

Data Sheets on Quarantine Pests

Potato stolbur phytoplasma

IDENTITY

Name: Potato stolbur phytoplasma

Synonyms: Tomato stolbur MLO
Classical stolbur MLO

Taxonomic position: Bacteria: Tenericutes: Mollicutes: Phytoplasmas

Common names: Stolbur (potato, tomato), big bud, fruit woodiness (tomato), female sterility (tobacco) (English)
Stolbur (French)

Notes on taxonomy and nomenclature: Potato stolbur phytoplasma is one of a group of phytoplasmas causing yellows type diseases in Europe, and falling within the broad concept of European aster yellows (Cousin & Smith, 1988; EPPO/CABI, 1996). Parastolbur and metastolbur are strains of stolbur; northern stolbur is probably caused by potato witches' broom phytoplasma (EPPO/CABI, 1996), pseudoclassic stolbur is poorly defined, and pseudostolbur is a physiological disorder (Valenta *et al.*, 1961). A little leaf disease of tomatoes, *Capsicum* and aubergines in south-eastern France has been attributed to an phytoplasma distinct from stolbur (Marchoux & Rougier, 1987).

Tomato big bud phytoplasma, mainly reported from other regions of the world than the EPPO region, causes a disease similar to stolbur. Since "stolbur" in Russian is translated as "big bud" in English, there is most probably some confusion between tomato stolbur and tomato big bud in the literature. Indeed, some authors (Khurana *et al.*, 1988) regard the two as simply synonymous. However, there are other indications (Clark *et al.*, 1989) that tomato big bud phytoplasma is serologically distinct from European aster yellows phytoplasma. In any case, the vectors of these phytoplasmas in different parts of the world are different. At present, this question must be considered unresolved.

EPPO computer code: POSBXX

EPPO A2 list: No. 100

EU Annex designation: II/A2

HOSTS

Potato stolbur phytoplasma typically attacks Solanaceae (45 species). The principal economic hosts are potatoes, tomatoes, *Capsicum* spp. and aubergines. The phytoplasma has an even wider host range (typically of an aster yellows type of phytoplasma), at least 16 further species in six other families having been shown susceptible, including weeds in the Asteraceae, Convolvulaceae (*Convolvulus arvensis*) and Fabaceae (*Trifolium* spp.). See also Valenta *et al.* (1961).

GEOGRAPHICAL DISTRIBUTION

Potato stolbur phytoplasma is the central and southern European representative of the aster yellows complex on Solanaceae. Similar but probably not identical phytoplasmas occur in other continents (EPPO/CABI, 1996).

EPPO region: Recorded in Austria (unconfirmed), Greece, Poland (unconfirmed), Russia (European), Ukraine, Yugoslavia. Widespread in Bulgaria. Locally established in Czech Republic, France, Hungary, Israel (Zimmermann-Gries, 1970), Italy, Romania, Switzerland (Bovey, 1956) and Turkey. Although the disease has been reported in Belgium and Cyprus it is not established in these countries. A similar, and possibly related disease, mal azul, is found locally in Portugal on tomato. Tomato big bud phytoplasma, originally reported in Australia and found also in China, India and other Asian countries, South Africa (Thompson & Mynhardt, 1987) and the USA, has recently been cited as present in Israel, Lebanon and Russia (European). See note under Identity.

Asia: Armenia, Azerbaijan, Cyprus and Israel (locally established), Kyrgyzstan, Tajikistan, Turkey, Uzbekistan.

Outside the EPPO region, many phytoplasmas cause symptoms on Solanaceae similar to stolbur: tomato big bud phytoplasma (see Identity), several distinct phytoplasmas in India, aster yellows phytoplasma (or more specifically potato purple-top wilt phytoplasma) in North America. These are currently regarded as different from stolbur, for example in the EPPO data sheet on potato purple-top wilt phytoplasma (EPPO/CABI, 1996); however, in the present state of knowledge, it is mostly not possible to say where stolbur occurs outside the EPPO region. Stolbur as such has been recorded in Niger (Reckhaus *et al.*, 1988).

EU: Present.

BIOLOGY

Stolbur is readily transmissible by grafting, irrespective of whether the stock or scion is infective, and also by dodder (*Cuscuta campestris*, *C. epilinum*, *C. trifolii*). *Orobanche aegyptiaca*, parasitizing roots of diseased tomato plants, has been shown to contain phytoplasmas; thus, it could be involved in transmission in the field. Stolbur is not thought to be transmitted in the true seed of any of its hosts, and there is conflicting evidence for its transmission in potato tubers. In general, aster yellows type phytoplasmas are not thought to be tuber-transmitted in potato.

The most important vector in eastern Europe is the leafhopper *Hyalesthes obsoletus*. Other vectors reported include (Neklyudova & Dikit, 1973): *Aphrodes bicinctus*, *Euscelis plebeja*, *H. phytoplasmakosiewiczii*, *Lygus pratensis*, *L. rugulipennis*, *L. gemellatus*, *Macrosteles quadripunctulatus*. In experiments, the incubation period of the phytoplasma in the vector was about 1-2 months and 1 month, respectively, for *A. bicinctus* and *E. plebeja*; while, for *H. obsoletus*, an incubation period of only 2-7 days has been reported.

Disease outbreaks seem to occur in cycles, being favoured by hot dry summers which stimulate vector migration; in Bosnia and Herzegovina, stolbur was epiphytotic in 1955 and 1964, but between these dates and after 1965 its levels were low (Buturovic, 1971). Thus, the most severe attacks appear to occur when climatic conditions force the vectors to transfer from infected wild host populations to solanaceous hosts which, otherwise, they tend not to favour. Furthermore, it is not clear whether vectors spread stolbur within economic host crops to any extent. In fact, in nature, the economically important host crops are not important for the continuity of the virus; an incomparably greater role is played by such wild plants as *Convolvulus arvensis*, clovers and, probably, Asteraceae and other plants.

Various strains of potato stolbur phytoplasma have been described: parastolbur and metastolbur in the Czech Republic (Valenta *et al.*, 1961), strains C, M, SM and P in France (Marchoux *et al.*, 1969). These are distinguished by the symptoms caused on various cultivars of tomatoes, *Capsicum* and aubergines.

For more information, see Savulescu & Pop (1956), Klinkovski (1957), Borges & Lourdes (1972).

DETECTION AND IDENTIFICATION

Symptoms

In general, three main types of symptom are distinguished: flower changes, premature wilting, and death without obvious flower changes; however, symptoms may be absent or hardly distinguishable; moreover, they will vary with the stolbur strain, environmental conditions and host resistance. For more information, see Bovey (1956), Savulescu & Pop (1956), Klinkovski (1957), Valenta *et al.* (1961), Zimmermann-Gries (1970).

On potatoes

Plants grown from infected tubers give rise to normal or spindly sprouts (hair-sprouting). Where normal sprouts arise, symptoms are first apparent about 60-80 days after sowing, as a yellowing and rolling of the leaves. This is followed by production of aerial stolons and tubers in different parts of the stems close to the axils.

On tomatoes (especially field-grown)

Leaves developed before infection become greenish-yellow, especially at the margins, which may roll upward. Newly formed leaves become more yellow and are smaller. Stems become thin at the apex as growth is stopped, but enlarged at the infection sites as a result of abnormal phloem formation. This appears as a greenish, water-soaked band 1-2mm wide, which extends towards the xylem. Lateral shoots develop, giving the plant a bushy aspect. Flower buds assume an abnormally erect position; the sepals, whose veins develop a violet colour, remain completely joined and the calyx is enlarged and cyst-like ("big bud").

Flowers, if already formed when infection occurs, become similarly erect, may be sterile and petals are greenish instead of yellow. Distortion is common, and petals of young flowers become totally dwarfed and green. Peduncles are thicker than normal. Fruit development is arrested following infection. Green fruits already formed become solid, dry and colour very slowly. Necrosis occurs at the embryonic centre in younger fruits. Pedicels of fruits are thicker than in healthy plants, in spite of the relatively small fruit size.

Morphology

The sieve tubes of infected plants contain typical aster yellows type phytoplasmas.

Detection and inspection methods

Stains for DNA can be used to detect phytoplasmas in sieve tubes, since these normally lack nuclei (Cousin & Jouy, 1984). Indirect immunofluorescence can also be used as a detection method (Cousin *et al.*, 1989), though it will not necessarily be diagnostic, since antisera are not very specific. A tissue blotting method has been described for tomato big bud phytoplasma (Lin *et al.*, 1990).

MEANS OF MOVEMENT AND DISPERSAL

Potato stolbur phytoplasma is naturally dispersed over fairly large distances by its leafhopper vectors. In international trade, young host plants (e.g. seedlings of tomatoes, *Capsicum* or aubergines) could carry the phytoplasma, but it is inherently rather improbable that such young plants should already be infected (since the disease is not seed-

borne). The probability of spread in potato tubers is extremely low, since the rate of transmission is very low and the disease would not be accepted in a certified seed crop.

PEST SIGNIFICANCE

Economic impact

While very high disease incidence is sometimes recorded (86%) (Citir, 1985) and the immediate yield loss in potato crops in some ecological situations can be extreme, the disease tends not to persist in stocks, only a small percentage of infected tubers giving rise to diseased plants. Late infections do not affect yield. The disease is possibly more significant on its other hosts, tomatoes and aubergines. In general, stolbur appears to be much less important now than it was in the 1950s. It continues to be of importance in the Czech Republic, Russia and Yugoslavia.

Control

The disease should present little problem in well managed crops. Use healthy planting material and control weeds (which are a potential reservoir of the phytoplasma).

Phytosanitary risk

Potato stolbur phytoplasma is considered as an A2 quarantine pest by EPPO (OEPP/EPPO, 1978), and is also of quarantine significance for COSAVE and NAPPO. The countries producing potatoes, and also various solanaceous vegetable crops, can reasonably seek to avoid the further spread of this pathogen, even if its economic importance is not very high. It is more questionable whether there is a practical pathway for spread of the pathogen by traded plants. The phytoplasma is much more likely to infect a crop through leafhoppers coming from wild plants than by being present in planting material. Even if infected plants were introduced into a new country, the possibility of spread would be remote, since the vector would not normally feed on that host. The phytoplasma would, therefore, probably die out with the introduced plant.

PHYTOSANITARY MEASURES

EPPO recommends (OEPP/EPPO, 1990) that planting material of host plants of stolbur should come from fields found free, with their immediate vicinity, from the disease at an appropriate time during the growing season. This applies not only to the crop but also to any other Solanaceae and to weeds.

BIBLIOGRAPHY

- Borges, M.; Lourdes, V. de (1972) Mycoplasma and potato diseases. *Potato Research* **15**, 187-199.
- Bovey, R. (1956) Une nouvelle maladie à virus de la tomate en Suisse Romande. *Annuaire Agricole de la Suisse* **57**, 599-611.
- Buturovic, D. (1971) [Contribution to the knowledge of stolbur and related diseases (mycoplasmoses) of potato in Bosnia and Herzegovina]. *Review of Research Works, Sarajevo Institute of Agricultural Research*, pp. 31-42.
- Citir, A. (1985) Preliminary investigation of potato diseases caused by MLOs in Erzurum region. *Journal of Turkish Phytopathology* **14**, 53-63.
- Clark, M.F.; Morton, A.; Buss, S.L. (1989) Preparation of mycoplasma immunogens from plants and a comparison of polyclonal and monoclonal antibodies against primula yellows. *Annals of Applied Biology* **114**, 111-124.
- Cousin, M.T.; Dafalla, G.; Demazeau, E.; Theveu, E.; Grosclaude, J. (1989) In situ detection of MLOs for Solanaceae stolbur and faba bean phyllody by indirect immunofluorescence. *Journal of Phytopathology* **124**, 71-79.

- Cousin, M.T.; Jouy, P. (1984) Comparative study of methods using Hoechst reagent and polychromatic stain for the detection of mycoplasma-like organisms in plants. *Agronomie* **4**, 341-346.
- Cousin, M.T.; Smith, I.M. (1988) The aster yellows complex. In: *European handbook of plant diseases* (Ed. by Smith, I.M.; Dunez, J.; Lelliot, R.A.; Phillips, D.H.; Archer, S.A.), pp. 121-124. Blackwell Scientific Publications, Oxford, UK.
- EPPO/CABI (1996) Potato purple-top wilt phytoplasma. In: *Quarantine pests for Europe*. 2nd edition (Ed. by Smith, I.M.; McNamara, D.G.; Scott, P.R.; Holderness, M.). CAB INTERNATIONAL, Wallingford, UK.
- Khurana, S.M.P.; Singh, R.A.; Kaley, D.M. (1988) Mycoplasma-associated potato diseases and their control in India. In: *Mycoplasma diseases of crops. Basic and applied aspects* (Ed. by Maramorosch, K.; Raychaudhuri, S.P.), pp. 285-316. Springer-Verlag, Berlin, Germany.
- Klinkovski, M. (1957) [Contribution to the knowledge on stolbur disease of potato]. *Proceedings of the 3rd Conference on Potato Virus Diseases, Lisse-Wageningen, 24-28 June, 1957*, pp. 264-277.
- Lin, N.S.; Hsu, Y.H.; Hsu, H.T. (1990) Immunological detection of plant viruses and a mycoplasma-like organism by direct tissue blotting on nitrocellulose membranes. *Phytopathology* **80**, 824-828.
- Marchoux, G.; Giannotti, J.; Laterrot, H. (1969) Le stolbur P, une nouvelle maladie de type jaunisse chez la tomate. Symptômes et examen cytologique des tissus au microscope électronique. *Annales de Phytopathologie* **1**, 633-640.
- Marchoux, G.; Rougier, J. (1987) Une nouvelle affection des solanées maraîchères: la maladie des proliférations et petites feuilles. *Phytoma* No. 392, pp. 53-54.
- Neklyudova, E.T.; Dikit, S.P. (1973) [Tarnished plant bugs as vectors of stolbur of Solanaceae]. *Trudy po Prikladnoi Botanike, Genetike i Seleksii* **50**, 36-39.
- OEPP/EPPO (1978) Data sheets on quarantine organisms No. 100, Potato stolbur MLO. *Bulletin OEPP/EPPO Bulletin* **8** (2).
- OEPP/EPPO (1990) Specific quarantine requirements. *EPPO Technical Documents* No. 1008.
- Reckhaus, P.; Reckhaus, S.; Adamou, I. (1988) Stolbur disease of tomato plants in Niger. *Plant Disease* **72**, 268.
- Savulescu, A.; Pop, I. (1956) [Contribution to the study of stolbur in Romania]. *Buletinul Stiintific, Sectia de Biologie si Stiinta Agricola* **8**, 723-737.
- Thompson, G.J.; Mynhardt, L. (1987) Tomato big bud disease in South Africa. *Phytophylactica* **19**, 109-111.
- Valenta, V.; Musil, M.; Misiga, S. (1961) Investigation on European yellows-type viruses. I. The stolbur virus. *Phytopathologische Zeitschrift* **42**, 1-38.
- Zimmerman-Gries, S. (1970) Stolbur - a new potato disease in Israel. *Potato Research* **13**, 146-150.