

EPPO Datasheet: *Ditylenchus dipsaci*

Last updated: 2023-10-10

IDENTITY

Preferred name: *Ditylenchus dipsaci*

Authority: (Kuehn) Filipjev

Taxonomic position: Animalia: Nematoda: Chromadorea:
Rhabditida: Anguinidae

Other scientific names: *Anguillulina dipsaci* Kuehn, *Ditylenchus allii* (Beijerinck) Tarjan, *Ditylenchus fragariae* Kirjanova, *Ditylenchus phloxidis* Kirjanova, *Tylenchus allii* Beijerinck, *Tylenchus devastator* (Kuehn) Oerley, *Tylenchus dipsaci* (Kuehn) Bastian

Common names: bloat disease of onion, brown ring disease of hyacinth, bulb eelworm, ring disease of bulbs, stem and bulb eelworm, stem and bulb nematode, stem nematode

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EPPO Categorization: A2 list

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EU Categorization: RNQP (Annex IV)

EPPO Code: DITYDI



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HOSTS

Ditylenchus dipsaci is known to infect over 500 different plant species, including many weeds. Up to 30 biological races of *D. dipsaci* have been identified based on their host preferences, forming a species complex (Sturhan *et al.*, 2008). 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. According to Whitehead *et al.* (1987), the sugar beet race is polyphagous but cannot multiply on lucerne, whereas the lucerne race can reproduce on sugar beet. It is known that some of the races can interbreed and that their progeny has different host preferences. See also Sturhan (1969), Eriksson (1974). Recently, the giant race of *D. dipsaci* has been recognized as a distinct species and is now known as *Ditylenchus gigas* (Vovlas *et al.*, 2011).

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

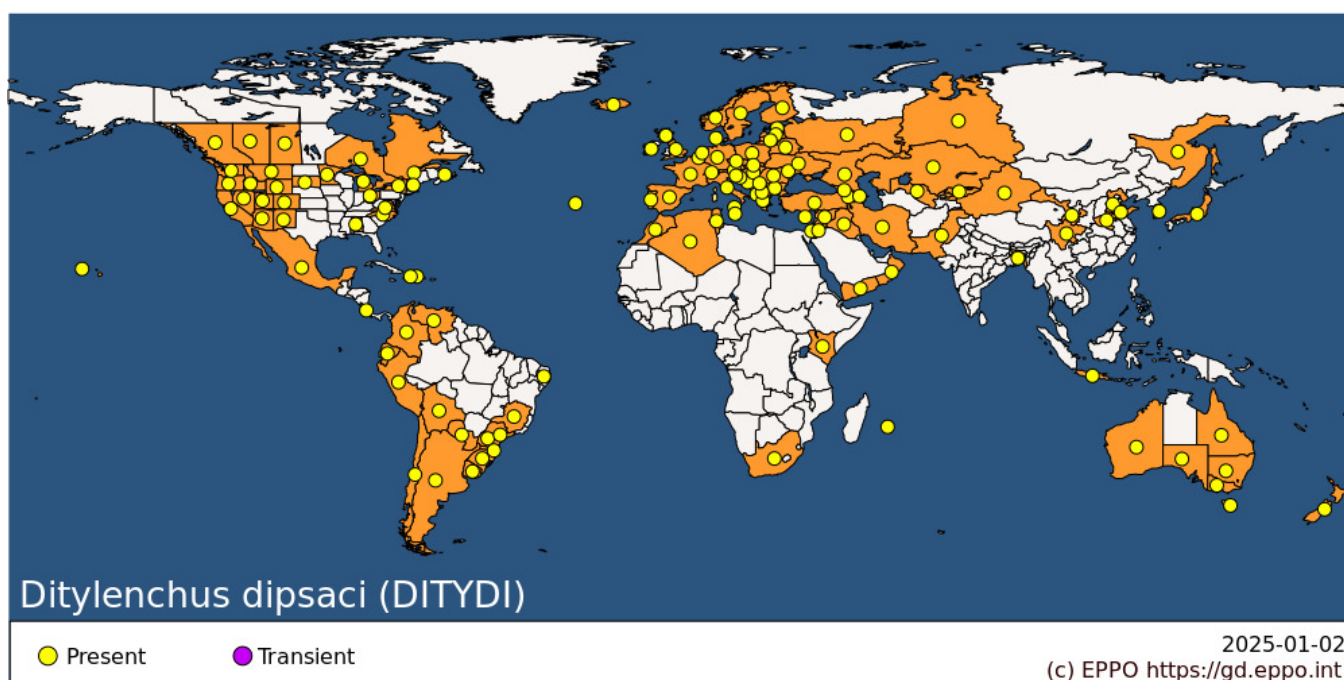
Host list: *Acanthophyllum cerastioides*, *Aetheorhiza bulbosa*, *Aethusa cynapium*, *Agave amica*, *Agrostemma githago*, *Allium ampeloprasum*, *Allium ascalonicum*, *Allium caeruleum*, *Allium cepa*, *Allium fistulosum*, *Allium galanthum*, *Allium giganteum*, *Allium oreophilum*, *Allium porrum*, *Allium sativum*, *Allium schoenoprasum*, *Allium sphaerocephalon*, *Allium triquetrum*, *Allium tuberosum*, *Allium vavilovii*, *Allium vineale*, *Alopecurus geniculatus*, *Amaryllis sp.*, *Amberboa moschata*, *Ambrosia artemisiifolia*, *Amsinckia menziesii* var. *intermedia*, *Anchusa arvensis*, *Anemone coronaria*, *Angelica archangelica*, *Anthoxanthum odoratum*, *Anthriscus sylvestris*, *Anthyllis vulneraria*, *Apera spica-venti*, *Apium graveolens*, *Arabidopsis thaliana*, *Arabis alpina*, *Arabis aubrietiioides*, *Arenaria serpyllifolia*, *Armoracia rusticana*, *Arnoseris minima*, *Arrhenatherum elatius*, *Asparagus setaceus*, *Asphodeline lutea*, *Atriplex patula*, *Atriplex sp.*, *Aubrieta deltoidea*, *Aucuba japonica*, *Avena byzantina*, *Avena fatua*, *Avena nuda*, *Avena sativa*, *Avena sterilis*, *Avena strigosa*, *Baccharis glutinosa* var. *glutinosa*, *Begonia tuberhybrida* hybrids, *Bellevalia romana*, *Bellis perennis*, *Beta vulgaris*, *Bouvardia longiflora*, *Brachypodium pinnatum*, *Brassica napus* subsp. *rapifera*, *Brassica napus*, *Brassica nigra*, *Brassica oleracea* var. *botrytis*, *Brassica oleracea* var. *capitata*, *Brassica oleracea* var. *gongyloides*, *Brassica oleracea*, *Brassica rapa*, *Bromus catharticus*, *Bromus inermis*, *Calceolaria integrifolia*

, *Callistephus chinensis*, *Camelina sativa*, *Campanula persicifolia*, *Cannabis sativa*, *Capsella bursa-pastoris*, *Capsicum annuum*, *Cardamine pratensis*, *Carduus acanthoides*, *Carex* sp., *Carlina vulgaris*, *Centaurea cyanus*, *Centaurea jacea*, *Cerastium arvense*, *Cerastium holosteoides*, *Chelone glabra*, *Chenopodium album*, *Cicer arietinum*, *Cichorium intybus*, *Cirsium arvense*, *Cirsium oleraceum*, *Cirsium palustre*, *Cirsium tuberosum*, *Cirsium vulgare*, *Cirsium x tataricum*, *Colchicum autumnale*, *Colchicum* sp., *Colchicum speciosum*, *Colchicum x agrippinum*, *Coleus scutellarioides*, *Coleus* sp., *Collomia biflora*, *Collomia grandiflora*, *Consolida orientalis*, *Convallaria majalis*, *Convolvulus arvensis*, *Crepis biennis*, *Crepis capillaris*, *Crepis foetida*, *Crepis leontodontoides*, *Crepis vesicaria* subsp. *taraxacifolia*, *Crocus sativus*, *Cucumis sativus*, *Cyclamen persicum*, *Cyclamen* sp., *Cynara cardunculus*, *Cynosurus cristatus*, *Dactylis glomerata*, *Daucus carota*, *Delphinium trolliifolium*, *Dianthus barbatus*, *Dianthus caryophyllus*, *Dianthus deltoides*, *Dianthus plumarius*, *Digitalis ferruginea*, *Digitalis grandiflora*, *Digitalis parviflora*, *Digitalis purpurea*, *Digitaria sanguinalis*, *Dipsacus fullonum*, *Disa uniflora*, *Echinochloa crus-galli*, *Elymus repens*, *Equisetum arvense*, *Erechtites praealta*, *Eremurus stenophyllus*, *Erigeron annuus*, *Erigeron canadensis*, *Eriocapitella hupehensis*, *Erodium cicutarium*, *Erysimum bicolor*, *Erysimum x cheiri*, *Erysimum x marshallii*, *Fagopyrum esculentum*, *Fallopia convolvulus*, *Festuca rubra*, *Ficaria verna*, *Ficus elastica*, *Fragaria chiloensis*, *Fragaria moschata*, *Fragaria vesca*, *Fragaria x ananassa*, *Freesia refracta*, *Fumaria officinalis*, *Galanthus hybrids*, *Galanthus nivalis*, *Galeopsis ladanum* subsp. *angustifolia*, *Galeopsis ladanum*, *Galeopsis segetum*, *Galeopsis speciosa*, *Galeopsis tetrahit*, *Galinsoga parviflora*, *Galium aparine*, *Galium tricornutum*, *Geranium dissectum*, *Geranium molle*, *Gilia achilleifolia*, *Gladiolus dalenii*, *Gladiolus hybrids*, *Glebionis segetum*, *Glycine max*, *Goepertia lindbergii*, *Gossypium* sp., *Gypsophila paniculata*, *Helenium* sp., *Helianthus annuus*, *Helianthus tuberosus*, *Helichrysum orientale*, *Helleborus orientalis*, *Hepatica americana*, *Hibiscus* sp., *Hibiscus trionum*, *Holcus lanatus*, *Holcus mollis*, *Hordeum vulgare*, *Hyacinthoides hispanica*, *Hyacinthoides non-scripta*, *Hyacinthus orientalis*, *Hyacinthus* sp., *Hydrangea macrophylla*, *Hyoscyamus niger*, *Hypochaeris radicata*, *Ipomoea batatas*, *Ipomopsis rubra*, *Iris* sp., *Isatis tinctoria*, *Ismene narcissiflora*, *Juncus bufonius*, *Kickxia spuria*, *Knautia arvensis*, *Kniphofia* sp., *Koeleria pyramidata*, *Lactuca canadensis*, *Lamium album*, *Lamium amplexicaule*, *Lamium purpureum*, *Lathyrus odoratus*, *Lathyrus sativus*, *Lavandula angustifolia*, *Leontodon hispidus* subsp. *hastilis*, *Leontodon hispidus*, *Leontodon incanus*, *Leontopodium nivale* subsp. *alpinum*, *Lepidium coronopus*, *Lepidium draba*, *Lepidium sativum*, *Lepidium virginicum*, *Leucanthemum vulgare*, *Liatris spicata*, *Lilium longiflorum*, *Lilium regale*, *Linaria vulgaris*, *Linum usitatissimum*, *Lipandra polysperma*, *Lolium multiflorum*, *Lolium perenne*, *Lolium pratense*, *Lupinus angustifolius*, *Lupinus luteus*, *Lycoris radiata*, *Lysimachia arvensis*, *Lysimachia* sp., *Manihot esculenta*, *Medicago falcata*, *Medicago lupulina*, *Medicago minima*, *Medicago orbicularis*, *Medicago polymorpha*, *Medicago sativa* subsp. *glomerata*, *Medicago sativa*, *Melampyrum arvense*, *Melilotus albus*, *Mentha arvensis*, *Mercurialis annua*, *Mollugo verticillata*, *Muscari botryoides*, *Muscari neglectum*, *Muscari* sp., *Myosotis arvensis*, *Myosotis discolor*, *Myosotis stricta*, *Myriophyllum verticillatum*, *Narcissus assoanus*, *Narcissus bulbocodium*, *Narcissus cyclamineus*, *Narcissus poeticus*, *Narcissus pseudonarcissus*, *Narcissus romieuxii*, *Narcissus* sp., *Narcissus tazetta*, *Narcissus x incomparabilis*, *Narcissus x odoratus*, *Navarretia minima*, *Nerine* sp., *Nicotiana tabacum*, *Nuttallanthus canadensis*, *Odontites vernus*, *Oenothera fruticosa*, *Oenothera glazioviana*, *Oenothera perennis*, *Oenothera tetragona*, *Onobrychis viciifolia*, *Ornithogalum candicans*, *Ornithogalum* sp., *Ornithopus sativus*, *Orobanche crenata*, *Oxalis* sp., *Oxalis stricta*, *Paeonia officinalis*, *Panicum miliaceum*, *Papaver rhoeas*, *Papaver somniferum*, *Pastinaca sativa*, *Penstemon barbatus*, *Penstemon eatonii*, *Penstemon gentianoides*, *Penstemon hartwegii*, *Persicaria lapathifolia*, *Persicaria maculosa*, *Persicaria pennsylvanica*, *Petroselinum crispum*, *Phacelia heterophylla*, *Phacelia tanacetifolia*, *Phaseolus coccineus*, *Phaseolus vulgaris*, *Phleum pratense*, *Phlox amoena*, *Phlox carolina*, *Phlox divaricata*, *Phlox douglasii*, *Phlox drummondii*, *Phlox paniculata*, *Phlox subulata*, *Physalis pubescens*, *Pilosella officinarum*, *Pisum sativum*, *Plantago lanceolata*, *Plantago major*, *Plantago maritima*, *Plantago media*, *Plantago rugelii*, *Poa annua*, *Poa pratensis*, *Poa trivialis*, *Polygonum aviculare*, *Polygonum* sp., *Potentilla anserina*, *Potentilla indica*, *Primula Polyanthus hybrids*, *Primula anisodora*, *Primula aurantiaca*, *Primula bulleyana* subsp. *beesiana*, *Primula bulleyana*, *Primula capitata*, *Primula chionantha*, *Primula chungensis*, *Primula cortusoides*, *Primula denticulata*, *Primula farinosa*, *Primula florindae*, *Primula frondosa*, *Primula helodoxa*, *Primula hirsuta*, *Primula japonica*, *Primula juliae*, *Primula latisecta*, *Primula luteola*, *Primula megaseifolia*, *Primula mollis*, *Primula nana*, *Primula obconica*, *Primula polyneura*, *Primula pulverulenta*, *Primula rosea*, *Primula saxatilis*, *Primula secundiflora*, *Primula sikkimensis* var. *sikkimensis*, *Primula sikkimensis*, *Primula sinensis*, *Primula veris*, *Primula vulgaris*, *Primula wilsonii*, *Prunus* sp., *Puschkinia scilloides*, *Ranunculus abortivus*, *Ranunculus acris*, *Ranunculus arvensis*, *Ranunculus asiaticus*, *Ranunculus auricomus*, *Ranunculus bulbosus*, *Ranunculus occidentalis*, *Ranunculus repens*, *Ranunculus* sp., *Raphanus raphanistrum*, *Raphanus sativus*, *Rheum rhaponticum*, *Roemeria argemone*, *Rosa* sp., *Rumex acetosa*, *Rumex acetosella*, *Rumex conglomeratus*, *Rumex crispus*, *Rumex obtusifolius*, *Saccharum officinarum*, *Saponaria officinalis*, *Saxifraga cotyledon*, *Schizanthus retusus*, *Schizanthus x wisetonensis*, *Scilla bifolia*, *Scilla luciliae*, *Scilla sardensis*, *Scilla siberica*, *Scilla* sp., *Scleranthus annuus*, *Scorzoneroides pyrenaica*, *Secale cereale*, *Senecio vulgaris*, *Sherardia arvensis*, *Silene noctiflora*, *Silene schafta*, *Simethis planifolia*, *Sinapis alba*, *Sinapis arvensis*, *Solanum carolinense*, *Solanum demissum*

, *Solanum lycopersicum*, *Solanum nigrum*, *Solanum stoloniferum*, *Solanum tuberosum*, *Solanum villosum*, *Solidago canadensis*, *Sonchus arvensis*, *Sonchus asper*, *Sonchus oleraceus*, *Sonchus sp.*, *Spergula arvensis*, *Sprekelia formosissima*, *Stachys arvensis*, *Stachys palustris*, *Stellaria media*, *Sternbergia lutea*, *Symphyotrichum squamatum*, *Tagetes patula*, *Takhtajaniantha tau-saghyz*, *Tanacetum cinerariifolium*, *Taraxacum officinale*, *Taraxacum sp.*, *Thlaspi arvense*, *Tigridia pavonia*, *Tigridia sp.*, *Tragopogon porrifolius*, *Trifolium arvense*, *Trifolium fragiferum*, *Trifolium hybridum*, *Trifolium incarnatum*, *Trifolium medium*, *Trifolium pratense*, *Trifolium repens*, *Tripleurospermum maritimum*, *Triticum aestivum*, *Tuberaria guttata*, *Tulipa gesneriana*, *Urceolina sp.*, *Urtica urens*, *Valerianella dentata*, *Valerianella locusta*, *Veronica agrestis*, *Veronica arvensis*, *Veronica hederifolia*, *Veronica peregrina*, *Veronica serpyllifolia*, *Veronica spicata*, *Vicia cracca*, *Vicia faba*, *Vicia lens*, *Vicia sativa*, *Vicia villosa*, *Viola arvensis*, *Viola tricolor*, *Vitis vinifera*, *Yucca flaccida*, *Zea mays*

GEOGRAPHICAL DISTRIBUTION

Ditylenchus 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 in tropical 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, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France (mainland), Georgia, Germany, Greece (mainland), Hungary, Ireland, Israel, Italy (mainland, Sicilia), Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Malta, Moldova, Morocco, Netherlands, North Macedonia, Norway, Poland, Portugal (mainland, Azores), Romania, Russia (Central Russia, Far East, Southern Russia, Western Siberia), Serbia, Slovakia, Slovenia, Spain (mainland), Sweden, Switzerland, Tunisia, Türkiye, Ukraine, United Kingdom (England, Scotland), Uzbekistan

Africa: Algeria, Kenya, Morocco, Reunion, South Africa, Tunisia

Asia: Bangladesh, China (Gansu, Hebei, Henan, Shandong, Sichuan, Xinjiang), Indonesia (Java), Iran, Iraq, Israel, Japan (Honshu), Jordan, Kazakhstan, Korea, Republic, Kyrgyzstan, Oman, Pakistan, Syria, Uzbekistan, Yemen

North America: Canada (Alberta, British Columbia, Ontario, Prince Edward Island, Québec, Saskatchewan), Mexico, United States of America (Alabama, Arizona, California, Colorado, Hawaii, Idaho, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Mexico, New York, North Carolina, Ohio, Oregon, South Dakota, Utah, Virginia, Washington, Wyoming)

Central America and Caribbean: Costa Rica, Dominican Republic, Haiti

South America: Argentina, Bolivia, Brazil (Minas Gerais, Paraíba, Paraná, Rio Grande do Sul, Santa Catarina, São Paulo), Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

Oceania: Australia (New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia), New

BIOLOGY

It is assumed that *D. dipsaci* invades seedlings through the stomata of the hypocotyl and cotyledons, and then migrates to the upper part of the hypocotyl, which later develops into the bulb or crown of the plant. *D. dipsaci* feeds on the cells of the host plant (Hooper, 1971). Injected enzymes in the host cells dissolve the middle lamellae, causing an imbalance in plant hormones, cell hypertrophy, and the formation of intercellular cavities (Duncan and Moens, 2013).

In onion plants at 15°C, the life cycle takes about 20 days. Females lay 200 to 500 eggs each. The reproductive capacity of *D. dipsaci* varies significantly based on environmental conditions and host tissue (Barbercheck and Duncan, 2004). Griffith *et al.* (1997) documented a daily production of 0.8 and 3.1 eggs on white clover (*Trifolium repens*) at temperatures of 10°C and 20°C respectively. Fourth-stage juveniles (dauer larvae) allow nematodes to survive in the absence of a host plant. They tend to aggregate on, or just below, the surface of heavily infested tissue to form clumps of "eelworm wool" and can survive in dry conditions for several years. They may also be attached to the seeds of host plants. Cool, moist conditions favour the infection of young plant tissue by this nematode.

DETECTION AND IDENTIFICATION

Symptoms

Infected plants commonly exhibit stunted growth, as well as swelling of the hypocotyl and epicotyl (Caubel *et al.*, 1994). Early infections in plants can lead to a low emergence rate and the death of young seedlings (Storelli *et al.*, 2021). Furthermore, *D. dipsaci* infection can have long-lasting effects, characterized by tissue rotting at harvest or during storage. The damage usually occurs in patches within the fields.

On Allium species

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 manner, 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 deformations or swellings, but causes leaf yellowing and death (Netscher & Sikora, 1990).

On lucerne

Infected plants decline 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. High levels of infestation can kill plants.

On sugar beet

Penetration of *D. dipsaci* on sugar beet seedlings results in the swelling of hypocotyls and the distortion of leaves (Storelli *et al.*, 2021). As the growing season progresses, secondary infection by soil-borne pathogens favored by *D. dipsaci* infestation contribute to crown decomposition in sugar beets (Storelli *et al.*, 2020).

Morphology

Slender transparent worms; adult about 1.2 mm long; head structure 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 (1971).

Detection and inspection methods

D. dipsaci can be isolated from soil or plant tissue using Oostenbrink dishes for 24-48 h (EPPO, 2013). Adult and larval individuals can be determined using an optical microscope on the basis of morphological characteristics. When necessary, molecular identification is used.

More details on the detection and identification of *D. dipsaci* can be found in the EPPO diagnostic protocol (EPPO, 2017).

PATHWAYS FOR MOVEMENT

In international trade, *D. dipsaci* is liable to be carried on dry seeds and planting material of host plants. In the field, *D. dipsaci* migration to the soil surface, where infection occurs, is initiated by rainfall or irrigation (Barbercheck and Duncan, 2004). Regular rainfall in spring or autumn just after sowing favours nematode infection.

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, sugar beet, legumes, strawberries, ornamental plants, especially flower bulbs).

Control

There is no effective direct management method for controlling of *D. dipsaci* in the field. Its broad host range and its capacity to survive many years without host plants hinders the success of crop rotation strategies (Jones *et al.*, 2013). Successions of crops with high nematode reproduction potential should be avoided.

Nematode-free (certified) seeds and planting material are 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). Abamectin B1 and hydrogen cyanide treatment on garlic bulbs prevent nematode transmission through seed material. The use of tolerant or resistant cultivars can also reduce the damage. Cultivars that are resistant (or partially resistant) to *D. dipsaci* have been reported in clover, alfalfa, faba bean, potatoes, and oat (Storelli, 2022).

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. Without control, *D. dipsaci* may cause complete failure of host crops within the EPPO region.

PHYTOSANITARY MEASURES

The implementation of certification schemes for the production of host plants of *D. dipsaci* can ensure the production of planting material free from the pest. Restrictions on the movements of plants for planting and seeds of host plants from countries where this nematode occurs may be recommended.

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ACKNOWLEDGEMENTS

This datasheet was extensively revised in 2023 by Alan Storelli, Agroscope, Switzerland. His valuable contribution is gratefully acknowledged.

How to cite this datasheet?

EPPO (2025) *Ditylenchus dipsaci*. EPPO datasheets on pests recommended for regulation. Available online. <https://gd.eppo.int>

Datasheet history

This datasheet was first published in 1992 in 'Quarantine Pests for Europe' and revised in the second edition of the book in 1997, as well as in 2023. It is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

CABI/EPPO (1992/1997) Quarantine Pests for Europe (1st and 2nd edition). CABI, Wallingford (GB).



Co-funded by the
European Union