PRA RECORD (version 3 of the Decision support scheme for PRA for quarantine pests) *Xanthomonas axonopodis* pv. *allii*

	European and Mediterranean Plant Protection Organisation		
	Organisation Européenne et Méditerranéenne pour la Protection des Plantes		
	Guidelines on Pest Risk Analysis		
	Lignes directrices pour l'analyse du risque phytosanitaire		
	Decision-support scheme for quarantine pests version N°3		
PEST RISK ANALYSIS FOR *Xanthomonas axonopodis* pv. *allii*			
Pest risk analyst:	EWG on *Xanthomonas axonopodis* pv. *allii*	2008-08-25/28	Gent David H. USDA-ARS, Forage Seed and Cereal Research Unit, Corvallis, OR (US) Krauthausen Hermann-Josef, Agricultural Service Centre, Neustadt/Weinstr. (DE), Pruvost Olivier CIRAD UMR PVBMT La Réunion (FR), Üstün Nursen Plant Protection Research Institute, Bornova/Izmir (TR); EPPO Secretariat: Petter Françoise, Brunel Sarah (CLIMEX study) The risk management part was reviewed by the Panel on phytosanitary measures in 2009-02.
Stage 1: Initiation			
1 What is the reason for performing the PRA?			A recently characterized bacterium, *Xanthomonas axonopodis* pv. *allii* (Roumagnac *et al*., 2004b) 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.
2 Enter the name of the pest			*Xanthomonas axonopodis* pv. *allii* (Bacterial blight of Onion)
2A Indicate the type of the pest			Bacterium
2B Indicate the taxonomic position			Proteobacteria, Gammaproteobacteria, Xanthomonadales, Xanthomonadaceae, *Xanthomonas*
3 Clearly define the PRA area			EPPO member countries (see http://www.eppo.org/ABOUT_EPPO/about_eppo.htm)
4 Does a relevant earlier PRA exist?			No

6 Specify the host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants) present in the PRA area.		*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).
7. Specify the pest 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.

Stage 2A: Pest Risk Assessment - Pest categorization

8. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	Yes	The pest is classified as a single bacterial species. It can be distinguished at the pathovar level based on pathogenicity tests (Gent *et al.*, 2005a). A detached onion leaf assay was recently developed (Picard *et al*., 2008). A multiplex PCR assay that detects all known strains of the pest is currently under final evaluation (manuscript to be submitted shortly).
9. Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms		Not applicable the organism is a clearly single taxonomic entity

and to be transmissible?

10. Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?	Yes	*Xanthomonas axonopodis* pv. *allii* is a pest of onion and other *Allium* crops where it is present.
11. Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?		N.A. (it is a pest)
12 Does the pest occur in the PRA area?	No	The pest is not know to occur in the PRA area
13. Is the pest widely distributed in the PRA area?	N.A.	
14. Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?	Yes	Onion and other *Allium* crops are widely grown outdoors in the EPPO region..
15. If a vector is the only means by which the pest can spread, is a vector present in the PRA area? (if a vector is not needed or is not the only means by which the pest can spread go to 16)		No vector needed. Spread is mainly with infested material. The bacterium can also spread with wind-driven rains, irrigation water, transportation by animals and humans, the use of contaminated equipment or clothes for plot maintenance operations.
16. Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?	Yes	The pest causes a disease in Alliums in areas with tropical, subtropical and continental climates. The pest has been reported in California (Nunez *et al.*, 2002), Colorado (Schwartz & Otto,2000), Georgia (Sanders *et al.*, 2003), Texas (Isakeit *et al.*, 2000) which have climatic conditions similar to some parts of the EPPO region (see Fig 1 the World Map of the Köppen-Geiger climate classification for the period 1951-2000).
17. With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on	Yes	Host plants are present and where the climatic conditions are suitable, the pest might cause significant yield reduction as it is the case in its current area of distribution.

society, on export markets) through the effect on plant health in the PRA area?		
18. This pest could present a risk to the PRA area.	Yes	*Xanthomonas axonopodis* pv. *allii* is a pest of crops widely grown in EPPO member countries. Damage is recorded in areas where the pest is present.

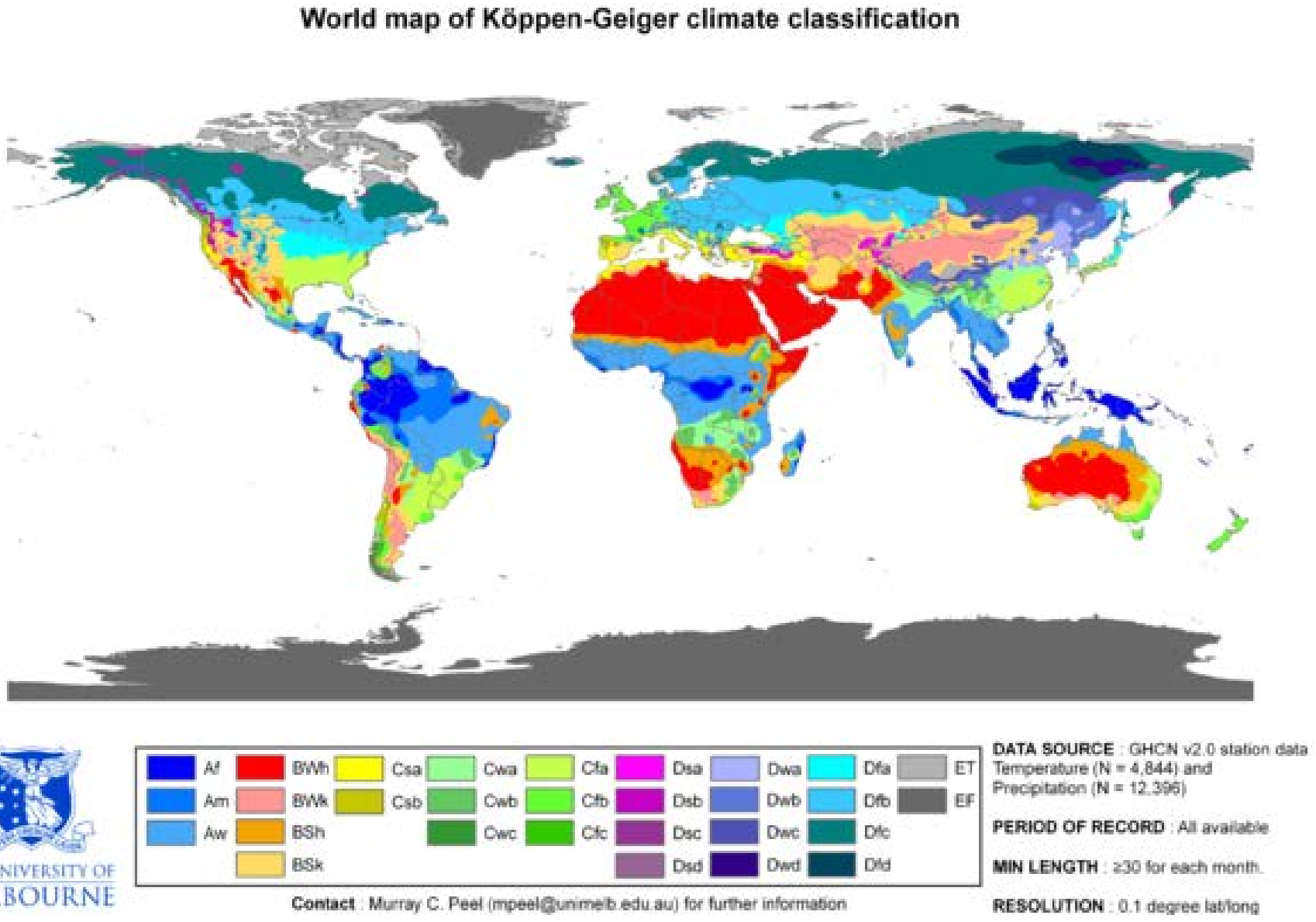

World map of Köppen-Geiger climate classification
Af
Am
Aw
BWh
BWk
BSh
BSk
Csa
Csb
Cwa
Cwb
Cwc
Cfa
Cfb
Cfc
Dsa
Dsb
Dsc
Dsd
Dwa
Dwb
Dwc
Dwd
Dfa
Dfb
Dfc
Dfd
ET
EF
THE UNIVERSITY OF MELBOURNE
Contact : Murray C. Peel (mpeel@unimelb.edu.au) for further information
DATA SOURCE : GHCN v2.0 station data
Temperature (N = 4,844) and
Precipitation (N = 12,396)
PERIOD OF RECORD : All available
MIN LENGTH : ≥30 for each month.
RESOLUTION : 0.1 degree lat/long

Fig 1

Section 2B: Pest Risk Assessment - Probability of introduction/spread and of potential economic consequences

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.1. Consider all relevant pathways and list them		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

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		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 exported 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.
1.2. Estimate the number of relevant pathways, of different commodities, from different origins, to different end uses.	**few** **low uncertainty**	Seeds of *Allium* spp. Seedlings of *Allium* spp.
1.3. Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.		Seeds of *Allium* spp. is the most important pathway. Although seedlings of *Allium* spp. are not a pathway for international trade from countries outside the EPPO region, it could be a pathway for further spread within the EPPO region.
Pathway No°: 1		Seeds of *Allium* spp.
1.4. How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Likely** **Low**	When significant disease development is observed in onion seed production fields, the pathogen is likely to be present in the seeds. In such fields, the pest was detected from symptomatic and asymptomatic plants (Humeau *et al.*, 2006). After the detection of the first outbreaks in the Réunion Islands in 1993 studies have been conducted showing that onion seed was a highly probable pathway for the introduction of the pathogen to Réunion Island from the neighboring island of Mauritius where the pest has been present since 1984 (Picard *et al.*, 2008). Contaminated onion seeds were also considered as the likely source of inoculum in Hawaii because the disease was found in onion field established in cleared brush land on the island of Molokai (Alvarez *et al.*, 1978). Outbreaks in onion seed production fields have been observed in South Africa (Pruvost, pers.

<table>
<tr><th>Question</th><th>Rating + uncertainty</th><th>Explanatory text of rating and uncertainty</th></tr>
<tr><td></td><td>uncertainty</td><td>comm., 2008)

As for the US, the pest is not present in the Pacific Northwestern U.S where the main onion seed production is located.</td></tr>
<tr><td>1.5. How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?</td><td>Likely

Low uncertainty</td><td>Over three years, outbreaks of bacterial blight of onion were induced in experimental plots sown with naturally contaminated seed lots a rate of 4 seeds per 10000 (Roumagnac et al., 2004b). Xanthomonas axonopodis pv. allii population sizes associated with contaminated onion seed were determined experimentally and ranged from $5x10^2$ to $2x10^6$ cfu per gram of seed (Roumagnac et al., 2000). Such bacterial concentrations were confirmed in subsequent studies (Roumagnac et al., 2004b; Humeau et al., 2006).
As showed by Gent & Schwartz (2005a) specific sprays provide disease suppression, but not complete control. Limited data is available on the effect of copper sprays on ‘infestations’, which would include epiphytic populations. It is highly improbable that ‘infestation’ on leaves or seeds could be prevented with copper sprays.
Control of fungi includes copper-based sprays.

No treatment of seed consignment is available.</td></tr>
<tr><td>1.6. How large is the volume of the movement along the pathway?</td><td>Minor

High uncertainty</td><td>There is no detailed data on the trade for seeds of Allium (statistics are available from EUROSTAT for bulbs of onions for planting but not for true seeds). The imports of vegetable seeds recorded form 2005 to 2007 from countries where the pest is present (Brazil, Japan, South Africa and the United States) are as follows.
<table>
<tr><th>EU (27) in Tonnes</th><th>Brazil</th><th>JAPAN</th><th>UNITED STATES</th><th>SOUTH AFRICA</th></tr>
<tr><td>Jan.-Dec. 2005</td><td>12</td><td>102</td><td>1814</td><td>100</td></tr>
<tr><td>Jan.-Dec. 2006</td><td>24</td><td>67</td><td>1784</td><td>97</td></tr>
<tr><td>Jan.-Dec. 2007</td><td>29</td><td>145</td><td>1918</td><td>151</td></tr>
</table>
Data gathered from German seed companies indicate that the total need for EU countries for onion seeds is estimated to be 800 tonnes (based on an area of ca. 200 000 ha and a sowing rate of 4 kg per hectare). These companies also indicated that 70 % of the seeds used in EU countries are of European origin, 20% are from Japan and 10% from the US.

No further specific information could be gathered from seed companies as of now.</td></tr>
</table>

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.7. How frequent is the movement along the pathway?	**Occasionally** **High uncertainty**	No information available
1.8. How likely is the pest to survive during transport/storage?	**Very likely** **Low uncertainty**	Contaminated onion seed lots were intercepted in Réunion Island in 1996 from Mauritius Island The pathogen was still culturable in 2006 from these seed lots (Pruvost, unpublished data)
1.9. How likely is the pest to multiply/increase in prevalence during transport /storage?	**Impossible** **Low uncertainty**	The pest will not multiply in seeds.
1.10. How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Very likely** **Low uncertainty**	In most EPPO countries there are no specific phytosanitary requirements for vegetable seeds (a phytosanitary certificate is required for the import of such seeds into the EU but this is linked to requirements concerning nematodes, EU 2000). No curative procedure is available for the moment. No symptoms are visible on seeds. Laboratory tests are needed for detection of contaminated seed lots but are not required now. Consequently, there is a high probability of contaminated seed to remain undetected after phytosanitary inspections done at the ports of entry in individual countries within the EPPO region It is very likely that the bacterium will survive existing pest management procedures.
1.11. In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	**Very widely** **Medium uncertainty**	Most seeds used for *Allium* production are produced within the PRA area but as *Allium* crops are cultivated throughout the EPPO region those that are imported may be distributed throughout the PRA area.
1.12. In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	**Yes**	The period of arrival is not relevant for seeds.
1.13. How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Very likely** **Low uncertainty**	The pathway is the seeds and even a low infestation (4 infested onion seeds in 10 000 is sufficient to result in an outbreak (Roumagnac *et al.* 2004b).
1.14. In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Very likely** **Low uncertainty**	The intended use of seeds is planting and the pest is seed transmitted (Roumagnac *et al.*, 2000; Roumagnac *et al.*, 2004b).

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.15. Do other pathways need to be considered?	**Yes**	
Pathway No°: 2		Seedlings of *Allium* spp.
1.4. How likely is the pest to be associated with the pathway at origin taking into account factors such as the occurrence of suitable life stages of the pest, the period of the year?	**Very likely** **Medium uncertainty**	There is no specific data available on the infection of seedlings of *Allium* spp. For another bacterium *Xanthomonas campestris* pv. *campestris*, it has been shown that seedlings are more likely to be infected than seeds. (Roberts *et al*., 1999). It is very likely to be similar for *X. axonopodis* pv. *allii*.
1.5. How likely is the concentration of the pest on the pathway at origin to be high, taking into account factors like cultivation practices, treatment of consignments?	**Very likely** **Low uncertainty**	Concentration of the pest on seedlings is likely to be higher than on seeds due to cultural practices (high plant density, humidity) (Roberts *et al*., 1999).
1.6. How large is the volume of the movement along the pathway?	**Minimal** **Low uncertainty**	There is no long distance trade of seedlings coming to the EPPO region ((Behr, Zentrale Markt and Preisberichtstelle, pers. comm., 2007). The only trade recorded is for leek seedlings but restricted between countries of the EPPO region (i.e. from Morocco, Portugal, the Netherlands, Italy and Greece).
1.7. How frequent is the movement along the pathway?	**Occasionally** **High uncertainty**	No information available.
1.8. How likely is the pest to survive during transport/storage?	**Very likely** **Low uncertainty**	The pest will survive during transport and storage. Transport is likely to be very short. The bacterium survives at least several months in onion leaves (Gent *et al.*, 2005b). These studies were conducted with leaves buried or left on the soil surface over a period of 9 months. The leaves were exposed to natural overwintering conditions in northern and southern Colorado.
1.9. How likely is the pest to multiply/increase in prevalence during transport /storage?	**Unlikely** **Low uncertainty**	Under wet conditions there is the possibility for the bacterium to spread from infected seedlings and consequently to increase prevalence in the consignment. However short transportation time and cool temperature do not favour pest multiplication.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.10. How likely is the pest to survive or remain undetected during existing management procedures (including phytosanitary measures)?	**Likely** **Low uncertainty**	Symptoms may be visible but in most cases the infection will be latent (very common for bacteria) or epiphytic (Gent *et al.*, 2005b). The EU import general requirements for plants for planting (e.g. plants should have been inspected at appropriate times and prior to export and found free from symptoms of harmful bacteria) do not prevent the introduction of plants with latent infection (EU, 2000).
1.11. In the case of a commodity pathway, how widely is the commodity to be distributed throughout the PRA area?	**Moderately widely** **High uncertainty**	There is little information available on the use of transplants. Information gathered in 2007 in the framework of the preparation of the PRA on *Iris yellow spot virus* indicated that onion transplants are mainly used in southern member countries but that it was declining (see 1.1). Transplants are widely used for leek production. Transplants also are used in organic farming (to allow a better weed control as transplants better compete with weeds) but no data are available on the area grown.
1.12. In the case of a commodity pathway, do consignments arrive at a suitable time of year for pest establishment?	**Yes**	Seedlings will be imported at an appropriate period for planting.
1.13. How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?	**Very likely** **Low uncertainty**	The inoculum is already in the seedling so a source of infection will be present, and transfer to other non infected plants can occur by wind or splashing water.
1.14. In the case of a commodity pathway, how likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) to aid transfer to a suitable host or habitat?	**Very likely** **Low uncertainty**	The intended use of seedlings is planting. This favours transfer of the pest.
1.15. Do other pathways need to be considered?	**No**	

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
Conclusion on the probability of entry. Risks presented by different pathways.	**The risk of entry is moderate to high with a medium uncertainty.** **Seed is the main pathway. Import of seedlings from outside the EPPO region is nearly zero.**	Most of the questions of the entry section for both pathways have been rated high, apart from the questions related to the trade for which information is lacking. Even if specific data on seed trade is not available, most seeds used in *Allium* production are produced within Europe (EU data from seed producing companies refer to 70% being of EU origin, although tracing the origin of seed is always difficult). Nevertheless: There are no official records of major outbreaks in seed production areas, but the uncertainty on the presence of the pest in seed production areas should be considered high. Potentially contaminated seeds will remain undetected after phytosanitary inspections done at the port of entry (as inspection does not target this pest). No curative procedure for seed disinfestation is currently applied. The probability of entry of *Xanthomonas axonopodis* pv. *allii* into the PRA area was consequently considered moderate to high with a medium uncertainty. Seed is the main pathway. Import of seedlings from outside the EPPO region is nearly zero.
1.16. Estimate the number of host plant species or suitable habitats in the PRA area (see question 6).	**Few** **Low uncertainty**	The pest has a narrow host range.
1.17. How widespread are the host plants or suitable habitats in the PRA area? (specify)	**Very widely** **Low uncertainty**	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 (Source FAO STAT, for details see Appendix 1).

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.18. If an alternate host or another species is needed to complete the life cycle or for a critical stage of the life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers), how likely is the pest to come in contact with such species?	**Not relevant**	No alternate host is needed.
1.19. How similar are the climatic conditions that would affect pest establishment, in the PRA area and in the current area of distribution?	**Largely similar For Mediterranean area and other warmer EPPO countries.** **Low uncertainty** **Medium uncertainty**	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 2). 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 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

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		temperate area could also 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.
1.20. How similar are other abiotic factors that would affect pest establishment, in the PRA area and in the current area of distribution?	**Completely similar** **Low uncertainty**	No data suggest that pH or soil type have an influence.
1.21. If protected cultivation is important in the PRA area, how often has the pest been recorded on crops in protected cultivation elsewhere?	**Very rarely** **Low uncertainty**	In the EPPO region, *Allium* crops are usually not produced under protected cultivation apart from transplant production. In Japan outbreaks were recorded on Welsh onion both in fields and in protected cultivation (Kadota *et al.*, 2000). This is the only known record in protected cultivation (in nursery boxes).
1.22. How likely is it that establishment will occur despite competition from existing species in the PRA area?	**Very likely** **Low uncertainty**	No case of efficient natural competition documented.
1.23. How likely is it that establishment will occur despite natural enemies already present in the PRA area?	**Very likely** **Low uncertainty**	No case of efficient natural antagonism documented at levels that will prevent establishment. Several saprophytic microorganisms (fungi, bacteria, viruses) can have a negative effect on *X. axonopodis* pv. *allii*, but none have been identified as having the potential of preventing establishment of the pest.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.24. To what extent is the managed environment in the PRA area favourable for establishment?	**Moderately favourable** **Medium uncertainty**	Important factors are: Irrigation: overhead irrigation favours infection and the spread of the pest (Roumagnac *et al.*, 2004b, Humeau *et al.*, 2006). In addition Gent *et al.* (2005b) showed that in infected onion fields with furrow irrigation the bacterium could be recovered from irrigation water collected at the bottom of the fields suggesting that the pathogen can be disseminated within and among fields in water. In several countries in the EPPO region overhead irrigation is common (it is used as part of the management of thrips). In others (e.g. Turkey) furrow irrigation is more important. High nitrogen fertilization has also been proven to favour the disease (Gent & Schwartz, 2005b) Studies made on the survival of the bacterium in crop debris show that culturable populations of *X axonopodis* pv. *allii* decreased more than 10^9 in leaves buried 25 cm deep. Consequently, cultivation practices such as deep ploughing reduces pathogen survival in crop debris (Gent *et al.* 2005b). Rotation is also important in the disease management (Gent *et al.* 2005c) as the bacterium does not survive epiphytically for longer than one season on weed species. Information on cultivation practices in EPPO member countries was not available to the EWG, making the judgment difficult. The EWG considered that the cropping conditions in the EPPO member countries are very diverse but all will tend to increase crop yield and likely favour disease development and rated it "moderately favourable".
1.25. How likely is it that existing pest management practice will fail to prevent establishment of the pest?	**Very likely** **Low uncertainty**	Bacterial neck rot, caused by *Burkholderia gladioli* pv. *alliicola*, is the main bacteria on recorded on onion in the EPPO region as described in PP 2/4(2) *Guidelines on good plant protection practice for* Allium *crops* (EPPO, 2000). It occurs mainly on onions after physical damage, caused for example by a heavy infection of *Peronospora destructor*, storm, hail or wind. In wet years, the disease can be observed during the second part of the growing season. Other bacterial diseases affect *Allium* crops but are of relatively minor importance and require no special control measures: *Burkholderia cepacia* (onion), *Pseudomonas syringae* pv. *porri* (leek), *P. fluorescens* (garlic). Management practices for fungi include copper-based sprays that are also partly effective against

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		X. *axonopodis* pv. *allii* but this is not enough to prevent establishment of the pest (see also answer to question 1.5)
1.26. Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the PRA area?	**Likely** **Low uncertainty**	Volunteer onion plants can display bacterial blight lesions and are an early source of inoculum. Moreover, the pathogen was asymptomatically detected from several weed genera in diseased fields, from irrigation water and crop debris (Gent *et al.*, 2005b). Eradication measures should include crop destruction, removal of plant debris or use of herbicides on crop plants as well as control of volunteer plants and weeds eradicate the pathogen, no host plants should be planted in the infected fields for at least two years. Nevertheless this is highly dependant on the ability to recognize symptoms in the field and to diagnose the pathogen, how early the eradication is started and the environmental conditions in the area. Large availability of host plants in private gardens may be a problem too.
1.27. How likely is the reproductive strategy of the pest and the duration of its life cycle to aid establishment?	**Very likely** **Low uncertainty**	Bacteria reproduce through binary fission. Generation time for the pest under optimal growth conditions (e.g. 28-30 °C with appropriate oxygenation) was approximately 1.5 hr (Pruvost, unpublished data). The generation time is highly dependent on environmental conditions, e.g., temperature, nutritive conditions, availability of aerobic conditions, pH, etc. Under environmental conditions highly conducive to disease development, a huge inoculum can build within a few days (Humeau *et al.*, 2006). Such conditions would markedly help establishment. However, non-conducive environmental conditions greatly suppress outbreaks.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
1.28 How likely are relatively small populations to become established?	**no judgment**	Outbreaks can result from mildly contaminated seed lots (4/10000) (Roumagnac *et al.*, 2004b) but this is environment dependent (Gent & Schwartz, 2005b). Difficult question to address precisely.
1.29 How adaptable is the pest?	**Moderate adaptability** **Medium uncertainty**	Not precisely known. However, when compared to most other pathovars of *Xanthomonas*, the genetic diversity of the pathogen was high (Gent *et al.*, 2004; Roumagnac *et al.*, 2004a; Gent *et al.*, 2005a). The pathogen is classified within *X. axonopodis* genetic cluster 9.2 (Rademaker *et al.*, 2000) (syn. *X. alfalfae sensu* Schaad *et al.*, 2005), a group more diverse than other genetic clusters. Members of this group were shown to have the ability to integrate foreign DNA (Basim *et al.*, 1999). Host range may be larger than the one for most *Xanthomonas* (Gent *et al.*, 2005a). Although infections of experimental hosts in genera other than *Allium* have not occurred under natural conditions this suggest an adaptability of the pest.
1.30. How often has the pest been introduced into new areas outside its original area of distribution? (specify the instances, if possible)	**Occasionally** **Medium uncertainty**	Its original area of distribution is not known (it may actually be different from the area where the pathogen was first described). It is present on different continents (Asia, Africa and the Americas). There is a number of new pest reports over the last decades, giving bacterial blight of onions the status of an emerging disease. There is uncertainty about the distribution of the disease in tropical and subtropical areas. Because of the diagnostic structures in place in the US, South Africa and Japan it is very likely that the pest was not present very long before it was identified. These reports can be considered as introductions into a new area. Countries and years of reports are: Barbados, 1971; Hawaii, 1975; Cuba, 1980s; Mauritius, 1984; Brazil, 1987; Réunion, 1993; Continental USA (four states), 1996-2001; Japan, 1998; Venezuela, 1999; South Africa, 1999.
1.31. If establishment of the pest is very unlikely, how likely are transient populations to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment)?	**Not relevant**	Establishment is not very unlikely.
Conclusion on the probability of establishment		The probability of establishment of the pest is high in the Mediterranean area and other warmer EPPO countries. The level of uncertainty is low. The risk of establishment is low to medium in the temperate part of the EPPO region. The level

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
		of uncertainty is medium.
1.32. How likely is the pest to spread rapidly in the PRA area by natural means?	**Moderately likely** **Medium uncertainty**	Once the pest is established in an area, it may spread locally by several means (e.g. rainfall). In epidemiological trials conducted in Réunion Island, the most likely source of inoculum (excluding inoculum from seeds) was identified as the migration of the pest over distances >500 m in association with wind-driven rains with wind speeds = 9 m s^{-1} (Humeau *et al.*, 2006). Spread would be exacerbated in the case of wind-driven rains (up to 1km) or aerosols. This is documented for many plant pathogenic bacteria (Gottwald *et al.*, 2001; Gottwald *et al.*, 2002, Kuan *et al.*, 1986, McInnes *et al.*, 1988). Billing and Berrie (2002) reported spread of *Erwinia amylovora* (the cause of fireblight of pome fruit) to a distance of 100 m or more from hawthorns to orchards trees by strong winds during storms. In the case of citrus canker caused by *Xanthomonas axonopodis* pv. *citri* spread up to 10 km associated with hurricanes has been documented (Gottwald & Irey, 2007). Although there is no specific study, the EWG considered that animals (insects, birds, etc.) can passively spread the pest. Although the global efficiency of such spread is assumed to be low.
1.33. How likely is the pest to spread rapidly in the PRA area by human assistance?	**Likely** **Low uncertainty**	Spread by human assistance within the PRA area is likely. The pest could be spread through plot maintenance practices (tools, clothes, equipment, and irrigation water). The pest could also move within the PRA area through contaminated seed or seedlings in the case of undetected or lately detected outbreaks.
1.34. Based on biological characteristics, how likely is it that the pest will not be contained within the PRA area?	**Likely** **Low uncertainty**	There is no evidence that the pest could be contained in countries where it is present and suitable conditions occur for disease development and spread.
Conclusion on the probability of spread	**Probability of spread is considered medium with a low uncertainty**	The probability of spread may be considered medium unless undetected outbreaks occur in seed production areas within the PRA area. In such case the spread would be much quicker. The risk of short distance spread is very high compared to the long distance one. Two questions in this section have been rated with a low uncertainty one is rated medium with some data inferred from other plant pathogenic bacteria.
Conclusion on the probability of introduction and spread **The overall probability of introduction and spread should be described. The probability of introduction and spread may be expressed by**		The probability of entry of *Xanthomonas axonopodis* pv. *allii* into the PRA area is considered moderate to high with a medium uncertainty. The risk of establishment of the pest is high in the Mediterranean part of the EPPO region and other warmer EPPO countries. The level of uncertainty is low.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
comparison with PRAs on other pests.		The probability of establishment is low to medium in the temperate part of the EPPO region. The level of uncertainty is medium. Probability of spread is considered medium with a low uncertainty
Conclusion regarding endangered areas **1.35. Based on the answers to questions 1.16 to 1.34 identify the part of the PRA area where presence of host plants or suitable habitats and ecological factors favour the establishment and spread of the pest to define 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.
2. In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to focus the assessment as much as possible. The study of a single worst-case may be sufficient. Alternatively, it may be appropriate to consider all hosts/habitats together in answering the questions once. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts/habitats.		
2.1. How great a negative effect does the pest have on crop yield and/or quality to cultivated plants or on control costs within its current area of distribution?	**Major**	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 where 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).

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
2.2. How great a negative effect is the pest likely to have on crop yield and/or quality in the PRA area without any control measures?	**Major** **Medium uncertainty**	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. An economic analysis was carried out during the EPPO PRA training workshop (2008-11-11/14). This macro-economic analysis is based on the information given on crop losses in the US (an average yield loss of 30% was chosen), plant protection products cost, area harvested in EPPO countries (see Appendix), average onion prices per country (information obtained on FAO stats). This allowed an estimation of the costs for 4 years to be made which amounted to 850 000 000 Euros (Soliman, pers. comm. 2008).
2.3. How easily can the pest be controlled in the PRA area without phytosanitary measures?	**With much difficulty** **Medium uncertainty**	In the northern EPPO countries, current management practice in onions crops do not include regular copper treatments (Krauthausen, pers.comm. 2008). However it seems to be frequent in Italy and possibly Spain. In Italy most of the authorized plant protection products for the control of *Peronospora destructor* (onion downy mildew) such as metalaxyl and iprovalicarb are mixed with copper. At present at least from 5 to 12 sprays per season are carried out on onion to control downy mildew (Bugiani, pers. comm. 2008). It should be noted that the interval between treatments is critical for *X. axonopodis* pv. *allii* and weekly application are required to reduce severity (Gent & Schwartz, 2005a). Preventive applications are recommended for onion downy mildew but the interval between treatments is between 10 and 14 days, weekly applications are only performed in case of outbreaks (EPPO, 2000). Finally, due to EU copper limitations or prohibition, problems may arise in the future.
2.4. How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area?	**Moderate** **Low uncertainty**	Preventive copper sprays would be needed (estimate of 10 sprays per year, Gent & Schwartz, 2005a). But as indicated above, limitations may arise in the future. There are some 'off-label' approvals for copper oxychloride on Alliums in the UK for bacterial rot (no details) but because of the environmental impact but it is assumed to be limited (Sansford, pers. comm. 2008). .
2.5. How great a reduction in consumer demand is the pest likely to cause in the PRA area?	**Minimal** **Low uncertainty**	The reduction of consumer demand was considered limited (no damage on the bulbs) but it could be affected by the fact that bulb size may be reduced and if more copper treatment are performed.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
2.6. How important is environmental damage caused by the pest within its current area of distribution?	**Minimal** **Low uncertainty**	No environmental impact recorded in the current area of distribution.
2.7. How important is the environmental damage likely to be in the PRA area (see note for question 2.6)?	**Moderate** **High uncertainty**	Management of bacterial blight of onion primarily consists of multiple applications of copper compounds mixed or not with ehylenebisdithiocarbamate (EBDC) fungicides used to enhance copper efficacy. Accumulation of copper in soils is very likely to have undesirable effects on soil ecosystems and can affect aquatic organisms.
2.8. How important is social damage caused by the pest within its current area of distribution?	**Minimal** **Low uncertainty**	No social impact is recorded.
2.9. How important is the social damage likely to be in the PRA area?	**Minimal** **Low uncertainty**	Social damage is not presumed to be higher than in the area of origin.
2.10. How likely is the presence of the pest in the PRA area to cause losses in export markets?	**Unlikely** **Low uncertainty**	Phytosanitary regulations are not easily accessible. The pest is not listed in the import requirements of countries such as New Zealand, Australia and the US (search made on Biosecurity Australia, Biosecurity New Zealand, APHIS websites on 2008-12-30). Problems may arise if more countries start regulating this pest on seeds or parts of plants. The pest is not known to persist in or on onion bulbs which is the most exported commodity (in total EPPO countries export 1,960,753 tonnes of onion dry an green representing 30% of the total amount of global exports).
As noted in the introduction to section 2, the evaluation of the following questions may not be necessary if the responses to question 2.2 is "major" or "massive" and the answer to 2.3 is "with much difficulty" or "impossible" or any of the responses to questions 2.4, 2.5, 2.7, 2.9 and 2.10 is "major" or "massive" or "very likely" or "certain". You may go directly to point 2.16 unless a detailed study of impacts is required or the answers given to these		**The answer to question 2.2 is major and 2.3 with much difficulty so answering the other questions may not be necessary**. The EWG went directly to question 2.16

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
questions have a high level of uncertainty.		
2.16. Referring back to the conclusion on endangered area (1.35), identify the parts of the PRA area where the pest can establish and which are economically most at risk.		The endangered part of the PRA area is the Mediterranean part of the EPPO region and other warmer EPPO countries and to a lower extent the temperate parts of the EPPO region. The EPPO member countries with areas considered at risk 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, Ukraine. The EPPO member countries with areas considered at risk with a medium level of uncertainty are: Austria, Belarus, Belgium, Czech Republic, Denmark, Finland, Germany, the Netherlands, Poland, Slovakia, Sweden, the United Kingdom.
Degree of uncertainty		Uncertainties affecting the evaluation: • Pest distribution worldwide, including in the EPPO region. There is no specific survey for the presence of the bacterium. • 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.
Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.		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.

Question	Rating + uncertainty	Explanatory text of rating and uncertainty
Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.		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 cropping conditions which are likely to be favourable for the pest. Host plants are grown throughout the EPPO member countries. There is no known 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.
List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.		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.
The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the associated pest risk.		The pest is an appropriate candidate for stage 3 of the pest risk analysis.

This is the end of the Pest risk assessment	

Stage 3: Pest risk Management

Question	Yes/No	Explanatory text
3.1. Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?	**No**	.
Pathway 1		**Seeds of *Allium* spp.**
3.2. Is the pathway that is being considered a commodity of plants and plant products? **If yes, go to 3.11,** **If no, go to 3.3**	**Yes**	
3.11. If the pest is a plant, is it the commodity itself? **If yes, go to 3.29,** **If no (the pest is not a plant or the pest is a plant but is not the commodity itself), go to 3.12**	**No**	
3.12. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest? **if appropriate, list the measures and identify their efficacy against the pest of concern, Go to 3.13**	**No**	The EU legislation does not include measures which could be effective against *X. axonopodis* pv. *allii* (EU, 2000). The situation for other EPPO countries is not known.
3.13. Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage or at import? **If yes, possible measure: visual inspection, go to 3.14**	**No**	The pest is transmitted by seeds and seeds show no symptoms when infested.

Question	Yes/No	Explanatory text
3.14. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)? **If yes, possible measure: specified testing, go to 3.15**	**No**	Detection techniques readily available include the use of semi-selective media and submission of putative *Xanthomonas* colonies to a pathogenicity test (Roumagnac *et al.*, 2000; Gent *et al.*, 2005c). An onion detached leaf assay may be helpful for pathogenicity testing of doubtful colonies (Picard *et al.*, 2008). A multiplex PCR assay is at final testing stage for identifying doubtful colonies and direct detection of the pest from seed macerates. Testing seed lots based on plating is common practice for several seed borne *Xanthomonas* sp. (e.g. International Seed Testing Association testing method 7-019: Detection of *Xanthomonas campestris* pv. *campestris* on *Brassica* spp. , http://www.seedtest.org/en/testing_methods_content---1--1132.html) However careful interpretation of a negative result is needed for seed lots with large population size of saprophytic bacteria. Therefore the Panel on phytosanitary measures decided not to recommend it as a reliable measure for detecting a pest absent from the region
3.15. Can the pest be reliably detected during post-entry quarantine? **If yes, possible measure: import under special licence/permit and post-entry quarantine, go to 3.16**	**No**	Not applicable for seeds.

Question	Yes/No	Explanatory text
3.16. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)? **If yes, possible measure: specified treatment, go to 3.17**	**No**	Seed treatments have been developed for other bacteria and other vegetable seeds but specific studies are needed to determine the efficacy of seed treatments and possible negative effect on *Allium* seeds before they can be recommended. The pest is a bacterium. Experimental seed treatments using 70% ethanol or 1% sodium hypochloride failed to clean naturally contaminated seeds from the pest (Roumagnac, unpublished data). In recent studies made on *Xanthomonas* spp. on *Brassica* spp. and *Daucus carota* physical seed treatments (hot water, aerated steam, electron treatment) gave significant reductions in seed infestation levels and reduced or eliminated transmission from seed to seedling *(*www.stove-project.net/STOVE_Poster-Roberts.pdf). Nega *et al*. (2003) suggested treatment of carrot and cabbage seeds against *X. campestris* with hot water at 50 ^{o} C for 30 minutes. A commercial thermal treatment (INCOTEC®) is available for leek seed for *Pseudomonas syringae* pv. *porri*, and *Xanthomonas* spp. on *Brassica*, *Daucus carota*, *Capsicum* and *Lycopersicum*.
3.17. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants) **If yes, possible measure: removal of parts of plants from the consignment, go to 3.18**	**No**	Not relevant
3.18. Can infestation of the consignment be reliably prevented by handling and packing methods? **If yes, possible measure: specific handling/packing methods, go to 3.19**	**No**	Not relevant
3.19. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?	**No**	Not relevant.

Question	Yes/No	Explanatory text
If yes, possible measure: import under special licence/permit and specified restrictions, go to 3.20		
3.20. Can infestation of the commodity be reliably prevented by treatment of the crop? **If yes, possible measure: specified treatment and/or period of treatment, go to 3.21**	**No**	The EWG considered that no treatment of the crop would be reliable to prevent the infection of seeds and even a low infection rate is sufficient to result in an outbreak in the fields (see Q 1.5 seed pathway).
3.21. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants) **If yes, possible measure: consignment should be composed of specified cultivars, go to 3.22**	**No**	Existing cultivars have been screened against the pest and there are only partially resistant onion cultivars were described (Lang *et al.*, 2004, O' Garro & Paulraj, 1997). Agronomic and market factors dictate which cultivars are suitable for a production region, the cultivars showing partial resistance were not the most suitable for agronomic reasons and are consequently of limited use worldwide. No information is available for other *Allium* spp.
3.22. Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)? **If yes, possible measure: specified growing conditions, go to 3.23**	**No**	*Allium* seed production is mostly done outdoors.
3.23. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages? **If yes, possible measure: specified age of plant, growth stage or time of year of harvest, go to 3.24**	**No**	Not relevant for seeds.
3.24. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)? **If yes, possible measure: certification scheme, go to 3.25**	**Yes**	Such schemes do not exist at the moment but could be developed. The following elements would need to be considered: production of seeds in areas free form the pest and testing.
3.25. Is the pest of very low capacity for natural spread? **If yes, possible measures: pest freedom of the crop, or pest-free place of production or pest-free area, Go to 3.28** **If no, go to 3.26**	**No**	The capacity was not considered very low (see 3.26).

Question	Yes/No	Explanatory text
3.26. Is the pest of low to medium capacity for natural spread? **If yes, possible measures: pest-free place of production or pest free area, Go to 3.28** **If no, go to 3.27**	**Yes**	Spread is primarily by splash dispersal (e.g. overhead irrigation) but there are documented examples of dispersal over more than 500 metres associated with wind-driven rains (see question 1.32). From this data the EWG concluded that the capacity for natural spread was low to medium. Consequently possible measures are • Pest-free areas • Pest-free place of production
3.28 Can pest freedom of the crop, place of production or an area be reliably guaranteed? **If no, possible measure identified in questions 3.25-3.27 would not be suitable, go to 3.29**	**Yes**	Standard procedures for the establishment and maintenance of pest-free crops, areas and places of production would be needed.
3.29. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts? **If yes, possible measures: internal surveillance and/or eradication campaign, go to 3.30**	**Yes**	Surveillance for this pest can be included in surveillance programmes. Special attention should be drawn on the recognition of symptoms. Eradication can be undertaken if outbreaks are detected early and foci are spatially restricted.
3.30. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them. **If yes, go to 3.31** **If no, go to 3.38**	**Yes**	Seed production in pest-free areas or pest-free places of production Inclusion of *X. axonopodis* pv. *allii* in surveillance programmes and preparation of an emergency plan for its containment and 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.

Question	Yes/No	Explanatory text
3.31. Does each of the individual measures identified reduce the risk to an acceptable level? **If yes, go to 3.34** **If no, go to 3.32**	**Yes**	Seed 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 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.
3.34. Estimate to what extent the measures (or combination of measures) being considered interfere with trade. **Go to 3.35**		There are no specific measures for this pest for the moment. Pest-free area or pest-free place of production and seed testing are common phytosanitary measures, which are required for other plant pathogenic bacteria of vegetable crops. Nevertheless they will result in additional costs for the exporting country and may interfere with trade where this exists (there are no data on exports of *Allium* seed to the EPPO region).
3.35. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences. **Go to 3.36**		Additional costs are expected for the countries where the pest is present (phytosanitary certification, official control measures, establishment and maintenance of pest-free areas and places of production). The measures are perceived to be cost-effective for the importing country (i.e. no costs would be incurred). A potential for disruption in the *Allium* seed supply could not be estimated because there are no data on imports of *Allium* seed into the EPPO region.

Question	Yes/No	Explanatory text
3.36.Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences? **If yes, For pathway-initiated analysis, go to 3.39** **For pest-initiated analysis, go to 3.38** **If no, go to 3.37**	**Yes**	• Seed production in pest-free areas • Seed production in 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. The importing country may consider including *X. axonopodis* pv. *allii* in its surveillance programme and prepare an emergency plan for its eradication.
3.38 Have all major pathways been analyzed (for a pest-initiated analysis)? **If yes, go to 3.41,** **If no, Go to 3.1 to analyze the next major pathway**	**No**	

Question	Yes/No	Explanatory text
Pathway 2		**Seedlings of *Allium* spp.**
3.2. Is the pathway that is being considered a commodity of plants and plant products? **If yes, go to 3.11,** **If no, go to 3.3**	**Yes**	
3.11. If the pest is a plant, is it the commodity itself? **If yes, go to 3.29,** **If no (the pest is not a plant or the pest is a plant but is not the commodity itself), go to 3.12**	**No**	
3.12. Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest? **if appropriate, list the measures and identify their efficacy against the pest of concern, Go to 3.13**	**No**	The EU council directive 2000/29/EC does not include measures which could be effective against *X. axonopodis* pv. *allii* (EU, 2000). Point 41 of Annex IV of this directive states that *Annual and biennial plants. other than Gramineae, intended for planting, other than seeds, originating in countries other than European and Mediterranean countries should be have been grown in nurseries, have been inspected at appropriate times, and prior to export, and found free from symptoms of harmful bacteria.*". Such inspection will no detect latent infections The situation for other EPPO countries is not known.
3.13. Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage or at import? **If yes, possible measure: visual inspection, go to 3.14**	**No**	Symptoms may be visible but in most cases the infection will be latent (very common for bacteria) or epiphytic (Gent *et al.*, 2005c).
3.14. Can the pest be reliably detected by testing (e.g. for pest plant, seeds in a consignment)? **If yes, possible measure: specified testing, go to 3.15**	**No**	The test recommended for seeds could also be used for seedlings but it is not practical because of the size of the samples to be tested that would have to be processed for one consignment. It has not been tested on seedlings.
3.15. Can the pest be reliably detected during post-entry quarantine? **If yes, possible measure: import under special license/permit and post-entry quarantine, go to 3.16**	**No**	Not applicable for consignments of seedlings on a large scale (even if the trade was considered minimal at the regional scale one consignment could consist of many plants to be kept under post-entry quarantine, and imported for immediate use).

Question	Yes/No	Explanatory text
3.16. Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)? **If yes, possible measure: specified treatment, go to 3.17**	**No**	No treatment is considered feasible for seedlings.
3.17. Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? (This question is not relevant for pest plants) **If yes, possible measure: removal of parts of plants from the consignment, go to 3.18**	**No**	Not relevant for seedlings.
3.18. Can infestation of the consignment be reliably prevented by handling and packing methods? **If yes, possible measure: specific handling/packing methods, go to 3.19**	**No**	Not relevant for seedlings.
3.19. Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice? **If yes, possible measure: import under special licence/permit and specified restrictions, go to 3.20**	**No**	Not relevant.
3.20. Can infestation of the commodity be reliably prevented by treatment of the crop? **If yes, possible measure: specified treatment and/or period of treatment, go to 3.21**	**No**	The EWG considered that no treatment of the crop would be reliable (see answer to question 1.5).
3.21. Can infestation of the commodity be reliably prevented by growing resistant cultivars? (This question is not relevant for pest plants) **If yes, possible measure: consignment should be composed of specified cultivars, go to 3.22**	**No**	Only partially resistant onion cultivars were described (Lang *et al.*, 2004; O' Garro & Paulraj, 1997) and they are of limited use worldwide. No information is available for other *Allium* spp.

Question	Yes/No	Explanatory text
3.22. Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)? **If yes, possible measure: specified growing conditions, go to 3.23**	**Yes**	Transplants are produced both under protected conditions and in the field. Seedlings should be produced from seeds free from *X. axonopodis* pv. *allii*. To prevent re-infestation, the seedlings should be produced under protected conditions that prevent wetness on leaves (avoiding any kind of overhead irrigation). Growing them indoors would prevent infection associated with wind-driven rains. This was perceived to be more the concept of a place of production freedom (see point 3.26)
3.23. Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages? **If yes, possible measure: specified age of plant, growth stage or time of year of harvest, go to 3.24**	**No**	Not relevant for seedlings.
3.24. Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)? **If yes, possible measure: certification scheme, go to 3.25**	**Yes**	Such schemes do not exist at the moment but could be developed. The following elements would need to be considered: production of seeds in areas free from the pest and testing.
3.25. Is the pest of very low capacity for natural spread? **If yes, possible measures: pest freedom of the crop, or pest-free place of production or pest-free area, Go to 3.28** **If no, go to 3.26**	**No**	The capacity was not considered very low (see 3.26).
3.26. Is the pest of low to medium capacity for natural spread? **If yes, possible measures: pest-free place of production or pest free area, Go to 3.28** **If no, go to 3.27**	**Yes**	Spread is primarily by splash dispersal (e.g. overhead irrigation) but there are documented examples of dispersal over more than 500 metres associated with wind-driven rains (see question 1.32). From this data the EWG concluded that the capacity for natural spread was low to medium Consequently possible measures are • Pest-free areas • Pest-free place of production
3.28. Can pest freedom of the crop, place of production or an area be reliably guaranteed?	**Yes**	Standard procedures for the establishment and maintenance of pest-free crops, areas and places of production can apply.

Question	Yes/No	Explanatory text
If no, possible measure identified in questions 3.25-3.27 would not be suitable, go to 3.29		
3.29. Are there effective measures that could be taken in the importing country (surveillance, eradication) to prevent establishment and/or economic or other impacts? **If yes, possible measures: internal surveillance and/or eradication campaign, go to 3.30**	**Yes**	Surveillance for this pest can be included in surveillance programmes with specific information on the recognition of symptoms. Eradication can be undertaken if outbreaks are detected early and foci are spatially restricted.
3.30. Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them. **If yes, go to 3.31** **If no, go to 3.38**	**Yes**	Seedling production in pest-free areas or pest-free places of production The following measure is not currently available but could be envisaged: - Inclusion of the pest in seedling certification schemes.
3.31. Does each of the individual measures identified reduce the risk to an acceptable level? **If yes, go to 3.34** **If no, go to 3.32**	**Yes**	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 the previous growing period • 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 rains or uffer zone of 1 km to 5 km depending on local climatic conditions (e.g. areas prone to storm). There is uncertainty on the minimum distance of such buffer zone. • Testing during the growing period.
3.32. For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level? **If yes, go to 3.34**		Not applicable

Question	Yes/No	Explanatory text
If no, go to 3.33		
3.34. Estimate to what extent the measures (or combination of measures) being considered interfere with trade. **Go to 3.35**		There are no specific measures for this pest at the moment. 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. They will result in additional costs for the exporting country which could interfere with trade. However, there are minimal imports of *Allium* seedlings into the EPPO region.
3.35. Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences. **Go to 3.36**		Additional costs are expected for the countries where the pest is present (phytosanitary certification, official control measures, establishment and maintenance of pest-free areas and places of production). They are effective for the importing country (i.e. no costs would be incurred). .
3.36. Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences? **If yes, For pathway-initiated analysis, go to 3.39** **For pest-initiated analysis, go to 3.38** **If no, go to 3.37**	**Yes**	• Seedling production in pest-free areas • Seedling production in pest-free places of production (open-field or protected conditions) Place of production freedom should consist of a combination of the following individual measures: • Pest should have been absent from the place of production the previous growing period • 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 rains or uffer zone of 1 km to 5 km depending on local climatic conditions (e.g. areas prone to storm). There is uncertainty on the minimum distance of such buffer zone. • Testing during the growing period. The importing country may consider including *X. axonopodis* pv. *allii* in its surveillance programme and prepare an emergency plan for its eradication.

Question	Yes/No	Explanatory text
3.38. Have all major pathways been analyzed (for a pest-initiated analysis)? **If yes, go to 3.41,** **If no, Go to 3.1 to analyze the next major pathway**	**Yes**	
3.41. Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment **Go to 3.42**		**Seeds of *Allium* spp. (pathway 1) is a more important pathways than seedlings of *Allium* spp. (pathway 2)**
3.42. All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. **Go to 3.43**	**Yes**	
3.43. In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. **Go to 3.44**	**Yes**	**A PC should be required**
3.44. If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of pest with a high natural spread capacity, regional communication and collaboration is important.		
Conclusion of Pest Risk Management. **Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.**		Measures for consignments Potential management options for seeds of *Allium* spp. Phytosanitary certificate and • Seed production in pest-free areas or • Seed production in pest-free places of production Potential management options for seedlings of *Allium* spp.

Question	Yes/No	Explanatory text
		Phytosanitary certificate and • Seedling production in pest-free areas or • Seedling production in pest-free places of production (open-field or protected conditions) All these measures are considered effective measures. Other measures Inclusion of *X. axonopodis* pv. *allii* in surveillance programme and preparation of contingency plan for its eradication. Measures to develop Development of a seed treatment for contaminated or suspicious *Allium* seed lots (see pathway 1, 3.16) Inclusion of the pest in seedling certification schemes. 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. Efficiency and possible adverse effects of a seed treatment need to be tested. 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.

References

Alvarez AM, Buddenhagen IW, Buddenhagen ES & Domen HY (1978) Bacterial blight of onion, a new disease caused by *Xanthomonas* sp.. *Phytopathology* **68**,1132-1136.

Basim H., Stall RE, Minsavage GV & Jones JB (1999) Chromosomal gene transfer by conjugation in the plant pathogen Xanthomonas axonopodis pv. vesicatoria *Pytopathology* **89**, p.1044-1049.

Billing E & Berrie AM (2002) A re-examination of fire blight epidemiology in England. *Acta-Horticulturae* **590**, 61-67.

CABI (1987) Xanthomonas campestris pv. campestris. [Distribution map]. Distribution Maps of Plant Diseases, May (Edition 5), Map 136.

Dye DW, & Lelliott RA (1974) Genus II. *Xanthomonas* Dowson 1939, 187. In: Bergey's Manual of Determinative Bacteriology, pp. 243-249. Williams & Wilkins, Baltimore.

EU (2000) Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the community. *Official Journal of the European Communities* **L169**, 1–112.

EPPO (2000) EPPO Standard PP 2/4(2) Guidelines on good plant protection practice *Allium* crops. Bulletin OEPP/EPPO Bulletin 31, pp 211-230

Gent DH, Al-Saadi A, Gabriel DW Louws FJ, Ishimaru CA & Schwartz, H. F. (2005a) Pathogenic & genetic relatedness among *Xanthomonas axonopodis* pv. *allii* & other pathovars of *X. axonopodis*. *Phytopathology* **95**,918-925.

Gent DH, Lang JM, Bartolo ME & Schwartz HR (2005b) Inoculum sources & survival of *Xanthomonas axonopodis* pv. *allii* in Colorado. *Plant Disease* **89**, 507-514.

Gent DH, Lang JM & Schwartz HF (2005c) Epiphytic survival of *Xanthomonas axonopodis* pv. *allii* & *X. axonopodis* pv. *phaseoli* on leguminous hosts & onion. *Plant Disease* **89**, 558-564.

Gent DH & Schwartz HF (2005a) Management of *Xanthomonas* leaf blight of onion with a plant activator, biological control agents, & copper bactericides. *Plant Disease* **89**, 631-639.

Gent DH & Schwartz HF (2005b) Effect of nitrogen fertilization & seed contamination on epiphytic populations of *Xanthomonas axonopodis* pv. *allii* & development of *Xanthomonas* leaf blight of onion. *Plant Health Progress*. http://www.plantmanagementnetwork.org/pub/php/research/2005/onion/ . [last accessed 2009-01-18]

Gent DH, Schwartz HF, Ishimaru CA, Louws FJ, Cramer RA & Lawrence CB (2004). Polyphasic characterization of *Xanthomonas* strains from onion. *Phytopathology* **94**, 184-195.

Gottwald TR, Hughes G, Graham JH, Sun XiaoAn & Riley T (2001) The citrus canker epidemic in Florida: the scientific basis of regulatory eradication policy for an invasive *Phytopathology* 91 (1), 2001 p.30-34

Gottwald TR, Graham JH & Schubert TS (2002) Citrus canker: the pathogen and its impact *Plant Health Progress* http://www.apsnet.org/online/feature/citruscanker/

Gottwald TR & Irey M (2007) Post-hurricane analysis of *citrus canker ii*: predictive model estimation of disease spread & area potentially impacted by various eradication protocols following catastrophic weather events. http://www.apsnet.org/online/feature/hurricane/ [last accessed 2009-01-18]

Houeto P, Bindoula G & Hoffman JR (1995) Ethylene-bisdithiocarbamates and ethylenethiourea: Possible human health hazards. *Environmental Health Perspectives* **103**, 568-573.

Humeau L, Roumagnac P, Picard Y, Robène-Soustrade I, Chiroleu F, Gagnevin L, & Pruvost O (2006). Quantitative & molecular epidemiology of bacterial blight of onion in seed production fields. *Phytopathology* **96,** 1345-1354.

Isakeit T, Miller ME, Barnes LW, Dickstein ER & Jones JB (2000) First report of leaf blight of onion caused by *Xanthomonas campestris* in the Continental United States. *Plant Disease* **84,** 201.

Kadota I, Uehara K, Shinohara H & Nishiyama K (2000) Bacterial blight of Welsh onion : A new disease caused by *Xanthomonas campestris* pv. *allii* pv. nov. *Journal of General Plant Pathology* **66**, 310-315.

Kuan TL, Minsavage GV & Schaad NW (1986) Aerial dispersal of *Xanthomonas campestris* pv. *campestris* from naturally infected *Brassica campestris*. *Plant Disease* **70,** 409-413.

Lang JM, Gent DH & Schwartz HF (2007) Management of *Xanthomonas* leaf blight of onion with bacteriophages & a plant activator. *Plant Disease* **91**, 871-878.

Lang JM, Gent DH & Schwartz, HF (2004) Differential response of onion cultivars to onion *Xanthomonas* leaf blight. *Allium Improvement Newsletter* **14,** 15-17.

McInnes TB, Gitaitis RD, McCarter SM, Jaworski CA, Phatak SC (1988) Airborne dispersal of bacteria in tomato and pepper transplant fields. *Plant Disease* **72**, 575-579

Nega E, Ulrich R, Werner S & Jahn M (2003) Hot water treatment of vegetable seed an alternative seed treatment method to control seed-borne pathogens in organic farming *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz* **110**, p.220-234.

Neto JR, Malavolta Jr. VA, Cardelli MA & Sinigaglia C (1987) Ocorrencia de uma nova doença bacteriana em cebola, no estado de Sao Paulo. *Summa Phytopathol.* **13**: 10.

Nunez JJ, Gilbertson RL, Meng X & Davis RM (2002). First report of *Xanthomonas* leaf blight of onion in California. *Plant Disease* **86**, 330.

O' Garro LW & Paulraj LP (1997) Onion leaf blight caused by *Xanthomonas campestris*: Alternative hosts & resistant onion genotypes. *Plant Disease* **81**, 978-982.

Paulraj L & O' Garro LW (1993) Leaf blight of onions in Barbados caused by Xanthomonas campestris. *Plant Disease* **77**, 198-201.

Picard Y, Roumagnac P, Legrand D, Humeau L, Robène-Soustrade I, Chiroleu F, Gagnevin L & Pruvost O (2008) Polyphasic characterization of *Xanthomonas axonopodis* pv. *allii* associated with outbreaks of bacterial blight on three *Allium* species in the Mascarene archipelago. *Phytopathology* **98**, 919-925

Rademaker JLW Hoste B, Louws FJ, Kersters K, Swings J, Vauterin L, Vauterin P & Bruijn FJ de (2000) Comparison of AFLP and rep-PCR genomic fingerprinting with DNA-DNA homology studies: Xanthomonas as a model system. *International Journal of Systematic and Evolutionary Microbiology* **50,** p.665-677.

Roberts SJ, Hiltunen LH, Hunter PJ & Brough J (1999) Transmission from seed to seedling and secondary spread of *Xanthomonas campestris* pv. *campestris* in *Brassica* transplants: Effects of dose and watering regime. *European Journal of Plant Pathology* **105**, 879-889.

Roumagnac P, Gagnevin L, Gardan L, Sutra L, Manceau C, Dickstein ER, Jones JB, Rott P & Pruvost O 2004a. Polyphasic characterization of xanthomonads isolated from onion, garlic & Welsh onion (*Allium* spp.) and their relatedness to different *Xanthomonas* species. *International Journal of Systematic and Evolutionary Microbiology*. **54**, 15-24.

Roumagnac P, Gagnevin L & Pruvost O 2000. Detection of *Xanthomonas* sp., the causal agent of onion bacterial blight, in onion seeds using a newly developed semi-selective isolation medium. *European Journal of Plant Pathology* 106, 867-877.

Roumagnac P, Pruvost O, Chiroleu F & Hughes G 2004b. Spatial & temporal analyses of bacterial blight of onion caused by *Xanthomonas axonopodis* pv. *allii*. *Phytopathology* **9,** 138-146.

Sanders FH, Langston Jr. DB, Brock JH, Gitaitis RD, Curry DE & Torrance RL (2003) First report of a leaf blight of onion caused by *Xanthomonas* spp. in Georgia. *Plant Disease* **87**, 749.

Schaad, NW, & Alvarez, AM (1993) *Xanthomonas campestris* pv. *campestris*: Cause of black rot of crucifers. In *Xanthomonas*, Swings, JG, & Civerolo, EL eds, Chapman & Hall, London, pp. 51-55.

Schaad NW, Postnikova E, Lacy GH, Sechler, A., Agarkova, I., Stromberg, P.E., Stromberg, V.K., & Vidaver, A.K. (2005) Reclassification of *Xanthomonas campestris* pv. *citri* (ex Hasse 1915) Dye 1978 forms A, B/C/D, and E as *X. smithii* subsp. *citri* (ex Hasse) sp. nov. nom. rev. comb. nov., *X. fuscans* subsp. *aurantifolii* (ex Gabriel 1989) sp. nov. nom. rev. comb. nov., and *X. alfalfae* subsp. *citrumelo* (ex Riker and Jones) Gabriel et al., 1989 sp. nov. nom. rev. comb. nov.; *X. campestris* pv. *malvacearum* (ex Smith 1901) Dye 1978 as *X. smithii* subsp. *smithii* nov. comb. nov. nom. nov.; *X. campestris* pv. *alfalfae* (ex Riker and Jones, 1935) Dye 1978 as *X. alfalfae* subsp. *alfalfae* (ex Riker et al., 1935) sp. nov. nom. rev.; and "var. *fuscans*" of *X. campestris* pv. *phaseoli* (ex Smith, 1987) Dye 1978 as *X. fuscans* subsp. *fuscans* sp. nov. *Systematic and Applied Microbiology* **28**, 494-518.

Schwartz HF & Otto K (2000) First report of leaf blight of onion caused by *Xanthomonas campestris* in Colorado. *Plant Disease* **84**, pp 922.

Schwartz HF, Otto KJ & Gent DH (2003). Relation of temperature and rainfall to development of *Xanthomonas* and *Pantoea* leaf blights of onion in Colorado. *Plant Disease* **87**, pp11-14. .

Serfontein JJ (2001). Xanthomonas blight of onion in South Africa. *Plant Disease* **85**:442.

Stall RE, Gottwald TR, Koizumi M & Schaad NC (1993). Ecology of plant pathogenic xanthomonads. In: *Xanthomonas* Swings, JG, & Civerolo, EL eds, Chapman & Hall, London pp. 265-299.

Trujillo, G., & Hernandez, Y. (1999) Identificacion de bacterias fitopatogenas en semillas de plantas cultivadas. In *XVI Congreso Venezolano de Fitopatologia* Barquisimeto, Venezuela: Sociedad Venezolano de Fitopatologia.

Appendix 1
Allium crops in the EPPO region.
Area harvested in 2006 (ha)
(source FAO STATS http://faostat.fao.org/site/567/default.aspx#ancor) accessed 2008-06-15

countries	Onions, dry	Onions (including shallots) green	Leek	Garlic
Albania	2764	596	1008	265
Algeria	38417	3.	4.	11433
Austria	2518			23
Belarus	10901	5.	6.	4155
Belgium	1046	7.	4750	8.
Bosnia and Herzegovina	5246	9.	10.	1846
Bulgaria	2217	1000	11.	846
Croatia	1365	12.	13.	2706
Cyprus	200	10	4	21
Czech Republic	2970	14.	15.	337
Denmark	1618	16.	359	17.
Estonia	249	18.	19.	79
Finland	885	20.	35	13
France	8735	2231	6281	3350
Georgia	3000	21.	22.	23.
Germany	8525	1368	3056	24.
Greece	7078	2216	2133	1711
Hungary	2690	65	106	1295
Ireland	152	25.	26.	27.
Israel	2830	230	28.	880
Italy	12887	29.	628	3071
Jordan	724	151	30.	100
Kazakhstan	16500	100	1300	31.
Kyrgyzstan	6100	32.	33.	2400
Lithuania	1863	34.	108	473
Luxembourg	1	35.	1	36.
Macedonia,The Fmr Yug Rp	3212	115	16	1101
Malta	330	37.	38.	37
Moldova, Republic of	6010	39.	40.	1970

Montenegro, Republic of	620	41.	42.	200
Morocco	29510	1100	13	3695
Netherlands	23000	1200	2725	221
Norway		694	143	43.
Poland	34942	44.	7238	45.
Portugal	4800	150	46.	250
Romania	33647	47.	185	13024
Russian Federation	122080	48.	49.	29900
Serbia	19282	50.	51.	9000
Spain	22700	2000	3000	16200
Sweden	902	52.	123	53.
Switzerland	697	121	473	1
Tunisia	7000	8000	54.	3600
Turkey	80000	22000	13000	15000
Ukraine	57300	3800	55.	19100
United Kingdom	8560	2070	1700	56.
Uzbekistan	26030	57.	200	2560
Total EPPO Countries	622103	51123	48585	150863

Appendix 2 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.

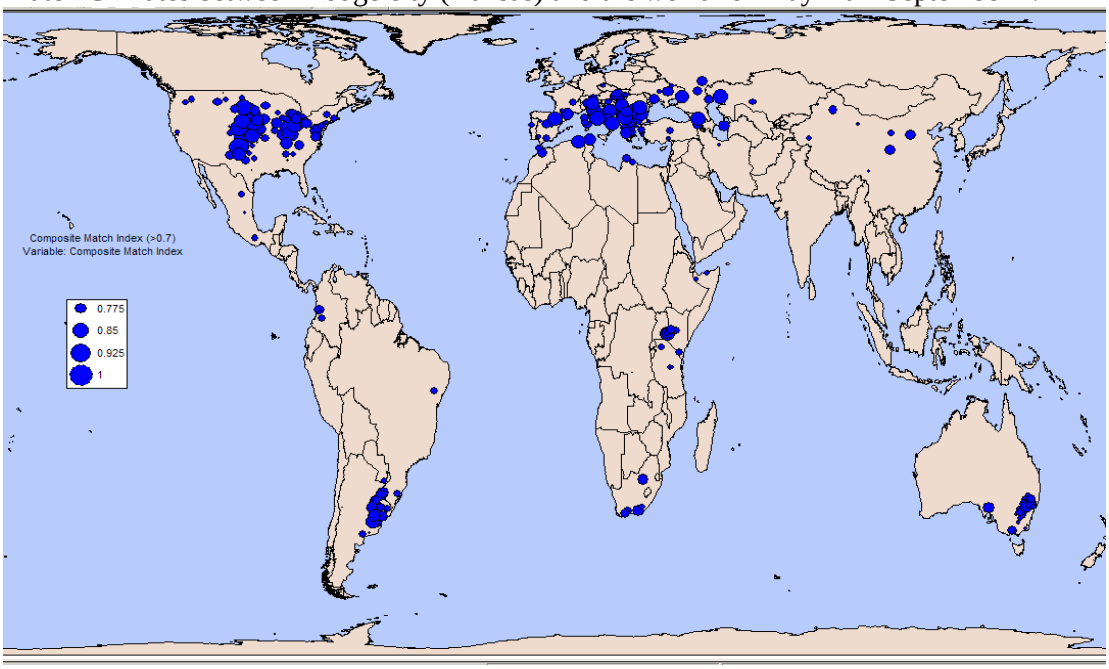
2. Biology (summary of elements presented in the PRA record)

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.

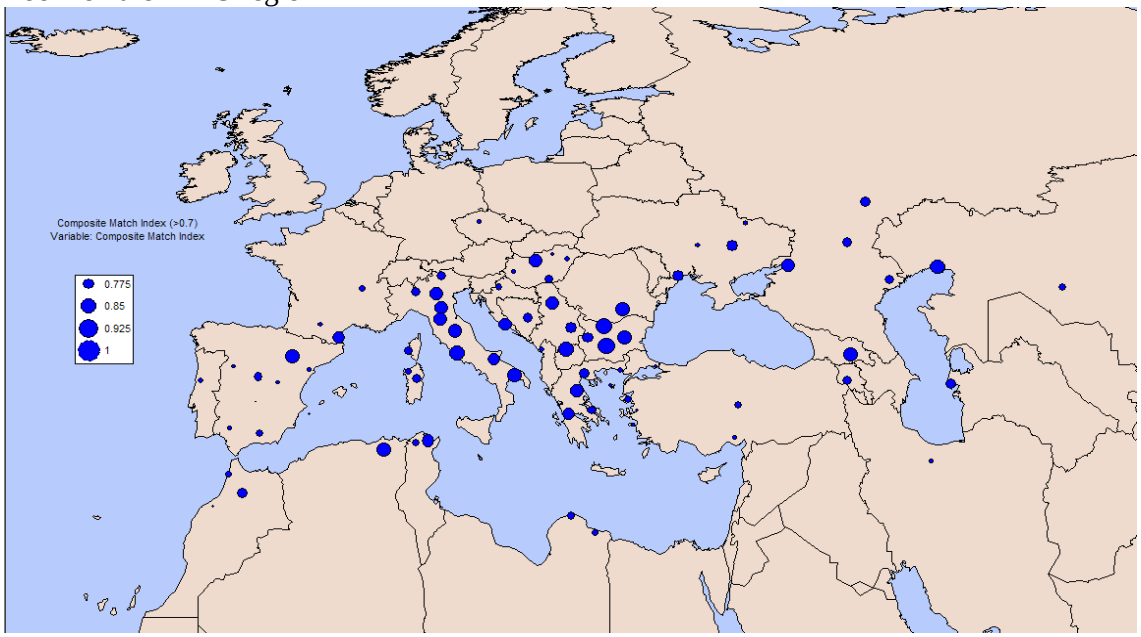
3. Match climates

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.

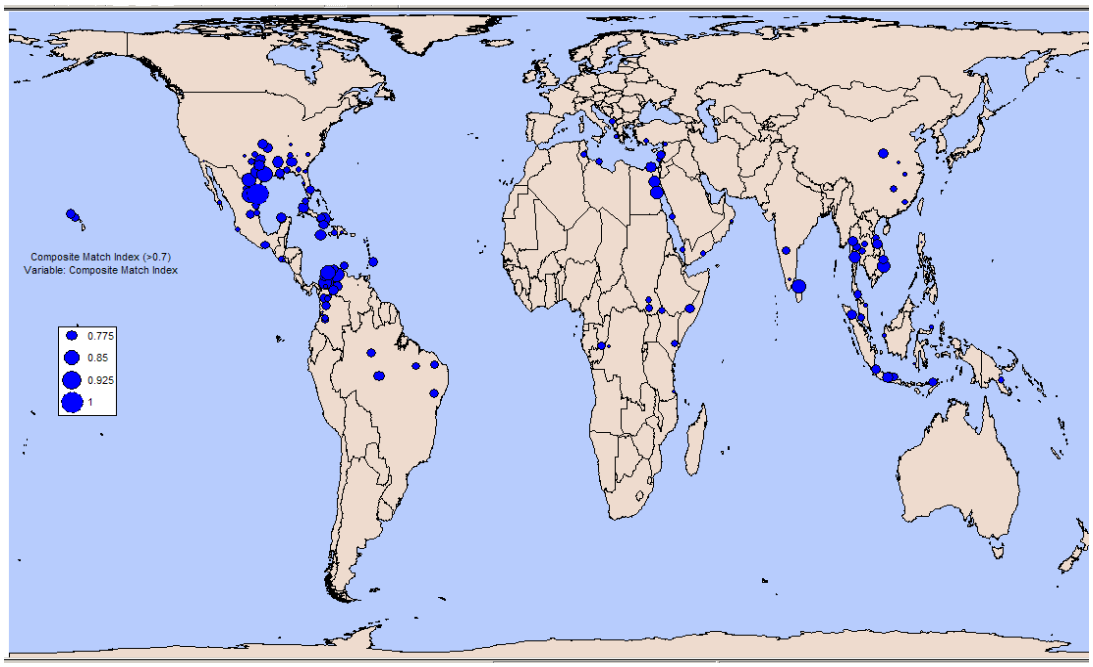


Zoom on the EPPO region



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.

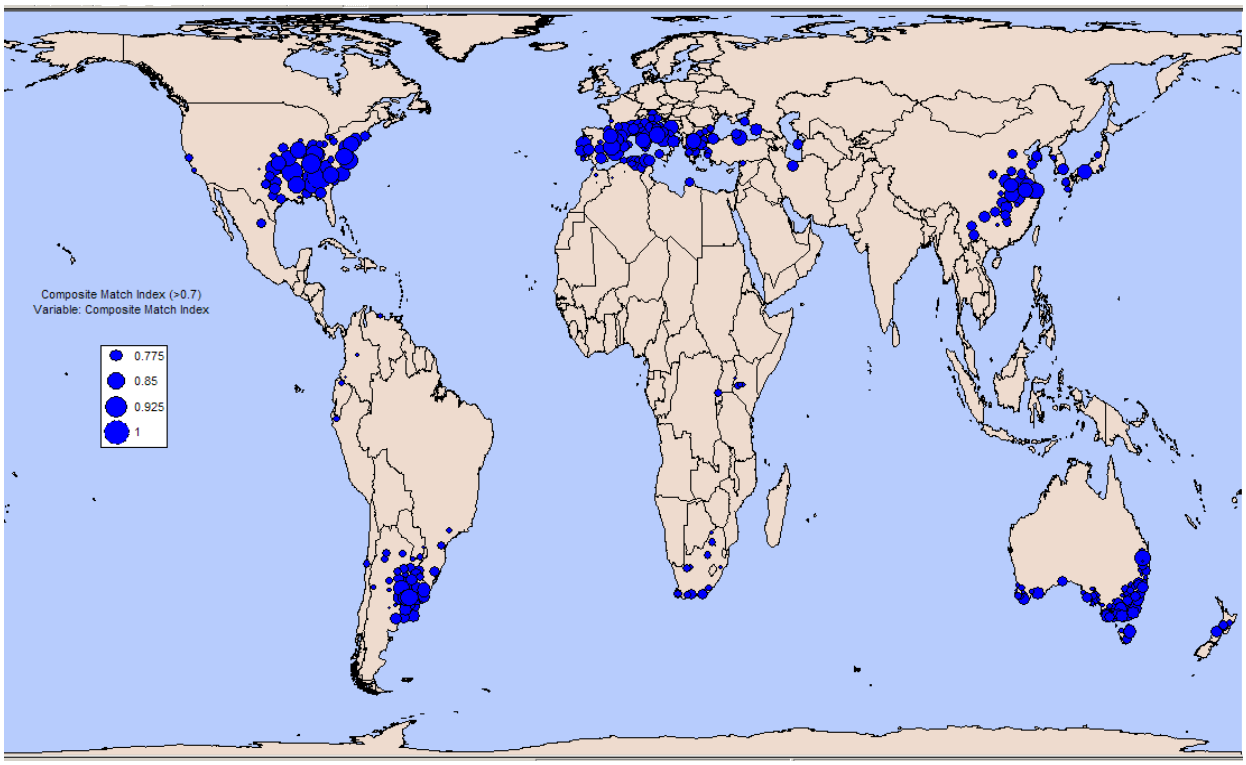
b. Match Climates between Brownsville (Texas) and the world, between May 7 and September 2



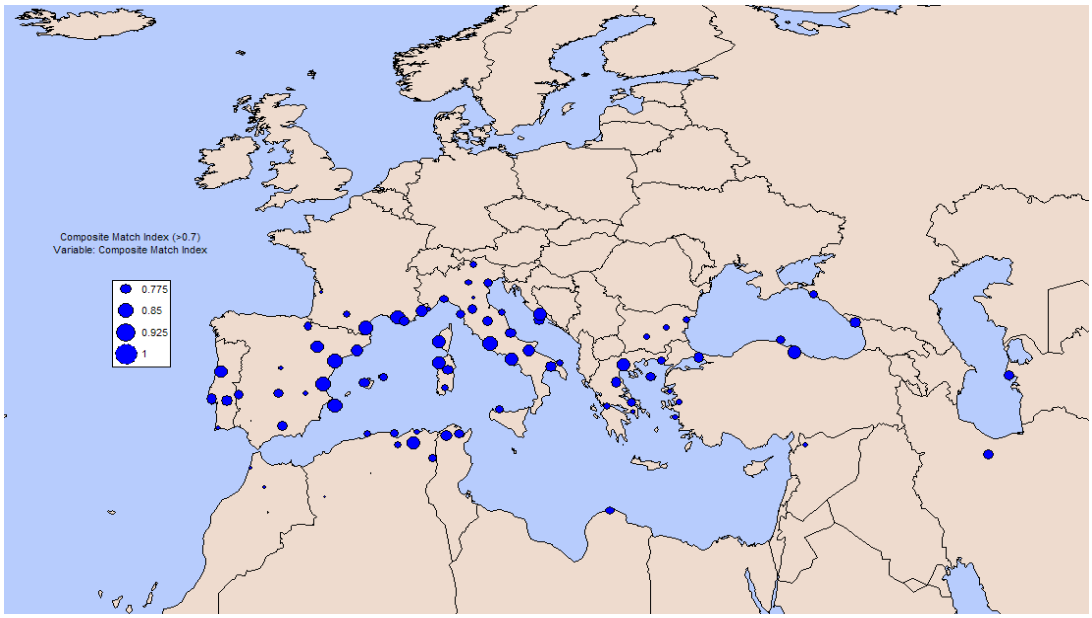
Zoom on the EPPO region

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,