CONTROL OF ROOT-KNOT NEMATODES - PAST, PRESENT, FUTURE

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Root-knot nematodes are serious pests on potato production in Washington. Root-knot nematodes were first observed in the Columbia Basin in Block 73 near Quincy in 1960. Since then these nematodes have spread rapidly throughout the Columbia Basin. The principal means of spread appears to be through recycling of irrigation water and infected seed potatoes. By 1965 three root-knot nematode species were reported to occur in the Basin. They were the northern (Meloidogyne hapla), southern (M. incognita) and Thames (M. thamesi) root-knot nematodes. M. hapla was considered to be the most important to potato production because of its wider distribution. The distribution of M. incognita and M. thamesi was limited to the Quincy Basin.

Research on soil fumigation for control of root-knot nematodes on potato was initiated in the Quincy Basin in the early sixties. Research, however, was limited until 1968 when the Washington State Potato Commission first began funding nematode research at Prosser. These control studies resulted in the rapid acceptance of soil fumigation as a standard control measure for root-knot nematodes in eastern Washington. In 1968 an estimated 3,000 acres of land used for potato production were fumigated and by 1970 over 25,000 acres were fumigated. The most commonly used fumigants were the soil injected 1,3-dichloropropenes (DD and Telone) and ethylene dibromide (EDB).

In 1978 the Columbia root-knot nematode (M. chitwoodi) was discovered in the Quincy Basin on potato tubers. A survey conducted in 1980 showed that M. chitwoodi was widely distributed in the major potato production areas of the Pacific Northwest (2). M. chitwoodi and M. hapla were the only root-knot nematode species found in this survey. Although M. incognita and M. thamesi had previously been reported in Washington, slides containing these nematodes have been re-examined and are now identified as M. chitwoodi. Thus, M. chitwoodi has been around for quite some time but was not recognized as a new species.

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Biology and control studies show that M. chitwoodi is more important on potatoes than M. hapla. M. chitwoodi damages tubers more severely and is more difficult to control than M. hapla. External symptoms produced by both species on Russet Burbank potato tubers are distinct. M. chitwoodi produces distinct pimple-like bumps or lumps on the surface of the tubers, whereas M. hapla produces more of a general swelling. It is sometimes difficult to differentiate between a tuber infected with M. hapla and a healthy tuber by external symptoms alone. However, internal symptoms produced by M. chitwoodi and M. hapla are similar. Both species produce typical brown spots within the tuber.

Meloidogyne chitwoodi and M. hapla have a wide host range (1,3). The principle difference between these species is that many of the graminae are hosts for M. chitwoodi but are not hosts for M. hapla. Thus, the cereals would be excellent crops to rotate with potato to suppress M. hapla populations. Crop rotation studies show that M. chitwoodi populations were highest following field corn "Pioneer 3732" than spring wheat "Fielders", contrary to greenhouse studies which show that wheat is a better host for M. chitwoodi than corn. This is because under field conditions corn is a longer season crop than wheat and M. chitwoodi is able to complete more generations on corn than wheat. Thus, wheat would be a better rotational crop than corn to minimize M. chitwoodi populations. Alfalfa is a good host for M. hapla but has a mixed reaction to M. chitwoodi race 1 and 2. Race 1 reproduced poorly or not at all on alfalfa and race 2 reproduces well (5). Thus, alfalfa would be a good rotational crop for race 1 but not race 2. Presently, no good rotational crop is available to suppress M. chitwoodi race 2 populations. Studies on the distribution of race 2 indicates that this race is widely distributed in the Pacific Northwest. Thus far in Washington, race 2 has only been confirmed in the Pasco area.

The severity of tuber damage by M. chitwoodi and M. hapla is greatly increased the longer the tubers remain in the ground, regardless of nematicide treatments. Thus, by harvesting tubers as early as possible much damage can be avoided. Early harvest is especially beneficial for fields infested with M. hapla, because severe tuber damage is usually not observed until late September to early October. On the other hand, severe tuber infection by M. chitwoodi may be evident by mid-August. Tubers infected with M. chitwoodi should be processed or sold immediately and not stored. At storage temperatures of 46-48°F, M. chitwoodi continues to develop and tuber damage is increased. M. hapla is not known to increase tuber damage at these storage temperatures.

The most common method used to control root-knot nematodes on potatoes remains soil fumigation with Telone II and metham sodium (Metam, Nemasol, Soil Prep and Vapam) (4,5). Telone II is applied by soil injection with tractor drawn chisels and metham sodium by application through a sprinkler system. However, in fields heavily infested with M. chitwoodi, soil fumigation alone may not be adequate. Nonfumigant nematicides show promise in suppressing M. chitwoodi infection within tubers, especially in combination with the soil fumigants (5). The best treatment for controlling M. chitwoodi has been the combination of the soil fumigants with Mocap applied as a broadcast incorporated treatment just prior to planting.

Mocap is registered for suppression of M. chitwoodi at 6 lbs AI/A and control of M. hapla at 9 lbs AI/A. Temik also provides added benefits of nematode control when combined with a soil fumigant. However, results with Temik have not been as consistent as those obtained with Mocap for control of M. chitwoodi.

In 1985, midseason nonfumigant nematicide applications were included in our nematicide plots. The purpose of the midseason treatments was to determine how well these materials could protect the tubers from nematode infection. Our studies show that M. chitwoodi does not infect tubers until about mid-July. Thus, if nematicide applications are made prior to tuber penetration, tuber infection could be greatly inhibited or delayed. Results obtained from these studies were very promising. Also included in the 1985 nematicide trials were two experimental nonfumigant nematicides from FMC and Union Carbide Corporations. The results obtained with both compounds were very encouraging. Both performed better then Mocap in controlling M. chitwoodi.

Since 1984 potato growers have lost the use of two soil fumigants (DD and EDB) and presently only two (Telone II and metham sodium) are available for use. How long these fumigants will be available is not known. Fumigation, however, does not always provide effective control, especially for M. chitwoodi. Studies are needed to determine the conditions contributing to fumigation failures. Due to the cost and loss of nematicides, alternative methods of managing root-knot nematodes are needed; more efficient use of chemicals, crop rotation, resistant crops, and/or biocontrol.

References:

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