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Integrated Approaches for the Management of Sugarcane Nematodes

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Introduction

The nematodes are generally found in all type of environment, from ocean depths to tops of mountains, from hot water springs to icy arctic and Antarctic, from barren lands to cultivated fields, and from meadows to tropical forests. Nematodes thus occupy any conceivable habitat on this earth. They constitute the largest groups of animal kingdom, comprising 80 to 90 per cent of all multicellular animals. The nematodes are basically aquatic animals but they have adopted terrestrial habits. They are mostly found in the soil and rarely any crop is free from their attacks. It has been estimated that one gram of soil habitats the following numbers of organisms: bacteria 108, actinomycetes 105, fungi 105, micro algae 103, protozoa 103, nematodes 101 and other invertebrates 105. Plant parasitic nematodes are recognized as potentially serious constraints to crop productivity. Rarely is any crop free from nematode attack, whether in the field, the orchard, kitchen garden or polyhouse, yet growers are unaware of the presence of nematodes mainly due to their microscopic size and protected condition within the soil.

Plant parasitic nematodes are one of the important biotic constraints in sugarcane production in subtropical and tropical regions of the world. It is estimated that nematodes cause an average annual yield loss of 15.3% worldwide in sugarcane. Among the 20 life sustaining crops of the world, highest monetary loss due to nematodes is reported in sugarcane. In India nematodes are reported to cause about 10-40 % yield loss in sugarcane. However, losses may become still higher if nematodes are associated with other biotic and abiotic stresses in the field. Plant parasitic nematodes are soil inhabiting, microscopic roundworms that feed on plant roots. Nematode damage symptoms are often confused with symptoms of nutrient deficiencies even in the presence of optimum moisture and nutrients in the soil or other physiological disorders making diagnosis very difficult.

Over 15 genera and 50 species of plant parasitic nematodes have been reported from sugarcane, but most records are of nematodes extracted from soil, or from mixed root and soil samples, and therefore evidence of their feeding and reproducing on sugarcane. In India five genera *viz, Pratylenchus, Meloidogyne, Hoplolaimus, Tylenchorhynchus*and *Helicotylenchus*are found widely prevalent in sugarcane ecosystem. Of these, lesion nematode *Pratylenchus* spp. is the most predominant and economically important genus. This nematode is widely prevalent in both subtropical and tropical regions and reduces yield and quality of cane in both light and heavy soil types. Root knot nematodes *Meloidogyne* spp. are a problem mainly in light sandy loam and sandy soils. The damage threshold level for root knot and lesion nematodes in sugarcane is one nematode/g of soil. Nematodes are

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generally slow in establishing and inflicting economic damage. It is often thought that sugarcane, being a relatively hardy crop, may not succumb to these tiny worms. Sugarcane is cultivated in a long duration of one year followed by 2-3 ratoons with little disturbance of soil facilitate the build up of high nematode population in just 2-3 crop cycles which results in yield decline in subsequent crops. Further, monocropping of sugarcane to meet the cane demands of increasing number of sugar factories makes phytonematodes a constraint to sustainable sugarcane production in many parts of India.

Root knot nematode, Meloidogyne spp.

They cause galls or knots of varying sizes along the root, usually near the root tips, resulting in chlorosis and stunting. The leaves are rolled and appear short of moisture. This is more accentuated in ratoon crops, where the foliage has a yellowish colour, which resembles that of nitrogen-deficient plants. As in other grasses, root galls on sugarcane are small and may take the form of nodules and elongated curled thickenings at or near the root tips, which can be easily overlooked. In heavily infested plants, signs of yellowing and stunting are seen, and the leaves are characterized by waxy golden yellow bands extending from the tip to the sheath. The juveniles enter the root through the region of root tip. Heavy larval infections stop the root growth by affecting the meristematic zone. The pressure from the expanding giant cells, maturing nematodes, and egg masses causes mechanical damage to the root tissues, such as blockage or malformation of the xylem vessels. Lateral root proliferation in sometimes, but not always, associated with gall formation, but pronounced root curvature is associated with nematode infection.

Lesion nematode, Pratylenchus spp.

Leaves turn pale, yellowing, chlorosis in patches, and general stunting are common symptoms. Nematodes invade the cortical parenchyma. The cells adjacent to the nematodes become brownish and often collapse. The cane roots are thickened with a few fine roots and show dark, round or elongated lesions. Reduction in the yield of sugarcane increases as the nematode population densities.

Lance nematode, Hoplolaimus spp.

Stunting of the plant and loss in both fresh and dry weight of the tops, root growth retardation, and sparse and stubby roots may lead to decay gradually. Cell necrosis leads to the damage of root parenchymatous tissue, which may further result in weakening of the roots. At heavy infestation, the infected clumps can be easily pulled out.

Spiral nematoede, Helicotylenchus spp.

Severe stunting and chlorosis are the main symptoms and induces brownish, reddish lesions on adventitious roots, leading to disorganization and collapse of the cells of cortical tissue. This results in sloughing of the epidermis. The nematodes may penetrate deep into the cortex and stele. Blunt, malformed roots and small branch root reduction is also caused.

Stunt nematode, Tylenchorhynchus spp.

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The nematodes feed mainly on the epidermal cells and root hairs, they make the root bare, giving it a coarse appearance. The roots become stubby, blunt, irregular, and sparse resulting in poor growth.

Management of nematodes

Deep summer ploughing and soil solarisation

During the onset of summer, the infested field is ploughed with disc plough and exposed to hot son, which in turn enhances the soil temperature and kills the nematodes. Soil solarisation using plastic mulch during summer months further increases the efficacy of the treatment. This approach also helps in suppressing weeds and other soil borne pathogen

Crop rotation and intercropping

Rotation with legumes, soybeans, sunflower, paddy, mustard, coriander, and marigold is effective. Rotation with trap/antagonistic crops like sun hemp and sesame can minimise the nematode population in soil. Intercropping with short duration legumes like soybean and green gram reduces the population of lesion and root knot nematodes infecting the sugarcane.

Green Manuring

Green manuring is a conventional practice of growing plants like sun hemp or daincha and ploughing them *in situ* to provide nutrition to the main crop after proper decomposition and reduces the population of plant parasitic nematodes. This process not only changes the soil environment during the decomposition, but also affects the soil micro fauna. It also improve the organic matter and nitrogen status of the soil. It could be sown along ridges at the time of planting sugarcane and incorporated in soil 45 days after planting.

Organic Amendments

Adding decomposable organic matter to the soil is recognized as a very efficient method for changing the environment of soil and rhizosphere, thereby adversely affecting the life cycle of nematodes. Application of cured press mud at 15 t/ha during the field preparation helps in suppression of plant parasitic nematodes. Press mud being rich in nutrients and organic matter serves as a good substrate for the multiplication of nematode antagonistic fungi and bacteria in soil. Apply poultry manure @ 2 t/ha or neem cake @ 2 t/ha before last ploughing reduces the nematode population.

Trash Mulching

Mulching with cane trash @ 5t/ha and its incorporation into soil during earthing-up operation will bring down the population of nematodes by increasing the organic matter and population of nematode antagonistic microbes in soil. Besides reducing nematode population trash mulching also helps in suppressing weeds and conserving soil moisture.

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Biological Methods

Application of biocontrol agents like *Pochonia chlamydosporia*, *Purpureocillium lilacinum or Trichoderma viride* @ 20 kg/ha at the time of planting mixed with moist FYM or cured press mud and distributed uniformly will help in suppressing the plant parasitic nematode.

Resistant varieties

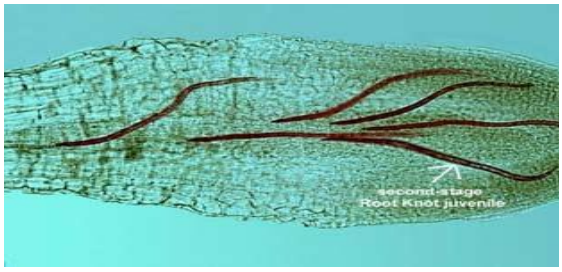
Resistant/tolerant varieties are Co 290, Co 527, Co 1001, Co 726, Co 927, Co 711, Co 997 will help in suppressing nematode in sugarcane fields. If one particular variety is resistant/tolerant to some nematodes, it need not be fully resistant/tolerant to other species also.

Chemical methods

Apply carbofuran 3G @ 33 kg/ha at the time of planting or 2 months after planting or cartap hydrochloride 3 kg/ha to be effective against sugarcane nematodes.

A typical plant-parasitic nematode

Invasive stage of root knot nematode



Root Knot Nematode in sugarcane roots

Lesion Nematode