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Seed Borne Nematodes and their Management

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ABSTRACT

Quality seed is key input for securing food availability to the overgrowing population. Wide ranges of factors affect growth and development of mother seed plants. Nematode infection is a main factor, causing severe damage to crop and seed quality. This article is about different type of seed borne nematodes, their mode of infection and management at field level.

Domestication of food crops evolved parallel to human civilization and Agriculture came into existence. However, human have evolved much, but dependency on food remain unsurpassed. Agriculture is irreplaceable, depends on many biotic and abiotic components including availability of quality seed. Sanskrit *sloka* quoted "*subeejam sukshetraya jayate sampadayte*" describes as, good quality seed in healthy soil at right time produce maximum yield. As many scientific studies reveal that being a basic and cheap input of Agriculture, quality seed alone may increase crop yield by 15-20 %. Quality seed is major aspect for securing food availability to the overgrowing population. Seed is miniature form of future progeny, carrying traits from the mother plant and its quality depends upon the environment in which mother plant has been grown.

A wide range of factors affects growth and development of mother plants preparing to bear future progeny (seed) including biotic and abiotic factor. However, corrective measure at right time could help to save the plant, but the quality of seed may deteriorate and affect the future generation to great extent. However, in case of disease and pest infestation, poor quality seed is produced by infected mother plant which results in sever to full crop loss in the field either due to low seed emergence or seedling vigor or both at the same time. Nematode infection is major factor, causing severe damage to crop and seed quality (Esser, 1991). Crop damage from nematodes is asymptotic in most cases, and it often remains unseen by the many other factors inhibiting plant growth. The common recommendation to poor growth is application of fertilizer or irrigation water, and leaf yellowing often indicates nutrient deficiency. However, after nematode infection, addition of more water or nutrients usually exaggerates the problem. These microscopic roundworms are a major reason for poor crop yields (Sturhan, 1985).

Most plant-parasitic nematodes are ecto-parasitic (around soil), but many are endo-parasitic species found in rhizosphere (Ladygina, 1974). Soil-inhabiting ecto-parasitic nematodes become critical when their population outstrip economic threshold level. Major nematode parasites are polyphagous, high reproductive rate and have easy means for spread and dispersal (Suryanarayana, 1978) for example (*Aphelenchoides ritzemabosi, A. besseyi, Ditylenchus dipsaci*). The Seed-borne pathogenic nematodes (*Anguina tritici, Aphelenchoides arachidis, Ditylenchus dipsaci*) have developed special adaptive mechanisms *viz.* desiccation resistance. Further, normal mode of transmission, parasites transmit by seed very efficiently. Elimination of seed borne nematode from seed production chain is crucial for global food security. Some of the important seed borne nematodes are following:

Seed gall nematode: *Anguina tritici* reported late in 1743 as first seed borne nematode. In wheat and rye this nematode causes seed gall or ear cockle, seed transformed in to gall containing dried larvae of nematode. Yield loss due to infection may range from 30-70 %, but in severe case, it may goes up to 100 %.

White tip nematodes: *Aphelenchoides besseyi* is one of the economically important seed borne nematode infecting rice crops all over the world. Feeding at leaf tips in rice results in whitening of the top 3-5 cm of the leaf, leading to necrosis known as "White Tip". Diseased plants are stunted, lack vigor and produce small panicles.

Root-knot nematode: Root-knot nematodes belong to the genus Meloidogyne. The two most common species in the tropics are *M. incognita* (southern root-knot) and *M. javanica* (Javanese root-knot). The root-knot nematodes feed and mature inside the roots of plants. Their feeding induces abnormal enlargements of the

root, called galls. Root galls are the primary symptom of root-knot nematodes.

Reniform nematode*: Rotylenchulus reniformis* has a wide host range on cultivated and non-cultivated plants. This nematode causes root rotting and reduced uptake of water and soil nutrients. The symptoms are general lack of vigor, discoloration of foliage, and (or) stunted plants.

Burrowing and lesion nematodes: Adult burrowing nematodes (*Radopholus similis*) and lesion nematodes (*Pratylenchus spp.)* cause root rot. These worm-shaped nematodes are migratory, living most of their life, including the hatching and feeding stages, inside the roots and sometimes the lower stem of their host plants.

Sugar-beet cyst nematode: The sugar-beet cyst nematode (*Heterodera schachtii*), is primarily a problem on cabbage, broccoli, and cauliflower in Hawaii in the Kula, Maui. This nematode penetrates the root, and the female enlarges as it matures to become a white, lemon-shaped structure that breaks through the root surface at maturity.

Foliar nematodes: *Aphelenchoides besseyi*, *A. ritzema-bosi*, and *A. fragariae* feed inside leaf tissue. The entire nematode life cycle completed in the leaves. Plants may stunted with deformed, discolored, or dying leaf tissue; "die-back" can also occur.

Controlling measures

Nematode management should be multifaceted. Since eliminating nematodes is not possible, the goal is to manage their population, reducing their numbers below the economic threshold level. The disease caused by seed borne nematodes can be manage by set of practices including prophylactic measures (planting resistant crop varieties, rotating crops, incorporating soil amendments), pathogen exclusion (quarantine, samsonite invader, seed treatment, use of certified plant stock) and applying pesticides. In some cases, soil solarization also may be practical.

Integrated Pest Management

Use of certified seed or plant stock is on prime concern, as they are the first line of infection, may cause severe damage in field. Further, use of resistant plant cultivars is an option but limited, because there are only a few and their nematode resistance is very specific (Islam, 2000). Crop rotation could involve in management as growing a crop that is not a host for the nematode is good practice to reduce inoculum load (Schmitt et al. 2000). Crop rotation also practice with some variation viz. fallowing, multicropping (intercropping), and green manuring. Weed control is a critical component of fallowing, as weeds are suitable hosts for many nematode species. Multi-cropping (intercropping) with plants that are antagonistic in nature to the nematodes are also taken in to consideration (Sivakumar, 1988). Green manuring add organic matter and may add substances that are antagonistic in nature and reduce or kill nematodes. Sudangrass and corn are excellent example of antagonistic green manure crops.

Soil solarization under clear plastic sheets that intercept and increase the heat from sun is an effective means for nematode management in the soil. The soil needs to be moist, well tilled, and heated to at least 140°F (60°C) for several days, should be done during the hot months and long days of mid-summer. Healthy plants grown in nematode-free media have a better chance to survive after being transplanted to the field.

Pesticides (nematicides)

Nematicides are sometime used in agriculture, but there are few in the market. Most nematicides are highly toxic, synthetic commercially available only to commercial growers. Two types of nematicides are there *viz.* fumigants and nonfumigants. Fumigant nematicides are usually more effective, but nonfumigant nematicides can also be used effectively. Fumigant nematicides such as metam sodium and 1, 3-dichloropropene are applied before planting. Some nonfumigant nematicides such as Nemacur, Mocap, or Vydate are moderately effective and can be used both pre- and post-planting.

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