Prepared by CABI and EPPO for the EU under Contract 90/399003

Data Sheets on Quarantine Pests

Ditylenchus dipsaci

IDENTITY

Name: *Ditylenchus dipsaci* (Kühn) Filipjev
Synonyms: *Tylenchus dipsaci* (Kühn) Bastian
Ditylenchus phloxidis Kirjanova
Ditylenchus fragariae Kirjanova
Taxonomic position: Nematoda: Tylenchida: Anguinidae
Common names: Stem nematode, stem and bulb eelworm, onion bloat (English)
Nématode des tiges (bulbes) (French)
Stengelälchen, Stockälchen (German)
Bayer computer code: DITYDI
EPPO A2 list: No. 174
EU Annex designation: II/A2

HOSTS

D. dipsaci is known to attack over 450 different plant species, including many weeds. However, it occurs in more than ten biological "races" some of which have a limited host-range. The race(s) that breed on rye, oats and onions seem to be polyphagous and can also infest several other crops, whereas those breeding on lucerne, *Trifolium pratense* and strawberries are virtually specific for their named hosts and seem to have relatively few alternative host plants. The tulip race will also infest *Narcissus*, whereas another race commonly found in *Narcissus* does not breed on tulip. It is known that some of the races can interbreed and that their progeny have different host preferences. See also Sturhan (1969), Eriksson (1974).

The principal hosts are faba beans, garlic, *Hyacinthus orientalis*, leeks, lucerne, maize, *Narcissus pseudonarcissus*, oats, onions, peas, *Phlox drummondii*, *P. paniculata*, potatoes, rye, strawberries, sugarbeet, tobacco, *Trifolium pratense*, *T. repens*, tulips. It has also been reported on carnations, celery, *Hydrangea*, lentils, rape, parsley, sunflowers, wheat.

GEOGRAPHICAL DISTRIBUTION

D. dipsaci occurs locally in most temperate areas of the world (Europe and the Mediterranean region, North and South America, northern and southern Africa, Asia and Oceania) but it does not seem able to establish itself in ropical regions except at higher altitudes that have a temperate climate. In most countries regulatory measures (e.g. certification schemes) are applied to minimize further spread of *D. dipsaci*.
EPPO region: Albania, Algeria, Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus (unconfirmed), Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Liechtenstein, Malta, Moldova, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia (European), Slovakia, Spain, Sweden, Switzerland, Syria, Turkey, Tunisia, UK, Ukraine, Yugoslavia.

Asia: Armenia, Azerbaijan, China (Gansu, Hebei, Henan, Shandong), Cyprus (unconfirmed), Iran, Iraq, Israel, Japan (Honshu), Jordan, Kazakhstan, Korea Republic, Kyrgyzstan, Oman, Pakistan, Syria, Turkey, Uzbekistan, Yemen.
Africa: Algeria, Kenya, Morocco, Nigeria, Tunisia, Réunion, South Africa.
North America: Canada (Alberta, British Columbia, Ontario, Prince Edward Island), Mexico, USA (Alabama, Arizona, California, Florida, Hawaii, Michigan, New York, North Carolina, Utah, Virginia, Wyoming.
Central America and Caribbean: Costa Rica, Dominican Republic, Haiti.
South America: Argentina, Bolivia, Brazil (Pernambuco, Parana, Rio Grande do Sul, Santa Catarina, Saõ Paulo), Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela.
Oceania: Australia (New South Wales, South Australia, Tasmania, Victoria, Western Australia), New Zealand.
EU: Present.

BIOLOGY

D. dipsaci is a migratory endoparasite that feeds upon parenchymatous tissue in stems and bulbs, causing the breakdown of the middle lamellae of cell walls. Feeding often causes swellings and distortion of aerial plant parts (stems, leaves, flowers) and necrosis or rotting of stem bases, bulbs, tubers and rhizomes. During cold storage of bulbs and tubers, *D. dipsaci* and rotting may continue to develop.

In onion plants at 15°C, the life-cycle takes about 20 days. Females lay 200 to 500 eggs each. Fourth-stage juveniles tend to aggregate on or just below the surface of heavily infested tissue to form clumps of "eelworm wool" and can survive in a dry condition for several years; they may also become attached to the seeds of host plants (e.g. onions, lucerne, *Trifolium pratense*, faba beans, *Phlox drummondii*). In clay soils, *D. dipsaci* may persist for many years. Cool, moist conditions favour invasion of young plant tissue by this nematode.

For further information see Seinhorst (1956), Dekker (1969), Hooper & Southey (1978).

DETECTION AND IDENTIFICATION

Symptoms

In general, this nematode causes swellings and distortion of aerial plant parts and necrosis or rotting of stem bases, bulbs, tubers and rhizomes (see section on Biology).

On *Allium* spp. (onions, garlic, leeks, etc.)

Penetration of onion leaves by *D. dipsaci* causes leaf deformation and leaf swellings or blister-like areas on the surface. The leaves grow in a disorderly fashion, often hang as if wilted and become chlorotic. Young plants can be killed by high infestations. The inner scales of the bulb are usually more severely attacked than the outer scales. As the season advances the bulbs become soft and when cut open show browning of the scales in concentric circles. Conversely, *D. dipsaci* on garlic does not induce deformation or swellings, but causes leaf yellowing and death (Netscher & Sikora, 1990).

On lucerne

The crop declines in patches in the field and damage is more serious in humid climates. The whole plant becomes desiccated and presents symptoms of stunting and swelling at the base of the stem with conspicuous shortened internodes. With heavy infestation, plants can be killed.

On tobacco
Invasion by the nematode of the lower part of the stem causes stunting and deformation of the plant followed by "stem break".
On faba beans
D. dipsaci causes swelling and deformation of stem tissue or lesions which turn reddish-brown then black, depending on cultivar and environmental factors. Newly formed pods take on a dark-brown appearance. The lesions envelop the stem and increase in length, often advancing to the edge of an internode. Leaf and petiole necrosis is also common under heavy infestations, but can be confused with symptoms induced by fungal leaf pathogens. Infected seeds are darker, distorted, smaller in size and may have speckle-like spots on the surface. Heavy infestations often kill the main shoots, stimulating secondary tiller formation. The more severe symptoms are usually induced by the "giant race" on faba beans (Sikora & Greco, 1990).

Morphology
Slender transparent worms; adult about 1.2 mm long ("giant race" in faba beans about 2 mm long); head skeleton moderately developed, spear about 10-12 µm long with distinct basal knobs; lateral fields with four incisures; tail terminus sharply pointed. Post-vulval sac extending about half-way to the anus. See Hooper (1972).

Detection and inspection methods
D. dipsaci can be isolated from samples of suspected seed material (according to symptoms) by dissection in water at 20 times magnification. Nematodes leave the dissected tissue and swim actively in the water. Microscopic examination at 800 times magnification is necessary for correct identification of the nematode species.

MEANS OF MOVEMENT AND DISPERSAL

In international trade *D. dipsaci* is liable to be carried on dry seeds and planting material of host plants. In the field the fourth-stage juvenile can withstand desiccation for many years, and although soil densities seem to decrease rapidly, the nematode can survive for years without a host plant. Nematode survival and damage are greater in heavy soils as compared to sandy soils. It can also survive on a number of weeds. Irrigation water and cultivation by contaminated farm tools and machinery are other sources of inoculum dissemination.

PEST SIGNIFICANCE

Economic impact
D. dipsaci is one of the most devastating plant parasitic nematodes, especially in temperate regions. Without control, it can cause complete failure of host crops (e.g. onions, garlic, cereals, legumes, strawberries, ornamental plants, especially flower bulbs).

Control
Control by crop rotation is limited by the polyphagous habit of some races of *D. dipsaci* and by persistence of the nematode in clay soils. Chemical treatments of the soil are not an economic proposition for large areas. However, it may sometimes be worth treating small patches, after lifting and destroying the affected plants (bulbs) together with a margin of surrounding healthy ones, to eradicate a slight infestation before it spreads.

Nematode-free (certified) seeds and planting material are most essential to prevent crop damage by *D. dipsaci*. Hot-water treatments with different temperature-time combinations, depending on type and state of seed material, are operational and efficient to control D. dipsaci (Gratwick & Southey, 1972). Systemic nematicides may be effective to some extent

in controlling *D.dipsaci* in some ornamental crops. The use of tolerant or resistant cultivars can also reduce the damage.

Phytosanitary risk

At present, the distribution of the different races throughout the region is patchy and some countries apply official control measures to limit spread. Other countries regard the pest as being a quality pest which can be effectively controlled by production and use of healthy planting material. It is certainly true that, without control, *D. dipsaci* may cause complete failure of host crops within the EPPO region. EPPO lists it as an A2 quarantine pest, and CPPC, IAPSC and NAPPO also consider it to be of quarantine significance.

PHYTOSANITARY MEASURES

The implementation of certification schemes for the production of host plants of *D. dipsaci* can provide planting material free from the pest. Imports of soil and plants for planting and seeds of host plants from countries where this nematode occurs should be restricted.

BIBLIOGRAPHY

Dekker, H. (1969) *Phytonematologie*. VEB Deutscher Landwirtschaftsverlag, Berlin, Germany, 526 pp.

Eriksson, K.B. (1974) Intraspecific variation in *Ditylenchus dipsaci*. I. Compatibility tests with races. *Nematologica* **20**, 147-162.

Gratwick, M.; Southey, J.F. (1972) Hot-water treatment of plant material. *Bulletin, Ministry of Agriculture, Fisheries and Food* No. 201, 46 pp.

Hooper, D.J. (1972) *Ditylenchus dipsaci*. *CIH Descriptions of Plant-parasitic Nematodes* Set 1, No. 14.

Hooper, D.J.; Southey, J.F. (1978) *Ditylenchus*, *Anguina* and related genera. In: *Plant nematology* (Ed. by Southey, J.F.) vol. 1, pp. 78-97. Ministry of Agriculture, Fisheries and Food, London, UK.

Netscher, C.; Sikora, A. (1990) Nematode parasites of vegetables. In: *Plant parasitic nematodes in subtropical and tropical agriculture* (Ed. by Luc, M.; Sikora, R.A.; Bridge, J.), pp. 237-283. CAB International, Wallingford, UK.

Seinhorst, J.W. (1956) Population studies on stem eelworms (*Ditylenchus dipsaci*). *Nematologica* **1**, 159-164.

Sikora, R.A.; Greco, N. (1990) Nematode parasites of food legumes. In: *Plant parasitic nematodes in subtropical and tropical agriculture* (Ed. by Luc, M.; Sikora, R.A.; Bridge, J.), pp. 181-235. CAB International, Wallingford, UK.

Sturhan, D. (1969) Das Rassenproblem bei *Ditylenchus dipsaci*. *Mitteilungen der Biologischen Bundesanstalt für Land- und Forstwirtschaft* **136**, 87-98.