

INTEGRATED NEMATODE MANAGEMENT – AN OPTION FOR SUSTAINABLE POTATO PRODUCTION IN IDAHO

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Nematode management requires flexibility and must take into account species or races of nematodes, the availability of resistant or non-host plants, the cropping system and the cropping history, economics, and the climate. Historically, nematode management has focused on exclusion and nonchemical management tactics since few nematicides were available prior to 1943. Although few nematode management practice are available, due to lack of hard data and variables such as nematicide dosage, costs of chemicals, efficacy of management tactics, and crop susceptibility, the outlook for integrated nematode management is positive. Following the basic strategies of INM such as prevention, cultural practices, resistant cultivars, nematode-resistant trap crops and chemical control will lead to the success of integrated nematode management at field level.

Integrated Nematode management (INM) on potato is a sustainable approach to managing nematodes by combining biological, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. It is an interdisciplinary system approach to combat potato nematodes. Ideally, INM implies a bio-intensive approach to nematode management in which chemical nematicides are rarely, if ever, used. The intentions of INM are to balance economic goals of farmers with larger goals of society, and to maximize farmer profitability while minimizing negative effects of nematode control on human health and the environment. INM on potato has come into practice in many parts of the country due to the recognition by growers of human health and safety risks associated with chemical nematicide use, environmental hazards, development of nematode resistance to available nematicides, decreased availability of labeled nematicides, and the need for economically viable management strategies.

IMPORTANCE OF INM

In the current agricultural scenario, INM have been emphasized due to the social, economical and environmental status in the agricultural society. Economic and social welfare of the INM depends upon a healthy environment and agricultural economy. INM programs developed so far have already contributed to a decline in chemical inputs on many crops. This decline has the dual effect of increased profitability and environmental protection. Increased public concern about nematicide and pollution of streams and groundwater, effects on farm worker health, impacts on non-target species and general food safety has generated interest in programs with the potential to reduce these factors while maintaining farm productivity and profitability.

Following components are recognized as the factors that can contribute the enhancement of potato nematode management in a progressive way.

1. Identify cultivars of bean and alfalfa resistant to the root-knot nematode and include them as rotational crop in the cropping system.
2. Determine the host status of root knot nematode on the predominant commercial cultivars of corn in Idaho.
3. Evaluate the efficacy of new oil radish varieties to suppress the population of root knot nematode in a potato cropping system.
4. To evaluate the in vitro toxicity of oilradish, rape seed and mustard hybrids on the inhibition of egg hatching of *M. chitwoodi* under controlled conditions.
5. To study the efficacy of different formulations of metam sodium on *M. chitwoodi* on potato under field conditions.

I. SCREENING OF BEAN CULTIVARS

An experiment was conducted under green house conditions to screen the tolerance level of 30 cultivars of bean against the Columbia root-knot nematode (*Meloidogyne chitwoodi*) and include them as a rotational crop in a potato cropping system. Experimental design was a completely randomized block design with 30 cultivars of seven replications each. Single seed of each cultivar was planted in a cone filled with 1400 cc of sterilized soil. Two weeks after planting, seedlings were inoculated with 3000 second stage juveniles of *M. chitwoodi* obtained from culture maintained on tomato plants. Normal cultural practices were carried out. Eight weeks after planting plants were uprooted, nematodes were extracted from roots of each cultivar, and populations were recorded. Dry weight of root from each cultivar was recorded and nematode population was represented as number of nematodes per g dry weight.

Tolerance among the bean cultivars varies depending on the progeny and the characteristics of the specific cultivars. Nematode reproduction is an accepted parameter of root-knot nematode resistance and a terminology for the classification of host reaction. In two cultivars, 'Apore' and 'UI114,' total nematode population in the root and the population per g of the root was minimum.

II. SCREENING OF ALFALFA GENOTYPES

Two experiments were conducted under green house conditions to evaluate the tolerance level of five alfalfa cultivars to the lesion nematode *P. penetrans*. Cones of 150 cc capacity were filled with sterilized soil and seeds of each of alfalfa cultivar were planted in each cone. After germination, seedlings were thinned to three per cone and inoculated with *P. penetrans*, maintained on corn roots in tissue culture, at the rate of 100 nematodes per container. 100 days after planting plants were uprooted and data on nematode

population in the root and total population including root and shoot population were estimated. Fresh and dry weights of the shoot, as well as root, were also recorded. Data indicated that in the cultivar ZC 950A there is a significant difference in the parameters as compared to the susceptible cultivar Lahontan. Fresh and dry weight of root was significantly higher, while the total nematode population in the root and soil+ root population was lower than the susceptible cultivar Lahontan.

III. GREEN MANURE STUDIES

Efficacy of cultivars of oil radish and mustard were tested to include them in the long term rotation practices. A cultivar of oil radish (Colonel) and the Mustard (Metex) were planted on August, 2001. Before planting of green manure crops the nematode population among the treatments were similar and differences observed were not statistically significant. But the nematode population was reduced as a result of planting of oil radish and mustard cultivars. Potato cv. Russet Burbank was planted on April 18, 2002, and harvested on August 28, 2002. Data indicated that there is a significant difference in the total and marketable yield as compared to fallow. Mustard 'Metex' as previous crop produced more yield than the oilradish 'Colonel'.

In another experiment rapeseed 'Humus' and oilradish 'Commodore' and 'Colonel' were planted in Fall 2001 and incorporated in to the soil eight weeks after planting. Potato cv. Russet Burbank was planted on spring and yield data was recorded at harvest. There is a significant reduction in root knot nematode infested tuber s in the green manure crop planted plots as compared to fallow. It reduced from 75.0 % in the fallow plots to 26.4 % in the green manure planted plots. Market yield also increased by the green manure crops as compared to fallow treatment.

IV. EGG HATCHING STUDY

A study was conducted under controlled conditions to evaluate the effectiveness of rapeseed and mustard hybrids on reducing egg hatch of Columbia root-knot nematode (*Meloidogyne chitwoodi*). Three treatments (rapeseed root exudate, mustard root exudate, and water), replicated five times, were compared to determine the effect of exudates on *M. chitwoodi* egg hatch. Root exudates were collected at weekly intervals for four weeks and the experiment repeated to determine if exudate effectiveness varies with the age of the plant. The overall egg hatch was progressively and significantly reduced when exudates of all cultivars of rape or mustard were applied, when compared to the control.

V. HOST STATUS STUDY

A study was conducted under green house conditions to find out the host status of Northern root knot nematode *M. hapla* on the predominant commercial corn cultivars of Idaho. The experiment was conducted under green house conditions in a completely randomized block design with twelve corn varieties of five replications each. Seeds of the respective corn varieties were planted on February 26, 2002, in a pot filled with sterilized soil mixture. One week after planting, the pots were inoculated with second stage

juveniles of *M. hapla* (2000/pot) extracted from potato tubers. Eight weeks after planting the crop was harvested on April 23, 2002, and data on fresh and dry weight were recorded. Nematodes were not detected either in the soil or in root of any of the corn varieties studied.

CHEMICAL MANAGEMENT

VI. MANAGEMENT OF STUBBY ROOT NEMATODE BY TEMIK AND FOSTHIOZATE

A field experiment was conducted to study the efficacy of Temik and Fosthiozate on the control of stubby root nematode in a potato field. A location in Rexburg with indigenous populations of stubby root nematode was selected. Treatments were applied in randomized block design with five replications to individual plots (6 rows x 100 ft). Fosthiozate treatments were surface broadcast using a hand held plot sprayer. Temik was applied at planting with commercial planter and Agrimerk was pre plant incorporated by disking. Within one hour of application, all plots were disked two times to incorporate the chemical. Potatoes were planted on May 10, 2002, and harvested (2 rows x 25 ft) on September 27, 2002. Yield, quality, and nematode infestation was determined after 60 days of storage. Yield of potato tubers under different treatments indicated that there is an increase in marketable yield attributable to the different combinations of Temik and Fosthiozate as compared to control plots. Percent of nematode infection ranges from 35.0 to 10.0. Lowest level of nematode infestation was observed in the treatment of 20lbs/A Temik.

VII. CHEMICAL MANAGEMENT OF COLUMBIA ROOT NEMATODES BY VYDATE

Another experiment was conducted to determine the efficacy of Vydate in comparison to Temik and Control in reducing the nematode population and increasing the tuber yield. Temik was applied at planting with a commercial planter. Data indicated that percent of infection was reduced to 14.1 % as a result of treatment when compared to 49.1 % infestation in the control. However, no significant difference could be observed between the untreated control and treated plots in terms of total and marketable yield.

VIII. CHEMICAL MANAGEMENT OF COLUMBIA ROOT NEMATODES BY METAM SODIUM

A field experiment was conducted to study the efficacy of four rates of Metam Sodium and metam potassium on the control of Columbia root knot nematode in a potato field. Experimental design was a randomized block design with six treatments of seven replications each including an untreated check. Potato cv. Russet Burbank was planted on April 4, 2002, in the plots measuring 15 x 50 feet. Potatoes were harvested on September 10, 2002. Yield differences and nematode infested tubers in different categories were recorded. Application of all rates of Metam Sodium and Metam Potassium treatments significantly reduced the root knot nematode infected potato tubers as compared to the

untreated control. The percent of nematode infection ranged from 0.0 – 31.9. Lowest level of nematode infection was observed in the Metam Sodium treatment of 40 gal/A. In general, all treatments significantly increased the marketable and total yield of potato tubers as compared to the untreated control.

IX. CHEMICAL MANAGEMENT OF COLUMBIA ROOT NEMATODES BY FOSTHIOZATE AND MOCAP

Another experiment was conducted to determine the different formulations of Fosthiazate along with Vapam (7 treatments) are effective in reducing the nematode population and increasing the tuber yield. A field with indigenous population of root-knot nematode was selected. Experimental design was a randomized complete block design with seven treatments of five replications each including an untreated check. Fosthiazate treatments were surface broadcast using a hand held plot sprayer. Telone II and Vapam were applied as broadcast by ripper and fumigation bar, respectively. Potato cv. Russet Burbank was planted on May 10, 2002, in plots measuring 6 rows x 100 feet. Potatoes were harvested on September 27, 2002, and yield, quality, and nematode infestation was determined after 60 days of storage. Data indicated that application of Fosthiozate significantly reduced the root knot nematode infected tubers on potatoes as compared to untreated control. The percent of nematode infection ranged from 0.1 – 27.6. Lowest level of nematode infection was observed in the Vapam + Fosthiozate combination. In general, among all treatments, application of Fosthiozate alone or along with Vapam significantly reduced the percent of root knot nematode infected tubers.

X. COMPARATIVE PERFORMANCE OF CHEMICAL NEMATOCIDES FOR COLUMBIA ROOT KNOT NEMATODE MANAGEMENT

This research compared the efficacy of Metam Sodium and Mocap to an untreated check in reducing Columbia root knot nematode damage in potato production. A field with indigenous population of root-knot nematode was selected. Experimental design was a randomized complete block design with five treatments of five replications each including an untreated check. Mocap was surface broadcast on 27th September, 2001 using a tractor-mounted plot sprayer with 800 Z flat fan nozzles at 50 psi. Telone II and Vapam were applied as broadcast by ripper and fumigation bar, respectively. Potato cv. Russet Burbank was planted on May 10, 2002, in the plot size of 6 rows x 100 feet. Potato was harvested on September 27, 2002, and yield, quality, and nematode infestation was determined after 60 days of storage. Application of all treatments significantly reduced the root knot nematode infected potato tubers as compared to the untreated control. The percent of nematode infection ranged from 0.04 – 24.4. The lowest level of nematode infection was observed in the Metam Sodium alone or in combination with Telone II or Mocap. In general, among all treatments, application of Metam Sodium alone or Telone significantly increased the Marketable yield of potato tubers as compared to the untreated control. Since the nematode infestation in the field was low Mocap alone performed as well as the other treatments.