ROOT-KNOT NEMETODE IN THE COLUMBIA BASIN

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Root-knot nematodes were rarely observed in the Columbia Basin before 1961. Since that time the incidence of root-knot infestations has rapidly increased and now these nematodes are known to occur throughout the area. The question of how a soil inhabiting organism could be introduced and become widespread in newly developed agricultural land has received considerable attention during the past few years. In this discussion we shall look at the possible means by which root-knot nematodes were first introduced into the Columbia Basin and the probable pathways for the rapid spread of these nematodes.

To date we have no information indicating that root-knot nematodes were present in the Columbia Basin prior to the development of irrigation. We can only assume that they were first introduced by man through the planting of infected, vegetatively propagated materials. Prime carriers for introduction of root-knot nematodes into the Columbia Basin were obviously mint roots and potato seed.

When Verticillium wilt posed a serious threat to peppermint production in the Yakima Valley in the late 1950's, a number of mint plantings were moved to the Columbia Basin. Some planting stocks carried root-knot nematodes and roots from these were spread through subsequent plantings over wide areas. Since root-knot did not pose a serious economic problem in mint, we were unable to have root-knot nematodes included in the quarantine order covering mint wilt. Basin growers are now enduring the consequences in production of potatoes and other crops.

Planting of infected potato seed may also have been an important factor in introduction of root-knot nematodes. This supposition has been difficult to prove even though observations have been made which indicate, in specific cases, that seed produced in Western Washington has carried root-knot nematodes.

It should be mentioned that although the above sources of infestation probably account for most of the initial introductions, other sources may have been involved to a lesser degree. Among these, garden shrubs, tree seedlings, bulb crops, soil adhering to farm machinery, etc. could have been involved.

Following initial introduction, spread of root-knot nematodes within the Columbia Basin has been exceedingly rapid. Localized spread within and between fields may be accomplished through cultural practices and the accompanying transport of soil or plant refuse containing nematodes. It is doubtful that such means could be responsible for the rapid spread of nematodes throughout the Basin since they would necessitate free exchange of farm equipment over wide areas or the active transport of infested soil from one farm to another.

The question has often been asked, "Do the heavy winds which are characteristic of eastern Washington aid in the spread of nematodes?" It would be possible for strong winds, by moving infested soil or refuse, to transport those nematodes which can withstand dessication. Since root-knot nematodes cannot survive drying, the chance that they might be spread by wind is extremely remote.

Another question often asked is, "Is it possible to spread nematodes through manure from animals which have been fed nematode-infected potatoes?" It is true that careless handling of infected tubers could serve to spread root-knot. Experiments have shown, however, that if proper precautions are taken, there is little danger of spreading nematodes by this means. Nematodes do not survive passage through the gastrointestinal tract of beef animals. Spillage of infected tubers around the feed bin will not affect spread if they undergo alternate freezing and thawing, or if the infected tissues are composted with manure. If infected tubers are ensiled before they are fed, any root-knot nematodes present will be destroyed.

The last and most important means of dissemination we shall consider involves the use and re-use of irrigation water. Recently developed irrigation systems have been carefully designed to provide effective irrigation while removing as little water as necessary from our natural waterways. Thus, we have established irrigation systems which are commensurate with sound conservation policies. The principle of water conservation through use and re-use of irrigation water has been employed effectively within irrigation districts and individual farms alike. Unfortunately, even the best practices may be influenced unfavorably by factors we had no reason to consider or to suspect during the developmental phases.

Our recent studies on spread of plant parasitic nematodes via contaminated irrigation water may serve to illustrate this point. We noted that nematode infestations were apparently spreading in the direction of flow of irrigation water. Futhermore, in a number of root-knot and alfalfa stem nematode infested fields, the only logical source of infestations appeared to be through irrigation water. Instances were observed where fields less than five years removed from sagebrush desert developed both uniform and severe infestations. These fields had no history of vegetatively propagated planting stock or exchange of equipment from lands known to be infested.

Our initial studies were with canals at the lower end of the Yakima Valley. We found that irrigation water from this location carried large numbers of nematodes normally associated with soil environments. Among these were significant numbers of plant parasitic species, including root-knot nematode.

In 1966 studies were initiated to determine the nematode load of irrigation water in the Columbia Basin. Thirty-three collection sites were selected and sampled at weekly or biweekly intervals throughout the growing season. Activities were concentrated in those areas serviced by the West Canal from Ephrata to the Royal Slope and Potholes Reservoir.

The West Canal was sampled at six locations in the Quincy Basin as follows: Ephrata, Washington, Winchester, Babcock Canal intake, White Trail Road, George, and Frenchman Tunnel. Seasonal averages of nematodes extracted from samples taken at these points were 0.24, 0.88, 23.15, 16.0, 12.0 and 4.73 nematodes per gallon of water, respectively. Peak populations occurred from late April through early June when concentrations of over 50 nematodes per gallon of water were found at White Trail Road. Plant parasitic nematodes accounted for 7% of the nematodes extracted from water of the West Canal. It is interesting to note that no plant parasitic nematodes were extracted from water samples collected at Ephrata, Washington or above this point.

Nematode acquisition in the West Canal is by the return flow of used irrigation water. For example, in Block 73, water is pumped to the north at Winchester, then flows to the east and west along several laterals and is returned to the West Canal. In the interim, excess water from irrigated fields is also returned to the West Canal.

Alfalfa is the predominant crop in the area served by laterals east of Winchester. The seasonal average of nematodes collected at the eastern end of one lateral was 190.9 nematodes per gallon of water, with 14.5% of these being plant parasites. A peak population of 879.9 nematodes per gallon was observed on April 23. At this time the alfalfa stem nematode, Ditylenchus dipsaci averaged 156.4 per gallon.

A second location 1.6 miles southwest of Quincy, where used water is also returned to the West Canal, was also sampled. Here the seasonal average was 485.4 nemas per gallon of water. A peak population was observed on April 30 when 1300.3 nemas were extracted per gallon of water. At this time plant parasites reached 77.3 per gallon.

The effect of empoundment of water in the Potholes Reservoir on nematodes was studied. Two sources of water for this reservoir were found to contain large nematode populations, these being the 645 and Lind Coulee drainways. The Lind Coulee drainway was sampled at a point to the northeast of O'Sullivan Dam where it intersects Hiway 110. Here the seasonal average was 214.54 nemas per gallon of water and 3.4% of these were plant parasites. DW645 was sampled at 6 locations starting at its source near Winchester, Washington and ending at a point near the Potholes Reservoir. The intervals between these points ranged from 5.9 to 7.3 miles. Following DW645 from its source, the seasonal averages of nematodes per gallon of water were 325.28, 164.12, 119.17, 47.88, 1.2 and 0.74 with 2.6%, 3.5%, 4.1%, 3.1%, 0.0% and 0.0% of these being plant parasites, respectively. Water flowing from the Potholes Reservoir had a seasonal average of 0.26 nematodes with no plant parasites being found during two years of observation.

These data show that impoundment of water in the Potholes Reservoir effectively stopped spread of nematodes. However, they do not show what factors are responsible for population decline. The average number of nematodes carried in the relatively clean water of the West Canal dropped from 23.15 to 4.73 per gallon in a distance of 25.5 miles. On the other hand, in a comparable distance [26.4 miles] in DW645 wasteway, the average population dropped from 164.1 to 1.2 per gallon. Most water carried by DW645 wasteway originates as run-off from irrigated fields and also carries a heavy load of silt and organisms other than nematodes.

In studies started in 1967 we set out to determine if plant parasitic nematodes carried in irrigation water could become established on irrigated crops. Although this experiment is in its initial year, pin nematode has been found to be introduced via canal water onto clean land and has subsequently developed in large numbers on mint. It is likely that other parasitic species, including root-knot nematodes, will follow.