N, P AND K FERTILIZATION OF RUNNING OAK TO STIMULATE MAST PRODUCTION

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ABSTRACT

Neither the frequency nor quantity of mast crops of running oak (Quercus pumila, *Walt*) *were measurably increased by fertilizer treatments using N, P, and K singly and in combinations at levels 0 and 112 kg per ha.*

Acorn mast is important in the diet of many wildlife species such as whitetailed deer (*Odocoileus virginianus*), bobwhite quail (*Colinus virginianus*), eastern wild turkey (*Meleagris gallopavo*) and squirrels (*Sciurus spp.*) (Downs, 1949). Since most hardwoods, especially those of the genus *Quercus*, are not fire tolerant (Toole, 1965), in the Gulf Coastal Plain they occur largely along major rivers, lakes, ponds and marshy areas (Stoddard, 1963). This is due largely to the practice of frequent burning, first by aborigines and later by white settlers and their descendents (Stewart, 1963).

The slash-longleaf pine forest of the southern lower Coastal Plain does not have a high carrying capacity for any of the region's major wildlife species with the exception of bobwhite quail. The major reasons for this are lack of available food and cover. Considerable effort is being expended to remove hardwoods and to convert natural stands of longleaf pine (*Pinus palustris*) forest to monocultural slash pine (*P. ellotti*). Both trends are likely to damage the existing wildlife habitat (Stransky and Halls, 1967).

One species of the oak family, running oak (*Q. pumila*) is adapted to the fire dis-climax of the lower Coastal Plain and has potential as a food source for wildlife in pure pine plantations. High mast production has been achieved in cultivated situations (Young and Powell, 1963).

Running oak is a shrubby, deciduous plant that is generally under .9 m in height, rarely 1.8-2.4 m. The erect shoots and regeneration develop from underground runners. Running oak is a member of the red oak group. However, its acorns mature in one season, differing in this respect from most other native species of the red or black oak group (Kurz and Godfrey, 1962).

Young and Powell (1963) reported that running oak occurs in a narrow band 16 km to 80 km inland from the Atlantic Coast in the Southern Coastal Plain resource area from North Carolina, through South Carolina, across middle south Georgia and into Alabama and northern Florida in a similar position relative to the Gulf Coast. Running oak ranges throughout northern Florida in pine flatwoods and open sandy pine-oak scrub, the same general habitat as dwarf-live oak (*Q. minima*) which it resembles morphologically and in its occurrence on burned sites (Kurz and Godfrey, 1962).

The objective of this study was to investigate the influence of several fertilizer treatments on the mast production of running oak.

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MATERIALS AND METHODS

Test Sites

Five 30.4 m X 30.4 m blocks were established on the Silver Lake Experiment Station, International Paper Company, Bainbridge, Georgia. The soil type in this site was Ruston loamy sand. Soil Samples showed that the soil pH was 5.7 and that available nitrogen, phosphorus and potassium was low. Similar plots were established on Waycross State Forest, Waycross, Georgia. The soil type on this area was Leon sand. The soil pH was 4.7 and levels of available nitrogen, phosphorus and potassium were low.

Both study areas were located in the lower Coastal Plain. The Waycross State Forest is adjacent to the Okefenokee Swamp whereas the Silver Lake site was 3-4 km north of Lake Seminole and the Flint River. Each site had been winter prescribed burned approximately 1 year previous to plot establishment with the Silver Lake site being burned 3 to 4 years consecutively.

Plot Design and Treatment

A randomized complete block design utilizing a factorial arrangement of 3 fertilizers each was tested. The levels of application were 0 and 112 kg per ha of available K_20 (93 kg actual K) in the form of muriate of potash, available P_20_5 (48 kg actual P) in the form of super-phosphate, N (112 kg actual N) in the form of ammonium nitrate and all of their combinations. A single application, during the month of March, 1971 while plants were dormant, was made at the Silver Lake site and in March, 1972 on the Waycross State Forest site.

Each fertilizer treatment was applied to a 4 sq. m sample plot of running oak plants. Treatments were randomly assigned to each sample plot. Each treatment was replicated five times.

Each plot at Silver Lake was surrounded by a wire cage to eliminate damage by deer. No cages were used on the sites on Waycross State Forest.

Data Collection and Analysis

Acorns were collected when mature or when predation by birds and rodents began. Empty capsules indicating that acorns were taken by predators were recorded in a separate category. Acorns were oven dried at 70°C until weight losses were negligible, the number of acorns and their gross weight were recorded. Due to differences in the number of plant shoots and shoot height per plot, the shoots in each plot were counted and the average height determined to enable an analysis of covariance.

RESULTS AND DISCUSSION

Silver Lake Site

Acorns were produced on this site the first fall following treatment (Table 1). No acorns were produced on any plots in 1972, 1973 and 1974.

Analysis for total acorns indicated that there were no significant differences (.05 level) attributed to any fertilizer treatments or their interactions, either before or after adjustment for stockings.

Potassium and nitrogen X potassium interactions appeared to have greater influence than the other treatments with the increased level of potassium tending to reduce the total acorn yield. These effects were not statistically significant.

Average dry weight per acorn for each plot was derived by dividing "Dry Weight (Grams)" by acorn number and thereby represents the average weight for the total acorns harvested for each plot. The analysis of covariance for this response also indicated no significant differences attributed to treatments or interactions.

The total dry weight for all acorns produced on each plot was obtained by multiplying the average dry weight of harvested acorns for each plot by the total number of acorns produced by that plot (including empty capsules). Again, no statistically significant effects were indicated by the analysis of covariance. Potassium and its interactions with nitrogen displayed more variability than did other sources.

Since no acorns were produced in 1972, 1973 or 1974, treatments had no significant effects on frequency of crops produced. No differences in leaf color were noticed in any plots.

Waycross State Forest

No acorns were produced on any plots in 1972, 1973, 1974 or 1975. The results show that neither nitrogen, phosphorus, potassium or their interactions at the levels used in this

Table 1. Silver Lake total plot values for 1971.

Treatment[1]	*Total no. of stems per plot*	*Total no. of acorns per plot*	*Average dry weight per acorn (g)*	*Total dry weight of acrons per plot (g)*
1 $N_0P_0K_0$	422	78	2.39	39.23
2 $N_0P_0K_1$	341	74	2.14	43.31
3 $N_0P_1K_0$	510	57	2.27	24.19
4 $N_0P_1K_1$	461	81	2.18	29.89
5 $N_1P_0K_0$	519	147	2.26	82.40
6 $N_1P_0K_1$	308	33	2.60	16.37
7 $N_1P_1K_0$	377	271	2.00	158.39
8 $N_1P_1K_1$	370	29	1.22	9.88
Total	3308	770	17.06	403.66

[a] N_0 represents 0 kg of N/ha
N_1 represents 112 kg of N/ha
P_0 represents 0 kg of P_{205}/ha
P_1 represents 112 kg of P_{205}/ha
K_0 represents 0 kg of K_{20}/ha
K_1 represents 112 kg of K_{20}/ha

experiment resulted in a larger acorn crop being produced; neither did the treatments result in more frequent mast crops. No differences in leaf color or plant vigor were noticed.

The reasons that acorn production was not established are not known. Very little work with nutrient requirements of hardwoods seed production has been done, especially those of the genus *Quercus*, except for cultivated varieties of pecan (*Carya illinoensis*). Even in this species, the effects of fertilizer on yield and nut quality have been erratic (Worley, 1974).

Other factors to consider would be soil pH and the availability of nutrients at different fertility and pH levels. However, the soil pH of 5.7 at Silver Lake did not appear to be excessively low. The optimum pH for pecans is pH 7, but they do flourish on some sandy soils with a pH 6 (Brison, 1974).

Another factor could be related to micronutrient availability. Worley et al. (1972a) reported that zinc deficiencies can seriously affect pecan production. Also, Worley et al. (1972b) reported that magnesium deficiencies can seriously affect pecan production.

Probably a major influencing factor affecting running oak acorn production is fire. Williams (Personal Comm.)[1] found that mid-summer burning dramatically increased acorn production of running oak and dwarf-live oak in the Florida flatwoods.

Although climatic conditions during the test period seemed normal, they could have affected mast setting and retention and mast quantity. Climatic conditions considered good for running oak are not known. Another factor to consider would be the possibility of increased competition of weed species with the running oak plants because of the availability of more nutrients.

The results of these tests with nitrogen, phosphorus and potassium on mast production of running oak were not conclusive. They do illustrate that the intracacies of nutrient utilization are very complex matter and further studies are needed.

LITERATURE CITED

Brison, F. R., 1974. Pecan culture. Capitol Printing, Austin, Texas. pp. 292.

Downs, A. A., 1949. Trees and food from acorns. U.S.D.A. Yearbook of Agriculture, Trees, pp. 571-573.

[1] Williams, Lovett E., Personal Comm., July 9, 1976. Florida Game and Freshwater Fish Commission, Gainsville, Florida.

Kurz, Herman and R. K. Godfrey, 1962. Trees of North Fla. University of Fla. Press. Gainesville. pp. 311.

Stewart, O. C., 1963. Barriers to understanding the influence of use of fire by aborigines on vegetation. Proc. Annual Tall Timbers Fire Ecology Conference. 2:117-126.

Stoddard, Herbert L., 1963. Bird habitat and fire. Proc. Annual Tall Timbers Fire Ecology Conference. 2:163-175.

Stransky, J. J., and L. K. Halls, 1967. Woodland management trends that affect game in coastal plain forest types. Proc. Ann. Southeastern Assoc. Game and Fish Commissioners. 21:104-107.

Toole, R. E., 1965. Fire damage to commercial hardwoods in southern bottom lands. Proc. Annual Tall Timbers Fire Ecology Conference. 4:145-152.

Worley, R. E., 1974. Effect of N, P, K and lime on yield, nut quality, tree growth and leaf analysis of pecan (*Carya illinoensis* W.) J. Amer. Soc. Horticultural Sci. 99(1)49-57.

________________ R. L. Carter and A. W. Johnson, 1972. Effect of magnesium sources and rates on correction of acute mg. deficiency of pecan. J. Amer. Soc. Horticultural Sci. 100(5):487-490.

________________ S. A. Harmon and R. L. Carter, 1972. Effect of zinc sources and methods of application on yield and leaf mineral concentration of pecan *(Carya illinoensis*, Koch). J. Amer. Soc. Horticultural Sci. 97(3):364-369.

Young, W. C., and J. D. Powell, 1963. Runner oak shows promise for wildlife habitat improvement. Georgia Agricultural Research 5(2):4-5.