2001-02

FOR THE SLV RESEARCH CENTER COMMITTEE AND THE COLORADO POTATO ADMINISTRATIVE COMMITTEE (AREA II)

TITLE: Biology and Management of Columbia Root-knot Nematodes (*Meloidogyne chitwoodi*) of Potato in the San Luis Valley, Colorado

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PROJECT STATUS: (Ongoing)

SIGNIFICANT ACCOMPLISMENTS FOR 2001:
During the fall of 2000, reconnaissance soil samples were taken from several fields that were previously cropped to wheat and had a history of Columbia root-knot nematode to establish a site with high populations for a research plot. Plots were placed in an area that had fall population levels of 1,290/250 g soil. Average populations in the plots at planting in 2001 had declined to 55/250 g soil suggesting a winter mortality of 96% in our experimental plot. Obviously, more research needs to be conducted to determine the amount of mortality that can be expected through the winter in the San Luis Valley and the effect of winter severity on mortality.

Experimental treatments were set up to compare rates of 1 and 1.5 lb a.i./a of oxamyl (Vydate) and if there was a difference in the amount of water (0.25" vs 0.50") used to apply the Vydate. However, when treatments were evaluated at harvest, symptoms were not observed on any of the treatments. The high mortality of nematodes during the winter, which resulted in lower populations at planting, may have played a part in the fact that no symptoms were observed at harvest. Another factor in the lack of symptoms may be a lower than expected reproductive efficiency of the first generation of nematodes caused by hail damage to potato plants early in the season. As a result of the hail, potato plants probably used more of their energy in producing shoots and leaves rather than on root maintenance and production. We are speculating that this lack of energy available to the roots, and thus to the nematodes, caused a portion of the

nematodes to die within the roots, reducing population increase and tuber infection later in the season.

Other significant accomplishments for the 2001 growing season include the first ever population dynamics work done in the San Luis Valley on Columbia root-knot nematode on potato. While data are still being analyzed for interpretation, early indications are that the nematode is behaving fairly similar in the San Luis Valley of Colorado as in the Columbia Basin of Oregon. However it can be speculated that Columbia root-knot nematode may be adapting to the cool, short season of the San Luis Valley, as evidenced by slightly earlier completion of the second and third generation. If confirmed, this discovery has important implications for the SLV and may be a partial explanation for why nematode problems appear to be increasing in the area. Also significant to the project is the initial understanding of when infection occurs and when symptoms develop in the tuber. Because the hail delayed plant development, tubers were not present to collect to examine for infection until August 10. However, storage at room temperature to allow symptoms to develop determined that these tubers were already infected. Other tubers collected at harvest are still in storage that have not been evaluated so it is still possible that these tubers will develop symptoms that may provide useful information necessary for the threshold work. The research committee can expect additional information from this study as it becomes available through the spring and summer of 2002.

FINANCIAL BENEFIT TO POTATO GROWERS IN SLV:

Nematodes have become a serious threat to potato production in the San Luis Valley in recent years. Recommendations from other areas with nematode problems, such as the Pacific Northwest, would suggest that all fields with nematodes should be treated with metam sodium and or Telone at costs that may exceed $240/acre. However, because the SLV has a short, cool growing season not all nematode densities may need to be treated and less expensive nematicides, like Vydate (as inexpensive as $50/acre) may be sufficient. As this project proceeds, it will determine the management parameters to establish when treatment is necessary and control measures that will provide adequate control of root-knot nematode and corky ringspot at minimal cost.

PROJECT SUMMARY:

This project will examine several features of nematode biology and management in the SLV.

1) Follow population dynamics of Columbia root-knot nematodes in relation to soil degree-days and examine how this behavior may be affected by treatment with Vydate. Understanding population biology can help determine when a nematode population is most vulnerable to a nematicide application, as well as when a nematicide treatment may have little effect. It also helps for making recommendations on when to take nematode samples.

2) Determine when symptom expression occurs in relation to degree-days. By determining when nematodes develop to cause symptoms we should be able to determine how long tubers need to be protected and when the last Vydate application can occur.

3) Determine how high nematode densities need to be before any treatment is necessary and if there is an upper limit in nematode density that Vydate will not control.

4) Determine the optimum timing for applications of Vydate to control root-knot nematode and corky ringspot with the fewest number of applications.

OBJECTIVE 1: Observe population dynamics of Columbia root-knot nematode in the San Luis Valley of Colorado in relation to accumulated soil degree-days.

Population dynamics studies of Columbia root-knot nematode on potato have been performed in areas of the Pacific Northwest (Pinkerton et al. 1991), but whether Columbia root-knot nematode follows the same pattern in the San Luis Valley is unknown. If recommendations to reduce tuber damage caused by Columbia root-knot nematode are to be credible, it is imperative that population dynamics of Columbia root-knot nematode are well understood in the San Luis Valley.

Agro Engineering will be asked to sample treatments one, two, four, and six in objective five every other week until July 17th and then will be required to sample on a weekly basis until harvest. (A complete treatment list is available in Appendix I) The soil samples will be sent to OSU where they will be extracted and counted.

OBJECTIVE 2: Determine when tuber infection and symptom expression occurs in relation to degree-days.

It is essential that we determine when infection of tubers occurs and when tuber symptoms express in order to develop specific management recommendations for the San Luis Valley. For objective two to be accomplished, Three S Farms will have to leave a portion of field 14 untreated. Ideally, a small wedge could be left untreated where plots for objective two could be located. Agro Engineering will collect weekly tuber samples in the untreated area from the second week of July until the middle of August. Tuber samples will then be sent to OSU where they will be peeled and time of infection and symptom expression will be determined.

OJBECTIVE 3: Determine initial density of Columbia root-knot nematode that does not require control.

Determining if a lower threshold for Columbia root-knot nematode exists in the San Luis Valley may be the most important objective of this project. If it can be determined that Columbia root-knot nematode below a certain level does not require control, unnecessary applications of nematicides can be prevented.

As in objective two, objective three will require Three S Farms to leave an area untreated (will be the same area as for objective two). At planting, I will sample numerous (25-50) plots within the untreated area to establish nematode levels at planting. (A plot for objective three is simply twenty feet of row.) The plots will be harvested and a sample will be evaluated at harvest and another sample will be placed in storage and evaluated in the spring of 2003. The amount of damage will be related to the nematode density at planting to determine the population level below which no treatment is necessary.

OBJECTIVE 4: Determine initial density of Columbia root-knot nematode that causes damage when treated with Vydate.

It is important to determine if there is an initial population level of Columbia root-knot nematode that will cause tuber damage when the crop is treated with Vydate. If an upper threshold for Vydate exists, growers will know when to implement other control measures, and if an upper threshold for Vydate does not exist, they will be confident that Vydate will offer adequate protection at any population level.

Objective four can be accomplished in any area of the field, without any requirements from Three S Farms. The methods for objective four will be the same as objective three with the only difference being that the plots will receive Vydate when the grower applies it.

OBJECTIVE 5: Determine the efficacy of various Vydate applications to control both Columbia root-knot nematode and Corky Ringspot disease.

Vydate is a non-fumigant liquid nematicide/nematostat whose use on potato has been rapidly increasing since it secured a chemigation label. Although Vydate can kill nematodes on contact as a nematicide, it also controls root-knot nematodes by nematostatic action. As a nematostat, Vydate disorients nematodes and prevents feeding and penetration of roots and tubers. However, once the concentration of Vydate falls below a critical concentration in the soil solution, believed to be 1 ppm, nematodes recover and are once again able to infect roots and tubers. Although it is being widely used in potato, there is still little information on the number of applications, interval between applications or the rate required to prevent nematode recovery and achieve adequate control at minimal cost.

Objective five will consist of six treatments that will be replicated five times in a randomized block design in field 14. In an attempt to reduce the cost of this objective and obtain uniform application across plots, we are going to use tarps stretched over PVC frames to keep Vydate off of specific plots during farmer applications rather than using small plot applicators to apply Vydate to individual plots. All applications will be at 1 lb a.i./a and, except for in-furrow treatments, will be applied through the pivot in 0.5 in water. See Appendix I for a treatment list of various comminations of these application times.

We anticipate that root-knot nematode and corky ringspot can be controlled in Russet Nugget with four applications but the best times to make those applications is unknown. Consequently, three of our experimental treatments examine different timings of four applications. These examine; having all applications at the beginning, middle or spread throughout the season. One treatment with five applications and one treatment with six applications are also included in case four applications are not sufficient and so the effects of all application times on nematode populations can be monitored. In the process, we will test in-furrow applications at planting since our work in Oregon during 2001 suggested that this procedure could increase control.

It is presumed that Three S farms will be applying Vydate to the entire field 4 times during 2002 to control both Corky ringspot disease and Columbia root-knot nematode. If possible, we would like those four applications to occur on June 5th, June 26th, July 17th, and July 31st. Three S

Farms would be required to make at planting applications on the treatments that receive them in our plots. Three S Farms would also be asked to make one extra application (August 11th), unless they plan on making this application, over our plots. Spring reconnaissance sampling will be performed in field 14 by Agro Engineering to find a location for the plots close to the pivot road. I will be in the San Luis Valley at planting to lay out the plots, take at planting samples, help apply the at planting application to the appropriate plots, and build the frames for the tarping system. Three S Farms will be asked to put the tarps up before each Vydate application on the appropriate plots and take them down the following day. Please see Appendix I for a schedule of tarping events. Last year, I put up and took down ten tarps that were scattered across an entire half circle in approximately ninety minutes. I fully expect that since the tarps will be clustered together in field 14, set up time and take down time will be approximately 45 minutes each. DuPont will provide compensation for Three S Farms for the extra application on August 11th and the time spent putting up and removing the tarps during each Vydate chemigation event. The plots will be harvested and three tuber samples will be taken. One will be peeled and evaluated immediately (harvest sample), another will be placed in storage and evaluated in the spring of 2003 (storage sample), while the last one will be allowed to reach maximum symptom expression by storing at room temperature.

FUNDING REQUEST:

2001 Allocation: $18,000

2002 Request:

Nematode Processing of Soil and Tuber Samples	$10,800
Travel	4,000
Supplies	2,850
Agro Engineering Subcontract	4,000
Shipping Samples to Oregon	1,800
Total	**$23,450**

Appendix I

COLUMBIA ROOT-KNOT NEMATODE AND CORKY RINGSPOT DISEASE EXPERIMENTS
Tentative SLV Treatment List 2002
Three S Farms Blanca, CO (Field 14)

	At Planting In-Furrow May 1st 0 DD^	Emergence June 5th 300 DD^	June 26th 600 DD^	July 17th 900 DD^	July 31st	Aug 11th**
Treatment 1	--	T	T	T	T	T
Treatment 2	V	V	V	V	V	V
Treatment 3*	V	V	V	V	V	--
Treatment 4	V	V	V	V	T	T
Treatment 5*	--	V	V	V	V	--
Treatment 6	V	T	T	V	V	V
		10 Tarps	10 Tarps	5 Tarps	10 Tarps	10 Tarps

*Treatments 3 and 5 will be located outside of the area that receives an extra application of Vydate, so we don't have to buy tarps and Smiths don't have to put extra tarps up and down.

** August 11th application of Vydate is presumed to be one that the Smiths will not put on the rest of their field.

^ DD = Degree Days (Base 5C) accumulated since planting
V = Vydate application at 1# a.i. per acre T = Dates when plots are tarped