Data sheets on pests recommended for regulation
Fiches informatives sur les organismes recommandés pour réglementation

**Xanthomonas axonopodis pv. allii**

**Identity**

**Scientific name:** Xanthomonas axonopodis pv. allii (Roumagnac et al., 2004a,b).

**Synonyms:** Xanthomonas campesiris pv. allii (Kadota et al., 2000).

**Taxonomic position:** Proteobacteria: Gammaproteobacteria: Xanthomonadales: Xanthomonadaceae.

**Common names:** Xanthomonas axonopodis pv. allii is the causal agent of onion bacterial blight (syn. Xanthomonas leaf blight of onion).

**EPPO code:** XANTAA.

**Phytosanitary categorization:** A1 List no. 353.

**Hosts**

Although primarily associated with outbreaks on Allium cepa L. (onion) worldwide, X. axonopodis pv. allii was found to infect Allium fistulosum (Welsh onion), Allium sativum (garlic), Allium porrum (leek), Allium schoenoprasum (chive) and A. cepa var. ascalonicum (shallot) after artificial inoculation (B Bowen et al., 1998; Kadota et al., 2000; Roumagnac et al., 2004a,b). The three former hosts were also reported to be susceptible in the field in addition to A. cepa L. (Kadota et al., 2000; Picard et al., 2008). Non-Allium plant species (primarily citrus and legume species) have been reported as hosts under artificial inoculation (Gent et al., 2005a; O’Garro & Paulraj, 1997) but no symptoms caused by X. axonopodis pv. allii have ever been reported from these species under field conditions, making their host status uncertain.

**Geographical distribution**

**EPPO region:** absent.

- **Asia:** Japan (Kadota et al., 2000).
- **Africa:** Mauritius, Réunion (Roumagnac et al., 2000), South Africa (Serfontein, 2001).
- **North America:** USA (California, Colorado, Georgia, Texas) (Isakeit et al., 2000; Schwartz & Otto, 2000; Nunez et al., 2002; Sanders et al., 2003).
- **Central America and the Caribbean:** Barbados (Paulraj & O’Garro, 1993), Cuba.
- **South America:** Brazil (Neto et al., 1987), Venezuela (Trujillo & Hernandez, 1999).
- **Oceania:** Hawaii (Alvarez et al., 1978).

**Biology**

The bacterium can induce lesions on Allium leaves and scapes, but not on bulbs. Onion leaves are most susceptible at the bulb initiation period (Schwartz et al., 2003; Roumagnac et al., 2004b). Several putative primary inoculum sources have been identified: contaminated onion seed (Roumagnac et al., 2000), volunteer onion plants, irrigation water and crop debris (Gent et al., 2005b), seedlings used for transplant, contaminated equipment or clothes.

Bacterial blight outbreaks developed in fields established with onion seed contaminated at a rate of 0.04% in the cool season of a tropical environment (Roumagnac et al., 2004b). Analyses of disease patterns indicated a likely seedborne origin for the inoculum associated with the early stages of epidemics (Roumagnac et al., 2004b). Although not experimentally confirmed at that time, it was hypothesized that outbreaks in onion in Hawaii (Alvarez et al., 1978) had a seedborne origin. Recent data also suggests that the pathogen was likely to have been introduced to Réunion Island from Mauritius via contaminated onion seed lots (Picard et al., 2008). In onion seed production fields, seeds contaminated with X. axonopodis pv. allii were detected by semi-selective isolation and a nested polymerase chain reaction (PCR) test at levels up to 0.05%; the final disease incidence was 0.61. Contaminated seed originated from both diseased and asymptomatic plants (Humeau et al., 2006). Xanthomonas axonopodis pv. allii can survive and retain some culturability for at least 10 years in association with onion seed stored in a cool place (4°C) (Robene-Soustrade et al., 2005). Xanthomonas axonopodis pv. allii was not recovered from plants other than Allium in experimental sites in Colorado where an epidemic of Xanthomonas leaf blight did not occur the previous year (Gent et al., 2005b,c), although it was recovered from the foliage of several asymptomatic cultivates (alfalfa, chickpea, dry bean, lentil and soybean) and weed (Malva neglecta) species. In Northern and Southern Colorado X. axonopodis pv. allii was recovered from infested onion leaves 9 months after they were placed on the soil surface or buried to a depth of 25 cm, but culturable populations of the pathogen decreased 10⁴ to 10⁶ more in buried leaves (Gent et al., 2005b).

Disease development in onion is favoured by warm temperatures (Schwartz et al., 2003), but daily mean temperatures as low as 21–22°C allowed disease to develop in field
trials established in Réunion Island (Roumagnac et al., 2004b; Humeau et al., 2006). Over 3 years, disease development in Réunion Island was observed to be related to a succession of two climatic events – heavy rains followed by temperatures exceeding 20°C (Roumagnac et al., 2004b). As for many xanthomonads, the length of the latent infection period depends on temperature. Fitting the β-binomial distribution and binary power law analysis indicated aggregated patterns of disease incidence data from onion bulb and onion seed production fields. Secondary foci were detected after occurrence of wind-driven rains, confirming the importance of such environmental conditions for bacterial spread (Roumagnac et al., 2004b; Humeau et al., 2006). Overhead irrigation (Roumagnac et al., 2004a,b) or extensive nitrogen fertilization (Gent & Schwartz, 2005a,b) exacerbated disease development.

**Detection and identification**

**Symptoms**

On onion, lesions consist of lenticular water-soaked leaf spots which turn into dry chlorotic lesions that eventually coalesce (Figs 1–3). When disease is severe, leaf dieback can occur, resulting in a reduction of bulb size. The morphology of leaf lesions on other Allium species is similar to those on onion (Picard et al., 2008). Xanthomonas axonopodis pv. allii was also pathogenic to Mexican lime and grapefruit after bacterial infiltration, and produced lesions that were similar to citrus bacterial spot (i.e. water-soaked leaf lesions turning into necrotic spots) (Gent et al., 2005a). Host specialization among strains remains largely unknown. However, no host specialization was found on strains collected in Réunion Island and originating from outbreaks on onion, leek and garlic, respectively, which could all infect the same range of Allium species when tested (Picard et al., 2008).

**Identification**

Identification currently requires pure bacterial cultures. This is facilitated by the use of semi-selective media (Roumagnac et al., 2000; Gent & Schwartz, 2005b). Identification at the genus level can be achieved through sequencing of 16S rDNA (Moore et al., 1997) or characterization of xanthomonadin pigments (Schaad, 1988). Formal identification at the pathovar level requires fulfillment of Koch’s postulates, although molecular typing techniques such as repetitive sequence-based PCR (rep-PCR) and amplified fragment length polymorphism (AFLP) (Gent et al., 2004; Roumagnac et al., 2004a; Humeau et al., 2006) can be used for preliminary screening of strains to be inoculated. A multiplex PCR protocol usable on seed macerates without any culture step is now available as a screening test (Robene et al., 2015).

**Pathway for movement**

The most important pathway for long-distance movement of the pathogen is Allium seeds. Xanthomonas axonopodis
pv. allii may be spread over long distances via infected Allium seedlings used for transplant, but no documented cases are known. The pest is locally spread by wind-driven rains, irrigation water, humans, contaminated tools, equipment used in crop management and possibly via animals, although this has not been demonstrated.

**Pest significance**

**Economic impact**

Infection of the aerial parts of onion by the pathogen may lead to a reduction in bulb size. Yield losses for onion bulbs ranging from 10% to 50% have been reported in Continental USA (Schwartz & Otto, 2000; Nunez et al., 2002; Sanders et al., 2003). Although not precisely documented, the impact of the disease may be higher in tropical countries. Data from Barbados indicates cases where loss of an entire onion crop occurred (O’Garro & Paulraj, 1997). Severe reductions in onion bulb size have been recorded in South Africa (Serfontein, 2001).

**Control**

Control in the USA is most often partially achieved through a massive use of copper bactericides, sometimes with ethylenebisdithiocarbamate fungicides added, but this strategy is economically and environmentally unsatisfactory (Gent & Schwartz, 2005a). Alternative management programmes involving plant activators (acibenzolar-S-methyl), bacteriophages or antagonistic bacteria are being developed experimentally (Gent & Schwartz, 2005a; Lang et al., 2007). However, these new management programmes are not currently as affordable as conventional programmes which also protect onion against other diseases (Lang et al., 2007). Seed health testing should also be developed (Picard et al., 2008).

Prophylactic measures usually implemented for the control of plant pathogenic bacteria should be used. Although not experimentally evaluated, the host range of X. axonopodis pv. allii suggests that crop rotation should be considered in Integrated Pest Management (IPM) programmes. However, the longevity of the pathogen’s survival in the field in association with crop debris or in the absence of Allium spp. and weeds is not precisely known. Overhead irrigation should be avoided (Roumagnac et al., 2004b) and furrow or drip irrigation should be considered as alternative irrigation modes. No Allium cultivars have been consistently characterized as resistant to X. axonopodis pv. allii and no sources of resistance have been identified to date.

**Phytosanitary risk**

Xanthomonas axonopodis pv. allii can cause significant yield losses and high costs for chemical control (approximately 200 EUR per ha) (Lang et al., 2007) when conditions are suitable. This pest presents a risk for Allium spp. grown outdoors in the Mediterranean parts of the EPPO region and to a lesser extent the temperate parts of the EPPO region.

**Phytosanitary measures**

EPPO recommends that seeds and seedlings of host plants should be produced in areas free from or places of production free from Xanthomonas axonopodis pv. allii.

**Acknowledgement**

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**References**


Bowen P, Gibbs HAA & O’GLW (1998) Garlic, chives, shallot and leek are alternative hosts to Xanthomonas campestris, the pathogen of leaf blight of onion Allium cepa L. In 7th Int. Cong. Plant Pathol., pp. 6–96. ISPUP, Edinburgh, Scotland.


