

PLANT-PARASITIC NEMATODES: THE IGNORED MENACE OF PLANT PROTECTION SCIENCE

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INTRODUCTION

Nematodes are a group of highly simplified organisms that have been characterized under phylum Nematoda under Kingdom Animalia. An interesting debate can be coined around how much pre-dated are they in the tree of evolution, or they are and an exceptionally simplified branch of evolution. Interestingly, these are so much abundant in every known habitat on earth, that a popular belief has emerged claiming them to be the largest existing metazoic population.



Picture by Andy Murray from Eisenhauer and Guerra, 2019

As abundant as they are, their smaller size and ability to indulge in the food chain of their respective ecosystems have kept them hidden for centuries. However, some highly parasitic species gave away their identities by creating heavy losses in terms of human health, or agricultural produce. Of these, the main focus has always been given to the devastating animal parasites and is placed under the branch of medical science, helminthology. On the other hand, plant-parasitic nematodes, despite their highly damaging nature, have been constantly ignored in plant protection science. The current article highlights the importance of plant-parasitic nematode study and the devastating effects of ignoring it.

IMPORTANT PLANT PARASITIC NEMATODES (PPNS):

Despite their underestimated and unreported status worldwide, ppns have led to large amounts of agricultural losses. As per Singh et al. (2015), the ppns are responsible for a worldwide yield loss of about 12.3 % (\$157 billion), of which, about \$40.3 million is reported from India. The majority of farmers/growers unknowingly do not identify these as pest-production problems. However, the damages caused by ppns are too large to be overlooked. The most notorious genera of nematodes from around the world are namely, *Meloidogyne* (root-knot), *Pratylenchus* (root-lesion), *Heterodera* (cyst), *Globodera*, *Ditylenchus* (stem, bud, and root rot), *Tylenchulus*, *Xiphenema* (dagger), *Radopholus* (burrowing), *Rotylenchulus* (reniform) and *Helicotylenchus* (spiral). Apart from these, others like *Aphelenchoides* (bud and leaf), *Bursaphelenchus* (Pine and Palm), *Anguina* (seed gall), *Hirschmanniella* (rice root), etc., are also too damaging to be left out of the list. These genera are responsible for many infamous diseases of the century like, slow decline and spreading decline disease of citrus, pepper yellows, banana rhizome rot, tundu disease of wheat and barley, Kalahasti disease of groundnut, etc.



Lesion nematode (*Pratylenchus* sp.) Photo by Zane Grabau, MSU

Plant-parasitic nematodes are microscopic animals identified by three main characters: they are triploblastic, unsegmented with bilateral symmetry. They have a tubular body type which could be visualized as two parallel tubes, one placed inside the other. They feed on bacteria, fungi, protozoans, and other nematodes. About 15 percent of the known nematodes species are parasites of plants. The ppns possess a stylet (odontostyle) or a mural tooth in the oral region that is used to pierce, invade and suck the sap from plant tissues. The ppns might be similar in sense of parasitism, but they differ as per their area of inhabitation. Most of these are root invaders however, some are shoot parasites. Some ppns invade the cortical regions and inhabit the pericycle region, getting the highest protection. These are categorized as endoparasitic nematodes. Others that feed on the outer feeder roots without invading the plant tissues are known as ectoparasitic nematodes. There is a group of species that feed on the cortical tissue and half of their bodies hang out of the root system. These are known as semi-endoparasites. However, all of the above lack respiratory and circulatory systems and have sophisticated nervous and secretory-excretory systems.

DAMAGES BY PLANT-PARASITIC NEMATODES:

The damages caused by nematodes are usually confused with nutrient deficiency symptoms like day wilting, stunting, yellowing, and yield depression. The above-ground nematodes like *Aguiatritici*, *Aphelenchoides fragariae*, and *Ditylenchus* sp. Show dead buds, crinkled and distorted stem and foliage, seed and leaf galls, leaf lesions, and necrosis symptoms. In the case of root nematodes, the infection can only be identified by the root observation for galls, lesions, reduced root system (stubby and

coarse roots), rots, and excessive branching. Apart from these damages, tylenchids like *Meloidogyne* and *Pratylenchus* provide invasion pathways to other pathogens, causing disease complexes, and the trichodorids vector plant NEPO and NETU viruses like mosaic, ringspot, early browning, and rattle viruses and play an important role in the viral spread of various viral diseases. The invasive root parasites like cysts and root-knot nematodes are difficult to manage in a standing crop and stay dormant for a very long period in the soil or on alternate weed hosts. As per some studies, cyst eggs are viable up to 15 years, whereas, the seed galls of *Anguinatriticiare* viable for more than three and a half decades, making them impossible to be eradicated from infected areas. The golden cyst nematode, which has been a quarantine pest from Nilgiri hills in the country, has also been reported from the hilly areas of Himachal Pradesh.



NEMATOLOGY UNDERRATED:

Even though plant nematology is an economically important topic in agriculture, it is a very recent branch of science that was recognized and developed during the early 1940s. Thus, the coined information on their distribution and crop loss profile is quite scanty. The less awareness among farmers/growers regarding these pests, and even lesser number of specialized taxonomists in the country also adds up to the lack of identification and distribution patterns. The shortage of a nematologist army and extension officers that can identify the disease also diverts the emphasis of management on other pests. The notorious nature of ppns in respect to their eradication adds up to the lack of scientific fame and a long recommendation list of strict lines of chemical control with little work on alternative management systems due to restricted research facilities and funds. Also, there is a need for collaboration of other plant protection sciences with nematology to provide a better insight into their interactions.

FUTURE THRUSTS:

Interestingly, all the backdrops add up to the opportunities created for the young agriculturist seekers. As this branch of plant protection sciences is a road less traveled, its exploration opens a new door to investigations from management, identification to molecular manipulations, etc. More emphasis should be given to its studies during the undergraduate course work of agriculture and horticulture with at least 2 or more insightful courses. The extension personals should be trained for the identification of nematode parasitism and appropriate facilities should be generated in all the agricultural and horticultural institutions for their proper detection, confirmation, parasitism studies, and preparation of specialized area/climate or severity of disease-specific management systems.

Stand loss in cotton associated with high populations of reniform nematodes