Soybean cyst nematode: Its bio-ecology, symptoms and management

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Abstract

We all can get benefitted from various means and methods which we use during sowing of any crop and quiet be able to maintain the Economic Threshold Level in the entire crop growth period. In order to achieve this, few tactics can be included such as seed treatment and resistance of host-plant. The complicated phenomenon of induced defense mechanism can be manipulated to reduce the susceptibility of crop to damages caused by insect-pest. So, our focus is on one of the soybean crop pests- Soybean cyst nematode, *Heterodera glycines*. Several surveys with trials were conducted to see the effects of these tactics on our target pest.

Introduction

Cyst nematode of soybean, *Heterodera glycines* (Tylenchida: Heteroderidae), is a serious pest in Northern America and is believed to originate from China, Korea, or Japan studied by Schmitt et al. (2004). According to the studies in the United States during the year 1953-54 and after that got disseminated in all the major soybean-producing regions. Like Illinois and Iowa, soybean cyst nematode has been reported in all countries. Among all major pests or pathogens that regularly affect soybean yield, cyst nematode holds major role in reducing the economy Wrather *et al.* (2010).

Bio-ecology:

Heterodera glycines is a sexually dimorphic, obligate endoparasite that attacks soybean roots (Niblack et al. 2006). Soyabean is the predominant and preferred host plant for *H. glycines*, but alternative host plants have been observed. Some annual weeds found in the Midwestern United States, including henbit (*Lamium amplexicaule*), have supported *H. glycines* populations in a greenhouse environment (Venkatesh *et al.*, 2000). When eggs hatch in the spring, the second stage (J2) juveniles seek soybean roots. After reaching host plant roots, the nematode prepares a site for its nutrition termed as nurse cells among the vascular tissue of our crop (Johnson *et al.*, 1993). This feeding sites will provide nutrients to the nematode for the duration of its life cycle.

After three subsequent molts in the feeding site, adult males stop feeding and leave the soybean roots in search of females that remain adhered to the plant. The adult females are swollen and have a characteristic lemon-shaped appearance. After mating is completed, the females continue to grow and develop eggs. Females can produce 500 or more eggs under ideal conditions, with some eggs being pushed outside of her body in a gelatinous matrix. Depending on the region and temperatures throughout the growing season, *H. glycines* populations in a soybean can produce up-to 4 generations in a one year (Schmitt *et al.*, 2004). The eggs which are covered by the dead females (cysts) and the others dispersed outside of cysts in the soil can remain dormant up-to eleven years as given by Niblack *et al.* (2006). Because of their high fecundity and persistence in the environment, *H. glycines* populations are difficult to manage in fields that produce soybean, even after several years with a non-host crop like maize.

Nature of damage or symptoms:

- During The mid-season of the year the symptoms are most prominent which are mostly seen as stunted growth and yellowing of leaves above the ground due the severe infestation of the nematode. The stunted growth and rolling of the margin of leaves are very much similar to deficiency of potassium.
- The crop tends to mature faster as compared to the healthy plants, which leads to reaching senescence earlier than the actual time.
- Sometimes it is too late for recognizing the symptoms above the ground as it appears late and can be confused with physiological disorders, which may ultimately lead to heavy crop loss.
- Stunting of roots, discoloration of roots, and a smaller number of root nodule formation are few below ground symptoms.
- The females can be seen with the naked eyes attached with the roots.

Management:

Management of *H. glycines* and other nematode pests of soybean has included chemical based nematicides, with fumigants like ethylene bromide and 1,3-dichloropropene (1,3-D), and non-fumigants like aldicarb and ethoprop (Minton *et al.*, 1980, Trevathan and Robbins 1995).

Aldicarb and 1,3-dichloroproene are seldom used today because of the risks of environmental contamination and the current, stricter regulations and registration reviews (Thomas 1996, Davis *et al.*, 1997). Rather than treating large areas of farmland, newer nematicide products on the market for *H. glycines* management utilize a seed coating – also referred to as a seed treatment.

Some of the recent molecules has nematicidal value recommended for *H. glycines* contain a formulation of pathogenic microorganisms along their effective metabolites, that has nematicidal activity (Jones *et al.*, 2017, Mourtzinis *et al.*, 2017). Nematicidal seed treatments like these are attractive to growers because of safer handling; the lower amount of product needed per hectare and because they do not require the additional equipment and labor that were previously used for applications of fumigants to the soil.

Management of *H. glycines* has long relied on resistant cultivars and rotation schemes that include non-host crops. Soybean growers have access to hundreds of cultivars with host plant resistance for *H. glycines* and the three different source lines include PI 88788, PI 437654 and Peking. Despite these different sources of resistance, roughly 95% of the soybean races those are resistant to *Heterodera glycines* use the PI 88788 gene (Mitchum 2016, McCarville *et al.*, 2017).

Rotating the sources of resistance in cultivars is encouraged to slow the buildup of *H. glycines* populations and simultaneously prevent the buildup of virulent biotypes (HG-types) (Niblack 2005, McCarville *et al.,* 2017). Planting of non-host crops does not eliminate *H. glycines* populations from fields because the cysts and eggs can remain viable in soil for multiple years, but it does slow the buildup of populations compared to fields with two or more successive years

of soybean. Some treatments are also considered to have direct impact on the nervous system of the cyst nematodes as these compounds has multi-site action providing better effect as compared to other treatments (Niblack *et al.*, 2006; Jones et al. 2017; Mourtzinis *et al.*, 2017).

Integrated Pest management tactics include cultural methods as well as genetic methods which creates a combined effect on the pest management system. This type of module system in IPM maintains the health of nature as well as gives positive impact in managing the target nematode population. Some above ground and below ground symptoms are very confusing to physiological disorders so by application of such kind of methods it becomes easily manageable without any hazardous impact on the ecosystem (Ragsdale *et al.*, 2011, McCarville *et al.*, 2014). Planting of some resistant varieties can also help in preservation of yield.

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