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TANK TEST METHOD FOR DETERMINING ROOTSTOCK RESISTANCE TO PINE  
VOLE ATTACK

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ABSTRACT: Pine vole attack of one-year-old stem tissue of clones representing many hybrid and other species revealed 5 cultivars apparently less susceptible to damage when compared to Golden Delicious stems. Fusca seemed to be least attacked along with 74R5M9-62, PI 286613, N.Y. 11928, and Hall.

INTRODUCTION: Several methods of pine vole control have been used by growers in the Central-Eastern United States. For the past 15-20 years Endrin was used as a ground spray to control pine voles (4 & 5). However, where Endrin has been continuously used for over 10 years, resistant strains of mice have developed thus decreasing its effectiveness (2). In recent years anticoagulant baits have been used to control these resistant voles.

The development of new and effective rodenticides, that are also environmentally safe, has been an expensive and long term project. Many chemical companies faced with tighter federal registration laws and increased expenses are becoming more reluctant to invest money in the development of rodenticides (6).

Cultural management practices have not proven adequate for controlling the pine vole problem, & are expensive in terms of labor, energy, and machinery. Even though combinations of cultural and toxicant control methods have been found to be effective for vole control (2), the additional expense for cultural changes may be questionable.

New methods must be developed to control vole damage during periods when the grower cannot bait or spray (ie under snow). The development of rootstocks resistant to damage could greatly reduce the severity of the vole problem. Some rootstocks have been observed by Horticulturists to have vole damage differences. We have developed a screening technique for potentially resistant rootstocks.

MATERIALS & METHODS: Most of the cultivars used in these experiments were provided by Dr. Cummins at the Geneva Research Station in Geneva, N.Y. The material was collected and shipped while still fully dormant during the winter months (January - March) of 1977 and 1978 to

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Winchester, Va. Golden Delicious scions collected in the Winchester area, were used in a paired comparison tank test with the wood sent from Geneva.

The animals were adult pine voles trapped in the Winchester area and some juveniles raised in cages. Twenty mice were selected for each experiment, however, by the end of the period some animals were usually killed (2-5) in fighting. The tank was 6 feet in diameter with a circular partition in the center, 4 ft in diameter. Six inches of sandy loam soil mixed with oak bark mulch was put in the tank. The animals were then placed in the tank center partitioned area. In 1977, burlap strips were offered for bedding and in 1978 orchard grass and natural ground cover was used. The tank was insulated to keep the temperature at  $20 \pm 2^\circ$  C. It was also covered and kept in total darkness. The animals were offered water and commercial rat food ("Lab-Blox", Allied Mills, Inc., Chicago, Illinois) continuously throughout all experiments. There were 19 single-stem replications with the wood arranged in blocks equally spaced in the outer 12 inch circumference of the tank. The stems were placed in 4 inch floral tubes containing water to prevent the material from drying during the test. The wood ranged from 0.15 - 1.01 cm in diameter and 15-17 cm long taken from 1 year-old-wood. The floral tube was placed in the soil allowing approximately 10 cm of the stem to remain above ground and exposed to the voles. The holes in the partition were opened to allow the animals access to the wood. They were exposed to the wood for varying lengths of time, mostly 72 and 96 hrs. After this period the wood was removed and rated by a 0-4 damage rating: 0 = no damage, 1 = less than half girdled, 2 = 1/2 girdled or more, 3 = completely girdled, 4 = cut into at least two pieces (3), and a subjective measure of the % bark removed was also recorded.

**RESULTS AND DISCUSSION:** The rootstock *Fusca* has been rejected by the voles in 2 test years (1977, 1978, Table 1 and 2). A Japanese rootstock *M. X sublobata* PI 286613, Hall, and N.Y. 11928 also turned out significant in 1977 (Table 1).

Varying diameters of the wood was found to influence test results. This problem was reduced with the extraction of the diameter covariant in 1977 (Table 1) and eliminated by the use of paired comparison testing with similar diameter wood in 1978 (Table 2).

We felt the tank test used in the 1977 and 1978 experiments had certain advantages to caged trials (1) such as: 1) pine voles were placed in a more natural environment, 2) animal to animal variation was removed because all wood in an experiment was subject to exposure to all animals in the tank, 3) less wood is used, 4) more varieties and types can be tested at one time. The paired comparison testing in the 1978 trials removed to a large degree problems with the diameter factor and is the preferred method at this time.

Table 1. Damage to apple rootstock stems by pine voles in a 72 hr. tank trial, using 'Golden Delicious' as a standard.

Rootstock	Adjusted Damage (%) <sup>y</sup>	Adjusted Damage Rating (0-4) <sup>x</sup>
PI 286613	14 a <sup>z</sup>	1.1 a
NY 11928	15 a	1.2 a
Hall	18 ab	1.4 ab
Fusca	26 ab	1.7 abc
PK 14	35 bc	2.1 bcd
Golden Delicious (f) <sup>w</sup>	44 c	2.4 cd
Rink 752	46 c	2.5 d
Control	47 c	2.5 d
Parwar	50 c	2.6 d

<sup>z</sup> Mean separation, within columns by Duncan's multiple range test, 5%.

<sup>y</sup> Percentage arc sin transformed means presented were adjusted for wood diameter covariant. Percentages were an estimation of bark stripped from stem pieces.

<sup>x</sup> Damage rating: 0 = no damage, 1 = less than 1/2 girdled, 2 = 1/2 girdled or more, 3 = completely girdled, 4 = cut into at least two pieces. Means presented were adjusted for wood diameter covariant.

<sup>w</sup> Golden Delicious stems were allowed to absorb a 50:1 formaldehyde: water solution from the cut base for 72 hrs.

Table 2. Damage to apple rootstock stems by pine voles in a 96 hr. tank trial, using 'Golden Delicious' apple as a standard in paired comparison.

Rootstock	Diameter		Damage (%) <sup>z</sup>		Damage Rating (0-4) <sup>y</sup>	
	Rootstock	Golden Delicious	Rootstock	Golden Delicious	Rootstock	Golden Delicious
74R5M9-14	.148	.150 ns	15	23	1.5	2.2 *
74R5M9-56	.082	.087 **	32	79	2.1	3.5 **
Rob-5	.127	.126 ns	18	45	1.7	2.7 **
74R5M9-62	.133	.135 ns	7	22	1.2	2.2 **
74R5M9-57	.142	.143 ns	69	30	2.6	2.2 +
74R5M9-89	.115	.114 ns	41	55	2.2	2.7 *
Fusca	.111	.112 ns	5	48	1.1	2.5 **
Parwar	.170	.171 ns	59	18	2.3	1.7 +

\*,\*\* Plant material was less susceptible to pine vole attack in comparison with Golden Delicious, t test at 5% and 1%.

+,++ Plant material was more susceptible to pine vole attack in comparison with Golden Delicious, t test at 5% and 1%.

<sup>z</sup> Estimated percentage of bark stripped from stem pieces.

<sup>y</sup> Damage rating: 0 = no damage, 1 = less than 1/2 girdled, 2 = 1/2 girdled or more, 3 = completely girdled, 4 = cut into at least two pieces.

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