Mini data sheet on *Meloidogyne graminicola*

Meloidogyne graminicola was added to the EPPO A2 List in 2023. A full datasheet will be prepared, in the meantime you can view here the data which was previously available from the EPPO Alert List (added to the EPPO Alert List in 2017 – deleted in 2023).

Why: *Meloidogyne graminicola* (Nematoda: Meloidogynidae - rice root-knot nematode) was first described in 1965 from grasses and oats in Louisiana (US). Since then, it has been found attacking primarily irrigated rice crops in Asia, and parts of the Americas and Africa. As in July 2016, *M. graminicola* was detected for the first time in the EPPO region in several rice fields of Northern Italy, the EPPO Secretariat decided to add this nematode to the EPPO Alert List.

Where: Until recently, *M. graminicola* was only known to occur in Asia, parts of the Americas and in South Africa. In July 2016, it was detected for the first time in Northern Italy in 7 rice fields in the Piemonte region (provinces of Biella and Vercelli), where eradication measures were put in place. In 2018, it was also found in Lombardia.
EPPO region: Italy (Lombardia and Piemonte regions, under eradication).
Africa: Madagascar, South Africa (only one report).
Asia: Bangladesh, China (Fujian, Hainan, Hubei, Henan, Hunan, Sichuan, Zhejiang), India (Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal), Indonesia, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam.
North America: USA (Georgia, Louisiana, Mississippi).
South America: Brazil (Rio Grande do Sul, Santa Catarina, Sao Paulo), Colombia, Ecuador.

On which plants: The main economically important host of *M. graminicola* is rice (*Oryza sativa*) but this nematode has a wide host range of more than 98 host plants belonging to Poaceae and other plant families. *M. graminicola* has been found associated with other cereals and grasses, including weeds that are commonly present in rice fields. These weeds can be moderate to good hosts for *M. graminicola* and act as reservoirs when rice is not present during crop rotations. Within Poaceae, *M. graminicola* has been recorded on cultivated plants, such as: *Avena sativa* (oat), *Hordeum vulgare* (barley), *Panicum miliaceum* (millet), *Pennisetum glaucum* (pearl millet), *Saccharum officinarum* (sugarcane), *Setaria italica* (foxtail millet), *Triticum aestivum* (wheat), *Zea mays* (maize), and many weed species (e.g. *Alopecurus* spp., *Brachiaria* spp., *Cymbopogon citratus, Cynodon dactylon, Digitaria* spp., *Echinocloa colona, Imperata cylindrica, Leersia hexandra, Paspalum scrobiculatum, Pennisetum pedicellatum, Phyllanthus urinaria, Poa annua, Sacciolepis indica*).
In addition, several cultivated plant species belonging to Asteraceae, Cucurbitaceae, Fabaceae, Solanaceae and a few other families have been recorded as hosts of *M. graminicola*, such as: *Allium cepa* (onion), *Allium cepa* var. *aggregatum* (shallot), *Allium tuberosum* (Chinese chives), *Brassica juncea* (mustard), *Brassica oleracea* (cabbages), *Cucumis sativus* (cucumber), *Glycine max* (soybean), *Lactuca sativa* (lettuce), *Musa* sp. (banana), *Petunia* sp. (petunia), *Phaseolus vulgaris* (common bean), *Pisum sativum* (pea), *Phlox drummondii, Solanum lycopersicum* (tomato), *Solanum melongena* (aubergine), *Solanum tuberosum* (potato), *Spinacia oleracea* (spinach), *Vicia faba* (broad bean), *Vigna* spp.
In Italy, *M. graminicola* has been found associated with rice and weeds growing in the vicinity of affected rice plants (*Alisma plantago, Cyperus difformis, Echinocloa crus-galli, Heteranthera reniformis, Murdannia keisak, O. sativa* var. *selvatica* (wild rice), *Panicum dichotomiflorum, Panicum* spp.

Damage: As is the case with other root-knot nematodes, *M. graminicola* damages plants by affecting the development of their root systems which are distorted by multiple galls and devoid of fine roots. In upland and lowland rice fields infested by *M. graminicola,* when plants are in their first stages of vegetative development (early summer), patches of plants showing poor growth, loss of vigour, stunting, chlorosis with heavily affected root systems can be observed. In late summer and autumn, the above-ground symptoms may regress after flooding and fertilizing, as patches are colonised by the vegetation of growing and tillering plants. At this stage rice fields appear more uniform but infested plants show poor caryopsis production and empty spikelets. These symptoms are more evident in drained fields than in flooded fields. The infested roots present swellings and characteristic hook-shaped galls of different shapes and sizes, mainly formed at the root tips. According to the literature, it is estimated that *M. graminicola* can decrease rice yield by 20 to 80%, depending on the mode of cultivation (flooded or dry), environmental conditions, and soil structure. Severe infestation and large galls can be also observed on weeds. In Italy, *Alisma plantago, Cyperus difformis, Echinochloa crus-galli, Heteranthera reniformis, Murdannia keisa, Oryza sativa* var. *selvatica* and *Panicum dichotomiflorum* were found to be infested and showed the same above-ground symptoms as rice plants.
M. graminicola is an obligate sedentary endoparasite. Females lay eggs in masses within the root cortex. Second-stage juveniles (J2) then hatch, either remaining within the maternal gall or migrating in the same root to

multiply. Infested roots may contain large numbers of eggs and J2s. *M. graminicola* can survive in waterlogged soil for long periods, as eggs (within egg masses) or as juveniles. Female and male specimens occur within the same gall. Males can be present in large numbers within galls, but scarcely occur in the soil. Numbers of *M. graminicola* decline rapidly after 4 months but some egg masses can remain viable for at least 14 months in waterlogged soil. The nematode can also survive in flooded soil to a depth of 1 m for at least 5 months. In flooded conditions, J2s cannot infect rice plants but when fields are drained, they resume their infectivity by attacking the root tips. The optimum soil moisture for *M. graminicola* is between 20-30% (with a dry soil at rice tillering and panicle initiation). The optimum soil temperature for nematode development ranges from 22 to 29°C. Under these optimal conditions, *M. graminicola* completes its life cycle in 19-27 days on rice.

Dissemination: Natural spread is very limited, as juveniles can only move over short distances towards roots in the soil. In paddy fields, passive transport may also be facilitated by movements of water and wild animals. As a root-knot nematode species, *M. graminicola* can easily be disseminated with soil, plants with roots, and root material (roots, tubers and rhizomes). Aerial plant parts on their own (flowers, fruits, seeds and leaves) will not spread the nematode. Eggs and juveniles can be carried by soil (including sand and gravel) transported as such or adhering to clothing, footwear, vehicles, agricultural and other earthmoving machinery.

Pathway: Plants for planting, soil, soil attached to machinery or other material, soil debris mixed with unselected seeds from countries were the pest occurs. In addition, travelers coming from infested areas may transport the nematode (e.g. on hiking shoes, clothing, collected seeds or plants with adhering soil).

Possible risks: *M. graminicola* infests many plant species belonging to different families (mainly Poaceae but also Asteraceae, Cucurbitaceae, Fabaceae, Solanaceae) that include cultivated plants of economic importance to the EPPO region. The large host range of *M. graminicola* and its ability to survive for long periods in environments with low oxygen render its control difficult. Crop rotation with either non-host or poor-host crops is desirable, but may be difficult to implement in practice. Submerging fields with water for more than 18 months can control juvenile populations in the soil. Soil applications of nematicides in dry rice crops, biofumigations, and use of trap-crops in the rotation, can help in significantly reducing nematode populations in the soil. In addition, detection and determination of *M. graminicola* is difficult. Identification has usually been based on the presence of hook-like root galls on plant roots, however two molecular methods have recently been developed specifically for *M. graminicola* (i.e. SCAR marker for a rapid and reproducible identification; real-time PCR primers for the nematode quantification in the soil). As the possible establishment of *M. graminicola* in new areas represents a serious threat for economically important crops, in particular rice, cereals and other Poaceae, it seems desirable to avoid its further spread within the EPPO region.

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