INFLUENCE OF NEMATODE MANAGEMENT PRACTICES ON POTATO CULTIVATION IN IDAHO

Saad L. Hafez and P. Sundararaj

Nematodes are important pests of the Idaho potato crop. They reduce yield and quality, thereby causing economic loss to the industry. A reliable nematode diagnostic service reduces the damage caused by the nematodes and allows Idaho potatoes to be exported to other countries. Surveys conducted in Idaho revealed that eighty five species of plant parasitic nematodes belonging to 32 genera have been recorded on 31 host plants from 21 counties. Of which, 37 species and 15 genera are new records in this region. Among all, three groups of nematodes are important in potato production in Idaho. These groups include root knot nematodes (*Meloidogyne* spp), stubby-root nematodes (*Trichodorus* and *Paratrichodorus* spp.) and root-lesion nematodes (*Pratylenchus* spp.).

IMPORTANCE OF ROOT KNOT NEMATODE ON POTATO CULTIVATION

Root knot nematodes (*Meloidogyne* spp.) have been recognized as a major nematode pest on potato and can be found in abundance especially in sandy soils. Although there are several species of root knot nematodes, the two most common on potato in Idaho and eastern Oregon are the Columbia root knot nematode (*M. chitwoodi*) and Northern root knot nematode (*M. hapla*). Both species can attack potato and cause irregular enlargement or bumps in the outer layers of the tubers, rendering them useless for either fresh packing or processing. Root knot nematodes have a wide host range which leads to population increases when other susceptible crops are grown in rotation with potato. Damage in potatoes is usually most severe following alfalfa hay crops and during years with high spring temperatures. Root knot nematode field damage is usually localized in circles of various sizes, or spread throughout an entire field with random plants becoming chlorotic and stunted. Plants may wilt easily, especially in warm weather, due to root damage even though soil moisture may be adequate.

The host range of root knot nematodes is wide, including alfalfa (*M. hapla*), wheat (*M. chitwoodi*), and other crops that are commonly grown in rotation with potato in Idaho and eastern Oregon and Washington.

MANAGEMENT STRATEGY

Root knot nematodes can be effectively managed by adopting chemical, biological and cultural practices. Green manure crops are one of the safest biological practices available to control the root knot nematode on potatoes. In addition to reducing soil densities of nematode population, other benefits of using green manure trap crops include increased yields of subsequent potato crops, improved soil tilth and water holding capacity, reduced nitrogen leaching into groundwater, weed suppression, reduced soil

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erosion by wind and water, and suppression of soil born diseases. To effectively reduce nematode populations, green manure crops require at least eight weeks growth and can be planted either in early spring or late summer. Often, green manure crops can be conveniently planted after the grain harvest. Further studies are needed to find out the nematode suppression effects of newly developed green manure crops under Idaho conditions. Other management options include the use of more conventional nematicides. Temik offers valuable chemical suppression of root knot nematode species. If root knot nematode population is high, the use of other nematicides such as Telone II, metam sodium, Mocap or Vydate should also be employed. Further, application of Mocap either during fall or spring along with Vapam fumigation significantly reduced the nematode infested potatoes as compared to untreated check. However further studies are needed to improve the application rate and efficacy of these nematicides, how they perform in combination with other nematicides, when to apply these treatments for optimum efficacy, and what other cultural practices might be suitable.

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 the 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.

INM on potato crop can be achieved by adapting the following strategies at appropriate levels.

- Evaluate the efficacy of new oil radish varieties to suppress the population of root knot nematode on potato and their invitro inhibition on root knot nematode egg hatch.
- Determine the resistant reaction of bean and alfalfa cultivars to root knot nematodes and include them as a rotational crop in the cropping system.
- Determine different combination of chemical options for the sustainable potato nematode management.

POTATO NEMATODE MANAGEMENT VERSUS CONTROL

The philosophy of INM is to *manage* or *tolerate* certain levels of the nematode, that is, to reduce the damage to economically tolerable levels. This approach recognizes that crops are ecosystems and that the presence of the nematode does not necessarily mean existence of a problem. When INM is practiced, natural enemies of nematodes are enhanced and disturbed as little as possible so they can assist in reducing nematode populations, and chemical nematicides are used only when needed. The decision as to

what management technique to use and when usually involves knowing whether or not the nematode is present and at what stage of growth, the environmental conditions, and the susceptibility and growth stage of the crop. Often, the cropping history plays an important role in knowing what kinds of nematode problems to expect.

REALISTIC APPROACH OF INM

Information is a fundamental component for a realistic approach to potato INM for two reasons. First, because an understanding of the potato ecosystem is essential to preventing nematode problems. Second, because INM relies upon close monitoring of nematode populations in order to determine when a population has reached an economically damaging threshold. Economic thresholds for nematode are developed from research that takes two main factors into account:

- Physical damage caused by the presence of the nematode at a known level of infestation,

- Revenue losses resulting from that damage

INM approach in the potato cultivation can be achieved by the inclusion of following components.

1. Surveying the potato packing sheds and processing facilities to demonstrate the absence of exotic nematodes and the occurrence of Columbia root nematode.
2. Incorporating oil radish varieties for suppression of root knot nematode in a potato cropping system.
3. Including the lesion nematode resistant alfalfa cultivars to the potato cropping system.
4. Identifying the new nematicidal compounds for the management of potato nematodes.

I. SURVEY

Potato cyst nematodes (PCN) *Globodera rostochiensis* and *G.pallida* have been identified by APHIS as significant economic threats to food production and placed on the National Priority Pest List, as well as being on the Western Region CAPS committee pest list. Since these nematodes had never been detected in Idaho, a comprehensive statewide detection survey was conducted for these two exotic potato pests from 2005 to 2006. A total of 3,639 soil samples from packing sheds, representing lots of potatoes from 11 counties were found negative for *G. rostochiensis*. However, one sample from a potato shed was positive for *G.pallida*. A total of 52 tuber samples drawn from packing shed processing lines and cull piles were also found negative for both species of PCN. These samples represented lots for potatoes from 8 counties. Of 3,639 samples tested, 21 tested positive for the Northern root knot nematodes and 126 tested positive for the Columbia root knot nematode. The current survey confirmed that the pale potato cyst nematode *G.pallida* is found in Idaho. Relatively low levels of infestation of the established

nematodes species Northern root knot (0.6%) and Columbia root knot nematode (2.9 %) were found in the samples.

II. GREEN MANURE STUDIES

In a green house experiment the efficacy of three arugala varieties were compared for their ability to support the multiplication of *M. hapla*. All three varieties were planted in pots filled with sterile soil inoculated with nematode in a completely randomized block design with five replications each. Eight weeks after planting, the crop was harvested and data on fresh and dry weight of shoot and root along with the nematode populations in the soil and per g of root were recorded. Data at harvest indicated that, among all varieties, maximum nematode reduction was with the Lebanese arugala variety (Racola, 91.4%) and with oil radish (Defender, 95.0).

The efficacy of cultivars of oil radish and mustard were field tested as a part of a study on long term rotation practices. Cultivars, Comet, Defender, and Accent were planted in August, 2005. In the spring of 2006, potato plots were produced, and yield data at harvest indicated that there was a significant increase in total tuber yield in the green manure crop planted plots compared to fallow. Root knot nematode infected tubers were reduced from 23.9 % in the fallow plots to 0.2% in the green manure planted plots.

III. SCREENING OF ALFALFA GENOTYPES

An experiment was conducted under green house conditions to evaluate the tolerance level of fifteen alfalfa genotypes to the root lesion nematode *P. penetrans.* In the variety Ts 5000 there was a significant increase in the fresh and dry weight of shoot and root. This corresponded with the lowest level of *P. penetrans* root population and the lowest total population in both soil and root.

III. NEW NEMATICIDE STUDY

An experiment conducted under micro plot conditions to evaluate the efficacy of different formulations of Chancellor at different rates on Columbia root knot nematode on potato indicated that two rates of Chancellor and WD at the applied rate significantly increased the total potato tuber yield. Percent of nematode infected tuber was significantly reduced by the Chancellor (10pints) and WD (134lbs/A) as compared to the control and the Chancellor applied at the lower rate.

A microplot experiment was conducted to study the efficacy of DMDS product at different rates for control of Columbia root knot nematode in tomato. DMDS treatments and Telone II were applied and tomato seedlings were planted on June 23, 2006. Soil samples were again collected on June 13, 2006, from each treated plot and the nematode populations were estimated. Based on the nematode population in pretreatment and post treatment samples, the percent reduction of *M. chitwoodi* in individual plots and in the individual treatments were calculated.