SCREENING COVER CROPS TO REDUCE SOYBEAN CYST NEMATODE IN INFESTED FIELD

TECHNICAL REPORT

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Soybean cyst nematode (SCN), *Heterodera glycines*, is one of the most important pests of soybean production in North Dakota. It is an endoparasitic nematode, which infects through soybean roots, causes colonization of roots and ultimately affects growth and development of the soybean crop. This nematode not only infects soybean, but also invades other leguminous crops and weed species which play an important role in nematode survival and population increase in fields. Limited sources of resistance being utilized for developing resistant cultivars for managing this nematode cause the virulence changes in nematode populations, so integrated management strategy is necessary for sustainable management of this devastating soybean pest. Cover crops that are non-host to SCN and have the ability of reducing SCN population can be integrated in the management practice as an alternative means.

Previous studies have shown that different cover crops could suppress different plant-parasitic nematode population such as root-knot nematode (*Meloidogyne* spp.), root lesion nematodes (*Pratylenchus penetrans*), sugar beet cyst nematode (*Heterodera schachtii*), and potato cyst nematode (*Globodera* spp.). Cover crops may also reduce SCN populations, by three ways such as non-host with encouraging SCN egg hatching, producing toxic biochemical compound, and acting as a trap crop. In North Dakota, commonly grown cover crops have not been tested for SCN and no information is available about the interaction between the cover crops and SCN. The overall goal of this research is to sustainably manage soybean cyst nematode by utilizing cover crops as an alternative means. The specific objectives are to 1) screen common and potential cover crop species in North Dakota for host of soybean cyst nematode; and 2) evaluate cover crops for population reduction of soybean cyst nematode in infested fields.

To evaluate host range of SCN on cover crops, twenty-one commonly grown and potential to be grown cover crops in North Dakota were selected based on availability. Two naturally infested soil samples with high SCN numbers (10,000 and 5,000 eggs/100 cm3 of soil) were collected from two fields of Cass and Richland counties of North Dakota and SCN population density of each soil was determined by extracting nematodes. Subsamples were taken after thoroughly mixing the soil for nematode extraction and collected SCN cysts were crushed to obtain eggs and juveniles and counted under a microscope.

Each of the cover crop species and each of the two susceptible soybean cultivars (Barnes and Sheyenne) were planted in a cone-tainer containing 100 cm3 of soil and kept in a controlled growth chamber for 35 days at 27 °C. Experimental design was completely randomized design (CRD) with 5 replications. After 35 days, plants were taken out from the growth chamber and SCN white females (cysts) were extracted from soil and roots. Collected cysts were counted under the microscope for SCN white females (cysts) formed on roots. All cysts including the brown cysts from soil for each crop were crushed to obtain eggs and juveniles and counted for the final population density. The hosting ability of cover crops was determined by comparing average number of white females produced in each cover crop with the susceptible soybean cultivars. Reproduction factor (RF) was determined by dividing the final SCN population density by the initial population density in each cone-tainer. RF was used to evaluate the effects of cover crops on SCN population reduction.

Out of the twenty-one cover crops tested for host status in the greenhouse conditions, 13 of them showed non-host response such as annual ryegrass, camelina, carinata, ethiopian cabbage, faba bean, foxtail millet, radish, rape dwarf essex, red clover, sweet clover, triticale, and winter rye, which had no any white female developed on the roots. Three cover crops showed very low reproduction (no. of white females: 1 to 13) and five covers crops showed some levels of reproduction (no. of white females: >13 to 173). SCN reproduced less in all tested cultivars compared to the susceptible checks (827 to 1,251) (Table 1). All the tested cover crops had the lower final SCN population than the initial SCN population with reproduction factors ranging from 0.14 to 0.64 in both soil types, but field pea (RF: 1.82) and forage pea (RF: 2.56) showed increment in final SCN populations only in the soil having initial population density of 10,000 eggs/100 cm3 of soil.

Ten cover crops (annual ryegrass, Austrian winter pea, carinata, faba bean, foxtail millet, radish, red clover, sweet clover, turnip and winter rye) and the susceptible soybean cultivar (Barnes) were selected for microplot study based on the results from greenhouse experiments. Soil was collected from two fields in Cass and Richland counties. SCN population density of each soil was determined by extracting and counting nematodes. About 9-inch diameter plastic pots holding 5 kg of soil were used for planting crops. Selected cover crops were planted on both the soils from the fields. Standard seeding rate of each crop was used for determining number of plants per pot. Plants were kept in greenhouse for two weeks for better establishment before they were moved to the microplot in natural field conditions. Experimental design was randomized complete block design (RCBD) with 5 replications.

For setting up the microplot, required holes were prepared in the field and plastic pots were buried with the top part about 5-8 cm high above the soil surface. The remaining surface of the field was covered with plastic mesh, called weed barrier, to prevent the weeds and contamination of the pots from surrounding soil. External fence was built to prevent entry of animals such rabbits and others. Regular watering and required fertilization were done in the pots. After 75 days of planting, three soil cores were collected from each pot to determine the final population density. Reproduction factor was determined by dividing the final SCN population density by the initial population density in each pot. After soil sampling, plastic pots with crops were left as it was for winterkill then samples were collected again in the spring for determining the nematode population density and reproduction factor.

Out of the ten cover crops tested, annual ryegrass, carinata, faba bean, foxtail millet, radish, red clover, sweet clover, turnip, and winter rye significantly (P <0. 0001) reduced SCN population (RF: from 0.27 to 0.73) than non-planted naturally infested soil (RF: ranged from 0.76 to 0.99) of both soil types, but Austrian winter pea did not show any significant SCN population reduction (RF: 0.73 to 1.0) in both soil types. Annual ryegrass and radish had the lowest RF (from 0.27 to 0.33) compared to other cover crops (Figure 1).

More cover crops will be screened for hosting abilities to SCN in greenhouse conditions and effective non-host crops will be evaluated for SCN population reduction in the microplot in natural conditions. Mechanisms of population reduction will be investigated on cover crops, which are non-hosts with greater ability of SCN population reduction, to develop management strategies for control of soybean cyst nematode.

Table 1. Reproduction of soybean cyst nematode in different cover crops planted in each of two naturally infested soils (2W and 103) in greenhouse conditions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | No. of white females (cysts) per plant | |
| Crop | Scientific Name | Family | Soil 2W | Soil 103 |
| Soybean (Barnes) | *Glycine max* | Leguiminosae | 1251 | 827 |
| Soybean (Sheyenne) | *Glycine max* | Leguiminosae | 1235 | 684 |
| Forage pea | *Pisum sativum* L. | Leguiminosae | 173 | 7 |
| Field pea (Aragon) | *Pisum sativum* L. | Leguiminosae | 136 | 13 |
| Austrian winter pea | *Pisum sativum* subsp*. arvense* | Leguiminosae | 64 | 0 |
| Field pea (Cooper) | *Pisum sativum* L*.* | Leguiminosae | 21 | 0 |
| Hairy vetch | *Vicia villosa* | Leguiminosae | 17 | 25 |
| Turnip (Purple top) | *Brassica rapa* subsp. *rapa* | Brassicaceae | 8 | 2 |
| Turnip (Pointer) | *Brassica rapa* subsp. *rapa* | Brassicaceae | 5 | 1 |
| Crimson clover | *Trifolium incarnatum* | Leguiminosae | 1 | 13 |
| Annual ryegrass | *Lolium multiflorum* | Poaceae | 0 | 0 |
| Camelina | *Camelina sativa* | Brassicaceae | 0 | 0 |
| Carinata | *Brassica carinata* | Brassicaceae | 0 | 0 |
| Cow pea | *Vigna unguiculata* | Leguiminosae | 0 | 0 |
| Ethiopian cabbage | *Brassica oleracea* | Brassicaceae | 0 | 0 |
| Faba bean | *Vicia faba* | Fabaceae | 0 | 0 |
| Foxtail millet | *Setaria italica* | Poaceae | 0 | 0 |
| Radish | *Raphanus sativus* | Brassicaceae | 0 | 0 |
| Rape dwarf essex | *Brassica napus* | Brassicaceae | 0 | 0 |
| Red clover | *Trifolium pratens* | Fabaceae | 0 | 0 |
| Sweet clover | *Melilotus albus* | Fabaceae | 0 | 0 |
| Triticale | *Triticale hexaploide* Lart | Poaceae | 0 | 0 |
| Winter rye | *Secale cereale* | Poaceae | 0 | 0 |

Figure 1. SCN population reduction by different cover crops planted in microplot containing each of two naturally infested soils (Soil 2W and 103) in natural conditions.