Project Number 91-W5

GENETIC IMPROVEMENT OF STONE FRUIT ROOTSTOCKS FOR RESISTANCE TO NEMATODES

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OBJECTIVES

1. Use greenhouse screening procedures for 40 candidate rootstocks to detect resistance/tolerance to root lesion nematode. 2. Challenge 15 candidate rootstocks with high levels of sugar flotation - centrifugation extracted ring nematodes for greenhouse screening. 3. Hybridize germplasm identified as root lesion resistant/tolerant with known sources of root knot resistance during the 1991 bloom.

PROCEDURE

Plant materials used in the lesion nematode screening procedure were collected during the winter of 1991. Hardwood cuttings of clonally propagated candidate rootstocks were rooted in a 3:1 sterile mixture of sand:sandy loam soil. Seedlots to be screened were kept in a sterile environment at 4C until the emergence of root tips. All plants entering the lesion nematode screen were potted in a 3:1 mix of sterilized sand:sterile sandy loam soil. This non-organic soil mix is necessary to ensure growth and development of both the *Prunus* candidate rootstock and root lesion nematode.

For optimal results, 32 uniform explants of a candidate rootstock are necessary in the lesion nematode screen. Half the plants are used as uninoculated controls while each of the remaining plants are inoculated with 150 live lesion nematodes. Control and inoculated groups are further sub-divided into a short term (90 day) or long term (150 day) harvest period. Thus, a total of eight plants are sampled for both controls and inoculated at each harvest period.

At the designated harvest period total root and shoot fresh weights are measured. Root systems are mist extracted for five days to obtain the number of lesion nematodes infesting the roots. The total number of nematodes extracted is divided by the root weight to standardize nematode numbers. Control and inoculated groups are compared for root weight, shoot weight and nematodes per unit weight of root by standard ANOVA procedures.

The same 3:1 sterile sand:sandy loam soil mix is used for screening candidate rootstocks against ring nematode. For optimal results, 8 plants from an inoculated group and 8 non-inoculated controls are harvested after a 144 day growth period. Growth parameters of inoculated and control plants are compared using standard ANOVA procedures. Soil samples are collected from each plant and extracted to determine nematode density per 250 cc soil.

RESULTS

The 150 candidate rootstock accessions screened against root lesion nematode exhibited diversity with regard to plant vigor and suitability as a host (Table 1). Nematode carrying capacities of candidate root systems ranged from 0.3 (Red Glow) to 335 nematodes per gram root (fresh weight basis). Unsuitable hosts have been identified in six of the seven types of germplasm.

Candidate rootstocks that appear to be resistant to root lesion nematode are listed in Table 2. While root lesion nematodes were still observed on the root system after 150 days, the net populations were always lower than the initial number inoculated for each of these accessions. Accessions B5-13 and *P. tomentosa* are of limited value due to known graft incompatibility problems and their inability to hybridize with other, more suitable *Prunus* material. Bruce, Deep Purple and Red Glow are all plums and will be used extensively in hybridizations with root-knot resistant peaches. The 'apricot' group is comprised of Natsu-Goromo, PI 506392 and Tsuno-Ume. Using pollens from this group, hybridizations will be attempted on Bruce, Deep Purple and Red Glow to impart hybrid vigor in successful progeny.

Ring nematode screening tests for host suitability were initiated for 18 candidate rootstocks during 1991. At this writing, data are available for four of these accessions (Table 3). A level of 1000 sugar floated ring nematodes was used as the standard inoculum. There were insignificant differences in nematode populations across the rootstocks. Growth of roots and shoots of hybrid seed form the cross Nemared X PI 442380 was significantly reduced by ring nematode inoculation.

A much wider variety of root lesion nematode resistant *Prunus* candidate rootstocks was available this year for hybridization with known sources of root knot nematode resistance. Bruce, Natsu-Goromo, *P. angustifolia* and *P. japonica* were used extensively in hybridizations attempted to transfer root lesion nematode resistance to commercial rootstocks. Thirty-two specific crosses were performed during the 1991 bloom.

A progeny from a specific cross originally reported in the 1989 report is now sufficiently large enough for screening against root knot and root lesion nematodes. This is a hybrid between *P. japonica* and GF 557 - a commercial peach-almond hybrid rootstock. Dormant wood has recently been collected and placed in-vitro for micropropagation. There are five other *P. japonica* X 'peach' plants obtained during the 1990 bloom. The validity of their parentage has yet to be established.

CONCLUSIONS

Since 1988, 150 *Prunus* candidate rootstock accessions have been screened against root lesion (*Pratylenchus vulnus*) nematode using standardized greenhouse procedures. Resistance to root lesion nematode has not been identified in any of the 16 standard commercial rootstock cultivars which have been screened so far. However, at least nine sources of resistance have been identified among the candidate rootstocks. Sources of root lesion nematode resistance are present among the apricots, plums and *Prunus* species. During 1991, a total of 18 candidate rootstocks have ben inoculated with various levels of ring nematode (*Criconemella xenoplax*). Significant reductions in plant roots and/or shoots have been observed and are associated directly with the inoculation. A total of 32 hybridizations were performed during the 1991 bloom to incorporate root lesion and root knot nematode resistance. One hybrid (*P. japonica* X commercial root knot resistant cultivar), from crosses performed during the 1989 bloom, is now sufficiently large for clonal propagation and screening against root lesion nematode.

Table 1. Variability of candidate rootstock vigor and diversity of host suitability for root lesion nematode populations on 150 candidate rootstocks screened from 1988 to present. Values represent ranges across each germplasm type for the final harvest periods of each accession.

Germplasm Type	Shoot FW (g)	Root FW (g)	NPGR[1]	% Pop. increase (decrease)	No. accessions
Almond	5.8 - 35.0	3.9 - 23.6	22.0 - 135	56 - 759	4
Apricot	0.8 - 20.0	2.6 - 67.3	0.6 - 79	(99) - 3,718	6
Interspecific Hybrids	1.6 - 48.6	4.1 - 92.8	1.8 - 258	(72) - 1,101	21
Peach	2.3 - 33.6	6.7 - 119.6	11.0 - 335	(18) - 12,440	52
Peach-Almond	1.5 - 28.1	3.4 - 38.3	6.1 - 294	(48) - 1,190	12
Plum	0.8 - 93.4	2.8 - 216.0	0.3 - 183	(97) - 9,189	42
Prunus species	1.2 - 85.8	3.3 - 136.3	1.6 - 323	(88) - 24,898	12

[1] Nematodes per gram root (FW).

Table 2. Growth parameters and root lesion nematode populations for 9 candidate rootstocks resistant to *Pratylenchus vulnus*. All data are from the 150 day harvest period and represent an average ± standard deviation.

Accession	Shoot FW (g)	Root FW (g)	Nematodes per g root (FW)	% Population decrease
B5-13	1.7±0.6	3.2±0.5	16.4±12.2	66
Bruce	2.1±0.6	6.3±1.7	2.7±3.1	78
Deep Purple	5.3±0.9	10.3±1.3	1.6±1.3	90
Natsu-Goromo	0.4±0.1	3.9±1.6	0.6±0.7	99
PI 506392	2.1±1.2	6.1±1.1	11.3±3.4	53
P. japonica	6.3±2.8	12.1±4.9	1.6±1.8	88
P. tomentosa	8.5±5.1	16.6±12.8	1.9±3.1	88
Red Glow	5.9±3.2	23.1±6.9	0.3±0.6	94
Tsuno-Ume	5.6±2.5	13.9±2.0	2.8±4.4	77

Table 3. Harvest data for four seed propagated *Prunus* candidate rootstock accessions inoculated with 1000 ring nematode (Cx) per plant. Harvest occurred 144 days after inoculation. Tabular values indicate treatment means ± standard deviations.

Accession	Treatment	Shoot FW (g)	Root FW (g)	Root:Shoot	Cx/250cc soil
Harrow Blood X Okinawa					
	inoculated	5.5±1.2	8.3±0.8	1.56	297±174
	control	7.3±3.3	7.7±1.4	1.19	–
Nemared X PI 442380					
	inoculated	6.1±1.8	7.8±1.8	1.30	331±211
	control	9.2±2.7*	10.3±2.3*	1.17	–
P114-92 X GF 557					
	inoculated	5.9±2.7	6.7±3.0	1.16	201±77
	control	6.4±3.1	7.2±3.7	1.16	–
P114-92 X 9-24					
	inoculated	5.8±3.5	5.8±3.9	0.96	176±77
	control	5.8±3.0	4.7±2.9	0.80	–

* indicates significance at the 0.05 level.

Accessions inoculated with ring nematode on 5 July 1991 and no data are yet available:

P67-121	72-1
P67-154	71-48
P67-158	74-78
Deep Purple	74-78 X Lovell
St. Anthony	74-78 X Rutgers RL
Lantz	Lovell
Pisa #2	Pisa #5