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The Influence of Pine Vole Damage on  
Apple Tree Vigor and Fruit Yield

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Accurate estimates of financial losses caused by pine voles in apple orchards is essential in order to obtain reliable cost figures for use in evaluations of various control methods. Most pine vole damage occurs below ground and any attempt to evaluate the severity of the damage in relation to the loss in productivity of the tree proves very difficult. For this reason estimates of vole damage are usually only in terms of annual tree losses. However, damage to the trunk and roots caused by pine voles affect the vigor, yield, fruit quality and ultimately the market value of the crop. Therefore, information concerning these factors is essential to any attempt at pine vole damage appraisal.

A quantitative study was undertaken to determine differences in yield and vigor between apple trees showing visual symptoms of damage by pine voles and similar trees without these symptoms. Ulster County in eastern New York was selected as the study site because of its severe pine vole problem. Surveys of the apple orchards in this county showed approximately 37%, or an estimated 4410 acres of apples, were infested with pine voles. Three of the most economically important apple cultivars in eastern New York (McIntosh, Red Delicious and Rome) were selected for this study. Two test blocks were selected in pine vole infested orchards. One was a uniform four acre planting of eight year old McIntosh trees. The second block included both Red Delicious and Rome in a uniform ten acre planting of 20 year old trees. Test trees for each cultivar were selected in the same block so management patterns and environmental conditions would be similar. Eight trees showing visual symptoms of pine vole damage were compared to eight trees of the same cultivar not showing these symptoms. Damaged trees were selected by confirmed girdling activity on the tree trunk, chlorotic leaf symptoms, and high vole activity (as evidenced by tunnel systems and trapping). Damaged trees in this test were examined in detail to eliminate other factors causing leaf symptoms similar to vole damage, ie. Crown Rot, nitrogen deficiency, and winter injury.

Each of the three cultivars were analyzed for differences in yield, fruit weight, and grade (Table 1). The yield was obtained by counting the number of bushels of apples harvested per tree. Ten percent of the fruit from each tree were weighed and hand graded according to New York State Department of Agriculture and Market standards. Fruit size was calculated from the average fruit weight using data provided by C. G. Forshey. The most significant losses in yield from

pine vole damaged trees were in Rome, followed by Red Delicious and McIntosh.

Table 1.

## Effects of Pine Vole Damage on Fruit Yield

	Yield (Bu.)	Fruit Wt. (gm)	Price <sup>2</sup> /Bu.	Return per tree
<u>Mac</u>				
Damaged	3.9a	93.3a	\$4.43	\$17.29
Healthy	5.6a	122.5 b	4.92	27.57
<u>R. Del.</u>				
Damaged	5.3a	145.2a	5.77	30.56
Healthy	9.0a	154.2a	5.92	53.25
<u>Rome</u>				
Damaged	5.5a	117.9a	4.90	26.95
Healthy	10.0 b	176.9 b	4.65	46.54

<sup>1</sup> For a given variety, values followed by the same letter are not significantly different at the 5% level.

<sup>2</sup> Prices listed by USDA, Fruit & Vegetable Division, Newburgh, New York 1975-76.

Fruit weight loss from damaged trees was greatest in Rome and McIntosh. The price per bushel was calculated from the percent in each of 3 grades (Utiligy, U.S. No. 1, and U.S. Fancy) and the market value of each grade. This figure compares the total value of an average bushel of apples graded by color from pine vole damaged trees to nonaffected trees. In all three cultivars fruit from pine vole damaged trees graded slightly better (more color) than nonaffected trees. Low vigor and related sparse foliage, permitting better light exposure of the fruit, were the major reasons why fruit from damaged trees colored earlier and better. However when these values are combined with fruit size and yield and multiplied by the market value, substantial differences can be seen in the gross return per tree between damaged trees and nonaffected trees.

A commercial pack out of McIntosh apples was obtained from 63 bushels of fruit from pine vole damaged trees and a similar amount from nonaffected trees (Table 2). Commercial grading provided an important comparison with the hand grading done by the author. This fruit was harvested from a six acre block of 30 year old McIntosh trees. Damaged and nonaffected trees were carefully examined and selected in the manner previously described. Commercially graded fruit from damaged trees packed out better (more color and size) than fruit from nonaffected trees. This supports similar results obtained from hand grading. Differences in fruit size were not significant since this fruit was harvested entirely by

pickers who selected only marketable size fruit, leaving a lot of small fruit on damaged trees. When the differences in yield are added, the dollar loss per damaged tree is considerably higher than from the young McIntosh block used in the previous test. The reason for this is the much larger more productive trees used in the commercial pack out. In addition tree damage in this older block was much more severe from over 30 years of heavy pine vole infestation.

Table 2.

Effect of Pine Vole Damage on a  
Commercial Pack Out of McIntosh Apples

<u>Damaged Trees</u>	<u>\$ Value Pack out</u>	<u>Ave. Yield</u>	<u>\$ Yield per Tree</u>
Ave./Bushel	\$4.58	9.1	\$ 41.68
<u>Healthy Trees</u>			
Ave./Bushel	\$4.24	24.3	\$103.03

Tree vigor was examined by measuring terminal shoot length. Thirty shoots per tree were selected at random and measured at the same height above ground. The differences in terminal shoot lengths was significant for McIntosh and Red Delicious. These measurements provided a simple technique for early evaluation of the degree of tree damage, and the rate of recovery or decline each season.

Pine vole damage to the trunk and roots of apple trees had the greatest effect on tree vigor (Table 3). Terminal shoot measurements indicated losses in growth of 38% in McIntosh, 59% in Red Delicious and 36% in Rome.

Table 3.

Vigor and Yield Loss  
In Pine Vole Damaged Trees

<u>% Loss</u>	<u>McIntosh</u>	<u>Red Del.</u>	<u>Rome</u>
Vigor	38%	59%	36%
Yield	30%	41%	45%
Fruit Wt.	22%	6%	33%

Fruit yield and weight were significantly affected in pine vole damaged trees. Fruit yield losses were 30%, 41% and 45%, respectively. Losses in average fruit weight from damaged trees was 22% for McIntosh and 33% for Romes. There was little difference in the dollar value of fruit graded

from damaged and unaffected trees. Dollar losses in fruit yield and weight should be added to the other expenses involved in replacing and treating trees damaged by pine voles. These costs can give the grower, chemical industry, and government agencies a better understanding of the pine vole problem, and a more accurate basis for evaluation and registration of various control methods.