Mineral Content of Peach Trees as Affected by Nitrogen Source and Rate[1]

Ewell Rogers, *Colorado State University, Austin-Rogers Mesa Unit, Austin*

Abstract. Ammonium sulfate at 1.0, 1.5 and 2.0 lb. of actual N, and ammonium nitrate at 1.5, 2.0 and 2.5 lb. N were applied in 1964 and 1965 to 'Red Haven' and 'Giant Elberta' peach trees in Western Colorado. Ammonium sulfate increased yields of 'Red Haven' peaches, but ammonium nitrate did not increase yields. All N treatments increased the concentration of N in the leaves. Some N treatments depressed the uptake of K and Fe, but increased Mn. Correlations between chemical leaf analysis and physical characteristics are presented. Nitrogen treatments delayed fruit maturity and increased shoot growth.

Introduction

The use of leaf analysis to determine nutritional status of fruit trees has given rise to questions concerning factors which influence foliar nutrient concentration. The effects of ammonium nitrate and ammonium sulfate at 3 levels of fertilization on the chemical composition of peach leaves and tree response were studied during 1964 and 1965.

There have been numerous papers published on peach tree fertilization, particularly with respect to N applications (1, 2, 3, 4, 5). Previous literature, however, has dealt with peach trees of various ages, which were grown under widely-varying cultural and environmental conditions. The results presented in this report concern effects of various N sources and rates on uptake of N, P, K, Fe, Zn, Mn and on growth and production of 2 varieties of peaches in Western Colorado.

Materials and Methods

Experiments were conducted in 1964 and 1965 on 10-year old 'Red Haven' and 'Giant Elberta' (referred to as 'Elberta') peach trees on mesa clay loam soil near Grand Junction, Colo. The experimental design consisted of randomized blocks of 7 treatments, replicated 6 times in the 'Red Haven' and 7 times in 'Elberta' orchards. The following treatments were randomized and applied to single-tree plots: 1) control — no fertilizer; 2) 1.0 lb. actual N from ammonium sulfate per tree; 3) 1.5 lb. N from ammonium sulfate; 4) 2.0 lb. N from ammonium sulfate; 5) 1.5 lb. N from ammonium nitrate; 6) 2.0 lb. N from ammonium nitrate; 7) 2.5 lb. N from ammonium nitrate.

Fertilizer was applied in April and disked in along irrigation furrows on both sides of the trees.

Samples of 100 leaf blades were taken from the middle of terminal shoots in mid-June and July. Leaf N was determined by the Kjeldahl method. P was determined colorimetrically and K, Fe, Zn, and Mn by a Perkin-Elmer 303 atomic absorption spectrophotometer.

Samples of 20 fruits per plot were taken from picking boxes for size measurement. The yield was measured in pounds per tree for 3 pickings. Twenty fruits per plot were selected at first picking for color measurements. Fruit ground color measurements were made by a Gardner Automatic Color Difference Meter, Model AC-1, using a Gardner Standard No. CMY 0077 (Rd = 27.0, a = −3.7 and b = 33.8). Thirty terminal shoots per tree were measured in inches.

The correlation coefficients and analysis of variance were calculated according to the method of Snedecor (6).

Results and Discussion

The effects of N rate and source on the mineral content of the peach trees are shown in Tables 1, 3, and 4.

Nitrogen. An analysis of 2-year data on the effect of N on leaf mineral concentration is given in Table 1. Ammonium nitrate increased N in 'Red Haven' leaves when compared with non-treated trees. Ritter (5) found similar results with 'Elberta.' Ammonium nitrate and ammonium sulfate increased N in 'Elberta' leaves compared with the untreated trees. Similar results were found by Stebbins (8) with ammonium sulfate in 'Elberta' orchards. The higher rates of actual N from ammonium sulfate increased the N in 'Elberta' leaves when compared to the lower rates.

Table 1. Comparison of effect of $(NH_4)_2SO_4$ and NH_4NO_3 with no N. Two varieties, 2 years.

Nature of data	Variety	$(NH_4)_2SO_4$	None	NH_4NO_3	None
N (%)	Red Haven	—	—	3.39	2.93**
N (%)	Giant Elberta	3.07	2.77**	3.27	2.77**
1st picking (lb.)	Giant Elberta	106.10	145.98*	81.61	145.98**
Total fruit (lb.)	Red Haven	189.30	148.91*	—	—
Ground color	Red Haven	—	—	17.26	18.49*
A readings[a]	Giant Elberta	2.77	5.14**	1.55	5.14**
Shoot growth (inches)	Red Haven	16.36	12.20**	14.97	12.20*

[a]Gardner color meter. The smaller the number the greener the fruit.
*F value significant at the 5% level; **at the 1% level.

Table 2. Comparison of 2 and 1 lb. N from $(NH_4)_2SO_4$. Red Haven, 2 years.

	2 lb. N	1 lb. N
First picking (lb.)	59.57	94.14*

Table 3. Comparison of 2.5 lb. and 1.5 lb. N from NH_4NO_3. Giant Elberta, 2 years.

	2.5 lb. N	1.5 lb. N
Fe (ppm)	63.43	69.29*

Table 4. Comparison of 1.5 lb. N from NH_4NO_3 and $(NH_4)_2SO_4$. Red Haven, 2 years.

	NH_4NO_3	$(NH_4)_2SO_4$
K (%)	1.72	2.10**
Mn (ppm)	24.96	21.96*

Table 5. Comparison of 2 lb. N from NH_4NO_3 and $(NH_4)_2SO_4$. Giant Elberta, 2 years.

	NH_4NO_3	$(NH_4)_2SO_4$
First picking (lb.)	65.65	110.91*
Ground color A readings[a]	1.31	2.96*

[a]See footnote Table 1.
*5% significance. **1% significance.

[1]Received for publication October 5, 1968. Published with the approval of the Director of the Colorado State University Experiment Station as Scientific Series Paper No. 1360.

Phosphorus. There was no significant difference due to treatments in P content of leaves of either variety.

Potassium. The 2-year combined analysis indicated that 1.5 lb. N from ammonium nitrate depressed the uptake of K in 'Red Haven' leaves when compared with 1.5 lb. N from ammonium sulfate. Results are given in Table 4. Ritter (5) in Pennsylvania observed that high N was related to a reduction in foliar K in 'Elberta.' A correlation between percentage of N and percentage of K in 'Elberta' leaves analyzed in July 1965 showed a significant negative one.

Iron. The higher rate of N from ammonium nitrate depressed uptake of Fe in 'Elberta' leaves as shown in Table 3. Stebbins (8) observed on 'Elberta' trees in alkaline soils of Western Colorado that yellow color increased and the green color decreased in the leaves when 1.0 lb. of N from ammonium sulfate was applied, compared to unfertilized control trees. Stebbins also noted the yellow color and luminous reflectance of leaves were lowered when trees received 2.0 lb. N as ammonium sulfate plus 5 lb. sodium ferric ethylene-diamine di (o-hydroxphenylacetate) ($FeNa_2$ EDDHA).

Zinc. A correlation between percentage of N in leaves of both varieties and ppm Zn showed a significant negative one.

Manganese. One and one-half pound of N from ammonium nitrate increased the Mn content of 'Red Haven' leaves when compared to 1.5 lb. of N from ammonium sulfate, as shown in Table 4. Ritter (5) in Pennsylvania observed that Mn content in 'Elberta' leaves increased with increasing rates of ammonium nitrate. A correlation between percentage of N in 'Red Haven' leaves and ppm Mn in June 1965 resulted in a significant positive one.

Fruit size. The 2-year combined analysis for size on first picking indicates there was no difference due to treatments. Lott (3) noted increased size of peaches in Illinois due to nitrate fertilizer.

Yield. Ammonium sulfate increased and ammonium nitrate did not increase yields of 'Red Haven' when compared to no application of N. Neither source of N increased yields of 'Elberta.' Results are shown in Table 1. Ammonium nitrate and ammonium sulfate delayed maturity of 'Elberta' when compared to control trees. The higher rate of N from ammonium sulfate delayed maturity of 'Red Haven' when compared to the lower one.

Ammonium sulfate increased N content in 'Red Haven' leaves from 2.93% to 3.26%. Ammonium nitrate increased N content from 2.93% to 3.39%. In 'Elberta' ammonium nitrate increased the N content in the leaves from 2.77% to 3.27% and ammonium sulfate 2.77% to 3.07%.

Rizzi and Alderman (6) state the percentage of N in peach leaves during July should range between 2.5% and 3.2%. Proebsting (4) states that 3.2% N in peach leaves is considered reasonably high.

Rizzi and Alderman (6) suggest that between 11 and 16 ppm of Zn is low for peaches. In Western Colorado, Zn content in 'Elberta' leaves in July samples for both years ranged from 14 to 19 ppm Zn. The 'Red Haven' leaf samples in July 1964 and 1965 ranged from 17 to 27 ppm Zn. A correlation between N content of 'Elberta' leaf samples and percentage of K showed a significant negative one.

Nitrogen deficiency in peach trees results in less growth and yield as determined by Lott (3). Heavy N fertilization generally promotes tree growth and maximum yields, but fruit color and keeping quality may be inferior.

In this study, ammonium sulfate or ammonium nitrate did not increase yield in 'Elberta' peaches. Ammonium nitrate did not increase yield in 'Red Haven.' One might suspect that the depressing effect of N on uptake of other nutrients, such as Fe, Zn and K, was the limiting factor.

Fruit color. Ammonium nitrate and ammonium sulfate delayed yellow ground color development in 'Elberta.' Two pounds of N from ammonium nitrate delayed yellow ground color development in 'Elberta' more than 2.0 lb. of N from ammonium sulfate. A number of workers (1, 3) report that N delays maturity of peaches. A correlation between percentage of N in both peach variety leaves and the ground color of the fruit showed a significant negative one.

Shoot growth. Ammonium sulfate increased shoot growth of 'Red Haven' peach trees. Lott (3) reported significant increases of shoot growth in peaches with use of N fertilizers. A correlation between percentages of N in July 1965 'Red Haven' and July 1964 'Elberta' leaves and shoot growth resulted in a significant positive one.

Literature Cited

1. Havis, Leon and Anna L. Kilkeson. 1951. Interrelationships of nitrogen and potassium fertilization and pruning practice in mature peach trees. *Proc. Amer. Soc. Hort. Sci.* 57:24–30.
2. Kenworthy, A. L. and G. M. Gilligan. 1948. Interrelationship between the nutrient content of soil, leaves, and trunk circumference of peach trees. *Proc. Amer. Soc. Hort. Sci.* 51:209–215.
3. Lott, R. V. 1931. Some fruiting response of the peach to applications of nitrate of soda. *Proc. Amer. Soc. Hort. Sci.* 28:23–27.
4. Proebsting, E. L., Jr., G. H. Carter, D. W. Ingalsbe, and A. M. Neubert. 1957. Relationship between leaf nitrogen and canning quality of Elberta peaches. *Proc. Amer. Soc. Hort. Sci.* 69:131–140.
5. Ritter, C. M. 1956. Effects of varying rates of nitrogen fertilization on young Elberta peach trees. *Proc. Amer. Soc. Hort. Sci.* 68:48–55.
6. Rizzi, A. D. and Alderman, D. C. 1962. Correspondence. Department of Pomology, University of California, Davis, California.
7. Snedecor, G. W. 1946. Statistical Methods. Fourth Edition. The Iowa State College Press. Ames, Iowa. pp. 138–139; 400–430.
8. Stebbins, R. L., Gestur Johnson, D. K. Johnson. 1963. Response of peach to applications of nitrogen and chelated iron in Colorado. *Proc. Amer. Soc. Hort. Sci.* 82:114–119.
9. Weinberger, J. H. 1949. Some effects of nitrogen fertilizer on yield and maturity of Elberta peaches. *Proc. Amer. Soc. Hort. Sci.* 53:57–61.