

Selection for Resistance to the Northern Root-Knot Nematode in Red Clover

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Introduction

Little attention has been given to the development of resistance to nematodes in red clover (*Trifolium pratense* L.) even though considerable damage can be caused by nematode diseases in specific sites in the world. In some areas damage may be severe, but generally the effect is more subtle. In this latter case red clover plants tolerate the pest, but yield and stand longevity are reduced. Recently scientists in southern U.S. (Florida) have developed and released red clover germplasm with resistance to several species of the root-knot nematode complex [peanut root-knot nematode: *Meloidogyne arenaria* (Neal) Chitwood; southern root-knot nematode: *M. incognita* (Kofoid and White) Chitwood; and javanese root-knot nematode: *M. javanica* (Treub.) Chitwood]. This resistance greatly enhances the production and longevity of red clover in nematode infested sites.

In northern U. S., the northern root-knot nematode [*M. hapla* (Chitwood)] is the most widely distributed nematode species. *M. hapla* occurs primarily in sandy to sandy-loam soils in Wisconsin. An immediate concern is that *M. hapla* occurs very extensively in our extremely sandy soils in the center of the state. The major crop of the area is the potato (*Solanum tuberosum* L.) which is also extremely susceptible to *M. hapla*. Red clover is used in short rotations with potato to increase the organic matter of the soils, to provide a nitrogen source, and to improve general soil tilth. Resistant red clover germplasm would assist in reducing the population of *M. hapla* in the rotational sequence. Therefore, we initiated a recurrent phenotypic selection program to develop red clover germplasm with resistance to *M. hapla*.

Materials and Methods

The first cycle of selection was developed from intercrosses between selected plants of the cultivars

Arlington, Kenstar, and Marathon and the Wisconsin germplasm, C11. Selection was based on both field and greenhouse response to the nematode. All subsequent cycles were conducted in the greenhouse. In cycles 2 through 4 plants were grown and inoculated (15 - 20 juvenile nematodes per plant) in plastic flats containing a mixture of sterilized sand and soil (1:1 v/v). Beginning in cycle 5 individual plants were grown and inoculated in Cone-tainers™ using the same planting media. Nematodes used for inoculation purposes were maintained on tomato (*Lycopersicon lycopersicum* L.). Selection intensity ranged from 3% in cycle 1 to 20% in cycle 6. Selection was based on visual number of galls based on a 1 to 5 scale, where a score of 1 was essentially no galls to 5 which was severely invested with galls.

Results and Conclusions

Progress from selection was variable, but effective, between cycles 1 to 4 with only 15% of the plants resistant (disease score of 1 or 2) after the fourth cycle (Fig. 1). The effectiveness of selection increased drastically between the fourth and fifth cycle (37% of plants resistant in the cycle 5). Excellent progress was achieved in the next two cycles of selection such that after seven cycles 75% of the plants express the resistant reaction (Table 1). It is worthy to note that with no selection for resistance to *M. hapla*, Florida germplasm (FLMR7, selected for resistance to *M. arenaria*, *M. incognita*, and *M. javanica*) appears to have some resistance to *M. hapla*.

Cycle 7 germplasm is being prepared for release. Besides resistance to *M. hapla*, this germplasm has good persistence and moderate resistance to northern anthracnose caused by *Auridiobasidium caulivora* (Kirch.) Karak. In addition, it has moderate resistance to *M. arenaria*.

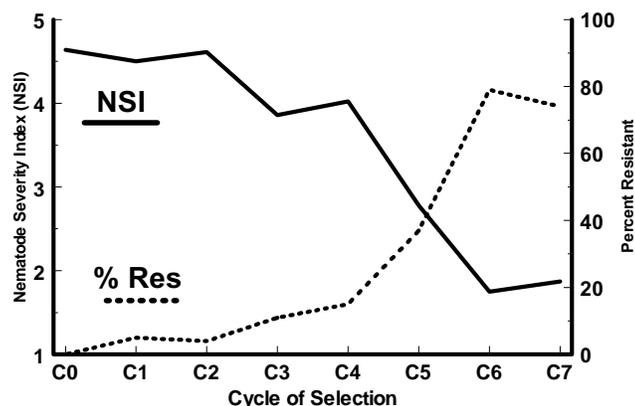


Figure 1. Response to selection for resistance to root-knot nematode in red clover.

Table 1. Response of red clover to seven cycles of selection for root knot nematode resistance.

Cycle/ Material	Percent plants with NSI of					#Plt	Mean	St Dev
	1's	2's	3's	4's	5's			
C0	0	0	4	31	65	26	4.62	0.571
C1	0	5	26	21	48	42	4.50	1.221
C2	0	4	4	21	71	28	4.61	0.737
C3	4	7	21	36	32	28	3.86	1.079
C4	0	15	15	23	46	26	4.00	1.131
C5	22	15	37	15	11	27	2.78	1.281
C6	54	25	14	7	0	28	1.75	0.967
C7	59	15	11	7	7	27	1.89	1.311
C7 SYN2	80	20	0	0	0	25	1.20	0.408
Marathon	0	0	4	23	73	26	4.69	0.549
Cherokee*	4	15	22	15	44	27	3.81	1.272
FLMR7**	27	27	19	27	0	26	2.46	1.174
LSD (5%)							0.66	

*Cherokee released in 1993 with resistance to *M. arenaria*, *M. incognita*, and *M. javanica*.

**FLMR7, advanced Florida germplasm selected for resistance to *M. arenaria*, *M. incognita*, and *M. javanica*.