

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

**10-16056
WPPR Point 8.4**

Report of a Pest Risk Analysis for *Sicyos angulatus*

This summary presents the main features of a pest risk analysis which has been conducted on the pest, according to EPPO Decision support scheme for quarantine pests.

Pest: *Sicyos angulatus* L.
PRA area: EPPO region
Assessors: EPPO Secretariat
Date: 2009-04

STAGE 1: INITIATION

Reason for doing PRA: *Sicyos angulatus* is recognized as an invasive plant in Spain and France and in other countries of the world (Japan, Korea, etc.). The “Diari Oficial de la Generalitat de Catalunya” (DOGC nùm. 4315 – 03/02/2005) declares that *S. angulatus* is officially recognized to be present in the region of Catalunya (ES) and establishes obligatory control measures. This plant could represent a threat for other countries of the EPPO region.

Taxonomic position of pest: Kingdom: *Plantae*
Family: *Cucurbitaceae*

STAGE 2: PEST RISK ASSESSMENT

Probability of introduction

Entry

Geographical distribution: **EPPO Region:** Austria, Bulgaria, Croatia, France (southwest, weed), Italy (northern, possibly also in Sicilia, weed), Moldova (invasive plant), Romania, Russia, Serbia, Turkey, Ukraine (established in the Western and Central parts).

Asia: China, Japan (weed), the Republic of Korea (Andong), Taiwan (naturalized).

North America (native): Canada (Ontario, Québec), USA (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, Nebraska, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin).

Central America & Caribbean: Antilles (Guadeloupe,

Martinique), Mexico.

Note: the plant is recorded as casual (meaning transient, not established) in Belgium (Flanders and Walloon) Czech Republic, Germany (e.g. in Berlin), Hungary, Norway and the United Kingdom.

The plant was considered an invasive plant in the Generalitat de Catalunya (Spain) and has been eradicated.

A record in Sweden was a confusion with *Echinocystis lobata* (Website Walk among the S-weeds).

There is also an unconfirmed data in Mexico.

Major host plants or habitats:

- Intensive and irrigated field crops (mainly maize in Europe, but also recorded in soybean and sorghum in the US)
- Along roads and railways and in waste lands, i.e. in man-managed environments,
- In semi-natural habitats (banks of inland waterways and water bodies, swamps, thickets, openings in floodplain forests, moist meadows in floodplain areas, etc.).

According to the CORINE Land Cover nomenclature, the suitable habitats are:

- Permanent crops (e.g. vineyards, fruit tree and berry plantations, olive)
- Continental waters (water courses, water bodies)
- Banks of continental water, Riverbanks / canalsides (dry river beds)
- Road and rail networks and associated land
- Other artificial surfaces (wastelands)
- Green urban areas, including parks, gardens, sport and leisure facilities

Which pathway(s) is the pest likely to be introduced on:

- Intentional introduction for ornamental or agricultural purposes: unlikely
- Unintentional introduction with grain of *Zea mays*: likely
- Unintentional introduction with grain of *Glycine max*: moderately likely
- Unintentional introduction with grain of *Sorghum spp.* : very unlikely
- Unintentional introduction as a contaminant on people's footwear and clothes: moderately likely
- Unintentional introduction with soil/growing medium (with organic matters) as a commodity: unlikely
- Unintentional introduction with soil as a contaminant on used machinery: moderately likely

Establishment

Plants or habitats at risk in the PRA area:

- Intensive and irrigated field crops (mainly maize in Europe, but also recorded in soybean and sorghum in the US)
- Along roads and railways and in waste lands, i.e. in man-managed environments,
- In semi-natural habitats (banks of inland waterways and water bodies, swamps, thickets, openings in floodplain forests, moist meadows in floodplain areas, etc.).

Climatic similarity of present distribution with PRA area (or parts thereof):

The plant is already present in Mediterranean climate (Spain, Croatia, Italy, Turkey), Atlantic (south-West of France) and temperate climates (United Kingdom, Hungary, Moldova, etc.). Moreover, the preference of *S. angulatus* is full or partial sun, and moist conditions. It cannot grow in shade. Its hardiness zone is 9, i.e. it is frost-tender.

Characteristics (other than climatic) of the PRA area that would favour establishment:

S. angulatus reproduced by seeds which can germinate throughout the entire growing season (Pheloung *et al.*, 1999). *S. angulatus* is fast growing in early summer (up to 2 m in 3 weeks), capable of producing shoots up to 6 m long. Without competition, early spring (May)-established plants attained a fresh weight of up to 86 kg and could produce an average of more than 42 000 seeds per plant.

The plant colonizes riverbanks. Seeds of the plant are dispersed by water (S. Kurokawa, pers. comm.; JF Larché, pers. comm., Kil *et al.*, 2006). This mode of dispersal is confirmed by Kurokawa *et al.* 2006 who performed ISSR (Inter-Simple Sequence Repeat) analysis on the *S. angulatus* populations widely distributed in Japan, in order to infer the genetic relationship among populations. Kil *et al.* (2006) state that heavy rains leading to soil erosion and floods greatly amplify seed export. The seeds can also be dispersed by machinery and soil.

The fruit has spines which allow it to attach to animals and people (JM Tison, pers. comm., 2007).

Which part of the PRA area is the endangered area:

According to a Climex matching climates with Bordeaux and Barcelona, where the plant is present and considered invasive, the temperate and Mediterranean areas of the EPPO region are at high risk (See Appendix 1).

And the countries considered at risk are: Algeria, Austria, Belgium, Bosnia, Bulgaria, Croatia, Czech Republic, France (including Corse), Germany, Greece, Ireland, Hungary, Italy (including Sardinia and Sicilia), Morocco, Serbia, Switzerland, Portugal, The Netherlands, Russia (Black Sea), Tunisia, Turkey, United Kingdom, Ukraine (Black Sea).

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

S. angulatus is characteristically a weed of maize, soybean and sorghum crops. This is the case in its native range (it is officially classified as a noxious weed in Delaware and Indiana, and as a weed in Kentucky and Nebraska). In Europe it is mainly found in irrigated maize fields. It has not been observed in soybean and sorgho fields as densities of soybean plants are lower than in maize, impeding

Sicyos angulatus to climb over the plants, and sorgho is not irrigated. In Japan, it grows in fields of maize and of sorgho for tillage. It is not a strong competitor for light and nutrients, and so does not reduce yields by direct competition. However, as an aggressive vining plant, it pulls maize or soybean plants to the ground, making them impossible to harvest (one plant of *S. angulatus* can pull down 4 rows of maize). Maize stems are broken by the traction and weight of the invasive plant.

S. angulatus can germinate throughout the growing season. Even at very low population densities (1/m²), it can make maize or soybean fields unharvestable by rapid development at the end of the season, causing collapse of wide areas of the crop (Webb *et al.*, 1981). Observations made in Japanese maize fields showed that yield was decreased by 80% by a population of 15-20 plants/10 m² and by 90-98% with 28-50 plants/10 m² (Shimizu, 1999). Studies in Japan suggest that the plant may also behave allelopathically (Uraguchi *et al.*, 2003).

S. angulatus is also a host of the polyphagous pest *Heliothis virescens* in North America (which attacks field crops such as cotton, tobacco, legumes and vegetables). It has been suggested that *S. angulatus* could contribute to build-up early season and over wintering populations of the pest (Pheloung *et al.*, 1999). A similar situation could arise for *Helicoverpa armigera* (Lepidoptera) in Europe.

Recasens *et al.* (2007) have estimated the cost of the eradication campaigns in Spain between 2004 and 2010 in Catalunya at EUR 78 320, as detailed:

- 2004: destruction of the infested fields, costs of machinery, transportation, compensation to farmers on 16.000 m², at 0.20 €/m² cost 3.200 €
- 2005: monitoring (6 months of a technical officer: 12.000 €), manual eradication (35 days of a technical officer at 60 €/day: 2.100 €) and use of herbicides (120 €) resulted in a total of 14.220 €
- 2006: monitoring (6 months of a technical officer: 12.000 €), manual eradication (3 days of a technical officer at 60 €/day: 180 €), resulted in a total of 12.180 €
- From 2007 to 2010, estimates are identical to 2006, resulting in a total of 48.720 €

Describe damage to potential hosts in PRA area:

Observations made in invaded riversides in Republic of Korea show that massive germination can lead to a 100% cover of the soil layer during the growing season. Average and highest seed densities at full maturation were 748 and 1128 seeds/m², respectively. A few seedlings/10 m² were enough to cover the whole grass mat by July (Kil *et al.*, 2006). This monospecific cover is a threat for other species and to the whole ecosystem.

How much economic impact would the pest have in the PRA

S. angulatus should have the same impacts than the one observed in its current area of distribution which are considered moderate.

area:

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

- the species is only recorded as a threat in France, Italy, Moldova and Spain while it is occurring in other countries (Austria, Bulgaria, Croatia, Romania, Russia, Serbia, Turkey, Ukraine (established in the Western and Central parts));
- The plant is not a strong competitor, but can pull the crop down, and make them difficult to harvest;
- Cultural practices such as tillage and the use of herbicides may limit the establishment of the weed;
- If taking at an early stage, the species can be eradicated or contained.

Estimate the probability of entry:

High

Medium uncertainty

Estimate the probability of establishment:

High

Low uncertainty

The probability of entry is high since the species is already present in the PRA area. The species may enter through various pathways.

The species already established in some countries of the EPPO region. Nevertheless, in some EPPO countries, the species is only casual.

Estimate the potential economic impact:

Moderate

Medium uncertainty

Major impacts recorded are:

- to be a weed of maize, soybean and sorghum. It is not a strong competitor for light and nutrients, and so does not reduce yields by direct competition. However, as an aggressive vine plant, it pulls maize or soybean plants to the ground, making them impossible to harvest (one plant of *S. angulatus* can pull down 4 rows of maize).
- *S. angulatus* can smother native vegetation of semi-natural or unmanaged habitats such as riverbanks, canal sides and floodplains and have a negative environmental impact in these habitats.

Degree of uncertainty

Medium

The following uncertainties have been identified :

- the precise longevity, germinability of the seeds and the effect of ingestion by animals,
- The ability of the plant to colonize other fields than maize fields in the EPPO region or elsewhere.
- The impacts on riparian ecosystems.
- The ability to usually used herbicides to limit the establishment and spread of the weed.

OVERALL CONCLUSIONS

Sicyos angulatus is very likely to spread further within the endangered area and to cause moderate economic impacts on maize crop. It would also have detrimental environmental effects.

Nevertheless, considering :

- the huge number of pathways, and their low to moderate probability to introduce the pest,
- the fact that the species is already widesperad in the EPPO region,

- the possibility to eradicate and contain the species in the first stages of invasion,

Internal measures such as monitoring/surveillance and eradication actions are considered more appropriate options than prevention of entry. Internal measures are detailed in the PM9 on *Sicyos angulatus*.

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1 Climatic prediction on *Sicyos angulatus*

The CLIMEX model is a computer programme aiming at predicting the potential geographical distribution of an organism considering its climatic requirements. It is based on the hypothesis that climate is an essential factor for the establishment of a species in a country.

For *Sicyos angulatus*, a match climate comparison has been undertaken.

1. Geographical distribution of the species and parameters

Sicyos angulatus is present in the following countries:

EPPO Region: Austria, Bulgaria, Croatia, France (southwest, weed), Italy (northern, possibly also in Sicilia, weed), Moldova (invasive plant), Romania, Russia, Serbia, Turkey, Ukraine (established in the Western and Central parts).

Asia: China, Japan (weed), the Republic of Korea (Andong), Taiwan (naturalized).

North America (native): Canada (Ontario, Québec), USA (Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, Nebraska, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin).

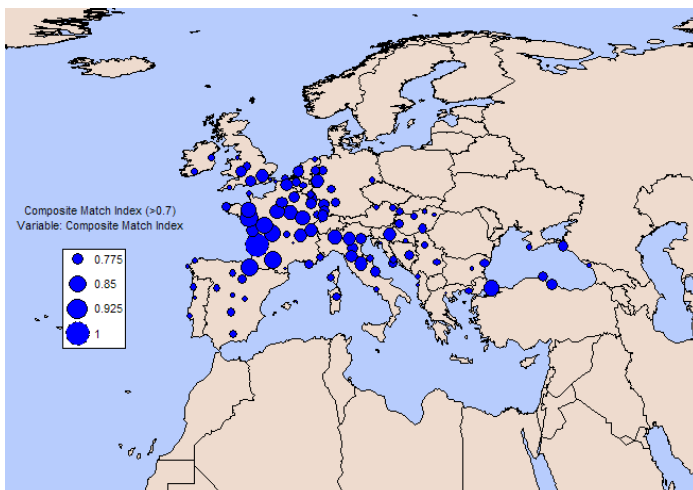
Central America & Caribbean: Antilles (Guadeloupe, Martinique), Mexico.

Note: the plant is recorded as casual (meaning transient, not established) in Belgium (Flanders and Walloon) Czech Republic, Germany (e.g. in Berlin), Hungary, Norway and the United Kingdom. The plant was considered an invasive plant in the Generalitat de Catalunya (Spain) and has been eradicated.

A record in Sweden was a confusion with *Echinocystis lobata* (Website Walk among the S-weeds). There is also an unconfirmed data in Mexico.

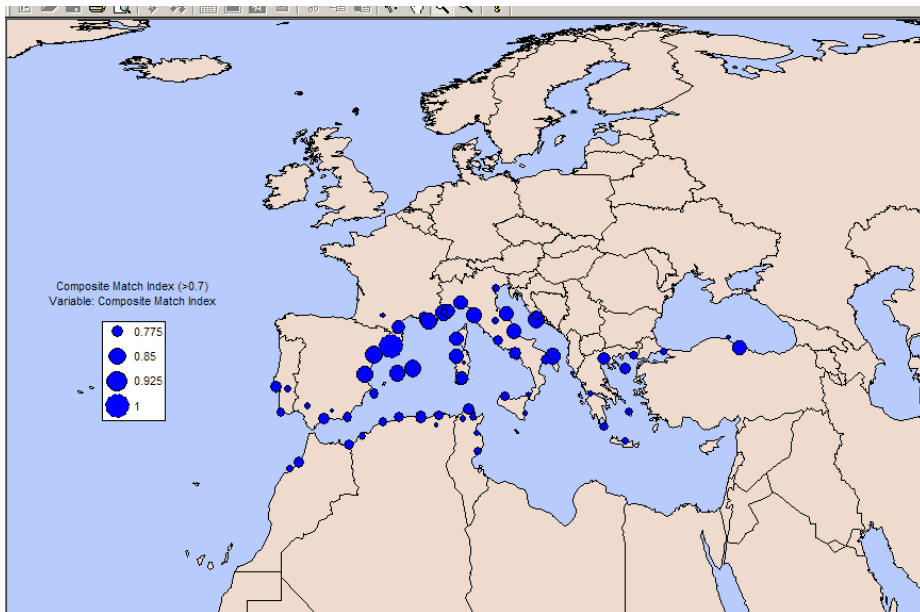
As the species is present and invasive in Barcelona and near Bordeaux, these places have been compared with the EPPO region:

Comparing Bordeaux (France) with Europe, with an Ecoclimatic index of 0.7:



The countries having a similar climate are: Austria, Belgium, Bosnia, Bulgaria, Croatia, Czech Republic, France (including Corse), Germany, Greece, Ireland, Hungary, Italy (including Sardinia), Serbia, Switzerland, Portugal, The Netherlands, Russia (Black Sea), Turkey, United Kingdom, Ukraine (Black Sea).

Comparing Barcelona (Spain) with Europe, with an Ecoclimatic index of 0.7:



The countries having a similar climate are: Algeria, Croatia, France (including Corse), Greece, Italy (including Sardinia, Sicilia), Morocco, Portugal, Tunisia, Turkey.

Taking into account the places having similarities to Barcelona and Bordeaux, the countries at risk are: Algeria, Austria, Belgium, Bosnia, Bulgaria, Croatia, Czech Republic, France (including Corse), Germany, Greece, Ireland, Hungary, Italy (including Sardinia and Sicilia), Morocco, Serbia, Switzerland, Portugal, The Netherlands, Russia (Black Sea), Tunisia, Turkey, United Kingdom, Ukraine (Black Sea).