

Data Sheets on Quarantine Pests

Clavibacter michiganensis subsp. *sepedonicus***IDENTITY**

Name: *Clavibacter michiganensis* subsp. *sepedonicus* (Spieckermann & Kotthoff) Davis *et al.*

Synonyms: *Corynebacterium sepedonicum* (Spieckermann & Kotthoff) Skaptason & Burkholder
Corynebacterium michiganense pv. *sepedonicum* (Spieckermann & Kotthoff) Dye & Kemp

Taxonomic position: Bacteria: Firmicutes

Common names: Bacterial ring rot (English)
Bactériose annulaire, flétrissement bactérien (French)
Bakterienringfäule (German)
Podredumbre anular (Spanish)

Bayer computer code: CORBSE

EPPQ A2 list: No. 51

EU Annex designation: I/A2

HOSTS

Natural infection causing disease has been found on potatoes only. Sugarbeet has been described as a natural symptomless host and the bacterium has also been found in sugarbeet seed (Bugbee & Gudmestad, 1988). In inoculation tests many members of the Solanaceae, including tomatoes and aubergines, were found to be susceptible.

In the EPPQ region, only potatoes are considered a significant host.

GEOGRAPHICAL DISTRIBUTION

EPPQ region: Algeria, Denmark, Finland, Norway, Poland, Russia (European, Siberia; widespread), Sweden and Ukraine. In Germany (Schleswig-Holstein), ring rot was found, but no recent outbreaks are known and the disease is not considered established. Reports that the disease occurs in Belgium, Czech Republic, Greece, Lebanon, Romania, Slovakia and Switzerland are unconfirmed. A record in Turkey has since been shown to be erroneous. It has been eradicated in France.

Asia: China (Anhui, Hebei, Heilongjiang, Henan, Hunan, Jiangsu, Ningxia, Shaanxi, Yunnan, Zhejiang), Japan, Kazakhstan, Korea Democratic People's Republic, Korea Republic, Nepal, Russia (Siberia), Taiwan, Uzbekistan. Unconfirmed reports from Afghanistan, China, Cambodia, Lebanon and Viet Nam.

Africa: Algeria.

North America: Canada (British Columbia to Newfoundland and Nova Scotia) and USA (Idaho, Kansas, Maine, New York, North Dakota, Oregon, Washington, Wisconsin). Unconfirmed report from Mexico.

Central America and Caribbean: Unconfirmed reports from Costa Rica, Haiti and Panama.

South America: Peru. Unconfirmed reports from Venezuela.

EU: Present.

Distribution map: See CMI (1983, No. 20).

BIOLOGY

After a diseased potato is planted, the bacteria multiply very rapidly and pass along the vascular strands into the stems and petioles. From there they reach the roots and maturing daughter tubers, sometimes within 8 weeks after planting. The daughter tubers may themselves be used as seed and perpetuate the disease. *C. michiganensis* subsp. *sepedonicus* apparently does not survive in the soil during winter. The bacterium can, however, survive and remain infectious on potato bags, barn walls, machinery and other equipment and in self-sown plants from an infected crop. The bacterium remained infectious at and above freezing temperatures for at least 18 months on burlap and for 63 months in infected potato stems (Nelson, 1984). If self-sown planters from a previously infected crop are lifted with an otherwise clean seed crop, that crop can be infected. *C. michiganensis* subsp. *sepedonicus* has a relatively low temperature optimum for growth (21°C) and is mainly confined to cooler areas of the world. The climate in north, north-west and central Europe is favourable to the disease. In the southern part of the EPPO region, climatic conditions would probably not favour ring rot except, perhaps, in mountainous areas.

DETECTION AND IDENTIFICATION

Symptoms

The symptoms shown by infected plants are rather variable and, because they usually appear late in the growing season, they may be obscured by or mistaken for potato blight (*Phytophthora infestans*), wilt (*Verticillium albo-atrum*), stem canker (*Thanatephorus cucumeris*) or drought. First symptoms of wilting develop in lower leaves, either all around the plant or only on one side of one stem. The margins of the leaves roll inwards and upwards and the surface loses its light shiny appearance. Leaves become progressively dull light-green, then grey-green with occasional mottling, then yellow and finally brown and necrotic. When infected stems are cut across, discoloration of vascular tissue is not obvious. Symptom formation is enhanced by hot, dry weather conditions.

Tuber infection occurs through the stolon. Earliest infections can be observed, when the tuber is cut across the heel end, as narrow glassy to cream-yellow zones along the vascular tissue near the stolon end. In the case of more advanced infections this narrow yellowish to light-brown zone surrounds all the vascular tissue. In later stages the vascular ring and the discoloured zone become soft. Characteristically, upon squeezing, the tissue outside the vascular ring is easily separated from the inner tissues and creamy, cheese-like ribbons of odourless bacterial ooze with macerated tissue are expelled. In these advanced stages, external symptoms may also be observed, consisting of reddish to brown blotches around the eyes. The skin shows irregular, often star-shaped cracks. These cracked tubers are very susceptible to secondary soft-rot micro-organisms which obscure the ring rot symptoms. Mild infections in both susceptible and tolerant potato cultivars may cause so-called latent infections of daughter tubers. Latent infections can only be traced by special detection methods (see under Detection and inspection methods).

Tuber symptoms may be confused with those caused by the bacterium *Ralstonia solanacearum* (EPPO/CABI, 1996b).

Morphology

C. michiganensis subsp. *sepedonicus* is a short, non-motile, Gram-positive rod (Hayward & Waterston, 1964).

Detection and inspection methods

Because symptoms of ring rot are variable and sometimes masked by other diseases, ring rot can be confirmed only by laboratory tests, including a pathogenicity test on aubergine and a serological test (De Boer & McNaughton, 1986). Until now a host test is essential for confirming latent infections. A method for inspection, detection (of latent infections) and identification of the pathogen is described by OEPP/EPPO (1990b).

MEANS OF MOVEMENT AND DISPERSAL

Important means of spread are the planting of infected seed potatoes and contamination of containers, equipment and premises. When seed potatoes are cut before planting the cutting knife is an important dispersal unit: after cutting an infected tuber, 20-30 healthy tubers may be infected. Planters and graders which have been contaminated by bacteria from a few badly diseased potatoes are also a potent infection source. Spread in the field from plant to plant is usually very low, but there is experimental evidence that some insects, including Colorado beetle (*Leptinotarsa decemlineata*; EPPO/CABI, 1996a), leafhoppers and aphids can transmit the disease (Duncan & Genereux, 1960).

PEST SIGNIFICANCE

Economic impact

Damage is caused by destruction of vascular tissues and subsequent wilting and dying of plants and secondary rotting of tubers. Crop losses have been mainly reported from North America (up to 50%; Easton, 1979) and Russia (15-30% of plants infected, up to 47% crop loss; Muller & Ficke, 1974). Where ring rot occurs in the EPPO region, the disease appears more sporadically and at low levels of infection. One of the reasons for low disease occurrence in this area will be the fact that cutting of potato seed and use of pricker-type planters is not common in Europe. However, when tubers are cut, higher levels may also occur (up to 30% crop loss in France; Lansade, 1950). Economic losses are due to wilt and tuber rotting in the field and in store. Indirectly, expenses of disinfecting sacks, machinery, stores, etc., prohibition of potato cultivation, and restriction or prohibition of export trade may increase economic loss. See also Sletten (1985).

Control

At the moment there is no method of direct chemical or biological control available. Breeding for resistance has produced some (mainly) tolerant cultivars which are not much used (Manzer *et al.*, 1987; Manzer & McKenzie, 1988). The most important methods of control are production of disease-free seed following strict certification and testing schemes (Nelson, 1984) and sanitation (Lynch *et al.*, 1989). Disinfection can be obtained by treatment with compounds from the quaternary ammonia, bleach, chlorine dioxide, iodine and phenol groups for at least 10 min, preferably under low organic load (Secor *et al.*, 1987).

Phytosanitary risk

C. michiganensis subsp. *sepedonicus* is listed as an A2 quarantine pest by EPPO (OEPP/EPPO, 1978). It is considered of quarantine significance throughout the Old World, for example by APPPC and IAPSC, but also in the New World (COSAVE, JUNAC). Several seed-potato-producing countries in the EPPO region are free from the pest, and also Mediterranean countries exporting ware potatoes towards the north. While the direct

economic impact of ring rot may only be moderate, especially with modern production systems, it would constitute a major extra constraint on seed potato production in countries where it does not occur, with considerable indirect effects on trade.

PHYTOSANITARY MEASURES

Ring rot can occur at low levels in potato production systems, and can cause latent infection of tubers. So phytosanitary measures aimed at potato consignments only are quite inadequate. Measures have to be aimed at the whole production system, at the material from which potato consignments are derived and at the place or area of production; for seed potatoes, in particular, they involve a series of multiple checks, each of which is considered by itself insufficient.

EPPO's specific quarantine requirements for *C. michiganensis* subsp. *sepedonicus* (OEPP/EPPO, 1990a) recommend that seed potatoes should only be imported from countries which can show, by surveys and tests, that they operate a seed-potato production and distribution system free from ring rot. This should involve laboratory testing for latent infection by the EPPO-recommended method (OEPP/EPPO, 1990b). This can readily apply to countries where ring rot has never been recorded, but can also apply to countries where ring rot is locally present, but does not enter the particular seed-potato production system under consideration. In addition, all seed and ware potatoes should come from stock, and a place of production, found free from ring rot, and from a field inspected during the last growing season (or two growing seasons if the previous crop was also potatoes) and found free from ring rot. Finally, hygienic precautions should be taken in storage and packing houses, and packing material and containers should be new or disinfected.

EPPO in fact proposes that countries may take even stronger measures; prohibition of seed and/or ware potatoes from countries where *C. michiganensis* subsp. *sepedonicus* occurs; requirement of proof by survey that the bacterium does not occur in a country.

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