

Crop rotation controls barley root-knot nematode at Tulelake

M. W. ALLEN · W. H. HART · KEN BAGHOTT

THE BARLEY ROOT-KNOT NEMATODE, *Meloidogyne naasi* Franklin, 1965, was found causing economic damage to barley in the Klamath Basin near Tulelake, California, in 1964. The species parasitizes barley in England and Wales and has been reported from sugar beets in Belgium. It also occurs in Illinois, Kansas and Oregon. Known infestations in California are in the Tulelake area, and a few locations in southern California where the nematode has been found on the roots of turf grasses. The infestation in the Tulelake area involves several thousand acres that have been cropped almost continuously with barley since the land was reclaimed. Other crops sometimes grown in the infested area include alfalfa, oats, potato and wheat.

Injury to barley plants is characterized by invasion of infective larvae into the roots of young plants early in the growing season. Samples from infested fields, taken early in May frequently have an average of 90,000 infected larvae per pint of soil. There is typical formation of spindle-shaped galls, and roots may be killed when there is massive infection (see photo). Heavily infected plants are stunted, become yellow and may die. Surviving plants tend to remain stunted and do not produce normal heads. Crop losses are variable, but with high larval populations, losses may reach 50 to 75 per cent of the crop.

Barley was planted in pots of sterilized soil, and then inoculated with egg masses of the barley root-knot nematode to show effects on plant growth. In these tests

the soil plots were inoculated with 2, 10, and 100 egg masses. A crop of barley was grown, harvested, and a second planting made. The effect of the nematode upon the second crop of barley is shown in the photo of plant top growth. The soil inoculated with 10 and 100 egg masses produced significantly less top and root growth (1% level) than pots receiving 2 egg masses or no egg mass (CK). The good growth of the barley in pot MO (inoculated with water in which the egg masses were washed) indicates that micro-organisms associated with the egg masses were not injurious.

The barley root-knot nematode in the Tulelake area differs biologically from
HOST AND NON-HOST PLANTS OF BARLEY ROOT-KNOT NEMATODE IN THE TULELAKE AREA.

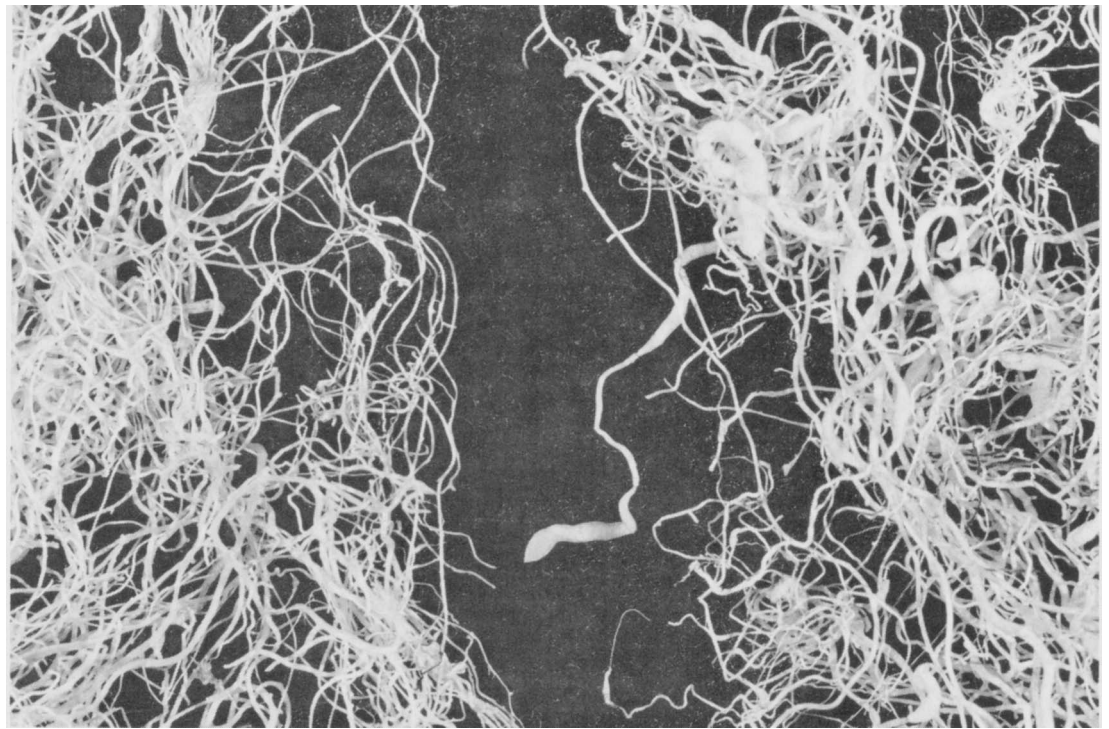
Hosts
Alsike clover
Barley (116 varieties)
Curley dock
Grasses (all species tested)
Oats (21 varieties)
Onion (very poor host)
Rice (3 varieties)
Rye
Sorghum
Sunflower
Wheat
Wild oats
Non-hosts
Alfalfa (African, Vernal, Ladok)
Australian winter peas
Beans (commodore, black eye)
Cantaloupe
Carrot
Celery
Clover (Kenland, Ladino)
Corn
Cotton (Acala 442)
Cucumber
Millet
Oats (Park, Cayuse, Curt, Indio, Kanota)
Peas (early perfection)
Potato (roots and tubers)
Safflower (P-4)
Squash
Tomato (commercial)

other root-knot nematode species in California: (1) there is only one generation per year on barley; (2) eggs of this species require exposure to chilling before they will hatch readily (maximum egg hatching occurs only after the eggs have been exposed to temperatures of about 40° F for a period of six weeks or more while eggs of other species hatch readily without exposure to low temperatures); and (3) the host range of *M. naasi* differs from other California species of root-knot nematodes, its principal hosts are in the grass family (Gramineae), some of the common hosts of the root-knot nematodes *M. incognita*, *M. javanica*, *M. hapla*, *M. arenaria* and *M. thamesi* are immune or highly resistant (see plant listing).

Control

The use of conventional soil treatments with nematicides is not economical in barley culture. Information obtained in greenhouse and field tests concerning the host range of the nematode was used as a guide in 1966, to establish a series of cropping sequences on an infested experimental plot at Tulelake. Crops included alfalfa, Australian winter peas, barley, oats (Park), onions, and potatoes, in addition to fallow. The 1969 barley yields resulting from several of the cropping sequences are shown in the table.

Records show that growing non-host crops, or fallowing infested land for one season prior to planting barley, will greatly increase yields. It is important that Park, Cayuse or other nematode-immune oat varieties be used if the crop



Hannechen barley roots to left, not infested; to right, infested with barley root-knot nematode.

prior to barley is oats. Row crops, such as onions or potatoes, may be advantageous because of the opportunity for controlling wild oats, which is a host of barley root-knot nematode. Tests 10 and 11 (see table) indicate very good increases in barley yields that can be obtained after one year of a highly resistant or immune row crop. Test 12, where potato was grown for two years preceding the 1969 crop of barley, resulted in the best yield. Test 11 substantiated grower observations that satisfactory barley yields can be obtained following a potato crop. In these tests onions and potatoes (as a crop preceding barley) increased yield to higher levels than did Park oats or fallow, but barley yields were nearly doubled with the two latter treatments as compared with those obtained in continuous barley crops (test 1).

Potatoes grown in heavily infested

field soil, and in infested soil in the greenhouse, showed no evidence of tuber penetration by larvae and no mature females were found in roots. In greenhouse tests, a very few females matured and produced eggs in onion roots but no mature females were found in the roots of field-grown onions. Immune oat varieties other than Park or Cayuse need further agronomic evaluation in the Tulelake

area before use as rotation crops to control barley root-knot nematode.

M. W. Allen is Professor, Department of Nematology; and W. H. Hart is Extension Nematologist, University of California, Davis. Ken Baghott is Farm Advisor, Modoc-Siskiyou counties. This research was supported by a grant from the U. S. Department of Interior, Bureau of Reclamation.

Hannechen barley top growth in pots inoculated with 100, 10, 2 and no egg masses (MO and CK) of barley root-knot nematode.



ROTATIONS AND RESULTING BARLEY YIELDS, 1969, TULELAKE, CALIFORNIA

Test No.	1966	1967	1968	1969 Yield Firbecks III barley lbs/acre*
1	Barley	Barley	Barley	2732 a
2	Barley	Oats	Barley	3078 a b
3	Barley	Onions	Barley	3578 b
4	Oats	Oats	Barley	4155 c
5	Barley	Barley	Fallow	4155 c
6	Fallow	Fallow	Barley	4309 c
7	Barley	Barley	Oats	4463 c d
8	Onions	Onions	Barley	4540 c d
9	Potato	Potato	Barley	4579 c d
10	Barley	Barley	Onions	4886 d
11	Barley	Barley	Potato	4925 d
12	Barley	Potato	Potato	5541 e

* Average of 4 replicates—yields with same letter not sig. diff. at 1%.