RETHINKING THE STANDARD TEST FOR ALFALFA STEM NEMATODE

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ABSTRACT

A greenhouse test was conducted to evaluate alfalfa entries for resistance to the alfalfa stem nematode under a 12 month incubation period. Significant differences were found among entries for ASI (average severity index) and percent resistant plants. No significant differences were found between Vernema, the resistant check variety, and Ranger, the susceptible check variety. Poor performance of Vernema and other commercial alfalfa varieties in the greenhouse and stem nematode infested fields in Washington and Oregon indicate a need for a reevaluation of the standard test and check varieties for alfalfa stem nematode.

Key Words: alfalfa, stem nematode, *Ditylenchus*, standard test

INTRODUCTION

Alfalfa stem nematode, *Ditylenchus dipsaci*, sometimes referred to as "bulb and stem nematode," feed on parts of plants above ground. Stem nematode as multiple hosts, but reproduces on alfalfa in Washington. Alfalfa is the only major crop in Washington that is seriously damaged by this nematode.

Although stem nematode is usually not a widespread problem in the Columbia Basin, it is a serious problem in the Yakima Valley and can be devastating in individual fields throughout the Pacific Northwest. Alfalfa fields irrigated from streams on the Umatilla Basin Watershed have shown severe infestation. The number of fields with symptoms of stem nematode varies from year to year based on the weather conditions that occur during late winter and early spring. Increased populations of stem nematode and feeding activity are favored by cool, wet weather. Damage is most severe under irrigation and in areas associated with early spring rains. A stand of alfalfa can decline rapidly after stem nematodes become established. Production of a stand can be unprofitable after the first year.

Stem nematode symptoms are most readily observed during early spring in established alfalfa stands. A recognizable symptom is stunted plants with white or light yellow leaves. Stunted plants typically have swollen nodes and shortened internodes. Infected stems become brittle and break off easily at the crown. Crowns of severely infected plants are swollen, discolored, and produce few stems. A small percentage of infected plants may have one or more stems that are completely white. This symptom is referred to as "white flagging" and is more prevalent on spring growth and regrowth following the first cutting. In the Yakima Valley white flagging can

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be observed through the growing season. Severely infected plants eventually die and weeds will begin to establish.

Stem nematodes, like other plant parasitic nematodes, are microscopic roundworms with a hollow, needle-shaped stylet used to puncture plant tissue for feeding. Stem nematodes survive unfavorable periods in the crown of infected plants, infested hay and crop debris, seed, and in soil. In Washington, stem nematode can survive in crown buds even when the ground is frozen. Long-term survival is possible under very dry conditions in hay, seed, and soil. The nematodes are spread to new areas by surface water runoff, irrigation, wind-blown crop debris, soil and crop debris clinging to equipment, humans and livestock, and with seed. Runoff water is very important in the spread of stem nematodes within a field and to adjacent fields. It has been estimated that as many as 10 million plant parasitic nematodes are applied with each irrigation cycle in the Yakima Valley (1). The nematode reproduces to high levels during periods of favorable temperature and rapidly spread when plants are wet. Adults are colorless and are about .04 inches long and cannot be seen without magnification. A complete cycle from egg to adult takes between 19 and 23 days when temperatures are around 59-70°F. A single female can lay up to 500 eggs. Because these conditions usually occur during early spring or mild winters, damage is most severe in the first cutting.

Over the past 11 years, a field infested with stem nematode has been observed. The field had been established with Vernema, the resistant stem nematode check for dormant alfalfa varieties. Although Vernema is listed as having high resistance with 60% resistant plants, the field was devastated and had no growth in the spring due to stem nematode. After Vernema was removed, the field was left fallow for one year and a modern variety classified as having high resistance to stem nematode was planted. Because the modern variety failed within two years, inexpensive seed (variety not stated) was planted. Due to reoccurring experience with shorted stand life, the non-stated variety was removed the fall of 2011.

Due to the lack of success of varieties classified as having resistance to stem nematode, an experiment was established in a greenhouse at Columbia Basin College (CBC). The standard test for stem nematode was developed in 1995 (2) and suggested the time for incubation after inoculation as 12 weeks. Because of delayed occurrence of symptom in the field, a longer incubation period of 12 months was used.

MATERIALS AND METHODS

Alfalfa entries were planted in a 5’ x 12’ bench in a greenhouse. Plots were 5” x 12” consisting of 4 rows planted with about 100 seeds per entry. At the cotyledon stage of growth, stand counts of each entry were recorded. Stem nematodes were collected from a field near Prosser, Washington and introduced to the bench in September 2010 to conduct germplasm screening. Following the screening, entries were seeded in the same soil. Plots were maintained for a full year with clipping at or just prior to bud stage when observed on the healthiest plants. In October 2011, the plots were dug and individual plants scored based on regrowth and plant health: 1 = Tall; healthy regrowth, 2 = Medium height; healthy regrowth, 3 = short regrowth; plant with moderate necrosis, 4 = plant alive; severe necrosis, 5 = dead or missing based on stand counts.

The test included 35 alfalfa entries with 4 replications and was analyzed as a randomized complete block design. ASI, percent resistant plants using number of plants in class 1 and 2, and percent resistant plants using number of plants in class 1, 2 and 3 were analyzed.

RESULTS AND DISCUSSION

Although selection for resistance to stem nematode has occurred for decades, results under field conditions have not shown as much progress as other pests. For example, the improvement of screening and testing for Anthracnose, Verticillium Wilt and Phytophthora root rot over the last 25 years have correlated well with performance in the field. In most cases, modern varieties classified as having resistance or high resistance to these diseases have not had problems. On the other hand, problems with stem nematode have continued.

Results from a long term stem nematode greenhouse test are shown in a table on page 4. Significant differences among varieties were found for ASI and for % resistant plants. However, there was not a significant difference between the resistant check variety Vernema and the susceptible check Ranger. The standard test suggests that the top two classes of plants be considered resistant. In this test, Vernema would be considered susceptible and when considering the top three classes, it would be considered as having low resistance at best. Observations in Washington over the last decade have confirmed that Vernema does not perform well in fields with the presence of stem nematode. The standard test for stem nematode calls for the evaluation of plants after 12 weeks in the greenhouse. Perhaps a longer duration test would be more appropriate for a pest such as stem nematode. Parents of the top five experimentals in the test were selected from older fields irrigated from the Yakima River in Washington and from fields irrigated from the Umatilla water shed in Oregon. Both areas have had long term problems with stem nematode. Based on this test, these experimentals would be classified as having moderate resistance at best. If this test was submitted to the National Alfalfa & Misc. Legumes Variety Review Board, it would not be accepted. The resistant check variety must be within an acceptable range of reaction of 45-70 % for Vernema. If resistance were adjusted to Vernema at the expected resistance level of 60%, then most of the entries in the test would be considered as having high resistance. The data suggests that it is time to rethink the standard test for alfalfa stem nematode.

LITERATURE CITED

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ACKNOWLEDGEMENTS

The experiment was partially supported by the USDA-ARS Vegetable and Forage Crops Research Unit, Prosser, WA. Research Leader and Location Coordinator: Ashok Alva

2011 Greenhouse Test for Stem Nematode

Entry	ASI	% Resistant plants Class 1-2	% Resistant plants Class 1-3
CB7006	4.3	15.0	23.8
CB8002	4.3	16.5	23.0
CB8003	4.3	14.0	21.8
CB9002	4.3	13.0	21.5
CB7007	4.3	14.8	21.0
54Q25	4.4	11.8	19.8
CB9001	4.4	11.3	18.5
Grandstand	4.4	10.5	18.5
Rebound 5.0	4.4	9.0	18.5
PGI427	4.4	10.8	18.0
CB001	4.4	9.8	17.8
DKA 43-13	4.4	11.5	17.5
DKA 50-18	4.4	11.0	16.3
54V09	4.5	8.3	15.8
CB7002	4.5	10.0	15.0
DKA 42-15	4.5	10.3	14.5
CB9007	4.6	6.3	13.0
CB8001	4.6	7.3	12.8
13RSupreme	4.6	7.5	12.8
Masterpiece II	4.6	8.3	11.3
Mountaineer 2.0	4.6	7.0	11.3
CB7003	4.7	5.5	11.0
Pillar	4.6	8.5	10.8
55V12	4.7	5.5	10.5
Vernema	4.7	5.3	10.5
CB7005	4.7	7.0	9.8
CB7004	4.7	5.3	9.3
CB9009	4.7	4.5	8.0
CB9008	4.8	3.3	6.5
CB9004	4.8	4.0	6.0
CB9003	4.8	3.0	5.8
54H11	4.8	2.5	5.8
CB9006	4.8	2.0	4.5
CB9005	4.9	1.8	4.0
Ranger	4.9	1.0	1.5
Mean	4.6	8.1	13.3
LSD 5%	0.32	6.8	10.01
CV %	4.9	59	52.7