Table 1. Effect of aluminum mulch on fruit yield, size, color, sugar content, and firmness for upper and lower halves of 'Orleans' apple tree, Kefar Giladi, Aug. 15, 1973 (density = 1428 trees/ha).

Variable	Aluminum mulch	Control	Difference	Pooled SE
Harvested fruit (kg/tree)				
Upper half	45.3	52.0	−6.7	6.2
Lower half	16.9	12.2	4.7	2.3
Drops (kg/tree)	5.8	2.9	2.9	–
No. fruits/tree				
Upper half	431	511	−80	60
Lower half	175	144	31	26
Fruit wt (g/fruit)				
Upper half	105.2	101.8	3.4	3.1
Lower half	97.1	85.4	11.7*	4.4
Fruit size, diam > 65 cm, (%)				
Upper half	41	33	8	4.0
Lower half	26	15	11*	4.4
Coloration, > 35% surface red, (%)				
Upper half	31	33	−2	6.5
Lower half	31	9	22**	5.5
Sugar content, total soluble solids, (%)				
Upper half	11.9	11.9	0	0.3
Lower half	11.7	10.9	0.8**	0.16
Firmness (kg per penetrometer head)				
Upper half	8.6	9.1	−0.5	1.0
Lower half	9.2	8.8	0.4	0.8

*, **Significant at 5% (*), 1% (**) level.

These differences could not be attributed to the statistically non-significant differences in the no. of fruits harvested as the data from individual trees receiving the same treatment showed no indication of a relationship between fruit no. and size. The mulch was removed the day before harvest and not replaced.

In order to study the effect of the treatment during the period of fruit bud differentiation on the subsequent season's yield, the same trees were harvested 1 year later, which was an "off-year" for yields throughout the region. The total wt of fruit harvested from the trees mulched the previous year was 30.0 kg per tree, compared with 20.4 kg from each tree in the untreated area. Unfortunately, neither the yield of individual trees nor of the upper and lower halves were separately recorded and therefore no statistical test of the significance of this large difference can be made. It may, however, be noted that this difference represents proportionately 6 times the pooled standard error of fruit harvested on the same trees in the previous year.

Application of the reflectant mulch required 7 m^2 of aluminized film per tree which took 20 min to establish. The subsequent folding and unfolding of the film to allow access to the trees took a negligible time. It is, however, unrealistic to assess the economic profitability of this treatment on the basis of this preliminary study, as it appears likely that cheaper reflectant materials and methods of application could be found if subsequent experiments confirm the yield increases reported in this study.

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A Rapid Method for Assessing Pine Vole Control in Orchards[1]

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Abstract. **A rapid method for assessing the presence of pine voles (*Microtus pinetorum* LeConte) in experimental plots was based on an apple activity test. This test was easily adapted to surveying the effect of grower applied treatments.**

Chlorophacinone (CPN) was superior to Endrin ground sprays for pine vole control in an orchard where Endrin had been used annually for over 10 years. Low levels of CPN at 0.112, 0.056, and 0.028 kg/ha (0.1, 0.5, 0.025 lb./acre) did not give adequate control of pine voles, and 0.224 kg/ha (0.2 lb/acre) appeared to be the lowest possible dosage level for control.

The pine vole has a limited home range (2, 4, 5) and resides in a 1-3 tree area depending on such factors as tree spacing, tree size, ground cover, population level, and season of year. For this reason relatively small plots (0.5-1.0 ha) may be used with little influence from adjoining undisturbed areas. Since great variations exist between populations from one tree to the next, it has been more expedient to measure the potential for vole damage in a plot or orchard by determining the percent of the tunnel system infested with pine voles. Trees with inactive or no tunnel system may be regarded as having no potential for damage.

The potential for vole damage must be assumed if voles are present in the tunnel system since factors (environmental stress periods, pine vole population levels, reproduction rates, etc.) affecting damage cannot be easily predicted in time to control the population. This assumption has led to the assessment of treatment effects based on vole activity in the tunnel system (2) as measured by % reduction in active sites (an active site refers to a feeding station 5-15 cm below the soil surface in a vole run or hole where a vole has gnawed on an apple placed at that site for a period of approx 24 hr).

Twenty-seven plots involving numerous treatments in 7 orchards in 4 states during 1972 and 1973 were exhaustively trapped after the last activity reading. Each plot consisted of approx 60 trees each with the interior 10-12 trees used for data collection points. This plot design allowed at least 2 border trees on all sides of the interior data collection area. Usually 2 activity sites were established at each of the interior trees in all plots if a site could be found. Activity sites were established by selecting the most active runs or holes within the drip line of the trees, at least 3m apart, preferably on opposite sides of the tree trunk and covered with a slab of wood or other suitable material. Since the pine vole seldom ranges outside of the tunnel system (4) no site was established where a tunnel system could not be found. An apple with approx 3-4 cm sector removed from the cheek was placed at each activity site. After 24 hr the apples were checked for vole tooth marks and the % active sites calculated. Pine voles were exhaustively trapped from all active sites for 5 days at the termination of each experimental plot. During the first 2-3 days, traps were run 3-4 times per day and only once per day thereafter. Sites were examined each day for activity, and traps were set at all sites where vole gnawing was detected on the

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apple. Victor house mouse traps baited with apple were used.

A highly significant quadratic correlation (R^2=.81, y = 14.61 + 54.84 x - 7.97 x^2) between percent active sites (y) and voles trapped per site (x) was found (Fig. 1) when the no. of voles was averaged over the total no. of sites in the plot. Therefore, the assessment of the pine vole presence in areas as small as 0.1 ha was easily determined using the activity method, especially when the activity was below the 30% level. Since a level of 10-25% (3) activity or less has been considered an adequate control level in field plots, this method provided a way of monitoring low population levels at various intervals of time without disturbing or affecting the population by trapping techniques as is the case with the North American Census of Small Mammals (NACSM) method (1). Monitoring treatments at various intervals of time may insure reliability of the data and some measure of the length of the treatment effect. Dead trapping techniques destroy any future assessment of a plot. Further, if time interval monitoring is to be done using a trapping technique, the size of the plot must be increased considerably so that different trees are trapped in subsequent population estimates. The activity method can be easily adapted to surveying treatments without reestablishing sites each time a population estimate is desired. Some fruit growers in the Virginia area have successfully utilized this technique to survey orchards before and after treatment and to keep abreast of the population changes in specific blocks.

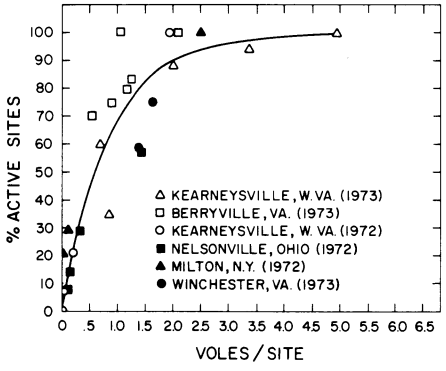

Fig. 1. Regression of % active sites on voles per site.

Table 2. Effect of Chlorophacinone and Endrin ground cover sprays on pine vole activity (1974).

Treatment	Orchard	Application method	No. sites[y] observed	% activity[z] Pre-treatment 2-7 days	Post-treatment 2 days	Post-treatment 21-34 days
CPN 0.224 kg/ha (0.2 lb./acre)	1	Vertical boom	40	93		25
Endrin 2.69 kg/ha (2.4 lb./acre)	1	Vertical boom	40	78		80
Control	2	No treatment	40	–	65	58
CPN 0.224 kg/ha (0.2 lb./acre)	2	Vertical boom	40	–	40	13
CPN 0.224 kg/ha (0.2 lb./acre)	2	Air blast	40	–	60	8

[z]A site refers to a vole run or hole below the soil level which appeared to be active. A limit of one site per tree was imposed for each observation date.

[y]Percent activity refers to the percent of sites having vole tooth marks on an apple placed in the hole or run approximately 24 hr previous.

In 1974, CPN was applied at the rate of 0.224, 0.112, 0.056 and 0.028 kg/ha (0.2, 0.1, 0.05, 0.025 lb./acre) with a hand gun at 3740 liter/ha (400 gal/acre) at 35 kg/sq cm (500 psi) to determine if lower levels of CPN would control pine voles (Table 1). Rates lower than 0.224 kg/ha (0.2 lb./acre) were not adequate for control.

In 2 orchards we surveyed the effects of grower applied ground sprays for pine vole control. The first grower sprayed one half of the block with Endrin at 2.69 kg/ha (2.4 lb./acre) and the other half with CPN at 0.224 kg/ha (0.2 lb./acre). Endrin had no effect at the normal recommended dosage in this orchard where Endrin had been used for over 10 years, but CPN was effective using the same application method (Table 2).

The second grower applied CPN with an airblast sprayer and a high pressure vertical boom sprayer, and compared these treatments to an untreated control. Unfortunately we did not have knowledge of the comparison until 2 days after treatment. We randomly placed apples in sites that appeared active at each of 40 trees 2 days after treatment. We suspect the boom application may have had a more rapid kill of pine voles initially than the airblast machine as indicated by the lower 2 day reading (Table 2). Both methods of application were effective 21 days after treatment.

The activity method was developed to determine the effectiveness of treatments in experimental plots; however, this technique can be easily utlized to assess grower applied treatments.

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Table 1. Effect of Chlorophacinone (CPN) ground sprays on pine vole control in apple orchards (Kearneysville, W. Va., 1974)

Treatment	Treatment date 1974	No. sites observed	% high activity[z] Oct. 30	Nov. 15	Nov. 26	Dec. 4	% activity[z] Oct. 30	Nov. 15	Nov. 26	Dec. 4	Voles per plot (Dec. 4-6)	Voles per site
Control		24	71	67	63	71	83	71	79	83	42	1.75
CPN 0.028 kg/ha (0.025 lb./acre)	Nov. 1	20	75	85	65	70	80	85	95	80	53	2.65
CPN 0.056 kg/ha (0.05 lb./acre)	Nov. 1	24	79	46	50	58	83	65	75	63	34	1.41
CPN 0.112 kg/ha (0.1 lb/acre)	Nov. 1	22	68	32	55	59	82	64	77	64	16	.73
CPN 0.224 kg/ha (0.2 lb/acre)	Nov. 1	23	61	39	17	17	74	48	43	35	4	.17

[z]Apples placed in 2 holes or runs located (5-15 cm below the soil surface) on opposite sides of the tree trunk were examined 24 hr after placement. High activity refers to a portion larger than a semi-sphere of 2.5 cm removed from the apple. Percent activity refers to all sites with vole tooth marks on apple.