# PEANUT SCIENCE

VOLUME 9 JULY - DECEMBER 1982 NUMBER 2

# Foliar Fertilization Effects on Yield, Quality, Nutrient Uptake, and Vegetative Characteristics of Florunner Peanuts.[1,2]

M. E. Walker*, T. P. Gaines and R. J. Henning[3]

**ABSTRACT**

This study was conducted to determine the effects of foliar-applied fertilizer on yield, quality, chemical composition, and vegetative characteristics of Florunner peanuts. Field experiments wre conducted over a four year period, 1976-1979, on two Coastal Plain soils. Foliar fertilizer containing, N, P, K, and S was applied at varying rates and intervals during the growing season. Plants were sampled at three stages of growth to study vegetative characteristics and chemical composition. Yield and quality factors were taken at harvest.

Foliar fertilizer applied at various rates at different time intervals did not increase yields at either location during the four year study. A slight increase in %SMK was noted in 1976 at one site for the highest rate applied late in the growing season. The two highest rates (168 and 224 kg/ha) caused severe burn damage to the foliage in 1977 and 1978, and consequently only the low rate (112 kg/ha) was used in 1979. In 1978, pod number was reduced with the highest rate at one location for one of three sampling dates, while at the other there was some increase in number of pegs and pods for one sampling date with increased foliar fertilization. Peanut tops were analyzed for N, P, K, Ca, and Mg. Phosphorus and K increased for the highest rate for one sampling date in 1978 at one site. Results of these studies indicate that foliar N, P, K, and S fertilization does not increase yield, grade, pegs, pods, or nutrient uptake of peanuts.

Key Words: Peg, pod, sound mature kernel, N, P, K, Ca, and Mg.

There have been numerous reports on the use of foliar fertilizer for soybeans (1, 3, 5, 7, 8). The results have been mixed with some researchers (3) reporting excellent yield responses and significant increases in the number of harvestable seed with foliar N, P, K, and S fertilization. Other researchers (1, 5, 7, 8) have not found the marked increase in yield, but some (1) have shown increased N, P, and K concentration in soybean foliage from the use of foliar fertilization.

The foliar fertilizer material being used apparently varies in phytotoxicity. Researchers in Florida (8) found that yields of Bragg and Cobb soybeans were not affected by one to five foliar sprays containing (2.8, 2.9, 8.4, and 1.2 kg/ha of N, P, K, and S, respectively) potassium polyphosphate and urea. However, yields declined when ammonium polyphosphate and $KNO_3$ were used in five weekly sprays. The yield reduction was associated with a burning of the foliage. Approximately 15% of the foliage was burned as a result of the first application, and additional applications continued to burn newly exposed leaves. It has also been reported that Cobb soybeans which received three applications of undiluted Folian™ (potassium polyphosphate) showed significant burns (5). Folian™ applied with equal amounts of water however, did not cause significant leaf damage at any time.

The research on foliar fertilization of soybeans has caused interest as to the potential of this practice for peanuts. There has been very little research on foliar fertilization of peanuts using a material containing N, P, K, and S. Researchers (6) have reported that increased rates of urea applied to the foliage of NC-FLA 14 and Florunner at 85 and 118 days after planting tended to increase yields. Due to the general lack of information, research was begun in 1976 to determine the effect of foliar fertilizer on yield, quality, and vegetative characteristics of Florunner peanuts. The results of four years of these studies are reported.

## Materials and Methods

Field experiments were conducted for four years (1976-1979) at Tifton, Georgia on a Fuquay loamy sand (Arenic Plinthic Paleudult; loamy, siliceous, thermic), and at Plains, Georgia on a Greenville sandy loam (Rhodic Paleudult; clayey, kaolinitic, thermic). Soil test values at the initiation of the experiments are shown in Table 1. Annual fertilization consisted of 560 kg/ha of 5-10-5 fertilizer broadcast and then turned with a bottom plow. The remaining cultural practices used were those recommended by the Georgia Agricultural Extension Service (4) for peanut

**Table 1. Initial soil pH and P, K, Ca, and Mg concentration of experimental plots at Tifton and Plains, Georgia.**

| Location | pH | P | K | Ca | Mg+ |
|---|---|---|---|---|---|
| | | -------- kg/ha -------- | | | |
| Tifton | 6.6 | 147 | 82 | 812 | 45 |
| Plains | 6.0 | 54 | 247 | 1018 | 156 |

+P, K, Ca, and Mg were determined on a 1:4 soil:double acid extract, and pH was determined on a 1:1 soil:water mix as described by Gaines and Mitchell (2).

[1]Contribution of the University of Georgia, Tifton, Georgia 31793.

[2]Mention of a trade name, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the University of Georgia and does not imply its approval to the exclusion of other products or vendors that may also be suitable.

[3]Assistant Professor and Chemist, Agronomy Department, Coastal Plain Experiment Station, Tifton, Georgia 31793; Associate Professor, Department of Extension Agronomy, Cooperative Extension Service, Tifton, Georgia 31793.

production. The experimental design was a randomized complete block with four replications. Individual plots for 1976 consisted of 2 rows of peanuts (cv. Florunner) 9.1 m long and 0.91 m wide with 2 border rows. Treatments were a control and a 3x3 factorial arrangement of fertilizer rate x time of application. Each foliar fertilizer rate (Table 2) was split into three applications and contained N, P, K, and S derived from the following materials. The N source was solid, 46% urea. The source of P, K, and S was potassium polyphosphate (21% K and 11% P) and potassium sulfate (27% K and 17% S). A solution of these materials was applied at the rate of 85 l/ha with a bicycle-type sprayer equipped with a system activated by carbon dioxide. Times of application ranged from early flowering (July 8) to early fruiting (August 5).

In 1977 and 1978, in addition to a control, Folian™ (trade name containing the following percentages of fertilizer materials: 12 N, 2.6 P, 4.9 K, and 0.5 S and weighed 1.19 kg/l) liquid fertilizer was applied at rates of 112, 168, and 224 kg/ha at early bloom (56 days after seed emerged) in a single spray application across a 1.8 m bed which contained 2 rows 9.1 m long. In 1977, these rates were also applied 84 days after emergence, both in a single application and split into 3 applications. In 1979, the two highest levels of Folian™ liquid fertilizer were deleted from the experiment, as were the 84 day treatments.

Five plants were selected at random from each treatment for chemical analysis and fruiting characteristics. Plant samples were taken approximately 10-14 days after a single application of Folian™ fertilizer and each 28 days thereafter for a total of three sampling periods from both locations in 1978 and from Tifton in 1979. Plants were rinsed with tap water to remove any soil or fertilizer residue from leaves or stems. The roots of the peanut plants were detached from the plant and discarded. Pegs and pods were counted, then detached; pods were oven dried and weighed. Leaves and stems were placed in the oven and allowed to dry overnight at 70 C for weight determination. The samples were ground in a Wiley Mill (1 mm sieve) and stored for chemical analysis. Total N, P, K, Ca, and Mg in plant tissue were determined by the methods of Gaines and Mitchell (2).

Peanuts were harvested with a field combine and yields were computed at 8.0% moisture. Sound mature kernels (SMK) were determined using standard Federal-State guidelines.

# Results and Disucssion

**Tifton and Plains - 1976**

At Tifton, foliar fertilizer had no significant effect on yield or SMK (Table 2). Foliar fertilizer significantly reduced the yield of Florunner peanuts at Plains. In general, the yield tended to be reduced as rates of foliar fertilizer were increased. There was considerable damage to the peanut foliage with the two highest rates of foliar fertilizer, which may have accounted for the lower yields for these treatments at Plains. Despite the damage to the foliage and lower yields, the percent SMK tended to be higher in the treated plants than in the control at Plains.

Foliar sprays were usually applied between 8:00 and 10:00 am to reduce the chance of phytotoxicity. Some researchers working with foliar sprays have reported no damage to soybean foliage from urea and potassium polyphosphate (8), while others (7) have reported significant burn on soybean leaves when using the same fertilizer materials.

**Tifton and Plains - 1977**

The fertilizer rates (Table 3) had no significant effect on yield or percent SMK of Florunner peanuts at Tifton or Plains when applied at 56 or 84 days after emergence with either one or three applications. Yields from the early application (56 days) of foliar fertilizer at Tifton and Plains tended to increase as the rate of foliar fertilizer were increased. The application of fertilizer 84 days after the plants emerged, and in a single or multiple application, showed no evidence of increasing the yield or grade of peanuts.

**Table 2. Effect of rate and time of application of foliar fertilizer on yield and SMK of Florunner peanuts at two locations in 1976.**

| Treatment+ | | | | Date of First | Yield | | | | SMK | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | P | K | S | Application | Tifton | | Plains | | Tifton | | Plains | |
| kg/ha | | | | | kg/ha | | | | % | | | |
| 0 | 0 | 0 | 0 | | 2690 | 2690 | 5830 | 5830 | 72.5 | 72.5 | 72.5 | 72.5 |
| 28 | 3.8 | 8.3 | 2.8 | July 8 | 2914 | | 4779 | | 72.0 | | 71.5 | |
| 28 | 3.8 | 8.3 | 2.8 | July 22 | 2866 | | 4927 | | 73.0 | | 74.2 | |
| 28 | 3.8 | 8.3 | 2.8 | August 5 | 2799 | 2859 | 5089 | 4932 | 72.2 | 72.4 | 74.2 | 73.3 |
| 56 | 5.8 | 12.0 | 4.2 | July 8 | 2642 | | 4661 | | 73.2 | | 73.0 | |
| 56 | 5.8 | 12.0 | 4.2 | July 22 | 2644 | | 4344 | | 73.0 | | 74.3 | |
| 56 | 5.8 | 12.0 | 4.2 | August 5 | 2622 | 2636 | 4534 | 4513 | 72.5 | 72.9 | 73.0 | 73.4 |
| 84 | 12.2 | 24.0 | 8.2 | July 8 | 2384 | | 4449 | | 73.8 | | 74.0 | |
| 84 | 12.2 | 24.0 | 8.2 | July 22 | 2650 | | 4145 | | 73.6 | | 74.5 | |
| 84 | 12.2 | 24.0 | 8.2 | August 5 | 2256 | 2430 | 4012 | 4202 | 73.2 | 73.5 | 75.5 | 74.7 |
| LSD (.05) Rates | | | | | NS | NS | 541 | 313 | NS | NS | 2.04 | 1.18 |

+Each fertilizer treatment was divided into three equal applications and applied approximately 10-14 days apart.

**Table 3. The effect of rate, time, and number of applications of foliar fertilizer on yield and grade of Florunner peanuts at two locations in 1977.**

| Treatment | | | | Time of Application After Emergence | Number of Applications | Yield+ | | SMK+ | |
|---|---|---|---|---|---|---|---|---|---|
| N | P | K | S | | | Tifton | Plains | Tifton | Plains |
| ----------kg/ha---------- | | | | | | -----kg/ha----- | | -------%------- | |
| 0 | 0 | 0 | 0 | | | 4266 | 2624 | 68.0 | 70.0 |
| 13.4 | 2.9 | 5.5 | 0.56 | 56 days | 1 | 4475 | 2684 | 67.5 | 68.5 |
| 20.1 | 4.4 | 8.3 | 0.84 | 56 days | 1 | 4596 | 2732 | 68.0 | 68.5 |
| 26.9 | 5.8 | 11.1 | 1.12 | 56 days | 1 | 5102 | 3262 | 68.7 | 69.7 |
| 13.4 | 2.9 | 5.5 | 0.56 | 84 days | 1 | 4284 | 3336 | 68.0 | 70.5 |
| 20.1 | 4.4 | 8.3 | 0.84 | 84 days | 1 | 4771 | 2952 | 67.0 | 70.0 |
| 26.9 | 5.8 | 11.1 | 1.12 | 84 days | 1 | 4384 | 2933 | 67.5 | 69.5 |
| 13.4 | 2.9 | 5.5 | 0.56 | 84 days | 3 | 4722 | 2830 | 70.0 | 71.0 |
| 20.1 | 4.4 | 8.3 | 0.84 | 84 days | 3 | 4604 | 3135 | 66.0 | 70.0 |
| 26.9 | 5.8 | 11.1 | 1.12 | 84 days | 3 | 4531 | 2686 | 68.5 | 71.0 |

+No significant difference due to rate, date, or number of applications at either location.

**Table 4. Effect of foliar fertilizer on vegetative characteristics at three sampling dates on Florunner peanuts treated at 56 days after emergence at two locations in 1978.**

| Rate | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | P | K | S | Pegs | Pods | Peg & Pod | Plant | Pegs | Pods | Peg & Pod | Plant | Pegs | Pods | Peg & Pod | Plant |
| (kg/ha) | | | | (No.) | (No.) | (g) | (g) | (No.) | (No.) | (g) | (g) | (No.) | (No.) | (g) | (g) |
| | | | | TIFTON | | | | | | | | | | | |
| | | | | July 18 | | | | August 16 | | | | September 14 | | | |
| 0 | 0 | 0 | 0 | 21.6 | 24.4 | 12.5 | 138 | 73.7 | 225 | 78.5 | 207 | 37.2 | 302 | 181 | 223 |
| 13.4 | 2.9 | 5.5 | 0.56 | 12.7 | 17.1 | 11.0 | 130 | 83.7 | 203 | 77.2 | 190 | 43.0 | 216 | 147 | 187 |
| 20.1 | 4.4 | 8.3 | 0.84 | 24.7 | 16.0 | 9.2 | 132 | 97.7 | 237 | 66.2 | 219 | 15.7 | 193 | 140 | 194 |
| 26.9 | 5.8 | 11.1 | 1.12 | 26.0 | 23.6 | 14.5 | 168 | 57.0 | 166 | 63.7 | 177 | 24.5 | 182 | 143 | 171 |
| | LSD (0.5) | | | NS* | NS | NS | NS | NS | 50 | NS | NS | NS | NS | NS | NS |
| | | | | PLAINS | | | | | | | | | | | |
| | | | | July 5 | | | | August 3 | | | | September 7 | | | |
| 0 | 0 | 0 | 0 | 13.7 | 21.3 | 16.2 | 201 | 64.5 | 267 | 107 | 270 | 10.0 | 239 | 176 | 205 |
| 13.4 | 2.9 | 5.5 | 0.56 | 18.5 | 27.1 | 20.7 | 200 | 30.5 | 242 | 100 | 227 | 10.0 | 203 | 165 | 172 |
| 20.1 | 4.4 | 8.3 | 0.84 | 22.5 | 24.0 | 13.0 | 170 | 87.7 | 336 | 126 | 288 | 9.2 | 257 | 187 | 197 |
| 26.9 | 5.8 | 11.1 | 1.12 | 23.0 | 28.7 | 17.2 | 224 | 72.2 | 257 | 93 | 246 | 13.0 | 300 | 217 | 235 |
| | LSD (0.5) | | | 7.2 | 7.3 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

*No significant difference due to rates of fertilizer

**Tifton and Plains - 1978**

The effects of fertilizer on vegetative characteristics of Florunner peanuts for three sampling dates at Tifton and Plains are shown in Table 4. At Tifton, only the data for the August 16 sampling was significantly affected; the number of pods were reduced with the highest rate of foliar fertilizer. The data also indicated that the number of pegs, peg and pod weight, and plant weight (less roots) tended to be less when treated with the highest rate of fertilizer. The same trend was evident in the samples collected September 14 but there was no significant difference. At Plains, the vegetative data taken on July 15 showed the only significant fertilizer effect; the highest rate produced a higher number of pegs and pods than where none was applied. There was evidence of burn on the foliage of peanut plants treated with the two highest rates of foliar fertilizer at each location. Researchers (5) in Florida found that three applications of Folian™ fertilizer damaged the foliage of soybeans, while material diluted with one-half water had no effect.

The tops of Florunner peanuts grown at Tifton and Plains were analyzed for N, P, K, Ca, and Mg (Table 5). The N, P, and Mg levels decreased with time, while the change in K and Ca levels changed very little with maturity. There was no evidence that the rates of foliar fertilizer had any effect on the concentration of these nutrients for peanuts grown at Tifton. At Plains, the only response noted was in tissue samples taken July 5 which showed higher levels of P and K where the higher rate of foliar fertilizer was applied.

The yield and grade of Florunner peanuts were excellent but not affected by the application of foliar fertilizer, with yields averaging 5850 and 5946 kg/ha and %SMK averaging 76.7 and 75.5 at Tifton and Plains, respectively.

**Tifton and Plains - 1979**

The application of foliar fertilizer had no significant effect on the number and weight of pegs and pods at Tifton nor on the chemical analysis (N, P, K, Ca, and Mg) made on the above-ground portion of the peanut plant. Differences noted among the sampling are shown in Table 6.

Peanut yield and grades from Tifton were not significantly different with respect to treatment and averaged 4193 and 4847 kg/ha, respectivey. The quality (SMK) of the peanuts at Tifton was improved with the addition of foliar fertilizer, as a 1.1 percent increase in SMK was noted over the check plots. There was no effect at Plains where the SMK averaged 77 percent.

**Table 6. The average vegetative characteristics and chemical analysis by sampling dates of Florunner peanuts. Tifton, Georgia.**

| Measurement | Sampling Date | | |
|---|---|---|---|
| | July 24 | August 22 | September 19 |
| Vegetative | | | |
| Pegs (no.) | 131 | 38 | 30 |
| Pods (no.) | 80 | 264 | 286 |
| Pegs & Pods (g) | 45 | 84 | 163 |
| Plant (g) | 108 | 152 | 138 |
| Chemical (Plant) | | | |
| N (%) | 2.56 | 2.16 | 1.84 |
| P (%) | 0.26 | 0.21 | 0.09 |
| K (%) | 2.51 | 1.70 | 2.23 |
| Ca (%) | 1.62 | 1.41 | 2.57 |

**Table 5. Chemical analysis of peanut plant tops sampled at three dates for 1978 crop grown at two locations and treated at 56 days after emergence.**

| Rate | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | P | K | S | N | P | K | Ca | Mg | N | P | K | Ca | Mg | N | P | K | Ca | Mg |
| kg/ha | | | | % | | | | | % | | | | | % | | | | |
| | | | | TIFTON | | | | | | | | | | | | | | |
| | | | | July 18 | | | | | August 16 | | | | | September 14 | | | | |
| 0 | 0 | 0 | 0 | 2.81 | 0.29 | 2.54 | 1.70 | 0.29 | 1.91 | 0.18 | 2.46 | 1.51 | 0.21 | 2.18 | 0.16 | 2.83 | 1.95 | 0.21 |
| 13.4 | 2.9 | 5.5 | 0.56 | 2.61 | 0.31 | 2.61 | 1.76 | 0.35 | 1.94 | 0.18 | 2.37 | 1.54 | 0.22 | 2.00 | 0.16 | 2.70 | 1.88 | 0.21 |
| 20.1 | 4.4 | 8.3 | 0.84 | 2.92 | 0.30 | 2.57 | 1.60 | 0.36 | 1.86 | 0.19 | 2.38 | 1.49 | 19.7 | 1.95 | 0.16 | 2.85 | 1.82 | 0.21 |
| 26.9 | 5.8 | 11.1 | 1.12 | 2.82 | 0.29 | 2.61 | 1.54 | 0.36 | 2.01 | 0.19 | 2.66 | 1.37 | 24.5 | 1.96 | 0.17 | 2.78 | 1.88 | 0.22 |
| LSD (0.5) | | | | NS* | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| | | | | PLAINS | | | | | | | | | | | | | | |
| | | | | July 5 | | | | | August 3 | | | | | September 7 | | | | |
| 0 | 0 | 0 | 0 | 2.80 | 0.26 | 2.56 | 1.18 | 0.68 | 2.24 | 0.16 | 2.48 | 1.28 | 0.58 | 1.92 | 0.12 | 2.32 | 1.34 | 0.53 |
| 13.4 | 2.9 | 5.5 | 0.56 | 2.85 | 0.24 | 2.92 | 1.11 | 0.66 | 2.30 | 0.17 | 2.61 | 1.46 | 0.56 | 1.77 | 0.11 | 2.53 | 1.26 | 0.45 |
| 20.1 | 4.4 | 8.3 | 0.84 | 3.04 | 0.27 | 2.74 | 1.22 | 0.67 | 2.31 | 0.18 | 2.40 | 1.23 | 0.59 | 1.77 | 0.11 | 2.31 | 1.14 | 0.50 |
| 26.9 | 5.8 | 11.1 | 1.12 | 2.85 | 0.29 | 3.22 | 1.12 | 0.63 | 2.25 | 0.18 | 2.67 | 1.29 | 0.56 | 1.77 | 0.12 | 2.55 | 1.28 | 0.48 |
| LSD (0.5) | | | | NS | 0.02 | 0.33 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

*No significant difference due to rates of fertilizer.

## Literature Cited

1. Boote, K. J., R. N. Gallaher, W. K. Robertson, K. Hinson, and L. C. Hammond. 1978. Effect of foliar fertilization on photosynthesis, leaf nutrition, and yield of soybeans. Agron. J. 70:787-791.
2. Gaines, T. Powell, and G. Allen Mitchell. 1979. Chemical methods for soil and plant analysis. Univ. Ga. Coastal Plain Exp. Sta. Agron. Handb. No. 1., 105 p.
3. Garcia, R., and J. J. Hanway. 1976. Foliar fertilization of soybeans during the seed-filling period. Agron. J. 68:653-657.
4. McGill, Frank, and Ronald J. Henning. 1979. Growing peanuts in Georgia. Ga. Coop. Ext. Service Bull. 640.
5. Nagel, D. H., W. K. Robertson, K. Hinson, and L. C. Hammond. 1979. Foliar fertilization of Cobb soybeans in Florida. Soil and Crop Soc. Soc. Fla. Porc. 38:122-125.
6. Pancholy, S. K., and A. L. Guy. 1979. Effect of foliar application of urea on peanut yield and seed quality. Am. Peanut Res. and Educ. Soc. Proc. 11 NO. 1 pp 58.
7. Parker, M. B., F. C. Boswell. 1980. Foliage injury, nutrient intake, and yield of soybeans as influenced by foliar fertilization. Agron. J. 72:110-113.
8. Robertson, W. K., K. Hinson, and L. C. Hammond. 1977. Foliar fertilization of soybeans (*Glycine max* (L.) Merr.) in Florida. Soil and Crop Sci. Soc. Fla. Proc. 36:77-79.

Accepted September 8, 1982