**EFFECT OF SOYBEAN CYST NEMATODE ON FUSARIUM**

**ROOT ROT OF SOYBEAN**

**TECHNICAL REPORT**

**NORTH DAKOTA SOYBEAN COUNCIL**

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Furarium root rot caused by *F. solani* and *F. tricinctum* are two common and serious root rot pathogens of soybean in North Dakota. Although *Fusarium* is common on soybean plants, it does not always cause yield losses. Healthy, well growing plants can produce new roots and compensate for the loss of decayed roots. Plants are more likely to suffer from Fusarium root rot when they are stressed by abiotic factors such as a lack of water or biotic factors such as other pathogens. Soybean cyst nematode (SCN) is now common in many soybean fields having been found in about 15 counties in the eastern part of North Dakota. SCN causes wounds as they penetrate the roots and they change the physiology of the root while feeding in the root. These effects of the nematode could increase the damage caused by Fusarium root rot. The goal of this research is to determine if the interaction of soybean cyst nematode with Fusarium root rot results in greater damage to the plant. The emphasis will be on determining the relationship between SCN egg levels, inoculum levels of Fusarium and severity of root rot. Our hypothesis is that SCN will increase the amount of root rot by these two Fusarium root pathogens, especially at moderate to low Fusarium inoculum levels.

This research was initiated in June 2016 with a field experiment where soil was infested *with F. solani* and *F. tricinctum* alone or in the presence of soybean cyst nematode at 5,000 eggs per 100 cc of soil. The susceptible soybean Barnes was grown in five liter pots filled with a sandy loam soil. The Fusarium inoculum was infested barley grains and the nematode inoculum was recently produced eggs added to the soil. Appropriate controls such as Barnes alone and Barnes + SCN alone were included in the test. Plant emergence, height of plants at various dates, root biomass, total plant weight, number of plants with unifoliate leaves and disease severity on roots were recorded after five weeks. Within three to four weeks most of the plants were dead or dying due to post-emergence damping off caused by both *Fusarium* species and root rot on surviving plants was so severe that plants did not grow sufficiently to allow SCN to develop. Because of these results there were no significant effects from soybean cyst nematode.

Similar but expanded experiments were conducted in the greenhouse with high and low inoculum levels of *F. solani* and *F. tricinctum* and a similar level of SCN eggs as in the field. Post emergence damping off was also high in the greenhouse experiments which affected the number of plants where measurements could be made. No consistent effects of SCN were found on the surviving plants, although in one experiment the presence of Fusarium (both species) + SCN resulted in significantly shorter plants at various dates compared to *Fusarium* alone. Also, in one experiment the addition of SCN with *F. solani* or *F. tricinctum* significantly reduced plant weight compared to the *Fusarium* alone. A major problem in these experiments was the high disease caused by Fusarium which resulted in poor plant growth which did not allow adequate development of SCN on some of the roots. Infection with *Fusarium* will often result in plants not unfurling the first trifoliate leaves and then the plant will not develop beyond that stage.

Additional greenhouse experiments were conducted where the distance between the inoculum and the seeds was increased to reduce severity of disease and prevent early death of seedlings. The experiment was run for 5 weeks with an egg level of 5,000 eggs per plant and then repeated. Emergence, plant height, root rot severity, root length, plant dry weight and root dry weight were measured. There were similar trends in both experiments with generally lower measurements associated with the addition of SCN to the soil when Fusarium was present, but not all differences between the two treatments were statistically significant. In one experiment with *F. solani*, the addition of SCN resulted in a significant reduction of plant dry weight and a significant increase in root rot severity. In another experiment, the addition of SCN with *F. tricinctum* resulted in lower plant height and plant dry weight compared to plants growing only with *F. tricinctum*.

Other greenhouse experiments were conducted to determine lower inoculum levels of *F. solani* that would insure a moderate amount of disease, but allow sufficient root growth for development of SCN on the roots within a five week period. Seven different inoculum levels (number of infested barley grains from 10 to 200/ plant) were tested for effects on disease development. Disease was scored on a 0-6 scale with 0 = no disease and 6 = high disease.

Increasing the inoculum level had significant negative effects on height, root length and root rot severity at 2 and 3 weeks after planting (Figure 1). The low levels of inoculum were used in following experiments to determine the interaction of SCN with Fusarium root rot.

Figure 1. Effect of inoculum level of *Fusarium solani* on root rot severity of soybean at three weeks growth. The horizontal axis shows various levels of inoculum with 10F the lowest and 200F the highest level.

More greenhouse experiments were conducted using various inoculum levels with the plants growing in our plant growth system that uses a water bath to control rooting zone temperature to favor growth of SCN. Inoculum levels of 25, 50 and 100 infested barley seeds per plant and 500 and 5,000 SCN eggs per plant were tested with both species of Fusarium and two five week experiments were run. The trends between experiments were similar with the addition of SCN into the soil with Fusarium. In general, adding SCN resulted in lower plant growth parameters and higher root rot severity, but not all differences between treatments were statistically significant (Table 1). In one experiment, the addition of SCN with *F. solani* significantly reduced plant height (Figure 2), the number of plants with unifoliate leaves after one week, and increased root rot severity at the lower inoculum level and 5,000 eggs/plant compared to *F. solani* alone. Similarly with *F. tricinctum*, in one experiment the addition of SCN resulted in a significant reduction in number of plants with unifoliate leaves at 1 week, plant height, dry weight, root length and root weight plus a significant increase in root rot severity, compared to *F. tricinctum* alone. Partial results are shown in Table 1.

**In conclusion**, at low levels of Fusarium inoculum soybean cyst nematode at high and moderate egg levels can reduce plant growth and increase root rot severity within a 5 week period following planting. The effects may be small and can be difficult to detect. However, the importance of the effects of the *Fusarium* + SCN interaction on yield of the soybean crop are at this stage of the investigation still unknown. Because Fusarium root rot is common in this area, this data is another indication that the management of soybean cyst nematode should also focus on keeping egg levels low in infested fields to avoid interactions with soil borne fungal pathogens.

Table 1. Effect of *Fusarium* spp*., H. glycines* (SCN), and Fusarium+SCN on

soybean growth in a water-bath plant growth system in the greenhouse.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment | Plant height (cm) | Plant dry weight (g) | Root length (cm) | Root dry weight (g) |
| **Fusarium solani \*** |  |  |  |  |
| CK | 20.33 a | 1.19 a | 19.00 a | 0.25 a |
| SCN5000 | 19.83 a | 1.20 a | 18.33 a | 0.24 a |
| FS25 | 15.67 b | 0.59 b | 16.00 b\* | 0.21 ab |
| FS25+SCN5000 | 15.33 b | 0.54 b | 14.67 bc\* | 0.18 bc |
| FS50 | 15.5 b | 0.37 c | 13.91 cd\* | 0.14 c |
| FS50+SCN5000 | 13.91 c | 0.38 c | 12.67 d\* | 0.13 c |
|  | |  |  |  |
| **Fusarium tricinctum** | |  |  |  |
| CK | 20.33 a | 1.19 a | 19.00 a | 0.25 a |
| SCN5000 | 19.83 a | 1.20 a | 18.33 a | 0.24 a |
| FT25 | 17.75 b | 0.51 b | 18.59 a | 0.16 b |
| FT25+SCN5000 | 17.67 b | 0.49 b | 15.50 b | 0.16 b |
| FT50 | 16.67 bc\* | 0.40 b | 15.33 b | 0.12 c |
| FT50+SCN5000 | 15.33 c\* | 0.26 c | 12.83 c | 0.07 d |

**\*** Treatments of inoculum are 25 or 50 infested grains per plant. SCN 5000 = number of

eggs per plant. CK denotes control. FS and FT denote isolates of *F. saloni* and *F. tricinctum*,

respectively. SCN denotes *H. glycines*. FS+SCN and FT+SCN denote the combined inoculations

of *Fusarium* spp. with *H. glycines*. Comparisons are Fusarium at a given inoculum level

compared to the same inoculum level but with SCN. Numbers followed by the same

letters are not significantly different at P= 0.05. Letters followed by an asterisk indicate a

significant difference at P=0.10.

Figure 2. Effect of *Fusarium solani* and *F. solani* + soybean cyst nematode (SCN) on growth of soybean. The plant on the top was growing in pathogen free soil, the plant in the middle was growing in soil infested with F. solani (FSSC11) and the plant on the bottom was growing in soil infested with F. solani + SCN.

