# MANAGEMENT OF THE COLUMBIA ROOT-KNOT NEMATODE ON RUSSET BURBANK POTATO, 1993

by
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The Columbia root-knot nematode (Meloidogyne chitwoodi) is the most important nematode affecting potato production in the Pacific Northwest. In 1993 several field studies were conducted on managing M. chitwoodi populations before planting potato. Studies included the use of crop rotation, green manure and nematicides.

## Crop Rotation

Crop rotation is the most common and effective cultural practice used to suppress nematode populations on most crops. However, crop rotation to manage root-knot nematodes is difficult because of their wide host range. In 1991 a crop rotation study was established at IAREC, Prosser in a field infested with M. chitwoodi race 2 to evaluate alfalfa germplasm W12SR2W1, super sweet corn cv. Harlequin and wheat cvs. Penawawa (spring) and Stephens (winter). Our previous studies have shown that W12SR2W1 and Harlequin exhibited resistance to race 2. Cropping sequences included 2 years continuous alfalfa, sweet corn and wheat, sweet corn followed by wheat, and wheat followed by sweet corn. In 1993 Russet Burbank potato was planted to all of the plots. Results showed that no matter the cropping sequence, wheat and sweet corn significantly ($P < 0.05$) reduced M. chitwoodi soil populations and tuber infection compared to growing alfalfa for two consecutive years (Table 1). These results confirm previous rotational studies that short season crops such as wheat and sweet corn are preferred to long season crops such as alfalfa and field corn. On alfalfa and field corn M. chitwoodi race 2 can complete more generations resulting in higher and deeper nematode population densities. The use of appropriate potato rotational crops to reduce nematode populations will greatly aid in the performance of a nematicide, green manure crop or other management practices.

## Green Manure

For the past several years, we have been evaluating the use of rapeseed and sudangrass or sudangrass-sorghum hybrids for managing M. chitwoodi populations before planting potato (1,2).

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Rapeseed and sudangrass when incorporated into the soil as green manure releases isothiocyanate and hydrogen cyanide, respectively, which are toxic to certain insects, fungi, nematodes, and weeds. Our studies show that rapeseed consistently provides about 80% control of M. chitwoodi. Results with sudangrass have been less consistent, ranging from 50-80% control. More detailed studies are needed on sudangrass as to the best time to incorporate to obtain the maximum benefits. Excellent results of 95-100% control have been achieved whenever Mocap at 12 lb ai/A have been used in combination with rapeseed or sudangrass. Within the potato rotational scheme rapeseed and sudangrass would be planted following wheat or sweet corn and incorporated as green manure in the fall for sudangrass and spring for rapeseed. Recent greenhouse studies suggest that spring and white mustards are as effective as rapeseed in controlling M. chitwoodi. In addition, the mustards require only 6-8 weeks of growth compared to 6-7 months for rapeseed.

In 1992 a rapeseed trial was established at Agri-Northwest, Inc., K2H farm, Pasco, Wa. in a field infested with M. chitwoodi. Jupiter rapeseed was planted in early September and incorporated 4 weeks before planting Russet Burbank potato. Treatments also included rapeseed + Mocap, Mocap, and Telone II. Although, nematode soil populations at harvest were relatively high in most of the treatments, this was not reflected in tuber damage (Table 2). Only 22% tuber cullage was observed in the untreated plots. All of the other treatments gave excellent control. Tuber damage may have significantly increased if harvest was delayed.

## Nematicides

Two nematicide trials were conducted at IAREC, Prosser to evaluate various nematicide treatments for control of M. chitwoodi on Russet Burbank potato. P retreatment nematode populations were relatively low in the plot areas ranging from 2-56 second stage juveniles per 250 $cm^3$ soil in the fumigation trial and 4-13 in the nonfumigant trial. Despite the low populations, tubers were severely damaged in the untreated plots with cullage of 99.6 and 90.8%, respectively. In the fumigation trial (Table 3) treatments that gave excellent control of M. chitwoodi included Telone II 20 gal/A shank-injected 18 inches deep; Telone II 10 gal + metham sodium (MS) 40 gal applied in 1/2-inch water; MS 55 gal shanked 18 inches deep in a broadcast spray; combinations of MS 55 gal shanked followed by MS 20, 30 and 40 gal in 1/2-inch water; and MS 35 gal shanked + MS 30 gal in 1/2-inch water; and chloropicrin 3 and 6 gal shank-injected 18 inches deep followed by 20 and 40 gal MS in 1/2-inch water. MS 55 gal applied in 1-inch water did not provide adequate control. Sprinkler applied MS has continually failed to provide control in this field. In the nonfumigant nematicide trial (Table 2) excellent control of M. chitwoodi were obtained with Mocap 10G 12 lb ai/A and experimental materials fosthiazate (ISK-Biotech Corporation) and HCN-80156 (United Agri Products). All of the nonfumigants were comparable to Telone II 20 gal.

In summary the soil fumigation treatments Telone II alone, Telone II + MS or Mocap, and MS shanked + MS sprinkler continue to perform well (4,5).

The results with MS shanked and Mocap suggests that these treatments are successful when M. chitwoodi population densities are low and shallow. However, in fields with high and deep population pressure these treatments do not provide adequate control (3). Fosthiazate performed as well or better than Telone II for the third consecutive year. The results obtained with HCN-80156 and chloropicrin + MS were very encouraging.

Literature Cited

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Table 1. Number of *Meloidogyne chitwoodi* second stage juveniles (J2) per 250 $cm^3$ of soil before planting and at harvest, and Russet Burbank potato tuber infection after 5 months growth following different crop rotation schemes, IAREC, Prosser, WA., 1991-1993.

| Cropping sequence 1991-1992 | Number of J2 | | Tuber infection | |
|---|---|---|---|---|
| | Preplant | Harvest | IF[1] | % culls[2] |
| Consecutive wheat or super sweet corn | 8 b | 191 b | 1.8 b | 29.5 b |
| Alternating wheat & super sweet corn | 2 b | 190 b | 1.6 b | 31.4 b |
| Consecutive alfalfa | 75 a | 1618 a | 3.7 a | 78.0 a |

Values for alfalfa and other rotations are means of five and 10 replicates, respectively. Means followed by the same letter do not differ at $P < 0.05$, according to least significant difference. Nematode soil population data were transformed to $Log_e (X+1)$.

[1] IF = infection index, where 0 = 0, 1 = 1-3, 2 = 4-5, 3 = 6-9, 4 = 10+, 5 = 50+, and 6 = 100+ nematode infection sites per tuber. Twenty tubers per replicate were hand peeled and evaluated for nematode infection.

[2] Tubers with 6 or more infection sites were graded as culls.

Table 2. Effect of Telone II, Mocap, and Jupiter rapeseed green manure alone and in combination with Mocap on soil population of *Meloidogyne chitwoodi*(MC), and tuber infection of Russet Burbank potato after 5 months growth, Agri-Northwest, Inc., K2H farm, Pasco, WA., 1993.

| Treatments (Rate ai/A) | No. MC/250 $cm^3$ soil | | Tuber infection | |
|---|---|---|---|---|
| | Preplant | Harvest[1] | IF[2] | % culls[3] |
| Untreated | 5 a | 739 ab | 1.1 a | 21.7 a |
| Telone II 20 gal | 8 a | 23 c | 0.0 b | 0.0 b |
| Mocap 10G 12 lb | 6 a | 34 bc | 0.0 b | 0.0 b |
| Rapeseed | 41 a | 966 a | 0.2 b | 5.0 b |
| Rapeseed + Mocap | 7 a | 255 abc | 0.0 b | 0.0 b |

Values are means of three replicates. Means followed by the same letter do not differ at $P < 0.05$, according to least significant difference. Nematode soil population data were transformed to $Log_e (X+1)$.

[1] Differs at $P < 0.10$.

[2] IF = infection index, where 0 = 0, 1 = 1-3, 2 = 4-5, 3 = 6-9, 4 = 10+, 5 = 50+, and 6 = 100+ nematode infection sites per tuber. Twenty tubers per replicate were hand peeled and evaluated for nematode infection.

[3] Tubers with 6 or more infection sites were graded as culls.

Table 3. Evaluation of Telone II, metham sodium and chloropicrin alone and in combinations for control of *Meloidogyne chitwoodi* on Russet Burbank potato, IAREC, Prosser, WA., 1993.

| Treatment (rate gal/A) | % culls[1] | Yield (T/A) |
|---|---|---|
| Untreated | 99.6 a | 26.7 d |
| Telone II 20 | 0.2 c | 38.4 ab |
| Metham 55 (1-in water) | 79.5 b | 31.4 cd |
| Telone II 10 + Metham 40 (½-in) | 0.4 c | 35.4 bc |
| Metham 55 (shank) | 0.0 c | 37.7 abc |
| Metham 55 (shank) + Metham 40 (½-in) | 2.1 c | 35.0 bc |
| Metham 55 (shank) + Metham 30 (½-in) | 0.1 c | 34.0 bc |
| Metham 55 (shank) + Metham 20 (½-in) | 0.5 c | 36.4 abc |
| Metham 35 (shank) + Metham 30 (½-in) | 0.4 c | 36.2 abc |
| Chloropicrin 3 + Metham 20 (½-in) | 0.04 c | 42.5 a |
| Chloropicrin 3 + Metham 40 (½-in) | 0.01 c | 37.4 abc |
| Chloropicrin 6 + Metham 20 (½-in) | 0.01 c | 38.8 ab |
| Chloropicrin 6 + Metham 40 (½-in) | 0.01 c | 40.0 ab |

Values are means of five replicates. Values in each column followed by the same letter do not differ at $P<0.05$, according to least significant difference test.

[1] Tubers with 6 or more infection sites were graded as culls.

Table 4. Evaluation of Telone II, Mocap, and experimental compounds fosthiazate and HCN-80156 for control of *Meloidogyne chitwoodi* on Russet Burbank potato, IAREC, Prosser, WA., 1993.

| Treatment (rate/A) | % culls[1] | Yield (T/A) |
|---|---|---|
| Untreated | 90.8 a | 22.8 d |
| Telone II 20 gal | 0.2 b | 39.4 a |
| Telone II 10 + Mocap 12 lb ai | 0.0 b | 35.0 abc |
| Mocap 10G 12 lb ai | 0.7 b | 33.8 bc |
| Fosthiazate 900EC 3.0 lb ai | 0.04 b | 31.3 bc |
| Fosthiazate 900EC 4.5 lb ai | 0.04 b | 32.1 bc |
| Fosthiazate 900EC 6.0 lb ai | 0.0 b | 30.6 c |
| HCN-80156 268 lb | 0.0 b | 31.5 bc |
| HCN-80156 357 lb | 0.0 c | 36.2 ab |

Values are means of five replicates. Values in each column followed by the same letter do not differ at $P<0.05$, according to least significant difference test.

[1] Tubers with 6 or more infection sites were graded as culls.