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# Response of Nodulating and Non-Nodulating Peanuts to Foliarly Applied Nitrogen[1]

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## ABSTRACT

Field experiments were conducted on Lakeland sand (Thermic, coated Typic Quartz-ipsaments) during 1981-82 to determine the effect of foliarly applied N on yield, grade, and N, P, K, Ca, and Mg concentration of leaves and seed of nodulating and non-nodulating peanut (*Arachis hypogaea* L.).

Nodulating cultivars; Florunner, Early Bunch, and Tifrun, and three non-nodulating experimental lines were sprayed 0, 1, 2 or 4 times at 13.5 kg N/ha beginning 28 days after emergence. Foliar application of N increased the yield of Florunner, Tifrun, and all non-nodulating lines, but had no effect on Early Bunch. The addition of N to non-nodulating peanut increased the percent fancy pods, extra large kernels, and weight of seed. Seed N concentration of non-nodulating lines increased with higher rates of N, but was higher in the nodulating cultivars. Seed of non-nodulating lines contained higher levels of P, K, and Mg than seed of nodulating lines. Nodulating lines had higher concentration of leaf N than did non-nodulating lines. The leaves of the non-nodulating lines contained higher levels of P, Ca, and Mg than those of the nodulating cultivars; whereas levels of K were higher for nodulating lines.


Key Words: *Arachis hypogaea* L., urea, yield, grade, quality, chemical constituents.

Numerous research reports have shown that soil applied nitrogen did not increase the yield and quality of runner-type peanuts (*Arachis hypogaea* L.) (3, 6, 7, 8, 9, and 10). However, Pancholy and Guy (4) reported that two applications of foliarly applied urea at rates up to 9 kg N/ha increased the yield of Early Bunch, Florunner, and NC-Fla 14 cultivars. Pancholy et al. (6) later reported that the application of urea to foliage of NC-Fla 14 and Florunner increased seed yield at 8.9 kg N/ha, but negatively affected seed yield at higher rates. They also reported that N increased total seed protein, soluble carbohydrates, and methionine of Early Bunch and NC-Fla 14 seeds. Gorbet and Burton (2) identified $F_3$ peanut plants which showed N starvation symptoms toward maturity and apparently had no nodules on the roots. The plants were derived from a cross between two normal nodulating parents. Evaluation in the $F_4$ through $F_6$ generation confirmed that numerous selections from this cross failed to nodulate in field tests. Pancholy et al. (5) found that soil application of varying rates of N to nodulating and non-nodulating peanut one month after planting had a negative effect on yield of Florunner but no effect on the non-nodulating lines. The seed protein of non-nodulating lines increased 50% with N application.

The purpose of this study was to determine the effect of foliarly applied N on yield, quality, and certain chemical constituents of leaves and seed of nodulating and non-nodulating virginia and runner type peanut.

## Materials and Methods

Six genotypes of A. *hypogaea* subspecies *hypogaea* consisted of Florunner, Tifrun, and Early Bunch (nodulating cultivars) and T-2289, T-2378 ru and T-2378 va (non-nodulating experimental lines) were selected as subplots in a split-plot design with five replications. The main plots were foliar urea treatments sprayed 0, 1, 2 or 4 times at 13.5 kg N/ha beginning 28 days after emergence. Linear and quadratic effects were obtained from treatment means to test response to foliarly applied N. The results are presented in appropriate tables.

A Lakeland sand (Thermic, coated Typic Quartz-ipsaments) located near Tifton, Georgia was chosen as the test site because of its relatively low soil nitrogen. On May 14, 1981 and May 17, 1982 seeds

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were planted 7.6 cm apart in two 6.1 rows spaced at 91 cm. Standard cultural practices were employed throughout both growing seasons which included fertilization, chemical pest control, irrigation, and gypsum application. Individual genotypes were mechanically harvested as each reached maturity. Dried pod weights were used for yield. Leaf and seed samples were taken both years for chemical analyses, and N, P, K, Ca, and Mg was determined by the methods of Gaines and Mitchell (1). Grade factors were based on Federal-State Inspection Service guidelines for percentage of sound mature kernels (SMK), extra large kernels (ELK), fancy pods, and weight of 100 seeds.

# Results

## Yield.

The yield of Tifrun significantly increased with increasing application of foliar N (Table 1). Florunner also showed a significant curvilinear increase with maximum yield at 32 kg N/ha. Applying foliar N to Early Bunch caused a yield decrease which was not significant. The two year mean yield of three cultivars combined had a significant linear yield increase.

The non-nodulating lines T-2289, T-2378 ru, and T-2378 va gave a significant increase in yield at 54 kg N/ha (Table 1). The mean yield of the three non-nodulating lines increased with each rate of N.

**Table 1. Foliar N effect on yield of nodulating and non-nodulating peanut.**

| Applied N | Nodulating Cultivars | | | | Non-Nodulating Lines | | | |
|---|---|---|---|---|---|---|---|---|
| | Florunner | Tifrun | Early Bunch | Mean | T-2289 | T-2378 ru | T-2378 va | Mean |
| (kg/ha) | (kg/ha) | | | | (kg/ha) | | | |
| 0 | 3849 | 3939 | 3936 | 3908 | 1249 | 975 | 1026 | 1060 |
| 13.5 | 4132 | 4098 | 3892 | 4041 | 1131 | 1124 | 1360 | 1220 |
| 27.0 | 4547 | 4330 | 3662 | 4181 | 1543 | 1336 | 1365 | 1419 |
| 54.0 | 4157 | 4598 | 3758 | 4171 | 1962 | 1748 | 1730 | 1783 |
| LSD (.05) | 390.6 | 390.6 | 390.6 | 225.5 | 390.6 | 390.6 | 390.6 | 225.5 |
| +linear | NS | 12.4** | NS | 4.7* | 15.0** | 14.5** | 12.0** | 13.5** |
| ‡quadratic | 32.3** | NS | NS | NS | NS | NS | NS | NS |

*, ** significant at the 0.05 and 0.01 levels, respectively.
+No. kg/ha change with each kg/ha of applied N.
‡Point of maximum or minumum responds interim of kg/ha of applied N.

## Grade and Quality.

The virginia types had higher percentages of fancy pods for both nodulating and non-nodulating peanut than the runner types regardless of N treatments (Table 2). Foliar N gave a curvilinear increase in percent of fancy pods for virginia type non-nodulating peanut, where maximum response was at 37 kg N/ha. Nodulating cultivars had a higher percent ELK than the non-nodulating lines when types were averaged (Table 3). The application of N had no effect on the percent ELK of nodulating cultivars, but a curvilinear trend for percent ELK for non-nodulating peanut, where maximum response was at 41 kg N/ha. Nitrogen application had no effect on seed weight of nodulating cultivars, but increased seed weight of non-nodulating lines (Table 3). The trend was curvilinear with maximum response at 37 kg N/ha. Nodulating peanut had higher seed weight than non-nodulating peanut.

**Table 2. Foliar N effect on percent fancy pods in nodulating and non-nodulating virginia and runner peanut.**

| Applied N | Peanut§ | | | |
|---|---|---|---|---|
| | Nodulating | | Non-Nodulating | |
| | va | ru | va | ru |
| (kg/ha) | Fancy (%) | | | |
| 0 | 88.2 | 22.2 | 34.3 | 18.6 |
| 13.5 | 85.8 | 22.7 | 43.2 | 20.0 |
| 27.0 | 84.2 | 24.2 | 45.5 | 21.5 |
| 54.0 | 84.1 | 22.0 | 44.8 | 21.9 |
| LSD (.05) | 4.8 | 3.4 | 4.8 | 3.4 |
| †linear | NS | NS | .67** | NS |
| ‡quadratic | NS | NS | 37.2** | NS |

*, ** significant at 0.05 and 0.01 level, respectively.

†Percent change with each kg/ha of applied N.

‡Point of maximum and minimum responds interim of kg/ha of applied N.

§Means arranged horizontally underscored by the same line are not significantly different according to LSD (.05).

**Table 3. Foliar N effect on percent extra large kernels (ELK) and seed weight of nodulating and non-nodulating peanut.**

| Applied N | Peanut§ | | | |
|---|---|---|---|---|
| | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating |
| (kg/ha) | ELK (%) | | Seed weight (g/100) | |
| 0 | 38.2 | 25.0 | 73.2 | 46.6 |
| 13.5 | 38.0 | 27.5 | 71.6 | 49.5 |
| 27.0 | 38.5 | 28.8 | 73.0 | 50.5 |
| 54.0 | 37.5 | 29.0 | 71.3 | 50.1 |
| LSD (.05) | 1.9 | 1.9 | 1.7 | 1.7 |
| †linear | NS | .21** | NS | .23** |
| ‡quadratic | NS | 41.4* | NS | 36.9** |

*, ** significant at the 0.05 and 0.01 level, respectively.

†Percent change with each kg/ha of applied N.

‡Point of maximum or minimum responds interim of kg/ha of applied N.

§Means arranged horizontally underscored by the same line are not significantly different according to LSD (.05).

## Seed Analysis.

Seed N of nodulating cultivars was higher for all treatments when compared with the non-nodulating lines (Table 4). Within nodulating lines, the trend showed decreasing seed N with increasing applied N; while for non-nodulating lines, seed N was increasing.

**Table 4. Foliar N effect on seed N and P of nodulating and non-nodulating peanut.**

| Applied N | Peanut§ | | | |
|---|---|---|---|---|
| | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating |
| (kg/ha) | N (%) | | P (%) | |
| 0 | 4.50 | 3.14 | 0.35 | 0.64 |
| 13.5 | 4.39 | 3.12 | 0.35 | 0.64 |
| 27.0 | 4.40 | 3.19 | 0.36 | 0.61 |
| 54.0 | 4.36 | 3.37 | 0.37 | 0.60 |
| LSD (.05) | .10 | .10 | .04 | .04 |
| †linear | -.002* | .005** | NS | -.001* |
| ‡quadratic | NS | NS | NS | NS |

*, ** significant at the 0.05 and 0.01 level, respectively.

†Percent change with each kg/ha of applied N.

‡Point of maximum or minimum responds interim of kg/ha of applied N.

§Means arranged horizontally underscored by the same line are not significantly different according to LSD (.05).

Foliar applied N had no effect on seed P for the nodulating cultivars, but showed a decreasing trend for non-nodulating lines. The non-nodulating lines con-

tained higher amounts of seed P than did the nodulating cultivars.

Foliarly applied N had no effect on seed N concentration of nodulating peanut, but 54 kg N/ha caused a significant increase in seed N content of non-nodulating peanut (Table 4). However, seed of the nodulating peanut contained higher amounts of nitrogen regardless of N treatment.

Foliarly applied N had no significant effect on seed P content of either nodulating or non-nodulating peanut. However, seed of non-nodulating peanut contained higher levels of P than seed of nodulating peanut. Seed of non-nodulating runner and virginia peanut contained higher levels of K and Mg than seed of nodulating runner and virginia peanut (Table 5). Seed of the nodulating virginia peanut contained a higher level of K than seed of the runner peanut. The virginia peanut seed contained more Mg regardless of nodulating ability.

**Table 5. Seed K, Ca, and Mg of nodulating and non-nodulating runner and virginia peanut.**

| Peanut | Peanut* | | | | | |
|---|---|---|---|---|---|---|
| | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating |
| | K (%) | | Ca (%) | | Mg (%) | |
| Runner | 0.58 | 0.80 | 0.042 | 0.039 | 0.14 | 0.16 |
| Virginia | 0.65 | 0.83 | 0.044 | 0.053 | 0.15 | 0.18 |

*Means arranged horizontally underscored by the same line are not significantly different according to LSD (0.05)

## Leaf Analysis

The nitrogen concentration in leaves of the nodulating and non-nodulating virginia and runner peanut was not affected by N treatments (Table 6). Non-nodulating runner lines showed a curvilinear trend where minimum response occurred at 29 kg N/ha. On the whole, nodulating cultivars contained more N in the leaf tissue than the non-nodulating lines.

The non-nodulating leaves contained a higher level of P than nodulating leaves (Table 7). The nitrogen treatments had no effect on the P level in leaves of either the nodulating or non-nodulating lines. The percent K in the leaves of the non-nodulating peanut showed a curvilinear trend with the application of foliar N where minimum response occurred at 32 kg N/ha. Nodulating peanut had a significantly higher level of K in the leaves than the non-nodulating. The percent Ca in the leaves of nodulating peanut increased as N rates increased. The non-nodulating peanut leaves contained a higher level of Ca than nodulating peanut but at the two highest levels of N this difference was not significant. The rates of N had no significant effect on the percent of Mg in the leaves of nodulating and non-nodulating peanut. Magnesium level was significantly higher in leaves of the non-nodulating peanut.

**Table 6. Foliar N effect on leaf N of nodulating and non-nodulating virginia and runner peanut.**

| Applied N | Peanut§ | | | |
|---|---|---|---|---|
| | Nodulating | | Non-Nodulating | |
| | va | ru | va | ru |
| (kg/ha) | N (%) | | | |
| 0 | 2.93 | 2.88 | 1.58 | 1.77 |
| 13.5 | 2.91 | 2.75 | 1.51 | 1.60 |
| 27.0 | 2.90 | 2.97 | 1.93 | 1.51 |
| 54.0 | 2.63 | 2.89 | 1.74 | 1.72 |
| LSD (.05) | .33 | .23 | .33 | .23 |
| †linear | NS | NS | NS | NS |
| ‡quadratic | NS | NS | NS | 28.6* |

*, ** significant at the 0.05 and 0.01 level, respectively.

†Percent change with each kg/ha of applied N.

‡Point of maximum or minimum responds interim of kg/ha of applied N.

§Means arranged horizontally underscored by the same line are not significantly different according to LSD (0.5).

# Discussion

Foliar application of N produced higher yield of Florunner and Tifrun, while yield of Early Bunch remained unchanged or tended to be slightly reduced.

**Table 7. Foliar N effect on leaf P, K, Ca, and Mg of nodulating and non-nodulating peanut.**

| Applied N | Peanut§ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating | Nodulating | Non-Nodulating |
| (kg/ha) | P (%) | | K (%) | | Ca (%) | | Mg (%) | |
| 0 | 0.17* | 0.25 | 1.03 | 0.97 | 2.98 | 3.33 | 0.14 | 0.31 |
| 13.5 | 0.15 | 0.26 | 1.05 | 0.74 | 3.04 | 3.42 | 0.14 | 0.30 |
| 27.0 | 0.20 | 0.22 | 0.97 | 0.75 | 3.22 | 3.33 | 0.16 | 0.29 |
| 54.0 | 0.17 | 0.24 | 1.05 | 0.82 | 3.20 | 3.31 | 0.16 | 0.29 |
| LSD (.05) | .04 | .04 | .11 | .11 | .19 | .19 | .03 | .03 |
| †linear | NS | NS | NS | NS | .004* | NS | NS | NS |
| ‡quadratic | NS | NS | NS | 31.8** | NS | NS | NS | NS |

*, ** significant at the 0.05 and 0.01 level, respectively.

†Percent change with each kg/ha of applied N.

‡Point of maximum or minimum responds interim of kg/ha of applied N.

§Means arranged horizontally underscored by the same line are not significantly different according to LSD (.05).

These data are supported by other workers (4) who reported an increase in Florunner yield with foliar N fertilization. However, they reported that Early Bunch also responded to added N.

The non-nodulating experimental lines (T-2289, T-2378 ru, and T-2378 va) gave a significant increase in yield with foliar urea application. Previous research (5) with a similar non-nodulating peanut showed no yield increase from soil applied N. All three non-nodulating lines plus Tifrun showed a yield increase between 12-15 kg/ha for each additional kg of N/ha applied.

Foliar N treatments had no significant effect on grade quality (% Fancy, ELK, and weight of seed) of Florunner, Tifrun, or Early Bunch. Similar data were reported by other research workers (10) in Georgia on runner type treated with varying rates of soil applied N. The application of N to non-nodulating peanut lines, however, gave a significant increase in the percent ELK and seed weight and percent fancy to only the virginia line. Research data on the fertilization of non-nodulated peanut are limited.

The non-nodulating lines showed a significant increase in seed N from N application; while the nodulating lines showed a significant decrease. Pancholy et al. (5) reported a significant increase in the protein level of non-nodulating peanut from soil applied N. The seed from non-nodulated lines also contained a higher amount of P, K, and Mg than nodulating cultivars regardless of N treatments.

Leaf N concentration of non-nodulating virginia and runner lines was approximately one percent less than from nodulating peanut even with the highest rate of N. During the growing season foliage of non-nodulating lines was lighter green in color throughout the growing season.

Foliar N application had no significant effect on leaf P and K concentrations of nodulating peanut lines, which also has been reported by other researchers for soil applied N (9).

However, the application of N to non-nodulating peanut reduced the K concentration in the leaves. The application of N increased the Ca concentration in the leaves of nodulating peanut. Other workers (7) also reported similar results.

The non-nodulating lines contained higher levels of Ca, Mg, and P in the leaves than nodulating cultivars. The high Ca and Mg leaf concentrations of non-nodulating peanut may account for the low K level found in the leaves.

The results of the two-year study indicate that Tifrun, T-2289, T-2378 ru, and T-2378 va did not reach a yield plateau with N treatments; while Florunner peaked at 32 kg N/ha. Only with seed N for non-nodulating lines was there no plateau reached. Seed N for nodulating lines and seed P for non-nodulating lines, no plateau was reached in declining response to increasing levels of applied N. Among quality and chemical data, only non-nodulating lines showed curvilinear responses to changing levels of N where the plateau response ranged between 29-41 kg N/ha. Additional research is needed to determine the effect of foliar applied N to peanuts grown on more productive soil types.

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