports from Guatemala, Mexico, the Dominican Rep. and Peru. In 2022, approx. 720 t from Guatemala, approx. 52 t from Mexico, approx. 35 t from Canada, approx. 10 t from the Dominican Rep., and quantities <10 t from other countries. American countries are not main suppliers of beans into Europe (https://www.cbi.eu/market-information/fresh-fruit-vegetables/green-beans/market-potential).
- Table 5. *Leguminous vegetables (other than the categories above) (UN Comtrade; 070890 Vegetables, leguminous (other than peas and beans), shelled or unshelled, fresh or chilled)* were imported from 17 countries where the pest is present into 22 EPPO countries in small quantities. In 2022, approx. 78 t from Guatemala, approx. 73 t from Peru, and quantities <10 t from other countries.
- Table 6. *Sweet corn (Eurostat; 07099960 fresh or chilled)* was imported from 7 countries where the pest is present into 11 EU countries. In 2022, approx. 88 t in total were imported from only 4 countries, of which approx. 75 t from the USA, 9 t from Peru, 4 t from Mexico and 45 kg from Ecuador. It is noted that imports have decreased over the period from the USA (from approx. 2700 t in 2018, to 160 t in 2020), Peru (approx. 14 t in 2018 and 2019), and slightly increased from Mexico (12 kg in 2019, 2.5 t in 2021). No imports from Colombia and Brazil are recorded for 2022, but in 2021, imports were respectively approx. 72 t and 2.5 t. There were imports <500 kg from Guatemala, only in 2018 and 2019.

Table 1. 070200 Vegetables; tomatoes, fresh or chilled

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina					Brazil					Canada				Chile					Colombia					Costa Rica				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Austria																	2976			929	440	36	35		89	27857	23608		
Belarus																	176												
Belgium																							45						
Czech Rep.	1994								360														17280	130		10200	528		
Estonia																	77												
Finland							35																						
France	80472	51				73	672			3280					2859					60	281853	20548	67200	180400	121446	34397	28790	22182	230458
Germany			280		2699	6269	46719	1482	38697	4959	10219	28409	12054		914		27	10920	263	2488	1454	429	179	287	144			62	131
Ireland				140		11044			206	335	1800	15169						580		1813	264	636	5892	834					756
Kazakhstan																													
Luxembourg							15		100	201				21				41	223					60					19
Netherlands																					1116	1855	1713						
Norway						168	4800	900		3962	3396				120								42						
Poland	1296			30			312	1008			3600				840	961	2850	26570				1				1760			68
Serbia																							3						
Slovakia						1511	332																			16537			
Slovenia		11				3		4			2880												74		600				
Spain							25746			19800					171600				102	24			810	6322		84000			
Switzerland						3600		114							300						30			1641					
Ukraine															25														
Total	83762	62	280	170	2699	22668	78631	3508	39363	32537	21895	43578	12054	21	176658	961	6106	38111	588	5314	285157	23505	93273	189674	122279	174751	52926	22244	231432

	Dominican Rep.					Ecuador					El Salvador			Guatemala					Haiti	Honduras		
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2020	2021	2022	2018	2019	2020	2021	2022	2019	2018	2019	2022
Austria																946						
Czech Rep.											63076		196322									
France	1410032	1592985	1723790	1255760	1162366	5153														1323	1104	
Germany								4104		20573								95			864	
Ireland														563								400
Luxembourg					24				18	47		109	198									
Norway									1380													
Poland																			2070	1632	4	
Slovakia										1800			93630									
Slovenia							15	11														
Spain						1110								20	58	20	102	306				
Switzerland	120					3192	672	3600														
Total	1410152	1592985	1723790	1255760	1162390	9455	687	7715	1398	22420	63076	109	290150	583	58	966	102	401	2070	2955	1972	400

	Mexico					Nicaragua		Panama			Paraguay	Peru					Venezuela
	2018	2019	2020	2021	2022	2021	2022	2018	2019	2020	2020	2018	2019	2020	2021	2022	2018
Austria	145	62	911						10	288	20			15946	1741		
Czech Rep.		5						4000				740	3750				
Estonia	5											144					
Finland	18	49			4								5				
France													598		2322		
Germany	5045	13183	10125	107223	3538	654	1080				215	10234	8489	11145	36580	1326	
Ireland															60		295
Kazakhstan												50					
Luxembourg				4								35	87		1201	3813	
Netherlands			80		69												
Norway		27			540											575	
Poland															436	1000	
Slovakia									2857							29099	
Slovenia		11										674	1095	2907	1644	333	
Spain	19985	595	20	40								324266	79200	158400			
Switzerland	133	109										5	78	3730			
Total	25331	14041	11136	107267	4151	654	1080	4000	2867	288	235	336148	93302	192128	43984	36145	295

Table 2. 080610 Fruit edible; grapes fresh

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina					Brazil					Canada			Chile					Colombia				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2019	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Albania														150			5164						
Austria	616	75		5887		595298	550255	2491230	1459530					1042330	660536	431158	396098		35		1200		
Azerbaijan							450							29346	39592	11646	21360	26222					
Belarus	26403	3501				23212	1393	42407	19826					226521	213329	149316	307571						
Belgium														90287	83464	117365	28746	96404					
Bosnia Herzegovina						630	758	200	225					33923	16290	13969	4779	3938					
Bulgaria														7478	12152								
Cyprus														17712									
Czech Rep.	125681	54308	86360	15600	24607	512163	232028	617985	1000185	1070452				1578347	774703	622539	883034	754582		1673			20800
Denmark						101905	55200	96480	156000	12480				377310	410232	125600	12000	165860					
Estonia	4318					87835	67088	100671	254056	365449				566036	236114	281926	170525	172249					
Finland	90		7544	32256	31281	853208	1435834	792786	713285	641011				676144	374058	130190	157935	40365					
France						473481	514500	1056		22080				4483390	3741807	1103833	1085596	965334	10229	2516			
Germany	178936	135519	103196	14126	696	9348984	11364174	6466080	8709558	6696165				12395374	7552560	12077464	11271592	9830594	640		9	972	6945
Greece														233023	239103	71500	71832	126936					
Ireland	12675					565311	570620	794673	1821793	1618823				1012276	865081	884797	704342	1181931	2295				
Italy									9875		16464			2743698	2271050	1707546	1299260	689148					
Jordan							240							134920	143664	88085	72815	22444					
Kazakhstan						765		150		4				27105	122652	17522	12482	112655					
Latvia														126772									
Lithuania	19680	20295								6240				495460	163885	286524	74735	298152					
Luxembourg			13			152900	36883	30	61199	74870			2	42418	53017	30619	58801	50822				4	
Malta														35424									
Montenegro						437				135				19476	12996	4422	4870	5152					
Morocco					590				495	225				123133	77147	28239	49420	20575		984			
Netherlands	759092	812440	794208	477766	336000	18584400	12880400	14769400	22568000	12996807				42900800	30336100	31271700	26080900	40610724	38130	66912			42677
North Macedonia					328	22				9				6767	6042	5969	6554	10018					
Norway	3052				23	935396	1032688	773572	1418842	879397				1039522	956639	652805	583156	812113	2250				131
Poland	48015	3608	35460	1530		141318	246190	478395	331986	186624				10047773	8467154	7080019	4832327	5639300	6303	28438			
Portugal						350		14534						3812099	4638051	3841050	3638411	4003051					
Rep. of Moldova						1328	100		1432					44528	36609	18050	52100	74333				205	
Romania														18696		88560		93136					
Russian Federation	1899758	2356663	1531746	2335261		30317	45078	232586	398029					17295971	12226953	11481685	14944770						
Serbia							120	4800	4600					8597	14665	41176	50144	65576					
Slovakia	43966	138787	146133	130490	231475	505956	579131	631964	693615	370837				122089	152277	52963	235350	220338					
Slovenia	803	228	153	418	64	5702	12167	9005	22272	151078		1004		270679	127457	69640	73024	101466		1		246	
Spain		17712			18597	670807	1259667	1891742	4931401	3900284				10186718	9259551	7944704	9885197	9516428			2680		
Sweden						140000	72000		24000					180000	25000	37000	37000	46000					
Switzerland	160	2785	344	810		549117	603827	782769	737094	568085				304683	397114	486127	305606	358694				1800	72
T³rkiye														112764	92803	33148		106736					
Ukraine				1530		7381	3283	2712	14253	345				307922	514025	437299	764953	505309	3838				
United Kingdom						10488931	13111659	13838412	16777623					33040042	25098525	26499996	19725677					17100	
Totall	3123245	3545921	2705157	3015674	643661	44777152	44675733	44833640	62129173	29561400	16464	1004	2	146217704	110412396	108226153	97908124	76726583	63720	100524	3889	20327	70625

	Costa Rica					Dom. Rep.	Ecuador					El Salvador		Guatemala					Honduras			
	2018	2019	2020	2021	2022	2022	2018	2019	2020	2021	2022	2021	2022	2018	2019	2020	2021	2022	2019	2020	2021	2022
Austria	51	70807	16679	120					101	121									37617	1142		
Belarus									808													
Czech Rep	38707	33774		210	2400					5	16360		18161									
Finland			3456	3168	37798																	
France		16147																				
Germany	7870	5534	2672	5523	4930		10113	72158	82338	101318	20106											180
Greece																						
Ireland	3542		870																			
Luxembourg		12				4				35	78	39	44									
Montenegro				594																		
Morocco				969																		
Netherlands				47987	13068		34580	57231	157112	243996	368731			35377	61995	8856	9348	35424				
Norway		275																				
Poland	4084	9187	4176	54292				10770	15111	6768	720						2040				2700	1050
Rep. of Moldova					1620																	
Russian Federation								73552	56769	74781												
Slovakia		377											4829									
Slovenia	127		438	935	1948				67													90
Spain		218778	36003							23500	39712			4404	1892	16994	11118	20874				
Sweden																						
Switzerland			600		136		1646			234	689											
Ukraine									630													
United Kingdom							27300	139284	250256	249696												
Total	54381	354891	64894	113798	61900	4	73639	352995	563192	700454	446396	39	23034	39781	63887	25850	22506	56298	37617	1142	2700	1320

	Jamaica			Mexico					Panama				Paraguay		Peru					Uruguay	
	2020	2021	2022	2018	2019	2020	2021	2022	2019	2020	2021	2022	2018	2019	2018	2019	2020	2021	2022	2019	2020
Albania																977		1936			
Austria															543828	672745	1107820	1317210			
Azerbaijan															18628	34555	31182	18970	12658		
Belarus													89120	12800	590895	580153	377448	543118			
Belgium															48616		12127	10376	22686		
Bosnia Herz.															3264	1813	1475	10294	8185		
Czech Rep.		17291	67410				1200								1833295	2201014	2090749	2378710	2475896		
Denmark															151340	262000	92000	129050	225296		
Estonia															765701	778121	549133	426512	427514		
Finland															320066	198385	105665	95694	57683		
France					18454	17712									4706947	3962824	837178	669028	647804	16200	
Germany				5636	1324	3060	4400		5164						8643425	9952347	9768394	10202477	17993093		
Greece																		56088	18696		
Ireland				58280	3911			1260							555673	1221773	1046166	825407	555337		
Italy															1303460	1039730	1388690	1908990	1048880		
Jordan																		12518			
Kazakhstan															30030	84926	64972	96601	18855		
Lithuania															496258	630482	332336	1029611	532340		
Luxembourg															59466	144602	162547	87711	93978		
Malta																14760		17712			
Montenegro															1278	2096	1916	5429	3653		
Morocco															121270	144060	150399	129680	152781		
Netherlands					15892						35424				50180400	52015300	47214300	67071215	53380818		
NorthMacedonia															4319	3358	4583	10342	8470		
Norway															1372016	1641332	1359199	1380346	2230256		4215
Poland					3739	2052			11875	1861		1620			10353115	11822443	10915266	9419348	7872620		
Portugal															2093481	2256096	2445323	4111557	3627202		
Rep. of Moldova															52228	39686	43944	58346	67938		
Romania																	18696	18696			
Russian Federation															9413306	10510174	10466386	14947459			
Serbia						94									7774	3236	71663	94256	117148		
Slovakia															424548	748922	505471	570448	1165990		
Slovenia															148201	102792	116339	194300	132538		
Spain				24395	14950	139620		93476							10823980	10763445	14628315	22397174	16615134		
Sweden															24000	35000		23000	63000		
Switzerland	1680			9000		810				1150					492365	517923	483927	659614	588989		
T³rkiye															74305	96682	67769		80792		
Tunisia															11218	615		1771			
Ukraine															285304	486785	564198	683579	480019		
United Kingdom				623438	999483	306158	15300								19249581	16887464	18295192	22558759			
Uzbekistan															1820						
Total	1680	17291	67410	720749	1057753	469506	20900	94736	17039	3011	35424	1620	89120	12800	125205400	129858616	125320769	164173334	110726250	16200	4215

Table 3. 070810 Vegetables, leguminous; peas (Pisum sativum), shelled or unshelled, fresh or chilled

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina					Brazil					Canada					Chile					Colombia				Costa Rica				Dominican Rep,	Ecuador			
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2021	2022	2018	2020	2021	2022	2018	2018	2019	2020	2021
Austria											28																						
Czech Rep.																				167							2						
Denmark						1																											
Finland																										18							
France	372								2				54	44	1						21								1417	7			
Germany								4		14						2340	581			90			205	972			15	10728			6		
Ireland	100					253	105		18																								
Israel															9595																		
Netherlands						1065			1485							11000							12960				14575						3612
Norway										29								2808	3276	702												18	
Poland																			4							4			3				
Russian Federation									213																								
Slovenia			10	10	10						21	759	58	234	8																		
Spain		9599									855										114	264											
Sweden												170																					
Switzerland						93	9	309	117				8	306	222			450						3									
T³rkiye													200																				
United Kingdom																22338		5994	12934						48304								
Total	472	9599	10	10	10	1412	114	313	1835	43	904	929	320	584	9825	35678	581	9252	16214	959	135	264	13165	975	48304	22	14592	10728	1420	7	6	18	3612

	El Salvador	Guatemala					Guyana			Honduras	Jamaica	Mexico			Panama	Paraguay	Peru				
	2022	2018	2019	2020	2021	2022	2018	2021	2022	2021	2018	2018	2019	2021	2019	2020	2018	2019	2020	2021	2022
Austria		145070	129085	72375	99060			9									14247	15687	10887	13799	
Belarus			12		60															153	
Belgium		444791	135876	59855	46215												375705	59580	312360	407628	74160
Czech Rep		7255	6370	8518	21387	20721										6	2171	3401	11098	5099	8839
Denmark			7453	83017	158336														48195		
Estonia		6501	7472	9288	12962	4873											1065	1062	2058	3192	2905
Finland		14564	255	1804	1093	247											2608	50	104	1574	233
France		450615	277551	67976	59557	46112											65310	26515	6768		
Germany		365875	340834	271566	223060	240910				120							296488	441223	574468	483749	293374
Ireland		12035	47298	185714	282359	14483												772		96366	25710
Kazakhstan			39	29	18	9															27
Luxembourg			94	668	1080	897												6		522	551
Netherlands		3694440	3415430	2957780	3166450	1960720						1121			5147		1091280	1648870	2047270	1970770	1298070
Norway		479161	440678	363106	333989	352777											205172	226282	183637	182305	136815
Poland		24471	24410	28216	46855	38867											1182	1101	3789	7401	4582
Rep. of Moldova			45	40																	
Russian Federation		35770	57184	35316	30624												213	1097	45	2114	
Serbia																			7		9
Slovakia	312	1505	8599	4497	9076	5487												1855	2414	2572	686
Slovenia		392	738	828	613	15		12	6								64			435	
Spain		11697	12726	9640	7934	12550											46330	56268	8946	22170	35194
Switzerland		98430	97575	86785	94856	76850	11			124				581			2004	17419	22277	33981	18169
Ukraine		763	796	1870	6746	335											48	135	33	200	249
United Kingdom		4819618	4882844	3641333	3848762						5780	9244	25220	3006			2181532	2903864	3193884	2911229	
Total	312	10612953	9893363	7890221	8451092	2775853	11	21	6	244	5780	10365	25220	3587	5147	6	4285419	5405187	6428240	6145259	1899573

Table 4. 070820 Vegetables, leguminous; beans (Vigna spp., Phaseolus spp.), shelled or unshelled, fresh or chilled

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina					Brazil					Canada					Chile				Colombia		Costa Rica				Dominican Rep.				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2021	2022	2018	2020	2018	2019	2020	2021	2018	2019	2020	2021	2022
Austria				20			53									129	25	202						109	149	50				
Azerbaijan													24000																	
Belgium																													857	
BosniaHerz.		48000									1875		20000		300															
Czech Rep.						10																				3	7			
Finland		75			51							50															108	94	160	645
France							1050						19		14		15									27285	4259	6411	5593	50
Germany									3074												675	328	162			184794	112007	23803	66635	4038
Ireland						75								4														275		
Italy															24825															
Jordan	47140																													
Luxembourg				12	6				3	1					20											51	13	10		18
Montenegro	4786														3500															
Netherlands										9																184622	173594	23195	65151	4835
Norway					32	225	100		65			720				50		80	300			56				12				36
Poland						26	12	1					24000					2									72			
Serbia				720	150																									
Slovakia							26																							
Slovenia	10			60	18						1830	500		6500	6000												12			
Spain												1															285			
Sweden				5000																										
Switzerland	10	118	300	109	1543	2	19	54	13	25		130	47	50		13				150			88	9		9858	5589	2610	2072	425
Ukraine																										12	9			
UK		2400	2916				3883				2993		2115													58975	28267			
Total	51946	50593	3216	5921	1800	338	5143	55	3155	35	6698	1401	70181	6554	34659	192	40	284	300	150	675	384	250	118	149	465662	324222	56398	140468	10047

	Ecuador					El Salvad.	Guatemala					Honduras					Mexico				
	2018	2019	2020	2021	2022	2021	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Austria	30	21	22				765	570	119	40									4		
Czech Rep.			30	18			36														
Estonia							15	45	73	57	93										
Finland							6		40											1184	460
France							501128	237407	27826		3						6242				
Germany	49	6057	6				12727	11479	10598	7216	3383					10		13949	28871	46908	48533
Ireland							508296	1280810	1338114	860904	715711									80	
Kazakhstan							6			15											
Luxembourg										1065	549				1845	2095					
Netherlands				290			24550	34005	39975	100592		20						1523	39		1162
Norway					71				591	2201								240		240	
Poland							201	1023	841	319											
Russia								128													
Slovenia							12						5								
Spain												1034	3181								
Sweden						369															
Switzerland							3874	4415	4244	2958	2959						2	28	1689	2922	1981
Ukraine									3	278											
UK							2473279	2009808	1922804	1569578				6300	907		25219	67405	205846	86203	
Total	79	6078	58	308	71	369	3524895	3579690	3345228	2545223	722698	1054	3186	6300	2752	2105	31463	83145	236449	137537	52136

	Nicaragua			Panama	Peru					Uruguay		Venezuela
	2020	2021	2022	2018	2018	2019	2020	2021	2022	2018	2021	2018
Austria							51					
Czech Rep.							6	15				20
Estonia						94	236					
Finland	540	720										
France				4202	15007	122	860					
Germany	1206	4179	6152		1240	630	1389	355	218			
Ireland						60						
Italy									1000			
Kazakhstan									9			
Luxembourg						104	8	678	153		434	
Netherlands					4715							
Norway					40		58		334			
Poland								15	500			
Slovenia					40			80	309			
Spain					1364				5028	24951		
Switzerland						55	40	24	9			
United Kingdom					39622	11763	76854	6462				
Total	1746	4899	6152	4202	62028	12828	79502	7629	7560	24951	434	20

Table 5. 070890 Vegetables, leguminous (other than peas and beans), shelled or unshelled, fresh or chilled

From UN Comtrade, import quantity in kg. Countries and years without data were deleted

	Argentina					Bolivia				Brazil				Canada				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2019	2020	2021	2022	2018	2019	2020	2021	2022
Austria																7920	30987	
Bosnia Herzegovina																	4	
Denmark												1						
Estonia						167	111	47										
Finland				1850													920	
France																	1021	12
Germany												14						
Netherlands													43		14		60	4
Norway					2000													1400
Poland												1808						
Portugal											50							
Slovakia														3750				
Slovenia	6		5	10													50	
Spain		1		3	2									10800				
Switzerland									5	17		5				8		
Türkiye				105										251	100	900		2080
Total	6	1	5	1968	2002	167	111	47	5	17	50	1828	43	14801	114	8828	33042	3496

	Chile				Colombia					Costa Rica					Dominican Rep.					Ecuador			Guatemala				
	2018	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2020	2021	2022	2018	2019	2020	2021	2022
Austria																	36			9			181	5778	8966	1272	
Czech Rep.		17																							3358	7090	1137
Denmark				113																							
Finland											20					20	27						27580	620	558		
France																2475	200						227	2975			
Germany					5015	4229	7604	8909	5164									1599	1888	100	17	26	16182	26821	81337	7892	6423
Luxembourg										185	128	53	57	220		12			10								
Netherlands															6400	6607	418	83			16	129	14404			19	1
Poland			1								187					3	14	6	6				41568	66671	63654	81345	70936
Spain	3														63	1380		286									
Switzerland															35	250	440	325	378								
UK																							109495	10558	12346	624	
Total	3	17	1	113	5015	4229	7604	8909	5164	185	335	53	57	220	6498	10747	1135	2299	2282	109	33	155	209637	113423	170219	98243	78497

	Honduras		Jamaica		Mexico				Nicaragua	Paraguay	Peru					Venezuela				
	2019	2022	2021	2022	2018	2019	2021	2022	2020	2020	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Austria							42				147	3								
Croatia											15									
Finland					5700						170	121								
France											15	439	990	40						
Germany	36	9					291		100		760	629	678	7842	15300					
Hungary															22					
Ireland			9	7																
Luxembourg					155	199	150													
Netherlands					50			84			168			1	25					
Norway										900										
Poland											50624	62732	16042	46068	58063					
Slovakia						40							2							
Slovenia		189					5	15												
Spain											17224			1						
Switzerland		10										9							59	8
Türkiye																1	100	400		800
United Kingdom						1173					24804			16219 4						
Total	36	208	9	7	5905	1412	488	99	100	900	93927	63933	17712	21614 6	73410	1	100	400	59	808

Table 6. 07099960 Fresh or chilled sweet corn

From Eurostat, import quantity in 100 kg. Countries and years without data were deleted

		DK	ES	FI	FR	GB	HR	IE	NL	PL	PT	SE	EUtotal
BR	2018								3,27		1,40		4,67
BR	2019					84,00							84
BR	2020		0,12										0,12
BR	2021								26,55				26,55
CO	2020		0,50										0,5
CO	2021		720,00										720
EC	2022		0,45										0,45
GT	2018				4,96								4,96
GT	2019								0,02				0,02
MX	2019								0,08			0,04	0,12
MX	2021				17,98				8,60				26,58
MX	2022		30,72		8,06								38,78
PE	2018		90,27		0,05	11,04	0,15		32,10				133,61
PE	2019		107,65		1,41	20,89			14,94				144,89
PE	2020		42,82		1,70				13,95				58,47
PE	2021		60,90					1,32	11,87				74,09
PE	2022		50,11					2,99	35,17				88,27
US	2018	682,88	0,11			26056,17			64,61			0,05	26803,82
US	2019	720,46	0,00			9516,88			171,40				10408,74

US	2020	499,92							1082,18	0,01			1582,11
US	2021		82,83		62,75				305,64				451,22
US	2022		89,76	0,11	112,22				541,28			10,44	753,81

ANNEX 11. Maps and data for certain hosts in the EPPO region

This annex present for some hosts of *C. virescens* in the EPPO region:

- a brief analysis.
- maps of distribution (from Monfreda *et al.*, 2008). They are only indicative as the distribution may have evolved since, and that they do not cover data for all EPPO countries.
- data on harvested area in ha (commercial production) in 2021 extracted from FAO (as the only source of data that covers all EPPO countries).

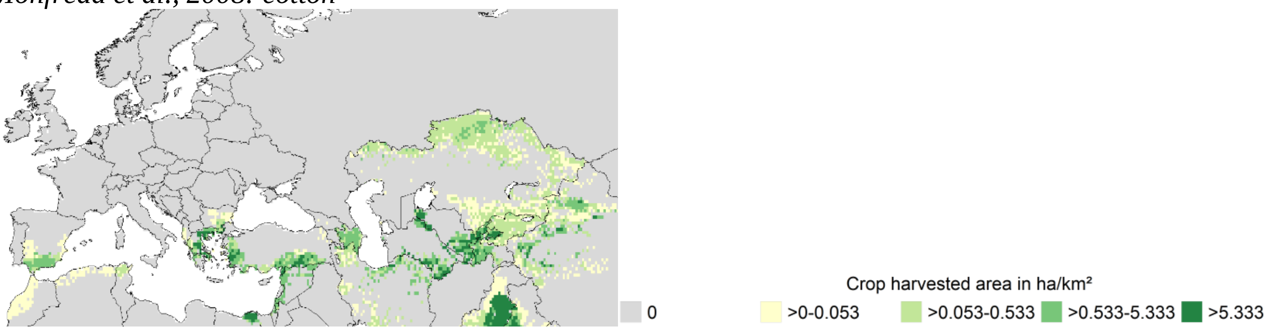
The discrepancies between maps and data may be due to the data used and year.

cotton
tobacco
soybean
alfalfa
sunflower
flax
chickpea
Phaseolus vulgaris and *Pisum sativum*
sesame
asparagus
tomato
grapevine
blueberries
okra

Cotton

In 2021, the harvested area in the EPPO region covered approx. 1.7 million ha in 11 countries of Central Asia and the Mediterranean Basin. The harvested area was over 1 million in Uzbekistan and 430000 ha in Türkiye, and over 100000 ha in Kazakhstan and Azerbaijan. Uzbekistan and Türkiye are respectively the 6th and 7th producers of cotton fiber worldwide in quantity, Türkiye being the 2nd producer worldwide in yield (Tokel *et al.*, 2022). In Spain, the area was approx. 58000 ha and in Kyrgyzstan approx. 19000 ha. In the EU, cotton is limited to parts of Andalusia (Spain) and Greece (Ceddia *et al.*, 2008, Engonopoulos *et al.*, 2021; Tokel *et al.*, 2021). Areas over 100 ha were also reported in, Israel, Tunisia, Albania, Algeria and Morocco.

Monfreda et al., 2008: cotton



FAO Stat for 2021: seed cotton, unginned

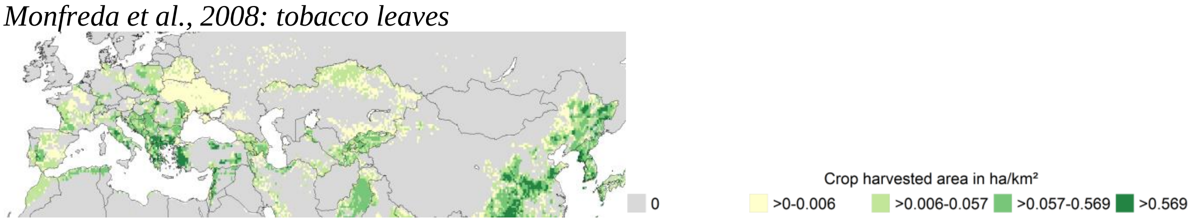
country	ha
Uzbekistan	1022448
Türkiye	432279
Kazakhstan	109971
Azerbaijan	100590
Spain	57914
Kyrgyzstan	19224
Israel	5542
Tunisia	2927
Albania	584
Algeria	305
Morocco	108
total	**1751892**

Areas below 1 ha reported from Georgia.

Tobacco

In 2021, the harvested area in the EPPO region covered over 160000 ha in 30 EPPO countries (Mediterranean Basin, whole of Europe and Central Asia). Türkiye was the major producer with over 68000 ha, followed by North Macedonia, Italy, Greece and Poland with approximately 9500-15000 ha each. These countries accounted for over 70% of the total area. In the EU, Italy, Spain, Poland, Greece, Croatia, France, Hungary and Bulgaria account for 99% of the EU tobacco production (https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/tobacco_en).

Monfreda et al., 2008: tobacco leaves



FAO Stat for 2021: unmanufactured tobacco

country	ha
Türkiye	68661
North Macedonia	15457
Italy	12860
Greece	10760
Poland	9570
Spain	7890
Serbia	5803
Algeria	4415
Bulgaria	3780
Croatia	3490
Hungary	3070

country	ha
Azerbaijan	3018
Uzbekistan	1946
Tunisia	1579
Georgia	1567
France	1310
Bosnia & Herzeg.	1070
Ukraine	1000
Albania	829
Romania	570
Morocco	465
Kyrgyzstan	440

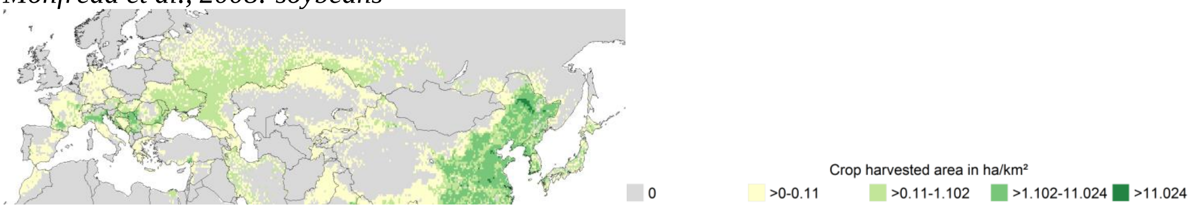
country	ha
Switzerland	409
Rep. of Moldova	400
Kazakhstan	334
Montenegro	116
Belgium	30
Jordan	28
Israel	12
Russian Fed.	11
total	**160890**

Areas below 1 ha reported for Belarus, Cyprus, Czech Rep., Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg, Malta, the Netherlands and Slovenia.

Soybean

In 2021, the harvested area in the EPPO region covered approximately 5.7 million ha in 31 countries (Mediterranean, throughout Europe to Russia, Central Asia), with over 75% in Russia and Ukraine (respectively approximately 3 and 1.3 million ha), as well as areas over 100000 ha in Italy, Serbia, France, Romania and Kazakhstan.

Monfreda et al., 2008: soybeans



FAO Stat for 2021: soya beans

country	ha
Russian Fed.	2990569
Ukraine	1322900
Italy	285460
Serbia	237036
France	154380
Romania	139610
Kazakhstan	112975
Croatia	86260
Austria	76740
Slovakia	64140
Hungary	62120

country	ha
Türkiye	43885
Germany	34200
Rep. of Moldova	22800
Czech Rep.	19680
Uzbekistan	11104
Bosnia & Herzeg.	10647
Poland	9210
Switzerland	2249
Bulgaria	1990
Slovenia	1890
Kyrgyzstan	1680

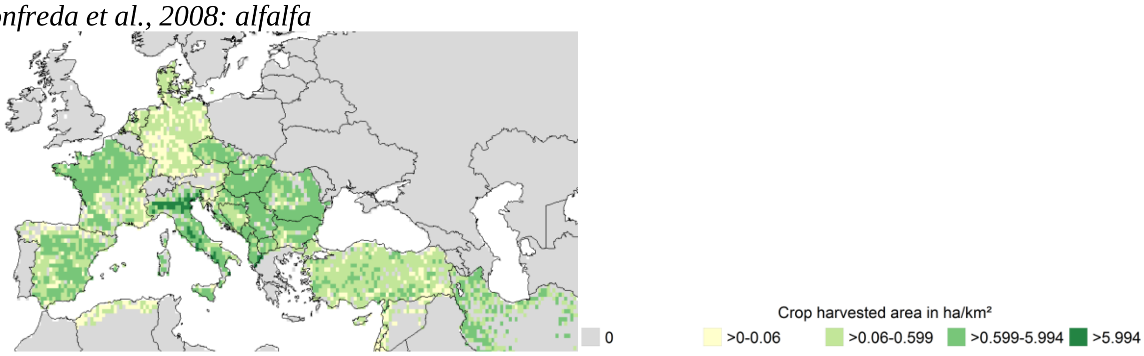
country	ha
Spain	1570
Lithuania	1540
Georgia	1000
Morocco	1000
Greece	820
Albania	155
North Macedonia	73
Azerbaijan	53
Luxembourg	10
total	**5697746**

Areas below 1 ha recorded from Cyprus, Denmark, Estonia, Finland, Jordan, Latvia and Malta.

In addition, there is a growing area of soybean in the UK; with approximately 2000 ha (https://www.pgro.org/soya/).

Alfalfa

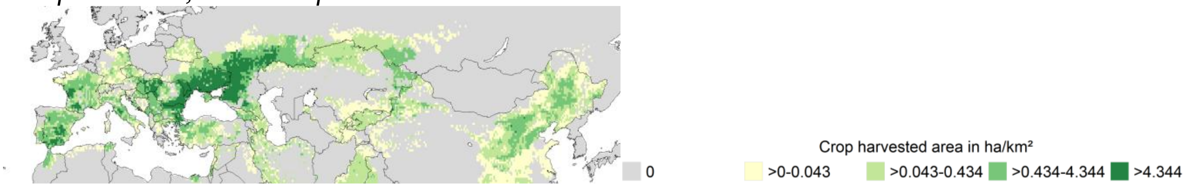
Monfreda et al., 2008: alfalfa



Sunflower

In 2021, the harvested area in the EPPO region covered over 23 million ha in total in 45 countries throughout Europe, the Mediterranean and to Russia. The main producers were Russia, Ukraine and Romania, with over 9.5, 6.5 and 1 million ha, as well as Kazakhstan, Türkiye and Bulgaria with areas over 800000 ha.

Monfreda et al., 2008: sunflower seeds



FAO Stat for 2021: sunflower seed

Country	ha
Russian Fed.	9641470
Ukraine	6665100
Romania	1123960
Kazakhstan	939766
Türkiye	900135
Bulgaria	836470
France	698360
Hungary	654690
Spain	631160
Rep. of Moldova	392100
Serbia	212736
Italy	116990
Greece	90540

Country	ha
Slovakia	73360
Croatia	40970
Germany	38300
Austria	24680
Czech Rep.	17980
Morocco	16286
Poland	14360
Azerbaijan	11095
Uzbekistan	10692
Tunisia	7533
Kyrgyzstan	7302
Portugal	5590
North Macedonia	5050

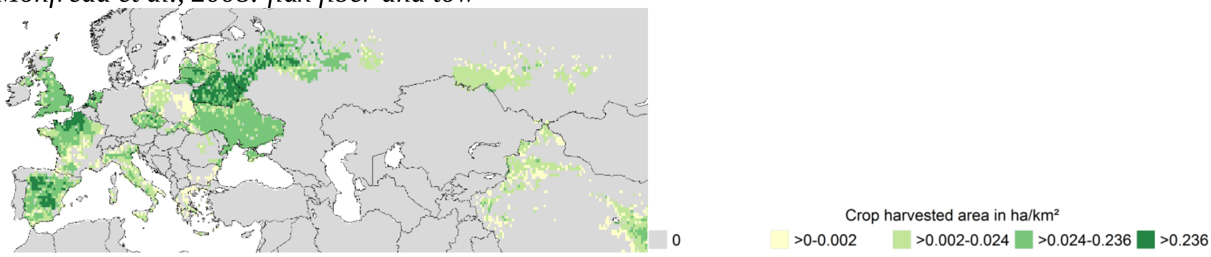
Country	ha
Tajikistan	5000
Switzerland	4833
Georgia	3000
Belarus	2000
Netherlands	740
Bosnia &Herzeg.	428
Slovenia	420
Albania	389
Israel	358
Algeria	189
Luxembourg	140
Ireland	30
total	**23194202**

Areas below 1 ha reported from Armenia, Cyprus, Denmark, Estonia, Jordan, Latvia and Malta.

Flax

In 2021, the harvested area in the EPPO region covered over 220000 ha in 13 countries, mostly in western Europe to Russia, with more than half in France, and over 98% together with Belarus, Russia, Belgium and the UK.

Monfreda et al., 2008: flax fiber and tow



FAO Stat 2021: flax, processed but not spun

country	ha
France	112580
Belarus	42300
Russian Fed.	36483
Belgium	15390
UK	10095

country	ha
Netherlands	1800
Italy	430
Poland	400
Bulgaria	390
Ukraine	96

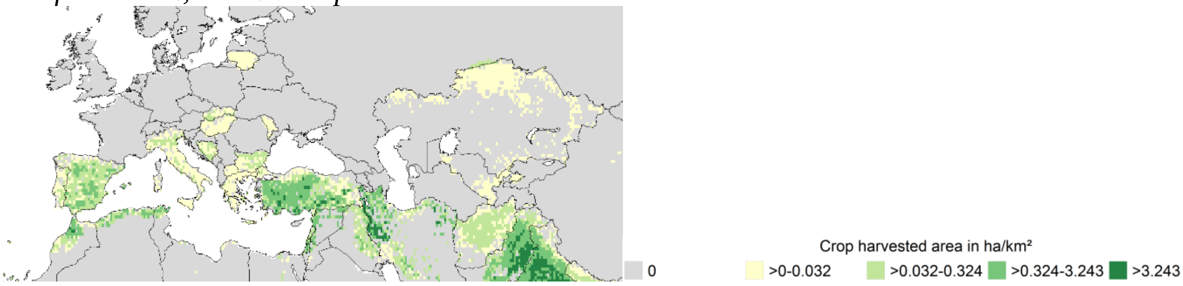
country	ha
Romania	40
Spain	10
Türkiye	8
total	**220022**

Areas below 1 ha reported from Austria, Bosnia and Herzegovina, Croatia, Cyprus, Denmark, Estonia, Finland, Greece, Lithuania, Luxembourg, Malta, Slovenia

Chickpea

Chickpea is grown mostly in the Mediterranean area and the Middle East, with some production in Central Asia, and in Central Europe.

Monfreda et al., 2008: chickpeas



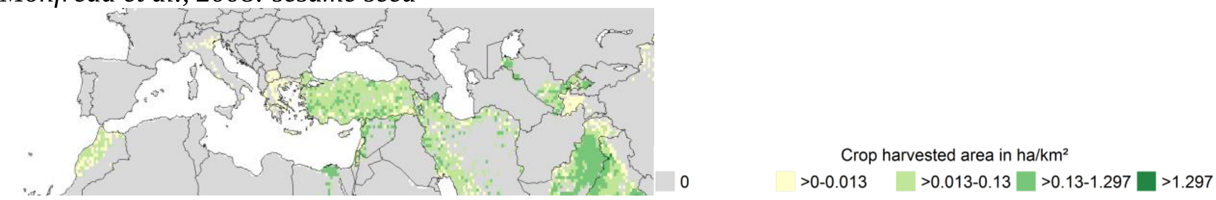
Phaseolus vulgaris* and *Pisum sativum

Beans and peas are mostly grown outdoors, although seed crops may be grown in protected conditions, and some fruit production may also be conducted in protected conditions (EPPO, 2022b). For example, in Spain, green beans are grown over 7571 ha (1489 ha in greenhouses), green peas over 16020 ha (120 ha in greenhouses) and dry peas over 116993 ha (MAPA, 2022).

Sesame

The cultivation area is restricted, mainly in the Middle East and Central Asia, as well as in parts of the Mediterranean.

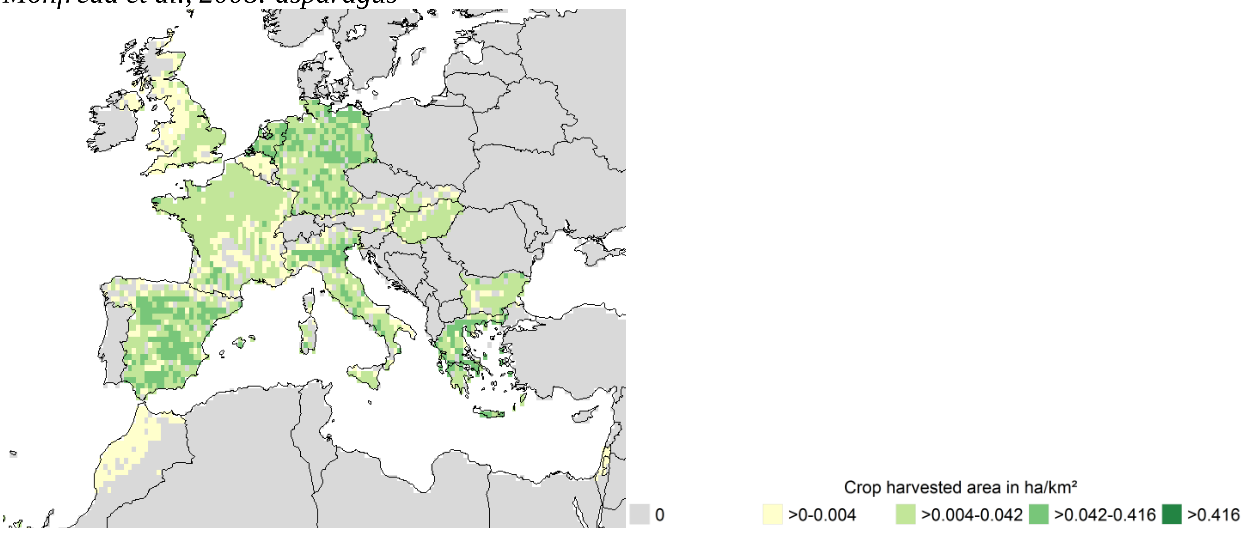
Monfreda et al., 2008: sesame seed



Asparagus

In 2021, the harvested area of asparagus in the EPPO region covered over 63000 ha in 26 countries, mainly in Europe and the Mediterranean, with over two-thirds in Germany, Spain and Italy.

Monfreda et al., 2008: asparagus



FAO Stat for 2021: asparagus

Country	ha
Germany	22280
Spain	13520
Italy	7450
France	6530
Netherlands	2860
UK	2272
Poland	2000
Greece	1680

Country	ha
Hungary	1270
Austria	750
Belgium	660
Switzerland	440
North Macedonia	299
Portugal	280
Denmark	210
Croatia	200

Country	ha
Slovenia	180
Romania	170
Sweden	150
Slovakia	140
Türkiye	139
Finland	40
Bulgaria	30
Luxembourg	20

Country	ha
Israel	11

Country	ha
Morocco	4

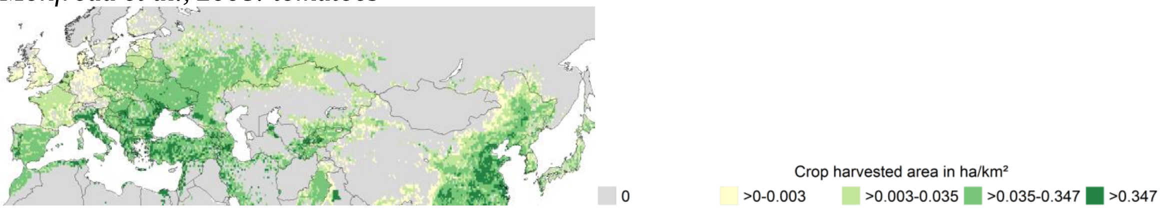
Country	ha
total	**63585**

Areas below 1 ha reported from Estonia and Jordan.

Tomato

In 2021, the harvested area extended in 47 EPPO countries throughout the EPPO region, with close to 800000 ha in total, with over 160000 ha in Türkiye, and 100000 ha in Italy.

Monfreda et al., 2008: tomatoes



FAO Stat for 2021: tomatoes

country	ha
Türkiye	165204
Italy	102060
Russian Fed.	78217
Ukraine	75800
Uzbekistan	60545
Spain	56110
Kazakhstan	31144
Algeria	25755
Tunisia	24540
Azerbaijan	20211
Romania	18130
Portugal	17780
Morocco	13875
Greece	13140
Kyrgyzstan	11655
Jordan	9471

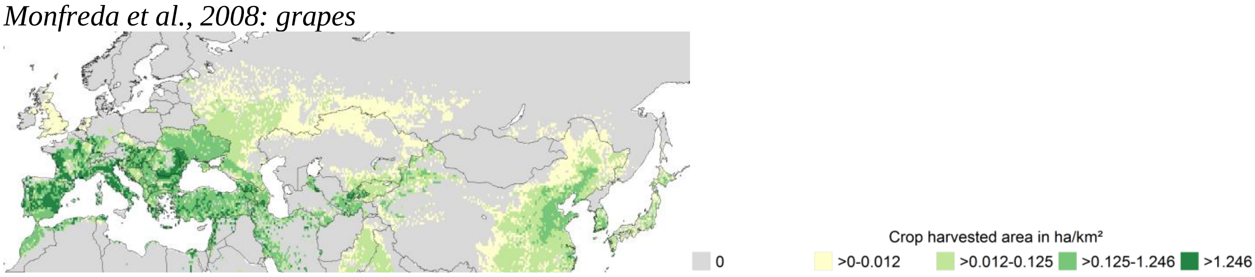
country	ha
Poland	7700
Serbia	7593
Belarus	6720
Albania	6693
France	6220
North Macedonia	5567
Israel	5499
Rep. Moldova	4200
Bosnia & Herzeg.	3691
Georgia	3400
Bulgaria	3070
Hungary	1940
Netherlands	1850
Lithuania	720
Belgium	630
Germany	400

country	ha
Croatia	290
Cyprus	260
Czech Rep.	260
Slovakia	240
Slovenia	210
Austria	200
UK	195
Switzerland	180
Finland	90
Montenegro	65
Sweden	40
Norway	39
Denmark	30
Estonia	10
Ireland	10
total	**791649**

Grapevine

In 2021, grapes were grown in 43 countries throughout the EPPO region on approximately 4.2 million ha, with the largest producers Spain (900000), France (750000), Italy (700000) and Türkiye (390000).

Monfreda et al., 2008: grapes



FAO Stat for 2021: grapes

country	ha
Spain	929390
France	757830
Italy	702670
Türkiye	390221
Portugal	175590
Romania	163610
Rep. of Moldova	122284
Uzbekistan	109585

country	ha
Germany	100710
Greece	89230
Russian Fed.	76512
Georgia	75775
Algeria	63443
Hungary	59070
Austria	42840
Morocco	39336

country	ha
Ukraine	34700
Tajikistan	33119
Bulgaria	28530
Turkmenistan	25007
North Macedonia	23776
Croatia	21210
Tunisia	20899
Serbia	20113

country	ha
Czech Rep.	16360
Azerbaijan	15100
Slovenia	14900
Armenia	14636
Switzerland	14629
Kazakhstan	12626
Israel	11173
Albania	10548

country	ha
Belarus	8723
Slovakia	7750
Cyprus	6220
Bosnia & Herzeg.	4533
Kyrgyzstan	4494
Jordan	3026
Montenegro	2628
Luxembourg	1230

country	ha
Poland	1000
Belgium	560
Malta	460
UK	456
Netherlands	190
Sweden	90
total	**4184020**

Areas below 1 ha reported from Estonia, Finland, Ireland and Lithuania.

In addition, recent figures for the UK mention over 3500 ha for 2023 (https://www.gov.uk/government/statistics/agricultural-land-use-in-england, https://winegb.co.uk/who-we-are/industry-stats).

Blueberries

In 2021, the harvested area in the EPPO region was over 30000 ha in 26 countries, mostly in Europe and the Mediterranean, with over two-thirds in Poland, Spain, Germany and Portugal.

FAO Stat for 2021: blueberries

Country	ha
Poland	10700
Spain	4570
Germany	3360
Portugal	2590
France	2237
Lithuania	1460
Italy	1200
Netherlands	850
Russian Fed.	733

Country	ha
Romania	710
Latvia	600
Croatia	380
Austria	220
Belgium	120
Switzerland	106
Denmark	100
Ukraine	100
Uzbekistan	97

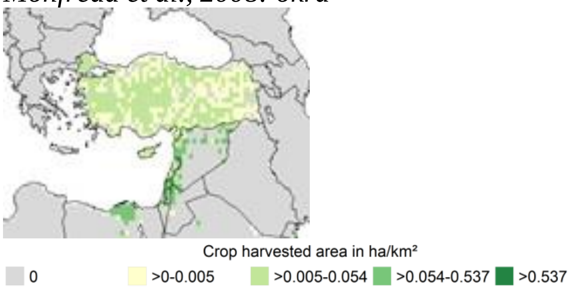
Country	ha
Finland	90
Bulgaria	70
Slovakia	70
Slovenia	70
Sweden	50
Hungary	40
Norway	20
Morocco	16
total	**30559**

Areas below 1 ha reported from Estonia, Greece, Kyrgyzstan and Malta.

Okra

In 2021, some production was reported only in Türkiye, Jordan and Albania, with over 6600 ha in total, of which approximately 70% in Türkiye. According to the map, okra is also grown in Israel.

Monfreda et al., 2008: okra



FAO Stat for 2021: okra

country	ha
Türkiye	4821
Jordan	1088
Albania	711
total	**6620**

ANNEX 12. Köppen-Geiger climate types associated with *Chloridea virescens* in the area of origin of the pest and the EPPO region

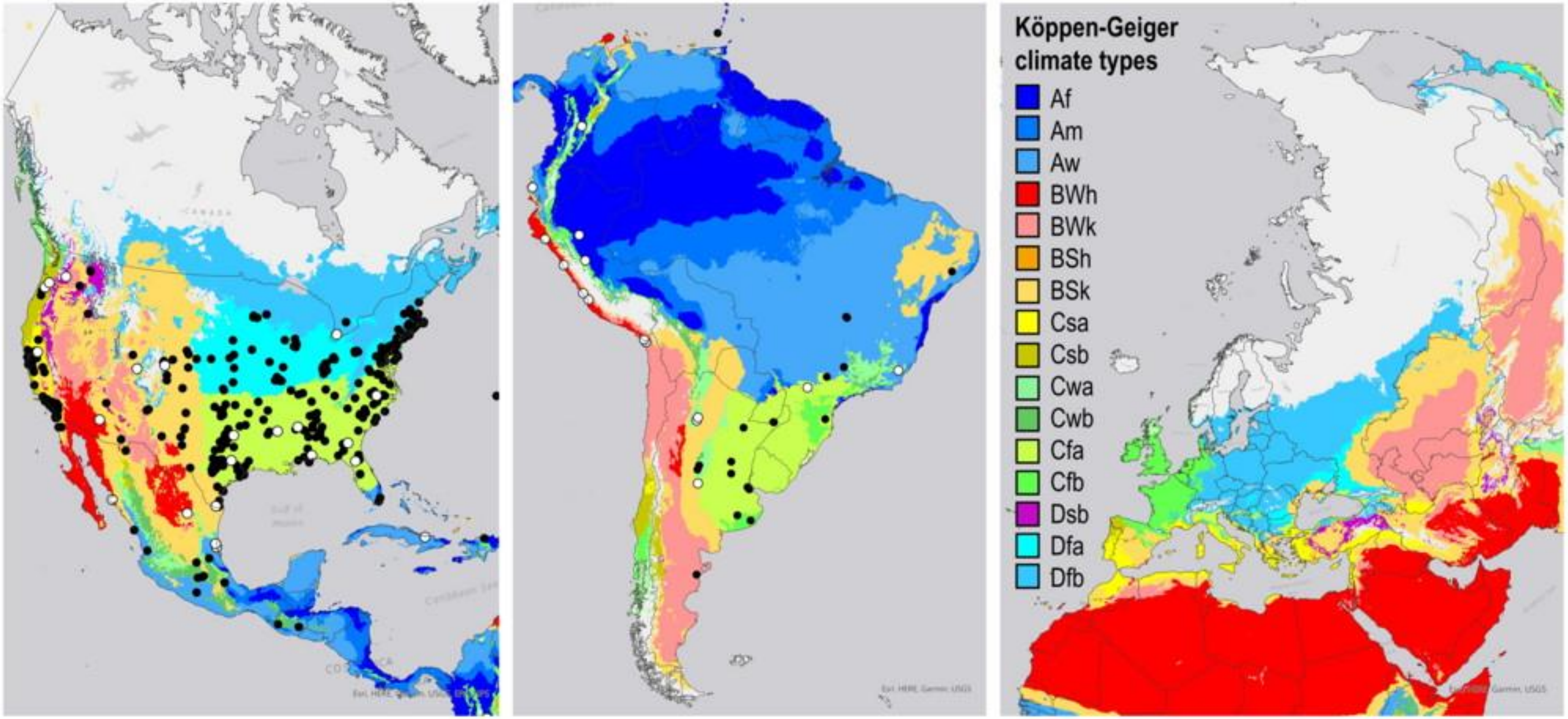
All maps in this Annex were prepared by J. Tuomola (Ruokavirasto, Finland).

Map 1. Köppen-Geiger: climate types associated with *Chloridea virescens* in the recent climate (1980–2016), based on observations from GBIF (2023) and various articles

Data for the distribution of the Köppen-Geiger types were derived from Beck *et al.* (2018) at a resolution of 0.083° (about 10 km at the equator).

Distribution records of *C. virescens* retrieved from GBIF (2023) [black dots] and various publications (coordinates mentioned in the articles or estimated based on locations mentioned in the articles) [white dots] are displayed. The country borders on the map were sourced from GADM (2020). A file with locations mapped is available at: https://upload.eppo.int/download/1795oc9f8bdff8.

Note that the following climates are not present in the EPPO region: Af, Am, Aw, Cwa, Cwb.



Map 2. Projection of Köppen-Geiger climate types for the EPPO region for the years 2071-2100 under the scenario RCP8.5.
Left: all climate types associated with *C. virescens* (as in Map 1). Note that the following climates are not present in the EPPO region in the projection for the years 2071-2100: Af, Am, Aw, Cwa, Cwb.
Right: the 7 Köppen-Geiger climate types that delimit the area where conditions are likely favourable to establishment in the EPPO region (see Fig. 4 in section 9.2.1 for the map showing the current distribution of these climate types in the EPPO region).