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Data Sheets on Quarantine Pests

Xanthomonas axonopodis pv. *phaseoli*

IDENTITY

Name: *Xanthomonas axonopodis* pv. *phaseoli* (Smith) Vauterin *et al.*
Synonyms: *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye
Xanthomonas phaseoli (Smith) Dowson
Xanthomonas phaseoli var. *fuscans* (Burkholder) Starr & Burkholder
Xanthomonas phaseoli (Smith) Dowson var. *phaseoli*
Xanthomonas fuscans (Burkholder) Burkholder
Taxonomic position: Bacteria: Gracilicutes
Common names: Common blight, fuscous blight (English)
Brûlure bactérienne (French)
Bakterieller Bohnenbrand (German)
Fettfleckenkrankheit (German)
Quema bacteriana (Spanish)
Notes on taxonomy and nomenclature: Strains producing a brown pigment in culture were formerly distinguished as var. *fuscans*. No particular significance is now attached to this, but the older literature, including the first edition of the EPPO data sheets (OEPP/EPPO, 1978), treated var. *phaseoli* and var. *fuscans* as separate pathogens, differing in some respects in their biology and pathogenic behaviour. There is a recent suggestion based on RFLP analysis (Gabriel *et al*., 1989) that *X. phaseoli* should be reinstated as a species distinct from *X. campestris* and that *fuscans* strains should remain in *X. campestris*, but this has been challenged (Young *et al*., 1991). More recently, the genus *Xanthomonas* was extensively revised with a number of pathovars elevated to rank of species and existing species descriptions substantially altered (Vauterin *et al.*, 1995). The new name *Xanthomonas axonopodis* pv. *phaseoli* was proposed as part of this revision.
Bayer computer code: XANTPH
EPPO A2 list: Nos 60/61
EU Annex designation: II/A2

HOSTS

The principal host is *Phaseolus vulgaris*, but other legume species are naturally infected, including *P. lunatus*, *Vigna aconitifolia* and *V. radiata*. *Lablab purpureus* and *Mucuna deeringiana* are possibly natural hosts. *P. coccineus*, *P. acutifolius* and *Lupinus polyphyllus* are hosts only by artificial inoculation (Bradbury, 1986). Almost certainly, all records of *X. axonopodis* pv. *phaseoli* on soyabeans refer to *X. axonopodis* pv. *glycines*, and on cowpeas to *X. axonopodis* pv. *vignicola*.

In the EPPO region, only *P. vulgaris* is a significant host.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Found in Egypt, Finland (unconfirmed), Lithuania, Moldova, Morocco (unconfirmed), Norway, Poland (unconfirmed), Sweden (unconfirmed). Widespread in Bulgaria, Hungary, Lebanon and Spain; locally established in France, Germany, Greece, Italy, Netherlands, Portugal (Madeira), Romania, Russia (European), Slovakia, Slovenia, Switzerland, Turkey and Yugoslavia. Found in the past but not established in the Czech Republic, Israel.
Asia: Bangladesh, Brunei Darussalam, Cambodia, China (Heilongjiang, Henan, Hunan, Jilin, Jiangsu, Liaoning, Zhejiang), Cyprus, Georgia, Hong Kong, India (Delhi, Maharashtra, Rajasthan, Uttar Pradesh), Indonesia, Israel, Japan, Lebanon, Korea Democratic People's Republic, Korea Republic, Malaysia, Myanmar (Burma), Nepal, Philippines, Sri Lanka, Taiwan, Thailand, Turkey, United Arab Emirates (IMI, 1996), Viet Nam, Yemen.
Africa: Angola, Burundi, Central African Republic, Egypt, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Nigeria, Rwanda, Somalia, South Africa, Sudan, Swaziland, Tanzania, Tunisia, Uganda, Zaire, Zambia, Zimbabwe.
North America: Bermuda, Canada (Ontario), Mexico, USA (more prevalent east of the Rocky Mountains: Colorado, Hawaii, Michigan, Montana, Nebraska, New York, Texas, Wisconsin, Wyoming).
Central America and Caribbean: Widespread in Central America; Barbados, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Guatemala, Honduras, Jamaica, Martinique, Nicaragua, Panama, Puerto Rico, St. Vincent and Grenadines, Trinidad and Tobago.
South America: Argentina, Brazil (widespread), Chile, Colombia, Ecuador, Paraguay, Uruguay, Venezuela.
Oceania: Australia (New South Wales, Queensland, Victoria, Western Australia), New Zealand, Samoa.
EU: Present.
Distribution map: See IMI (1996, No. 401); CMI (1973, No. 402).

BIOLOGY

The bacterium enters the leaves via stomata or wounds, and subsequently invades the intercellular spaces, causing a gradual dissolution of the middle lamella. The stem is entered in three ways: via the stomata of the hypocotyl and epicotyl; through the vascular system of the leaf; or from infected cotyledons. The seed is penetrated via the vascular system of the pedicel and funiculus. The micropyle also serves as a point of entry into the seed. Direct penetration of seed has not been observed. The pathogen either remains in the seedcoat or passes to the cotyledons when the seed germinates, and so infection of the young plant results.

The bacterium can remain viable for several years beneath the seedcoat. Other inoculum sources include infected plant debris in the soil and alternate host plants on which the pathogen can overwinter. Circumstantial evidence suggests that the organism can overwinter in the soil. A single source of inoculum in a crop may contaminate an area of more than 8 m around it; thus, one diseased plant in 10 000 is sufficient to cause a severe epidemic.

Dissemination in the field occurs in wind-driven rain, and insects (grasshoppers, *Melanoplus* spp.; Mexican bean beetle, *Epilachna varivestis*) are considered vectors in the USA. Overhead sprinkler irrigation may provide a means for spread, but not furrow irrigation. The disease is severe under conditions of high rainfall and humidity, with

maximum development around 28°C; disease intensity is not reduced by high K and P levels.

DETECTION AND IDENTIFICATION

Symptoms

Symptoms of common and halo blight diseases are very similar and it is seldom possible from a superficial examination to be certain which one is present.

On seed

If the infection occurred when the pods were young, the seed may rot or be variously wrinkled and shrivelled. If the bacteria enter by way of the funiculus, only the hilum may be discoloured, but this is difficult to detect on dark-seeded varieties. Strains producing the brown pigment (so-called *fuscans* strains) give more conspicuous seed discoloration.

On seedlings

When grown from infected seed, seedlings have injured or entirely destroyed growing tips. Angular, water-soaked areas frequently occur on the opposite sides of the primary leaves, indicating that the initial infection occurred while they were still folded together. Lesions on the stems of young seedlings begin as small water-soaked spots that gradually enlarge and sometimes become sunken. If these plants do not die, buds may arise in the axils of the cotyledons and produce dwarfed plants with few pods. Plants often exhibit a characteristic wilting during the heat of the day, with recovery of turgidity at night.

On plants

Following infection in the field, small, water-soaked areas appear on the leaf, enlarge and become encircled by a comparatively narrow zone of lemon-yellow tissue. These lesions turn brown, the leaf rapidly becomes necrotic and defoliation may result. The diseased crop takes on a burned appearance, which distinguishes it from halo blight infections in which the crop appears generally more yellow. In systemic infections, reddish brown discoloration of the veins and water-soaking of adjacent tissues occurs. If leaf infection starts at the petiole, the main vein and its upper branches appear water-soaked at first and later take on a brick-red colour. Lesions on the stems appear as reddish streaks, extending longitudinally. The stem surface often splits, releasing a yellow bacterial exudate (in halo blight infections, exudates are light cream or silver coloured). Stem girdling occurs, usually starting at the node above the cotyledonary attachment, and is completed when the pods are half mature. These weakened stems often break at the node.

On pods

Infections occur on any part as small, water-soaked spots which gradually enlarge and may be surrounded by a distinct zoning and narrow, reddish-brown or brick-red band of tissue. Infections may occur in the vascular elements of the sutures, causing water-soaking of the adjoining tissue. The infected tissue dries out and darkens, and droplets of yellow bacterial ooze may appear which, on drying, form a crust on the surface of older pod lesions. The whitefly *Trialeurodes abutiloneus* can cause similar leaf symptoms but, if present, nymphs will be found on the underside of the leaf at the centre of each spot.

For more details, see Burkholder (1930), Zaumeyer (1930), Zaumeyer & Thomas (1957), Hayward & Waterston (1965a; 1965b).

Morphology

X. axonopodis pv. *phaseoli* is a motile, aerobic, Gram-negative rod, 0.4-0.9 x 0.6-2.6 µm, with a single polar flagellum. Agar colonies are convex, yellow and wet-shining. In culture on complex media or media containing tyrosine, a brown, diffusible pigment is produced by so-called *fuscans* strains.

Detection and inspection methods

Laboratory testing may be done in order to detect internally borne bacteria (Ednic & Needham, 1973; Roth, 1985). A slurry from ground, surface-sterilized seeds can be cultured on a selective medium (e.g. MXP medium; Claflin *et al.*, 1987) and subsequent colonies characterized. An immuno-isolation procedure has been described by Van Vuurde & Van Henten (1983) and an immunofluorescent staining technique by Malin *et al.* (1983). ELISA techniques have been investigated but not yet fully developed. Schaad & Stall (1988) tabulated the growth of *X. axonopodis* pv. *phaseoli* on a range of semiselective agar media.

A rapid phage count may be used in identification. Bacterial suspensions (in nutrient broth) from agar colonies 24 h old are seeded onto nutrient agar plates. An initial test with high-titre phage preparations will eliminate isolates resistant to the phage. Plates can be examined for lysis at 24 and 48 h after inoculation with phage.

A DNA probe assay for *X. axonopodis* pv. *phaseoli* is under development (Gillis *et al.*, 1990).

Means of movement/dispersal

Natural movement occurs only over relatively short distances within or between fields. The only means of long-distance dispersal is by human transport of infected bean seed.

PEST SIGNIFICANCE

Economic impact

It is not always possible to separate the losses caused by common blight and those due to halo blight, *Pseudomonas syringae* pv. *phaseolicola*, since they frequently occur together in the same field and even on the same plant. Moreover, the severity of blight varies from year to year depending on weather conditions. As early as 1918, 75% of the fields in New York State (USA) were affected and serious losses occurred. In following years, losses of 20-50% were recorded. In 1953, the disease was widespread in western Nebraska (USA) and the loss caused was estimated at over 1 million USD. In 1976, it was the most economically important bacterial disease of beans in the USA causing an estimated loss of 4 million USD (Kennedy & Alcorn, 1980). Losses for the field bean crop in Ontario (Canada) varied from a high of over 1 251 913 kg in 1970, to a low of 217 724 kg in 1972. A model for the assessment of yield losses from bacterial blight has been developed in Ontario, using aerial infrared photographic surveys to assess disease levels (Wallen & Jackson, 1975).

In general, *X. axonopodis* pv. *phaseoli* causes most severe disease under fairly high temperature conditions (25-35°C), and also requires high rainfall and humidity. In the EPPO region, it is mainly present in eastern and southern areas, where it has a rather variable impact. In Romania, between 1962 and 1969, 45% of bacterial diseases of bean were caused by *X. axonopodis* pv. *phaseoli*, while in Hungary in 1974 only 4% were caused by this pathogen.

Control

Control methods (Severin, 1971) include: planting disease-free seed, disease escape by suitable choice of planting date, crop rotation (an 85% reduction of attack was obtained by alternating bean and maize crops in Romania), sprays and dusts (e.g. with copper compounds or streptomycin), and resistant cultivars (Leakey, 1973). Numerous sources of tolerance have been identified, but breeding is complicated by the fact that different genetic systems control the reactions in pods and leaves (Coyne & Schuster, 1974). Wallen &

Galway (1979) have used aerial monitoring to improve seed quality in a 10-year programme.

Phytosanitary risk

X. axonopodis pv. *phaseoli* is an A2 quarantine pest for EPPO (OEPP/EPPO, 1978). It occurs only locally or is not established in a number of bean-growing countries of the EPPO region, where its introduction on infected seed is liable to cause serious problems, especially under warmer conditions.

PHYTOSANITARY MEASURES

Precautions should be taken (OEPP/EPPO, 1990) to ensure a supply of healthy seed, by seed testing, by requiring area freedom, or by growing-season inspection of the seed crop.

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