THE ROOT KNOT NEMATODES, STUBBY ROOT NEMATODE AND ALFALFA STAND DECLINE

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Our goal in the study of nematodes attacking alfalfa has been to quantify the pathogenicity of the major root knot nematode species relative to alfalfa production, especially relative to the condition referred to as "Stand Decline". Essentially, alfalfa stand life has been decreasing nation-wide due to a complexity of factors and the nematode - alfalfa component is relatively unknown.

Our tests included 6 alfalfa cultivars of varying nematode resistance and 6 sources of root knot nematode inoculum. Each variable was tested in a 1 m^2 plot with five replications. Two additional treatments involved pre-plant fumigation of non inoculated sites and eventually indicated that at our test site there was essentially no value in soil fumigation of alfalfa except for the nematode control benefit provided. Agricultural methodologies approximated commercial alfalfa production except that soil compaction due to wheel traffic was negligible and some hand weeding occured during the first two years. Nineteen separate alfalfa harvests were made over a three-year period.

A UC Riverside race of Meloidogyne incognita originating from a single egg mass resulted in yields of 96 to 104% of the non inoculated. Yields during the first year tended to be greater than that of the non inoculated plots but there were no significant yield effects and although this nematode species was present after 3 years; it was very rarely found after the first year.

A local race or mixed population of Meloidogyne incognita and M. arenaria was collected on washed fig roots and the roots including egg and female stages were used as inoculum. This combination resulted in an overall yield of 94 to 102% of the non inoculated depending on alfalfa cultivar. Juveniles from a single egg mass culture of the preceeding population resulted in yields of 93 to 100% of the non inoculated. Neither population was readily found after the first year but at least one female was found at the end of the third year. In the presence of this isolate alfalfa yields were not significantly altered.

A single egg mass population of M. javanica originally from a bean field near UC Riverside resulted in a significant yield reduction on a single alfalfa cultivar. Vernal is a cool region, dormant type alfalfa grown primarily in north eastern states whereas M. javanica has preference for warmer climates. Yields were reduced by 85, 88 and 78% for each of the three years, respectively. The nematode population did multiply on this variety and among the other 5 alfalfa cultivars, however yields of the other cultivars ranged from 95 to 98% of the non inoculated and nematode damage was only significant ($P=0.01$) on the Vernal. Visual damage consisted of small root galls only scarcely visible with no above-ground symptoms. The number of plants per/plot gradually decreased but weed intrusion was notably no different from the non inoculated plots.

Inoculation of a mixed population of M. hapla and stubby root nematode, P. minor was found to be highly successful in every replicated site for each alfalfa cultivar. Both nematodes were well established after one year and the P. minor had become a contaminant among more than half the surrounding microplots by the second year. M. hapla did not move as readily but had reached a similar level of contamination by the end of the third year. This nematode combination provided no distinctive symptoms on the alfalfa except that the number of plants/plot declined more readily in their presence. Final yields reported as a percentage of the non inoculated were 86, 89, 83, 90, 88 and 92% for Moapa 69, Lahontan, WL 512, Cuf 101, Vernal and WL 451, respectively. All data were significant at the 1% level. The yield reductions occured during the second and third years. Relative weed invasion of the plots was no different from that with M. javanica.

Field soil taken from the 15 to 60 cm depth of a four-year old planting exhibiting "Stand Decline" was used for a comparative treatment. No attempt was made to purify or capture individual biological components in the soil except that five nematode species were identified and counted. Two of the nematode species, M. hapla and P. minor were

well established by the end of the first year but three other nematode species; Xiphinema americanum, Paratylenchus hamatus and Tylenchorhynchus sp. were not established until the end of the third year.

By the fifth harvest 3 of 5 replications of this inoculum were visibly affected. The following visual assessments were associated exclusively with the "Stand Decline" symptomology.

1). Superficial browning of tap and fine feeder roots

2). Weed invasion, especially of grasses, seems unabated

3). A slight, subtle chlorosis is apparent predominately during warmest growing periods

4). Reduction in the number of plants per plot.

5). Visual movement of the above symptoms at the rate of 60 to 90 cm per year into adjacent border areas and treatment plots.

By the end of the third year 4 of 5 replicates of this treatment were economically non-productive. By contrast, this was not the case among any treatments with the nematodes alone. Across all varieties yields were 90, 70 and 55% for each successive year, respectively. All alfalfa cultivars were affected with total yields being 69 to 76% of the non inoculated.

We have found a significantly important soil-borne condition associated with replant alfalfa which can result in rapid depletion of an alfalfa stand. The P. minor and M. hapla nematode combination may be a contributor to the malady but the nematodes alone contribute a lesser degree of damage and only a few of the overall symptoms in the "Stand Decline". None of the six alfalfa cultivars had differential resistance to the "Stand Decline" soil or to the nematode combination. All alfalfa cultivars possessed resistance to the M. incognita, M. arenaria and M. javanica populations we worked with except that Vernal cultivar was susceptible to M. javanica.

We developed a method for excavating and efficiently removing the root mass from a 13 liter volume of the surface 30 cm of soil profile. Within this soil volume the M. hapla and P. minor inoculum after 3 full years harbored 29,000 and 946 nematodes, respectively and resulted in an increase in root mass of 160% in tap root and 137% in fibrous and secondary roots over the non inoculated. The number of rhizobium nodules was also visibly increased. A similar soil volume taken from the "Stand Decline" treatment harbored 25,000 M. hapla and 553 P. minor however the tap and fibrous root weights were 82% and 45% respectively of the non inoculated. Deeper root sample comparisons will be necessary to understand the total nematode impact on alfalfa.

No publications of this research are available however we have begun preparation of a paper tentatively entitled: "Association of four root knot nematode species on six alfalfa cultivars". This work has been partially funded by The Consortium for Integrated Pest Management under EPA grant # CR-806277-02-0.