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POUR LA PROTECTION DES PLANTES

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WPPR point 8.3

Report of a Pest Risk Analysis for *Xanthomonas axonopodis* pv. *allii*

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:	*Xanthomonas axonopodis* pv. *allii*
PRA area:	EPPO member countries
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Date:	2008-09-25/28

STAGE 1: INITIATION

Reason for doing PRA:	A recently characterized bacterium, *Xanthomonas axonopodis* pv. *allii* (Roumagnac *et al*., 2004) causing damage to *Allium* crops has been reported from several parts of the world as responsible for an emerging disease. The pest was added to the EPPO Alert List in 2005-04 and was selected as a priority for PRA in 2007.
Taxonomic position of pest:	Proteobacteria, Gammaproteobacteria, Xanthomonadales, Xanthomonadaceae, *Xanthomonas*

STAGE 2: PEST RISK ASSESSMENT

Probability of introduction

Entry

Geographical distribution:	Asia: Japan (Kadota *et al.*, 2000) Africa: Mauritius, Réunion (Roumagnac *et al.*, 2000), South Africa (Serfontein, 2001) North America: USA (California, Colorado, Georgia, Texas) (Nunez *et al.*, 2002; Schwartz & Otto, 2000; Sanders *et al.*, 2003; Isakeit *et al.*, 2000). It should be noted that the pest is not present in onion seed production areas of the Pacific Northwestern U.S. Central America and Caribbean: Barbados (Paulraj & O' Garro, 1993), Cuba South America: Brazil (Neto *et al.*, 1987), Venezuela (Trujillo & Hernandez, 1999) Oceania: Hawaii, USA (Alvarez *et al.*, 1978) As this disease is not very well known, symptoms may not be recognized. Consequently it should be noted that the pest distribution worldwide is not

very well known.

Major host plants or habitats:

Allium species:

Allium species:

Host species on which disease outbreaks were observed in the field: onion (*Allium cepa* L.) (Alvarez *et al.*, 1978), Welsh onion (*A. fistulosum* L.) (Kadota *et al.*, 2000), garlic (*A. sativum* L.), leek (*A. porrum* L.) (Picard *et al.*, 2008).

Additional host species based on pathogenicity tests: shallot (*Allium cepa* var. *ascalonicum*), some cvs. of chive (*A. schoenoprasum* L.) (Roumagnac *et al.*, 2004a), grapefruit (*Citrus paradisi* L.), Mexican lime (*C. aurantifolia* L.) (Gent *et al.*, 2005a)

Following artificial inoculation bacterial multiplication was reported in plant families other than *Allium* (e.g. *Fabaceae, Rutaceae*) sometimes in association with visible symptoms (O' Garro & Paulraj, 1997; Gent *et al.*, 2005a). However outbreaks of *Xanthomonas axonopodis* pv. *allii* on these plant species are unlikely. Infection of *Fabaceae* host has not been reported outside of Barbados (Gent *et al.*, 2004; Roumagnac *et al.*, 2004a) even when using bacterial strains from this country (Roumagnac *et al.*, 2004a).

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

The pest is seed-transmitted. Nevertheless, it is not precisely known if the pest is endophytic or epiphytic. The fact that culturable populations of the pathogen were recovered from ethanol-disinfested seed suggests that *X axonopodis* pv *allii* is likely to be endophytic. However, it is not known whether external populations occur too.

The following pathways are identified.

Pathway 1: Seeds of *Allium* spp. from countries where *X. axonopodis* pv. *allii* occurs.

Pathway 2: Seedlings of *Allium* spp. (called transplants, i.e. small plants cultivated in a growing medium and then transplanted).

Onions in Europe are produced mainly from seeds or by sets. Sets are small onion bulbs (approx. 1.5 to 2 cm diameter) which are planted by machine. Information gathered by an EPPO Working Group in 2007 in the framework of the preparation of a PRA for *Iris yellow spot virus* indicates that in some southern countries of EPPO (Spain, Italy, Turkey) onions are also produced from transplants (seedlings). The importance of this production is declining. However, these transplants are usually not traded over long distances, they are produced where they are needed (Behr, Zentrale Markt und Preisberichtstelle, pers. comm., 2007). Transplants may also be used in case of shortage of domestic set production (Sundheim, pers. comm. 2008)

For the moment transplants are mainly traded for leek production. International movement of leek transplants is only within the EPPO region (e.g. Greece, Morocco, Portugal, Netherlands, France and Italy). Nevertheless the EWG considered that seedlings could play a role in the further spread of the pest in the PRA area if it was introduced in one part of the PRA area.

There is no report of bulb infection caused by *X. axonopodis* pv. *allii* and on its long term survival in or on bulbs (Humeau *et al.* 2006) so this

pathway (both sets and bulbs for consumption) was not considered.

The EWG considered that green parts are an unlikely pathway. First, the transfer of the bacterium from green parts of *Allium* to a susceptible host species was considered unlikely and would require a sequence of events to happen (green parts of plants discarded near to production places), this could happen if infected green parts are thrown on compost or used as mulch. Information on the frequency of such practice is lacking. Second among countries where the pest is reported, only Brazil is recorded in FAO stats (http://faostat.fao.org/site/535/default.aspx#ancor) as exporting green onions and shallots to EPPO countries for a share of less than 1% of total imports of such products (ca. 12 tones in 2005).This pathways was not considered further.

Establishment

Plants or habitats at risk in the PRA area:

The pest has a narrow host range it affects *Allium* species.

The area harvested in 2006 for the different *Allium* crops for the EPPO region is:

Crop	**Area (ha)**
Onion dry	622103
Onion green	51123
Garlic	15863
Leek and other *Alliaceae*	48585
Total	**872674**

These areas represent 13% of the whole vegetable harvested area in the EPPO region. It is grown in 46 out of the 50 EPPO member countries.

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

Disease development in onion fields was observed at mean daily temperatures ≥ 20°C (Roumagnac *et al.* 2004b). Epidemic conditions are thought to occur at warmer temperatures (24-32°C) and humid conditions (overhead irrigation, rainfall, Roumagnac *et al.*, 2004b, Humeau *et al.*, 2006). Rain is associated with disease severity and epidemic development (Schwartz *et al.* 2003).
It is expected that the pest could become established in all areas where such conditions occur.

A comparison of climate (based on CLIMEX Match) for onion vegetative growth and bulb initiation period was conducted (see Appendix). Locations chosen in the US were Brownsville (Texas) Atlanta (Georgia) and Dodge City (Kansas). It should be noted that *X. axonopodis* pv. *allii* is not present in Kansas but the climate of Dodge City, Kansas was considered more similar to the areas of the Arkansas River Valley in Colorado where the disease occurs most commonly (Gent pers. comm. 2008). Based on the comparisons it was estimated that the Mediterranean area and other warmer countries have climatic conditions which are largely similar with the current area of distribution. The level of uncertainty is low.
Consequently, the countries with areas considered climatically most similar with a low level of uncertainty are: Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, France, Greece, Hungary, Israel, Italy, Kazakhstan, Moldova, Morocco, Portugal, Republic of Macedonia, Romania, Russia Slovenia, Spain, Switzerland, Tunisia, Turkey, and Ukraine.

The Expert Working Group also estimated that the optimal temperatures for *X. axonopodis* pv. *allii* and *X. campestris* pv. *campestris* a bacterium are similar (Schaad & Alvarez, 1993). The presence of free water (rainfall,

irrigation) is a prerequisite for both pathogens. Consequently, the main parameter that would lead to disease establishment or not or is temperature. This is typical of most (if not any) xanthomonads (Stall *et al.*, 1993). Based on the fact that *X. campestris* pv. *campestris*, is widely distributed in Europe (CABI 1987), demonstrating that presence of fresh water is not a limiting factor, it is suggested that the EPPO temperate area could be suitable for establishment of *X. axonopodis* pv. *allii*. The level of uncertainty is medium.
Consequently, the countries with areas considered to be moderately similar with a medium level of uncertainty are: Austria, Belarus, Belgium, Czech Republic, Denmark, Finland, Germany, the Netherlands, Norway, Poland, Slovakia, Sweden, and the United Kingdom.

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

The main host plants are widely grown in the EPPO region. This does favour the establishment.

Which part of the PRA area is the endangered area:

Mediterranean part of the EPPO region and other warmer EPPO countries and to a lower extent the temperate parts of the EPPO region are at risk.

POTENTIAL ECONOMIC CONSEQUENCES

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

In countries where it is present *Xanthomonas axonopodis* pv. *allii* has caused significant yield losses of onions and high control costs when conditions have been suitable (24-32°C and humid conditions).
Xanthomonas axonopodis pv. *allii* negatively affects bulb size of onions because it destroys the foliage thus reducing yield . In the continental United States, yield losses in onions crops ranging from 10 to 50% were reported (Nunez *et al.*, 2002; Schwartz & Otto, 2000). In Réunion Island, yield losses of up to 50% were also recorded (Pruvost, unpublished data). Data from Barbados indicates cases for which an entire onion crop loss was observed (O' Garro & Paulraj, 1997).
For bulb onion production, *Xanthomonas axonopodis* pv. *allii* no lesions on bulbs have been recorded but still smaller bulbs would not be suited for certain markets. No specific data are available for other *Allium* species.
Regarding control costs, preventive copper sprays are needed to control the pest in onion crops (estimate of 10 sprays per year, Gent & Schwartz, 2005a). Lang *et al.* (2007) estimated the cost of these treatments at 250$/ha for the plant protection product only.

The economic impact has not been precisely evaluated, but likely depends on climatic factors.
In onion seed production plots in la Réunion Island the presence of lesions on floral stems was associated with an increase of infructescence lodging by 38% (Humeau *et al.*, 2006).

Describe damage to potential hosts in PRA area:

On onion, lesions consist of lenticular water-soaked leaf spots which turn into dry chlorotic lesions that eventually coalesce. When disease is severe, leaf dieback can occur, resulting in a reduction of bulb size. The morphology of leaf lesions on other *Allium* species is similar to those on onion (Roumagnac *et al.*, 2004).

How much economic impact would the pest have in the PRA area:

Yield losses in individual onion fields without control measures are expected to be similar to those reported in the US in the Mediterranean part of the EPPO region. In other areas the effect on crop yield may only be minor. The EWG chose the rating in a situation of worst-case scenario. The global impact on the industry is difficult to predict.

CONCLUSIONS OF PEST RISK ASSESSMENT

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

Estimate the probability of entry: The probability of entry of *Xanthomonas axonopodis* pv. *allii* into the PRA area is considered moderate to high with a medium uncertainty.
The likelihood of the pest to be associated with the pathway makes entry most likely.
Even if specific data is not available, imports of seed and seedlings are presumed to be minor thus making the entry less likely.

The pathways in order of risk are:
Seeds of *Allium* spp.
Seedlings of *Allium* spp.

Estimate the probability of establishment and spread: The probability of establishment of the pest is high in the Mediterranean area and other warmer EPPO countries.

The level of uncertainty is low.
Elements that make establishment most likely are a suitable climate in the Mediterranean areas and countries with warmer parts and some cultural conditions which are likely to be favourable for the pest. Host plants are grown throughout the EPPO member countries. There is no competition with other pests and no natural enemies. The fact that even a low proportion of infected seed may be sufficient to result in an outbreak makes also establishment likely.

The risk of establishment is low to medium in the temperate part of the EPPO region. The level of uncertainty is medium.

Estimate the potential economic impact: The most important economic impacts are crop yield losses (estimated between 10 to 50 % for onion bulbs).

The endangered part of the PRA area is the Mediterranean part of the EPPO region and other warmer EPPO countries and to a lesser extent the temperate parts of the EPPO region.

Degree of uncertainty Uncertainties affecting the evaluation:

- Pest distribution worldwide. No specific surveys for the presence of the bacterium are carried out.
- Origin of the different outbreaks reported throughout the world remains partly unknown
- The global impact on the industry is difficult to predict.
- Host range: Experimental work has shown that *Xanthomonas axonopodis* pv. *allii* can survive and multiply in association with *Citrus* (Gent *et al*., 2005a) but no natural outbreaks on *Citrus* have been recorded.
- Volume and frequency of trade of *Allium* seed and seedlings from contaminated areas to the EPPO region.
- Not all cultural practices for *Allium* in the EPPO region are well known.

OVERALL CONCLUSIONS The pest presents a risk for the EPPO region and is an appropriate candidate for stage 3 of the pest risk analysis.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management	**Seeds of *Alliums* sp** **Seedlings of *Allium* sp**
Other pathways identified but not studied	**Green parts of *Allium* sp** The EWG considered that green parts are an unlikely pathway (see explanation in the entry part of the report).

IDENTIFICATION OF POSSIBLE MEASURES

Possible measures for pathways

- **Pathway 1: Seeds of *Allium* sp**

Measures related to consignments:
No measures identified (testing of seeds a stand alone measure was not considered appropriate for a pest absent from the region)

Measures related to the crop or to places of production:
Seed production in pest-free areas or pest-free places of production
Place of production freedom should consist of a combination of the following individual measures:

- Pest should have been absent from the place of production in the previous growing period (based upon inspection and testing)
- Sanitation measures in the growing crop (e.g. prevention of infection with tools, equipments, etc.)
- Seeds produced from seeds free from the pest, or from bulbs.
- Buffer zone of 1 km to 5 km depending on local climatic conditions (e.g. in areas prone to storms). There is uncertainty on the minimum distance needed for the buffer zone.
- Testing during the growing period.

Other possible measures
The importing country may consider including *X. axonopodis* pv. *allii* in its surveillance programme and prepare an emergency plan for its eradication.

The following measures are not currently available but could be envisaged when available:
Treatment of seeds (thermal treatment)
Inclusion of the pest in seed certification schemes – including seed testing.

- **Pathway 2: Seedlings of *Allium* sp**

Measures related to consignments:
No measures identified.

Measures related to the crop or to places of production:
Seedling production in pest-free areas is considered an individual measure that reduces the risk to an acceptable level.

Place of production freedom also reduces the risk to an acceptable level and should consist of a combination of the following individual measures:

- Pest should have been absent from the place of production during the previous growing period (based upon inspection and testing)
- Sanitation measures (e.g., prevention of infection with tools, equipments, etc.)
- Seedlings produced from seeds free from the pest or from bulbs
- Protection from wind driven rain or buffer zone of 1 km to 5 km depending on local climatic conditions (e.g. in case of storm). There is uncertainty on the minimum distance of such buffer zone.
- Testing during the growing period

Other possible measures
The importing country may consider including *X. axonopodis* pv. *allii* in its surveillance programme and prepare an emergency plan for its eradication.

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

Pest-free area or pest-free place of production are common phytosanitary measures for plants for planting, which are required for other plant pathogenic bacteria of vegetable crops.

Degree of uncertainty	Uncertainties in the management part are: Efficiency of seed testing: current seed testing method relies on isolation of the pest which could be negatively affected due to overgrowth of saprophytic bacteria (measure not recommended). Efficiency and possible adverse effects of a seed treatment need to be tested (measure not recommended). Minimum distance required for a buffer zone for PFPP. Potential for disruption in the *Allium* seed supply due to phytosanitary measures could not be estimated Production of *Allium* seedlings in protected cultivation to prevent the infection is considered possible but should be further investigated.

CONCLUSION:

Recommendation for possible measures:

PC= Phytosanitary certificate, RC=Phytosanitary certificate of re-export

Pathway 1: Seeds of *Allium* sp	PC and, if appropriate, RC • Seed production in pest-free areas or • Seed production in pest-free places of production

Pathway 2: Seedlings of *Allium* sp	PC and, if appropriate, RC • Seedling production in pest-free areas or • Seedling production in pest-free places of production (open-field or protected conditions)

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Appendix climatic prediction for *Xanthomonas axonopodis* pv. *allii*

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.

CLIMEX provides tools for predicting and mapping the potential distribution of an organism based on:

(a) climatic similarities between areas where the organism occurs and the areas under investigation (Match Index),

(b) a combination of the climate in the area where the organism occurs and the organism's climatic responses, obtained either by practical experimentation and research or through iterative use of CLIMEX (Ecoclimatic Index).

For *Xanthomonas anoxopodis* pv. *allii,* a Match Climate study has been undertaken.

1. Geographical distribution of the species

EPPO region: absent
Asia: Japan (Kadota *et al.*, 2000) Okinawa
Africa: Mauritius, Réunion (Roumagnac *et al.*, 2000), South Africa (Serfontein, 2001)
North America: USA (California, Colorado, Georgia, Texas) (Nunez *et al.*, 2002; Schwartz & Otto, 2000; Sanders *et al.*, 2003; Isakeit *et al.*, 2000)
Central America and Caribbean: Barbados (Paulraj & O' Garro, 1993), Cuba
South America: Brazil (Neto *et al.*, 1987), Venezuela (Trujillo & Hernandez, 1999)
Oceania: Hawaii (Alvarez *et al.*, 1978)
Xanthomonas anoxopodis pv. *allii* most northern distribution is in the USA, in Colorado.

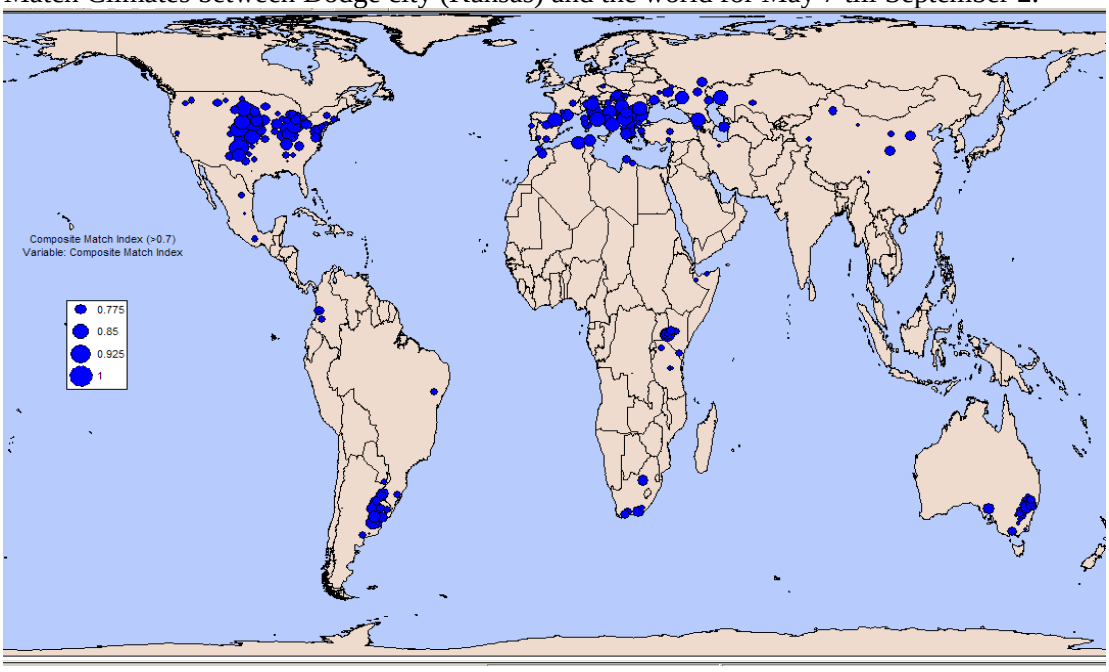
2. Biology (summary of elements presented in the PRA record)

Xanthomonas anoxopodis pv. *allii* is a bacterium which infects *Allium* spp. This pest develops on leaves during *Allium* vegetative growth and the bulb initiation period. Mean daily temperatures below 20°C prevent outbreak development but do not negatively affect pest survival. Consequently, it can survive during winter in debris. Rain is associated with disease severity and epidemic development. Overhead irrigation favours infection.

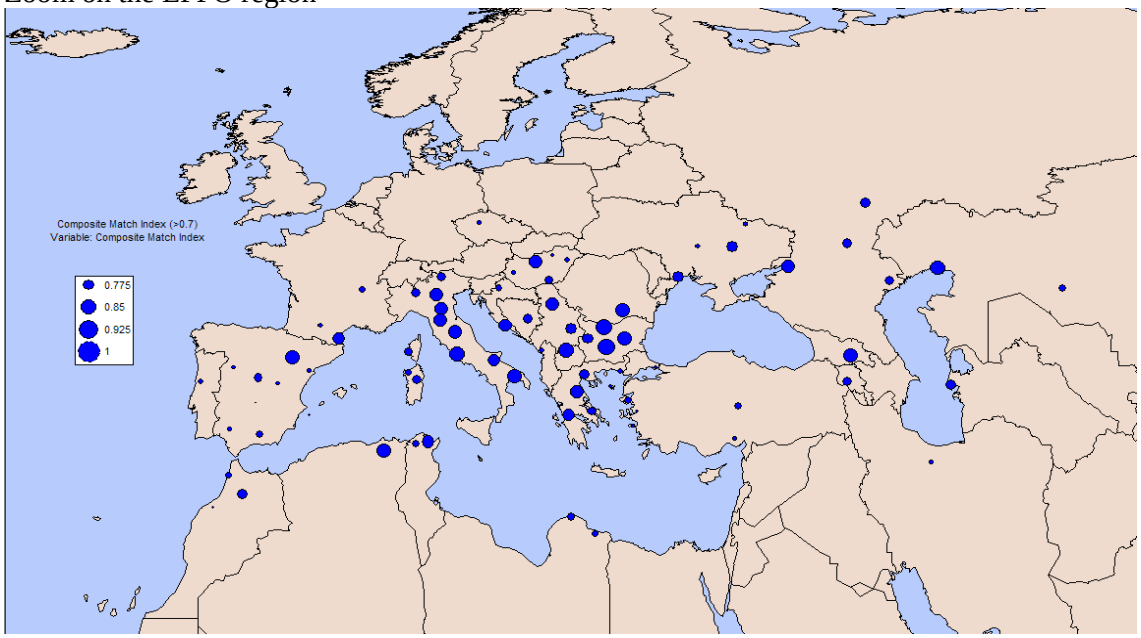
3. Match climates

Match climates for Dodge City (Kansas), Brownsville (Texas), Atlanta (Georgia) compared with the world during the onion vegetative growth and bulb initiation period i.e. May 7 till September 2 (this period covers the periods where onion are grown in Europe sowing is usually done between March and early May, bulb initiation starts in May harvest is between mid-July and September). It should be noted that *X. axonopodis* pv. *allii* is not present in Kansas but the climate of Dodge City, Kansas was considered more similar to the areas of the Arkansas River Valley in Colorado where the disease occurs most commonly (Gent pers. comm. 2008).

a. Match Climates between Dodge city (Kansas) and the world for May 7 till September 2.

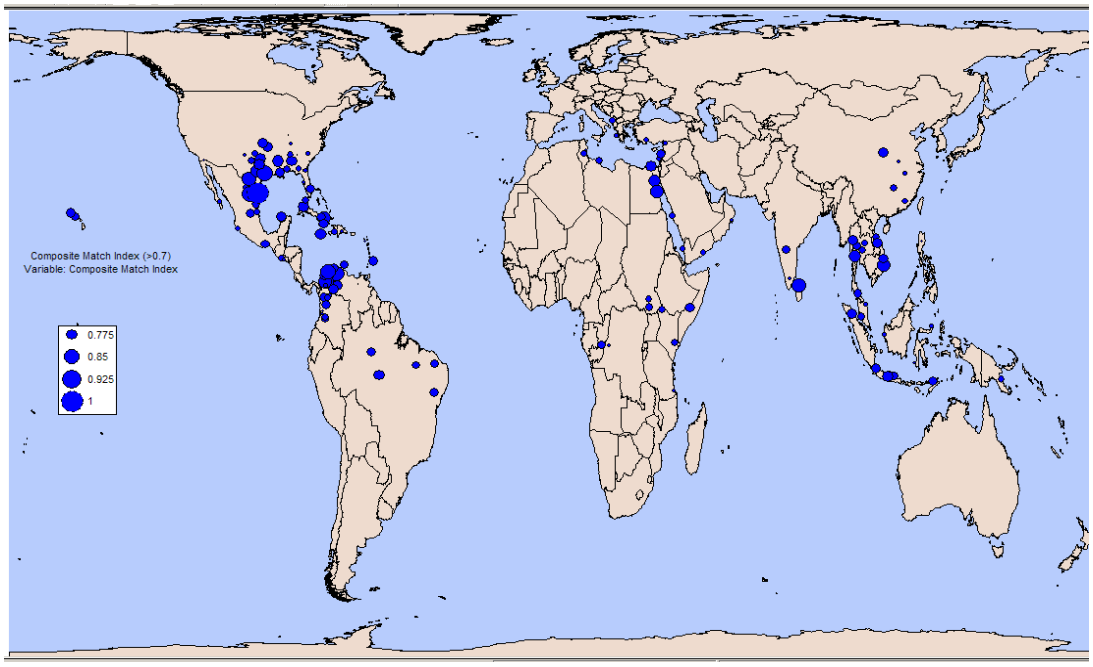


Zoom on the EPPO region



EPPO countries having on their territory (or part thereof) climatic conditions similar up to 70% with Dodge City (Kansas) between May 7 and September 2 are: Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, France, Greece, Hungary, Italy, Kazakhstan, Moldova, Morocco, Portugal, Republic of Macedonia, Romania, Russia Slovenia, Spain, Switzerland, Tunisia, Turkey, and Ukraine.

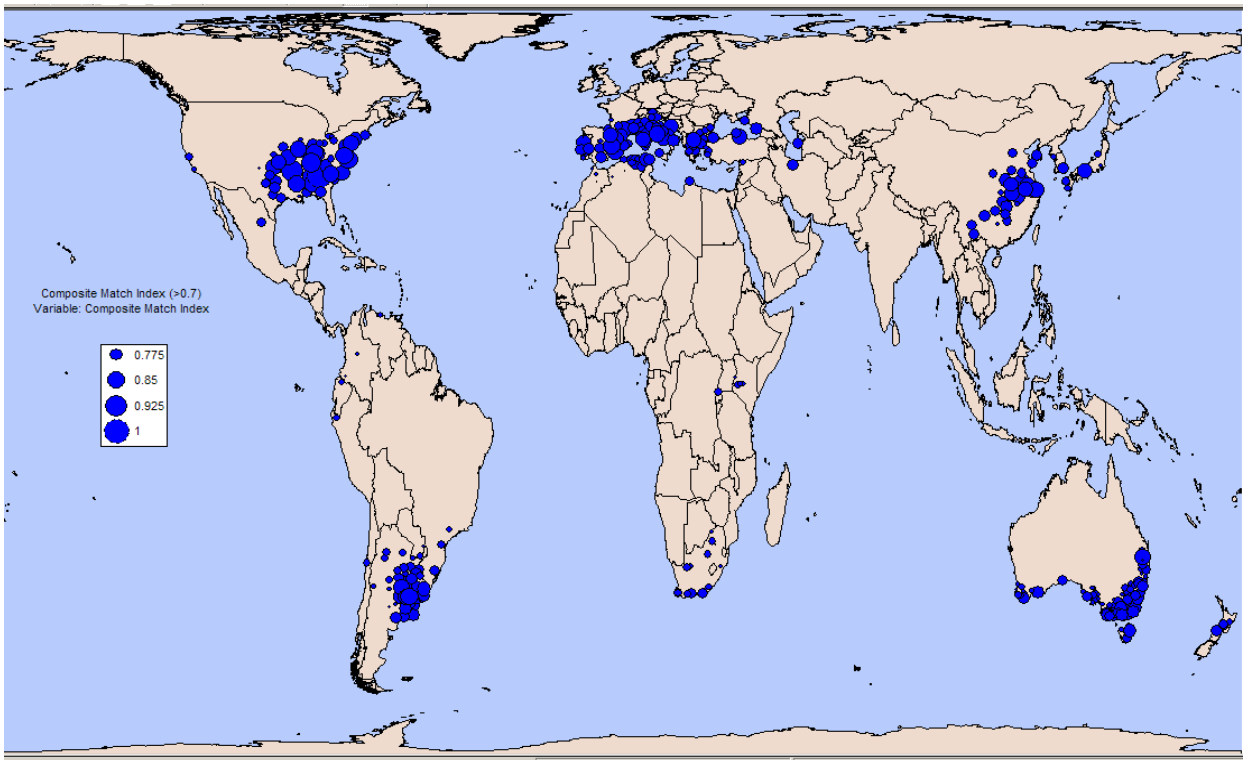
b. Match Climates between Brownsville (Texas) and the world, between May 7 and September 2



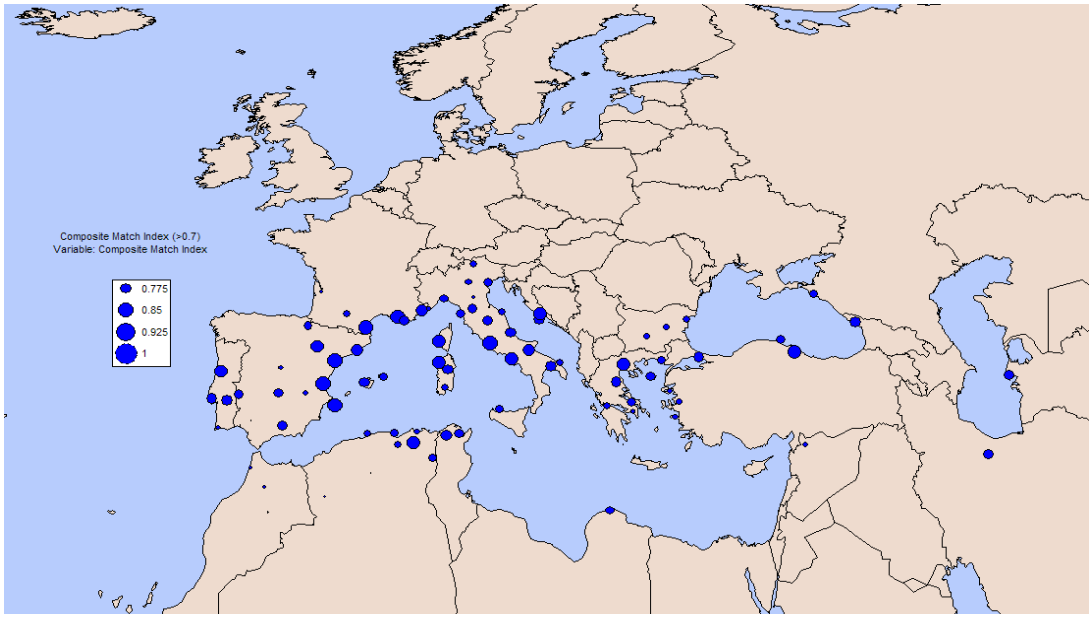
Zoom on the EPPO region

EPPO countries having, on their territory (or part thereof), climatic conditions similar up to 70% with Brownsville between May 7 and September 2 are: Albania, Greece, Israel, Tunisia, and Turkey.

c. Match Climates between Atlanta (Georgia) and the world between September 3 till December 2



Zoom on the EPPO region



The EPPO countries sharing , on their territory (or part thereof), a similar climate with Atlanta (Georgia) and the world between September 3 and December 2 are the same as the one identified in the previous Match Climates.

Conclusion

Based on CLIMEX Match location maps for Dodge City (Kansas), Brownsville (Texas) and Atlanta (Georgia) for onion vegetative growth and bulb initiation period (see appendix), it was estimated that the Mediterranean area is largely similar. The countries with areas at risk are: Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, France, Greece, Hungary, Israel, Italy, Kazakhstan, Moldova, Morocco, Portugal, Republic of Macedonia, Romania, Russia Slovenia, Spain, Switzerland, Tunisia, Turkey, and Ukraine. The level of uncertainty is low.

However, the Expert Working Group estimated that the optimal temperatures for *X. campestris* pv. *campestris* and *X. axonopodis* pv. *allii* are similar (see question 1.19). Based on the world distribution map of *X. campestris* pv. *campestris* (CABI, 1987) it is suggested that the EPPO temperate area could be suitable for establishment of *X. axonopodis* pv. *allii*.
The countries with areas at risk with a medium level of uncertainty are: Austria, Belarus, Belgium, Czech Republic, Denmark, Finland, Germany, the Netherlands, Poland, Slovakia, Sweden, and the United Kingdom.