Table 2. Influence of soil applications of lime on pH and mineral elements of the soil.[z]

$CaCO_3$ (kg/ha)	pH	P (ppm)	K (ppm)	Ca (meq/100g)	Mg (meq/100g)
Control	5.8b	2.5a	75.0a	1.7a	1.2a
500	5.8b	2.5a	72.3ab	2.5a	1.2a
1000	6.1ab	3.9a	70.0ab	3.2a	1.1a
1500	6.1ab	4.0a	68.0bc	3.4a	1.0a
2000	6.4a	4.2a	63.0c	4.0a	0.9a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

measured by spectrophotometricly (3,7). Berry volume was measured using a pycnometer and individual berry weight was calculated.

Samples of the 0-10 cm soil profile were taken after harvest from each plot and analyzed by the W.S.U. Soil Testing Laboratory for pH, P, K, Ca, and Mg.

$CaCO_3$ applied at 1000, 1500, and 2000 kg/ha reduced breakdown (Table 1). Only the 500 and 1000 kg/ha rates increased yield, and berry weight was increased only by the 1000 kg/ha rate. There were no significant differences in soluble solids, pH or anthocyanin concentration in the fruit from the different lime treatments.

Table 3. Influence of soil applications of lime on K, Ca, and Mg content of 'McFarlin' cranberries.[z]

$CaCO_3$ (kg/ha)	K (%)	Ca (%)	Mg (%)
Control	0.62a	.056a	.083a
500	0.53b	.058a	.073a
1000	0.53b	.064a	.070a
1500	0.51b	.067a	.070a
2000	0.49b	.068a	.070a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

The pH of the soil tended to increase with lime application rates but was significantly higher only at the 2000 kg/ha level (Table 2). P and Ca also tended to increase while Mg tended to decrease. K was significantly reduced at the 1500 and 2000 kg/ha rates of application.

The above changes in soil mineral levels were reflected in the mineral contents of the berries (Table 3). K levels were decreased by all lime applications. Ca tended to increase and Mg to decrease.

Cranberry vines in plots treated with 1500 and 2000 kg/ha developed chlorotic uprights near the end of the growing season. This probably accounts for the lower yields and reduced berry wt obtained from these plots.

It appears that the $CaCO_3$ level for optimum cranberry yield and keeping quality is critical. Under the conditions of this research, 1000 kg/ha gave highest yields and best keeping quality.

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Pecan Cultivars Differ in Leaf Elemental Concentration of Normal and Mouse-ear Leaf Tissue[1]

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Additional index words. Carya illinoensis, mineral nutrition.

Abstract. **Leaflet mineral concentration of normal and mouse-eared leaflets differed for different cultivars of pecan (*Carya illinoensis* (Wang.) K. Koch). Normal 'Schley' leaflets were higher in Mg, Cu, Cr and Pb than mouse-eared leaflets. Normal 'Desirable' leaflets were lower in Cr, Pb and Cd than mouse-eared leaflets. Normal 'Mohawk' leaflets were higher in Mn, Cu, Al, Cr, Pb, and Cd than mouse-eared leaflets. Normal 'Wichita' leaflets were lower in Ca, Mg, Zn, Cr and Pb than mouseeared leaflets. Normal 'Mohawk' leaflets had a higher Zn/Fe ratio and normal 'Wichita' had a lower Zn/Fe ratio than mouse-eared leaflets.**

A malady known as "mouse-ear" or "little leaf" has been observed on pecan trees for many years. Symptoms are a shortened midrib which changes the apical end of the leaflet from pointed to rounded. The leaflet is often cupped, wrinkled, and necrotic (5). Leaflets vary in size from almost normal but rounded to extremely small (1-2 cm diameter). The disorder usually appears in the spring growth cycle, while later cycles are sometimes normal. Symptoms are found most often on young trees, but they may occur on trees of any size, and occasionally only certain limbs are affected. Symptoms occur most often on soils of pH 6.5-8.0 (2,3) and were reduced by adding 2-4 kg $MnSO_4$/tree or by dipping leaves in 1-2% $MnSO_4$ solution thus linking the malady to Mn deficiency. Soil under mouse-ear trees was found to have higher levels of extractable P, K, Ca, Mg and Zn and mouse-ear trees had more Ca, Mn, Fe, Cu, Zn and Mo and less Mg in leaflet and stem tissue than normal trees (2). One sample/tree was taken June 15, 1977 from 4 'Schley' and 10 'Desirable' trees in an area near Moultrie, Georgia, which was becoming more severely affected by mouse-ear. In addition, samples were taken from 6 'Mohawk' and 3 'Wichita' trees in Tifton, Georgia. Soils were well-drained acid Tifton loamy sands (Ultisol Plinthic Paleudults: fine loamy, siliceous, thermic). An equal number of mouse-eared and normal trees of each cultivar were sampled except only 1 'Wichita' had mouse-eared leaves. The sample consisted of 50-100 middle leaflets of middle leaves on current seasons growth within reach from the ground. Samples were dried at 100°C and ground to pass a 20 mesh screen. One g of oven dry tissue from each sample was dry ashed

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Table 1. Elemental concentration of leaflets and leaflet Zn/Fe ratio of normal and mouse-ear pecan trees of 4 cultivars.

Leaf condition	Schley	Desirable	Mohawk	Wichita	Mean
		Ca (%)[z]			
Normal	1.85a	0.94a	1.90a	1.31a	1.50a
Mouse-ear	1.19a	1.12a	1.43a	2.44b	1.55a
		Mg (%)			
Normal	0.80b	0.55a	0.51a	0.47a	0.58a
Mouse-ear	0.55a	0.59a	0.49a	0.83b	0.61a
		Mn (ppm)			
Normal	440a	283a	577b	305a	401a
Mouse-ear	227a	224a	289a	525a	319a
		Cu (ppm)			
Normal	10.8b	4.0a	13.9b	7.1a	9.0b
Mouse-ear	5.7a	5.1a	6.8a	7.1a	6.2a
		Zn (ppm)			
Normal	205a	84a	167a	79a	134a
Mouse-ear	223a	114a	82a	247b	166a
		Al (ppm)			
Normal	532a	519a	1092b	546a	672b
Mouse-ear	501a	425a	593a	542a	515a
		Cr (ppm)			
Normal	2.87b	2.18a	3.98b	2.77a	2.95a
Mouse-ear	2.45a	2.44b	2.79a	3.39b	2.77a
		Pb (ppm)			
Normal	25.0b	17.7a	36.2b	24.9a	26.0a
Mouse-ear	19.5a	21.6b	26.4a	31.7b	24.8a
		Cd (ppm)			
Normal	1.41a	0.94a	2.18b	1.37a	1.47a
Mouse-ear	1.06a	1.18b	1.46a	1.87a	1.39a
		Zn/Fe ratio			
Normal	3.00a	1.90a	2.83b	1.30a	2.26a
Mouse-ear	4.11a	2.22a	1.21a	3.38b	2.73a

[z]Means are based on dry wt of leaflet tissue. Mean separation by General Linear Models procedure 5% level. Coefficients of variability (%) were: K=22, Ca=29, Mg=21, Fe=16, Mn=38, B=32, Cu=29, Zn=37, Na=32, Al=24, Si=30, Co=115, Cr=7, Ni=14, Pb=9, Cd=14 and Zn/Fe ratio=36.

at 500°C and analyzed for P, K, Ca, Mg, Fe, Mn, B, Cu, Zn, Na, Si, Al, Co, Cr, Ni, Pb and Cd by emission spectroscopy (4). Data were analyzed by the General Linear Models procedure (1).

There was no significant association between mouse-ear symptoms and leaflet P, K, Fe, B, Na, Si, Co or Ni. There were cultivar-symptom interactions for leaflet Ca, Mg, Mn, Cu, Zn, Al, Cr, Pb, Cd and for the leaflet Zn/Fe ratio (Table 1). Normal 'Schley' leaflets were high in Ca, Mg, Mn, Cu, Cr, Pb and Cd compared with mouse-eared 'Schley', but differences for Ca, Mn and Cd were not significant at the 5% level. Normal 'Desirable' leaflets were lower in Cr, Pb and Cd than mouse-eared leaflets. 'Mohawk' was similar to 'Schley' for most elements except Zn. Normal 'Wichita' leaflets were lower in Ca, Mg, Zn, Cr, and Pb than mouse-eared leaflets. High Zn/Fe ratio favored mouse-eared leaflets except for 'Mohawk', which was just the opposite. Normal leaflets were higher in Cu and Al than mouse-eared leaflets when the means for mouse-ear vs normal leaflets over all varieties are compared, but even then there were significant variety by symptom interactions.

There was some confounding of the location and cultivar effects, however, 'Schley' and 'Desirable' usually reacted differently at the same location.

The coefficient of variability (CV) was large for most elements, reflecting the usual large tree to tree differences in mineral concentration and the high CV's obtained with emission spectroscopy. Differences between means had to be large for significance.

Weight of each element/leaflet was calculated to determine if results would be different from concentration data. These data (not shown) revealed normal leaflets contained more of each element analyzed than mouse-eared leaflets, perhaps due to larger size of normal vs mouse-eared leaflets.

The data agree with that of Gallaher and Jones (2) that mouse-eared leaflets contain a higher concentration of Ca, Mn, Zn, and Mg than normal leaflets of some cultivars on some locations, but the opposite might occur if cultivar or location changes. No leaflet sample contained less than 100 ppm Mn suggested as a possible threshhold by Gammon and Sharpe (3).

The cause of mouse-ear, apparently results in differences in elemental concentration of leaflets that are inconsistent over different cultivars or locations.

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The Effects of Defoliation and Pruning on Flower Bud Initiation and Differentiation in 'Chico' Walnut (*Juglans regia* L.)[1]

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Additional index words. etiolation, pruning stimulus,

Abstract. **Heading back of 2nd flush growth to basal buds on vigorous young trees at different times of the year indicated that buds were converted from a vegetative to a reproductive state within 4 weeks after they were formed at the shoot apex. Defoliation or defoliation plus etiolation of 7 terminal nodes in July did not deter the buds at these nodes from differentiating pistillate flowers for the next season. Pruning greatly accelerated the differentiation processes.**

With long-lived perennial fruit species, inherent growth, bearing habits, mature tree size, and cultural practices are important considerations in pruning and training of young trees. When economi-

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