SOME GROWTH PARAMETERS OF SPANISH PEANUTS AS INFLUENCED BY VARIOUS NUTRIENT TREATMENTS

By

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CHAPTER I

INTRODUCTION

Peanuts continue to increase in importance as a cash crop in Oklahoma. The major reason for the continued increase in value of peanuts in recent years is the higher yields per acre. Peanuts rank higher than any other Oklahoma crop in gross income per acre and rank third in total cash income among all crops produced in Oklahoma. Improvements in mechanized production, varieties, and the use of fungicides, herbicides, and insecticides have contributed to the quality and quantity of the peanuts produced.

It has been exceedingly difficult to establish response limits of peanuts to soil treatments. In spite of contradictory results from fertilizer trials, higher per acre rates of fertilizers are commonly used on peanuts than for any other field crop grown in Oklahoma.

Peanut varieties currently produced in Oklahoma are those of the Spanish type. Basic nutritional needs of the peanut plant must be determined in order to provide information on which to base efficient fertilizer recommendations. While our present knowledge of peanut fertilization is far greater than it was a few years ago, it is still incomplete.

Experiment I was designed to compare the effects of the addition of certain nutrients, placed at various intervals in the soil "profile", on selected growth characteristics of Spanish peanuts.

Experiment II was designed to study the effects of calcium, placed in separate rooting and fruiting containers, on certain growth characteristics of Spanish peanuts.

CHAPTER II

LITERATURE REVIEW

The unique manner in which the peanut obtains nutrients from the soil has resulted in considerable confusion over the years. The grower must view the peanut as a plant with two active root systems; one, feeding deep in the soil, and the other being the short stubby root hairs formed near the tip of the peg as it penetrates the soil. The main root system functions as does the root system of most other plants except it is generally more active deep in the soil. The root hairs on the pegs and developing fruit also absorb nutrients near the soil surface and they are more selective in nutrient uptake than the main root system.

Phosphorus

Harper (21) found that phosphorus stimulated the setting of fruit and decreased the number of unfilled pods. Work in Alabama with Spanish peanuts indicated that phosphorus decreased nodulation during the first six weeks of growth resulting from separate applications of superphosphate, basic phosphate, and hydrated lime in immediate contact with the seed (16). Burkhart and Collins (11) also found that the degree of nodulation appeared to be an important factor in the utilization of phosphate by the peanut plant.

Batten (5) reported that phosphorus gave better results than any other element in peanut fertilization and recommended the use of 300 to

500 lbs. of superphosphate per acre. On some of the Black Belt soils of Alabama, peanuts were also found to be more responsive to phosphorus than any other element (2). It was concluded from early work in Mississippi, that acid phosphate gave the cheapest increase in the production of peanuts (18). Experiments conducted on Red Bay fine sandy loam soil in Florida showed that a significant yield response to phosphorus was obtained every year when phosphorus was added as superphosphate (31). Maximum yields were obtained when the soil contained 110 lbs. of P_2O_5 extractable with .03 N NH_4F in .1 N HCl per acre. Wahhab and Muhammad (34) got an increase in yield of 257 pounds of peanuts per acre when 37.5 pounds of available P_2O_5 per acre were added as superphosphate on a sandy loam soil. Under more favorable conditions increased yields from this same amount of P_2O_5 reached a maximum of 520 pounds per acre.

Gore (20) found that over a three year period, Spanish peanuts were only slightly affected by fertilization with phosphorus. West (35) in 1940 reported that the yield of Spanish peanuts was not significantly increased over a nine year period when a complete fertilizer and varying amounts of P_2O_5 were used on Tifton sandy loam soil. Two years later at a different location West (36) concluded that phosphorus seems to give better results than any other element as a peanut fertilizer. Phosphorus was applied as superphosphate at the rate of 300 to 500 pounds per acre.

Evelyn and Thornton (17), working on sandy loam soil at four sites, found that responses of peanuts to phosphorus were limited by the level of exchangeable potassium in the soil. The levels of exchangeable potassium ranged from .041 to .059 m. e. per 100 grams, and the available phosphorus content of the soil ranged from 38 to 81 ppm at the four sites. Phosphorus was added as superphosphate.

The preceding literature review on peanut response to phosphorus fertilization could be misleading in many cases as most of the workers used superphosphate as their source of phosphorus. In view of the rather exacting demands of certain peanut varieties for calcium, some of the increases in yield which were attributed to phosphorus may have been due to the calcium supplied in the phosphatic fertilizer. Evidence of this was first found when Albrecht (1) reported that additions of superphosphate to Spanish peanuts favorably influenced yields while triple superphosphate was of no value. O'Brien (28) also found that super- and dical-phosphate were superior to triple superphosphate as a source of phosphorus for peanuts.

Peanuts have been shown to respond to applications of triple superphosphate. Huber (24), working with triple superphosphate, indicated that whether phosphorus was applied alone or in combination with nitrogen or potassium the yield of peanuts was significantly increased. Work in Oklahoma also indicated that Spanish peanuts responded to phosphorus added as triple superphosphate (33).

Calcium

Burkhart and Collins (11), working with North Carolina runner peanuts, gave evidence that the presence of calcium in the fruiting medium has a definite favorable effect on fruit quality irrespective of the nature of the rooting medium. Gypsum applications were found to condition the plant in such a manner that the foliage became very susceptible to pathogenic leaf spot injury and subsequently severe defoliation resulted as the plants approached early maturity. The type of colloid in the fruiting medium had a pronounced effect on the calcium level required for production of high quality peanuts (26). At any given calcium level much poorer quality fruit was produced in either a montmorillonite or organic system as compared to a kaolinitic system. Work in Florida indicated that when calcium was added as dolomitic lime, peanut yields were significantly increased three out of four years (31). Brady et al. (10) reported a significant increase in fruit filling when a single calcium salt was added to the fruiting medium.

Colwell and Brady (13), in establishing placement differentials, applied 400 lbs. of gypsum per acre four to six inches below the seed at the time of planting. Gypsum exerted a marked beneficial effect on yield and quality of fruit when the exchangeable calcium level of the soil was .45 m. e. per 100 grams. The yield of peanuts was significantly larger when gypsum was placed in the fruiting zone rather than in the rooting zone. No significant yield increases were obtained when the exchangeable calcium level was 1.19 m. e. per 100 grams. These workers concluded that calcium was an element of major importance in the nutrition of large-seeded peanuts, and while very low soil calcium was adequate for vegetative growth, a large supply was necessary for proper development of fruit. North Carolina runner peanuts were grown on Ruston sandy soil.

Middleton et al. (27) found that 400 pounds of gypsum per acre, applied at early bloom, had no effect on yield or quality of White Spanish peanuts when the soil calcium level was .21 m. e. per 100 grams. On Improved Spanish 2B peanuts, calcium exerted a greater effect on fruit quality than on yield. Yield and kernel development were significantly increased when Virginia Bunch and North Carolina runner peanuts were grown on the same soil when calcium was applied. Colwell and Brady (14) observed that in addition to decreasing the number of "pops", calcium also functions in increasing the number of two cavity fruit formed by the large-seeded peanut varieties. It appeared that calcium prevented abortion of the fertilized ovules which apparently would otherwise occur at a very early stage of fruit development before shell enlargement had begun.

Bledsoe and Harris (7) suggested that the gynophores had a greater absorptive intensity for calcium and potassium from the external supply in the fruiting medium than for phosphorus or magnesium. The peanut gynophores were analyzed for calcium, potassium, phosphorus, and magnesium before and after entering a fruiting zone supplied with a complete nutrient solution. A North Carolina variety of peanuts was grown in sand cultures using separated rooting and fruiting zones. Early results also indicated that calcium could not be translocated from the rooting zone to the developing fruit in sufficient amounts to supply the needs in that region (6, 22).

Brady (8), in 1947, postulated that gynophore competition may be a factor affecting fruit filling as well as a shortage of calcium in the fruiting zone. Jumbo Runner fruit nearest the main stem were much more poorly filled than those of comparable age further out on the stems.

Reid and York (29) found that NC 2 fruit formation was prevented by deficiencies of nitrogen, calcium, and boron. Withholding phosphorus, manganese, molybdenum, and copper from the plants at early flowering failed to reduce the formation of fruit.

Potassium

Peanuts are very heavy feeders of potassium (33). Despite the relatively large amounts abosrbed by peanuts, the yield responses to applications of potash fertilizers are often very small or negligible on soils with low potassium contents. Reid and York (30) observed that the growth of peanuts may be reduced markedly due to potassium deficiencies before the characteristics of such deficiencies are evident.

Robertson et al. (31) reported a negative response to potash each year when more than 15 pounds of K_2O per acre were applied as potassium chloride. It was concluded that the level of exchangeable potassium in the soil did not seem to be responsible for the negative response. Brady and Colwell (9) reported a significant decrease in yield due to the addition of 45 pounds per acre of K_2O added as potassium metaphosphate at one North Carolina location. Virginia type peanuts were grown on soils ranging in soil potassium levels of 0.05 to 0.10 m. e. per 100 grams.

Work in North Carolina showed that 12 to 48 pounds of K_2O per acre proved beneficial in only one location (12). In several instances the yields were reduced by the application of potash. Other experiments conducted in North Carolina revealed that on a soil low in both potassium (0.05 m. e. per 100 grams) and calcium (0.25 m. e. per 100 grams) there was a significant increase in yield from the addition of potassium when adequate calcium was supplied (4, 9, 15). Without the addition of calcium, potash was found to decrease the yield of peanuts. These workers concluded that vegetative growth was stimulated by the added potash, and that the increased yields were due to the effect of the potash on the plant size and number of fruit rather than on kernel development.

An average of the yields obtained in an experiment conducted at the Georgia Coastal Plain Experiment Station over a ten year period showed that the use of 32 pounds per acre of potash in combination with nitrogen and phosphorus increased the yield of Spanish peanuts only 139 pounds per acre (3). West (35) found that by using a complete fertilizer and varying the K_2O content the yield of Spanish peanuts was significantly increased.

Futural (19) reported that when a complete fertilizer was placed 4, 8 and 14 inches directly below the seed the highest average response to fertilizer over a four year period was obtained for the eight inch depth placement. Spanish peanuts were planted on Tifton sandy loam soil and the equivalent of 500 pounds per acre of a 6-8-6 fertilizer was added at each depth.

CHAPTER III

METHODS AND MATERIALS

Experiment I

This experiment was designed to evaluate the effects of the addition of certain nutrients, placed at various depths in the soil, on the growth of Starr peanuts.

A combination of two soils was used for this experiment. The mixture was used in hopes of obtaining a soil with nutrient levels low enough to obtain a good response when additional nutrients were added to the soil. The two soils were obtained from the Agronomy Research Farm near Perkins, Oklahoma. One soil was taken from a low phosphate plot at the experiment station, the other soil from a wooded area east of the experiment Station. Only the surface soil (0-6") was taken from the plot, the sandy subsoil (12-24") was taken from the wooded area.

The two soils were dried, screened, and mixed together on an equivalent weight basis. Samples were taken to be analyzed in the laboratory and the results of the laboratory tests are shown in Table I.

Twenty gallon plastic lined garbage cans were used as soil containers for this experiment. These cans were eighteen inches in diameter and twenty-one inches deep. Various soil treatments were made by thoroughly mixing a given amount of soil with the prescribed fertilizer materials and then placing the mixture in six inch layers in the soil containers. Each six inch soil layer weighed approximately 34.96

TABLE I

CHEMICAL CHARACTERISTICS OF SOIL MIXTURE*

Percent organic matter	.68
Available phosphorus (ppm)	16.32
Cation exchange capacity (m. e. per 100 grams)	3.90
Exchangeable cations (m. e. per 100 grams)	
Calcium	.96
Magnesium	.43
Potassium	.36
Soil reaction (water paste, pH)	6.30

*All values are the means of three samples kilograms. The nutrients added and placement of the treated soils are shown in Table II.

The soil containers were located outdoors, and were arranged in a randomized complete block design with three replications. Three inoculated Starr peanut seed were planted in each pot on May 25, 1967. Plants had emerged in all pots eight days after planting, and were thinned to one plant per pot on June 14, leaving plants with as uniform growth as possible.

The plants were watered as needed with tap water and daily flower counts made. About the third week in June, the peanut plants became infested with thrips. Several applications of DDT and Malathion had to be used before control was established. About the second week in July, red spider mite damage was evident and applications of Malathion and Sevin were applied for control.

On September 30, 1967 (128 days after planting) soil samples were taken from each six inch increment from every pot, and the plants were removed from the pots. Each plant was separated into four parts; leaves and stems, roots, pegs without pods, and pegs with pods. The unshelled fruit were air-dried. The leaves and stems were dried in a forced air oven.

The air dry fruit from each pot were shelled and the kernels were separated into two categories; those held on a 15/64 x 3/4 inch screen and those passing through the same screen. All fruit were counted and weighed.

The peanut leaves were ground and analyzed for total calcium, phosphorus, and potassium by the method described by Jackson (25).

TABLE II

TREATMENT OF SOIL MEDIA

Nutrient Added	Placement (inches)
P, Ca	0-6
P, Ca	0-12
P, Ca	6-12
P, Ca	0-18
P, Ca*	0-18
Ca	0-12
Ca	0-18
P	0-6
P	0-12
P	6-12
P	0-18
K	0-18

*This treatment received no additional potassium, all other treatments received an equivalent of 40 lbs. per acre of K_2O added as K_2SO_4 the entire depth of the pot (0-18"). All pots received an equivalent of 10 lbs. per acre of nitrogen added as NH_4NO_3 the entire depth of the pot. Phosphorus was added as H_3PO_4 and calcium as $CaSO_4$ at the rate of 40 lbs. per acre of P_2O_5 and 800 lbs. per acre of $CaSO_4$, respectively.

Experiment II

This experiment was conducted to study the effects of calcium, placed in the rooting and fruiting zones, on certain reproductive and vegetative characteristics of Starr peanuts.

In order to treat the rooting zone and the fruiting zone separately, a special type container was designed (Figure 1). A circular galvanized pan, twenty-one inches in diameter and four inches deep was placed on top of a one gallon can. A 1.25 x 3.50 inch circular metal sleeve, located in the middle of the pan, connected the rooting and fruiting containers. The fruiting containers were coated with several coats of a black plastic paint to insure a moisture seal. The rooting containers were lined with plastic freezer bags. A gas dispersion tube was inserted through the bottom of each of the fruiting containers and extended to the bottom of the rooting containers. These dispersion tubes served as a means to change nutrient solutions in the rooting zone and as an aeration tube to the rooting zone.

White flint shot silica sand was used as a supporting medium for this experiment. The sand was washed several times with dilute hydrochloric acid and then washed several times with distilled water to remove the remaining chlorides. The sand was allowed to dry and then placed into each culture vessel. Each fruiting container received 21.79 kilograms of sand, resulting in a fruiting zone of 3.50 inches in depth. Each rooting container received 4.99 kilograms of silica sand.

The concentration of the salts used to supply the macro and micronutrients in the nutrient solutions used for this experiment were the same as those used by Bledsoe et al. (6). These concentrations were a modification of those originally recommended by Hoagland and Arnon (23).

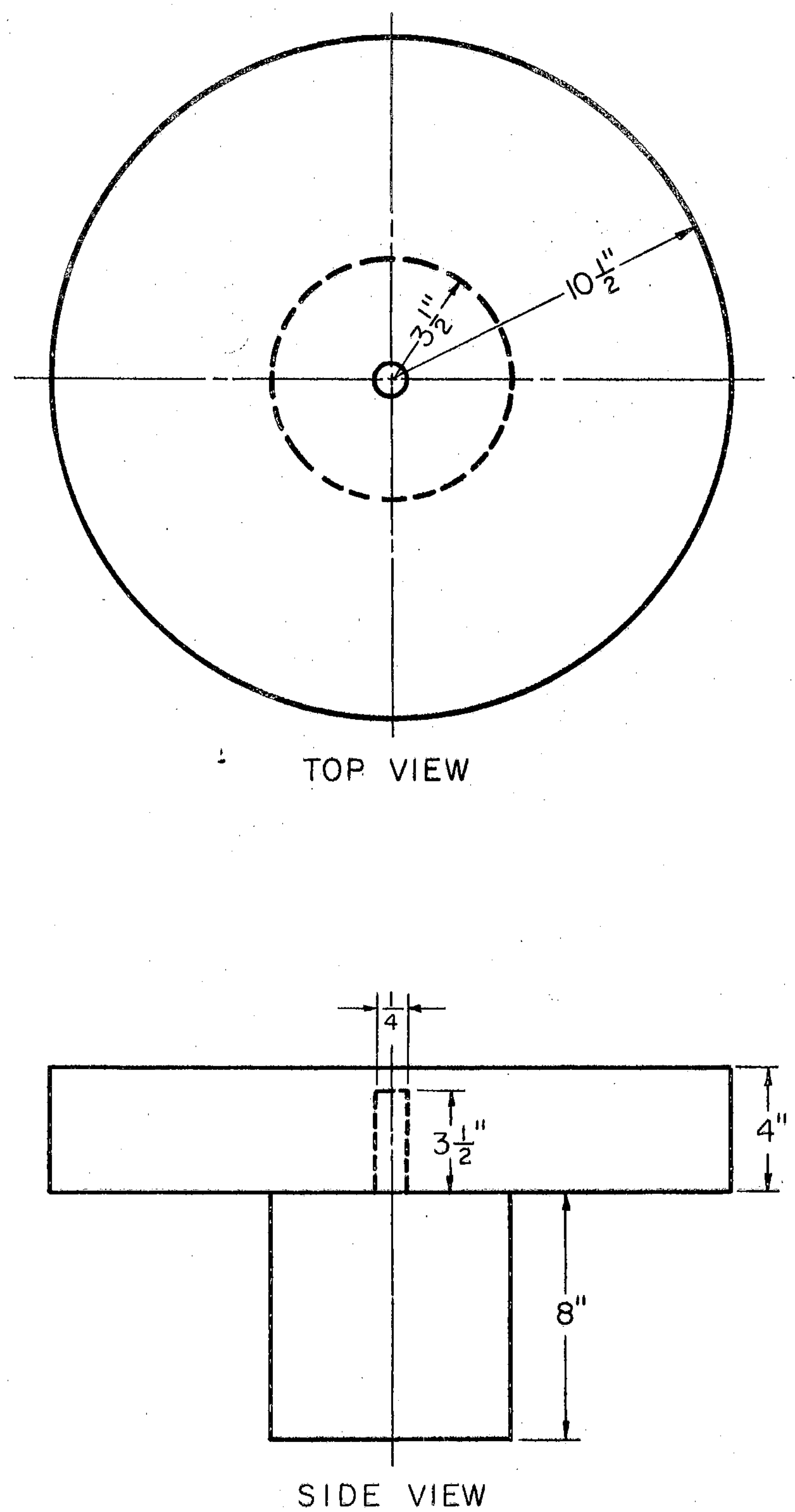

Figure 1. Top and side view of rooting and fruiting containers

The concentrations of the macronutrients were reduced to one half and the micronutrients reduced to one tenth of Hoaglands original solution. Ferrous iron in the form of ferrous sulfate was added when iron deficiency symptoms were observed on the peanut plants. All nutrient solutions were prepared using reagent grade chemicals and distilled water. The composition of the basic nutrient solution is shown in Table III. Additional calcium was added as calcium chloride. Sodium nitrate was used to maintain the same nitrogen level when the calcium source was omitted, as calcium was originally added as calcium nitrate.

This experiment was conducted in a greenhouse using a randomized complete block design with five replications. The fruiting zone of each culture vessel received one liter of its respective nutrient solution and the rooting zone of each culture vessel received 600 ml. of its respective nutrient solution.

Two inoculated Starr peanut seed were planted September 10, 1967, in the circular metal sleeves, connecting the rooting and fruiting containers. After two weeks only a total of three plants had emerged, therefore, an alternate method of germination was used. Thirty-five inoculated Starr peanuts were planted in five one gallon containers filled with washed quartz sand on September 25. On October 10 one plant, with as uniform growth as possible, was transplanted into the rooting medium of each container.

The rooting and fruiting zones were kept moist by daily applications of distilled water in order to maintain the nutrient solution levels in the containers. The nutrient solutions were changed every two weeks and the used solutions were analyzed for residual calcium.

A daily record of flower production was made during the flowering

TABLE III

BASIC COMPOSITION OF NUTRIENT SOLUTIONS

Source	Nutrient Supplied	Concentration of Nutrient (ppm)
$Ca(NO_3)_2 \cdot 4H_2O$	Ca	100.00
	NO_3	310.00
KNO_3	K	98.50
	NO_3	156.00
$MgSO_4 \cdot 7H_2O$	Mg	24.18
	S	31.83
KH_2PO_4	K	20.08
	P	15.95
$MnCl_2$	Mn	0.03
H_3BO_3	B	0.05
$CuSO_4 \cdot 5H_2O$	Cu	0.002
$ZnSO_4 \cdot 7H_2O$	Zn	0.005
$H_2MoO_4 \cdot H_2O$	Mo	0.005
$FeSO_4$	Fe	0.39
$CaCl_2$*	Ca	100.00
$NaNO_3$**	NO_3	310.00

*Additional calcium was added as $CaCl_2$

**$NaNO_3$ was used to maintain the same nitrogen level when the calcium source was omitted.

period. All plants were harvested on February 9, 1968 (129 days after planting) and separated into four parts: roots, leaves and stems, pegs with pods, and pegs without pods. The plant parts were dried in a forced air oven and the leaves were analyzed for total calcium. The unshelled peanut fruit were air dried, separated according to size, and the peanut shells were analyzed for total calcium.

CHAPTER IV

RESULTS AND DISCUSSION

Experiment I

Placing calcium, phosphorus, and potassium at various positions in the soil "profile" had little effect on reproductive and vegetative characteristics of Starr peanuts (Table IV).

The total phosphorus content of the peanut leaves was the only variable measured which represented significant differences among treatments. A comparison of all treatments showed that the phosphorus content of the peanut leaves was the highest when phosphorus was placed in the 0-12 inch soil interval whether in combination with calcium and potassium or in combination with potassium alone. The lowest phosphorus content of the peanut leaves occurred when calcium and potassium were added throughout the pot and no additional phosphorus was added. The wide variation among the phosphorus content of the leaves could not be explained in some cases. A few treatments which received no phosphorus were significantly higher than treatments that received an addition of phosphorus. This may have been partially due to the variations in phosphorus content of the untreated soil. The total phosphorus content of the peanut leaves is shown in Figure II and Table V.

There were no significant differences among treatments with respect to total calcium content of the peanut leaves (Table V). Possibly much of the added calcium was leached to the bottom of the soil containers.

TABLE IV

MEAN VEGETATIVE AND REPRODUCTIVE CHARACTERISTICS OF STARR PEANUTS AS INFLUENCED BY APPLICATIONS OF CALCIUM, PHOSPHORUS, AND POTASSIUM AT VARIOUS DEPTHS IN THE SOIL*

Treatment: Nutrient Added	Treatment: Placement (in.)	Dry weight of tops (g./pot)	No. flowers per pot	No. pegs per pot	Flowers producing pegs (%)	No. fruit per pot	Pegs producing fruit (%)
P, Ca	0-6	89.46	526.3	302.3	57.5	151.3	50.0
P, Ca	0-12	83.20	486.3	281.1	57.9	130.3	46.5
P, Ca	6-12	85.16	492.3	302.2	61.5	124.3	41.2
P, Ca	0-18	99.36	512.0	326.0	63.8	161.3	49.5
P, Ca**	0-18	102.96	520.4	313.6	60.1	126.0	40.1
Ca	0-12	96.23	470.4	268.1	58.0	115.3	43.0
Ca	0-18	102.66	503.3	295.8	58.7	141.3	48.0
P	0-6	90.06	545.3	297.3	54.5	142.0	47.8
P	0-12	99.00	562.3	268.9	47.8	116.3	43.3
P	6-12	100.60	524.0	270.1	51.6	143.7	53.2
P	0-18	103.26	558.3	337.4	60.1	154.7	45.9
K	0-18	96.20	515.3	266.7	51.6	143.0	53.8
F-value***		0.86	1.02	1.1	1.31	1.10	2.04
C.V. (%)		15.60	9.28	14.90	12.83	17.44	12.28

*All values are the means of three replications

**This treatment received no additional potassium; all other treatments received an equivalent of 40 lbs. per acre of K_2O added as K_2SO_4 the entire depth of the pot (0-18")

***F-values required are 2.27 and 3.24 at the 5% and 1% levels, respectively

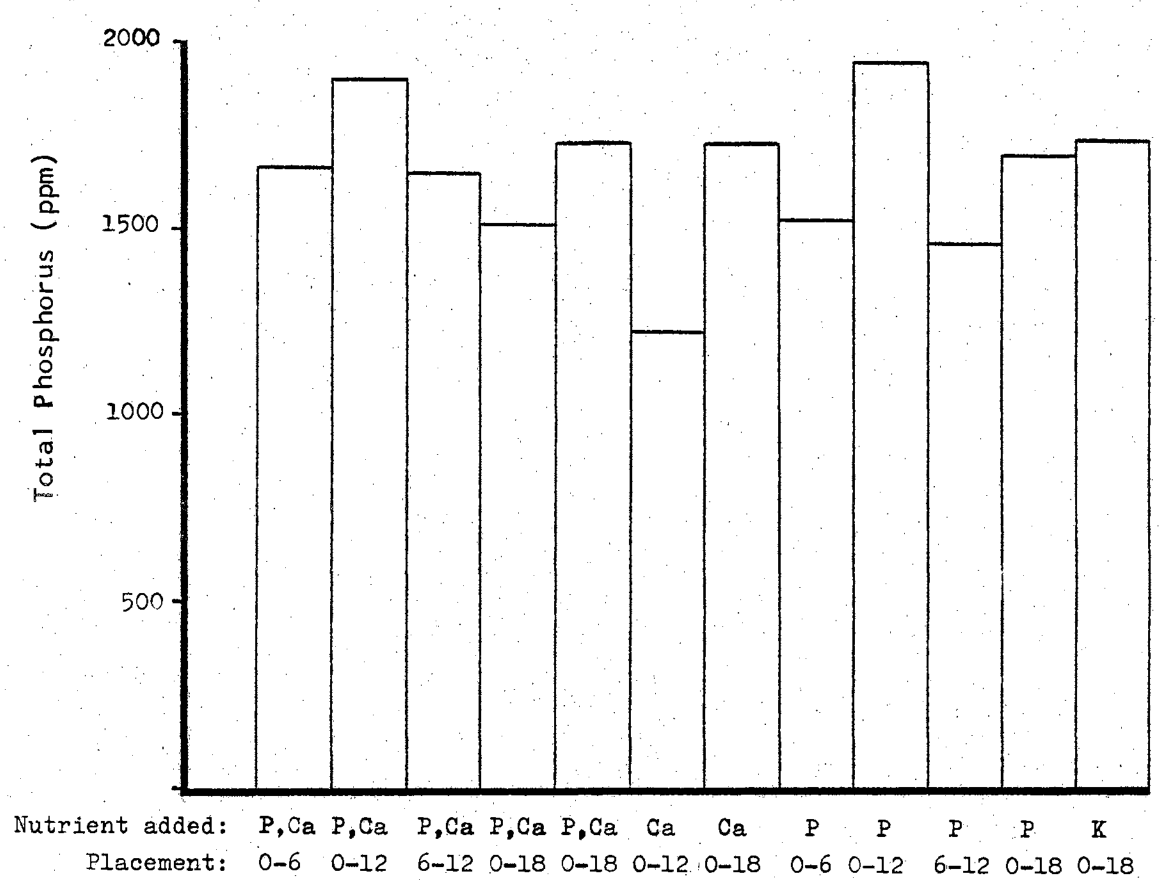

Figure 2. Total phosphorus content of peanut leaves.

TABLE V

TOTAL PHOSPHORUS AND CALCIUM CONTENT OF PEANUT LEAVES*

Treatment		Total Phosphorus	Total Calcium
Nutrient Added	Placement (in.)	(%)	(%)
P, Ca	0-6	0.166 ab**	2.53 a
P, Ca	0-12	0.191 b	2.50 a
P, Ca	6-12	0.165 ab	2.39 a
P, Ca	0-18	0.151 ab	2.37 a
P, Ca	0-18	0.164 ab	2.23 a
Ca	0-12	0.122 a	2.42 a
Ca	0-18	0.164 ab	2.40 a
P	0-6	0.153 ab	2.43 a
P	0-12	0.195 b	2.42 a
P	6-12	0.146 ab	2.31 a
P	0-18	0.170 b	2.32 a
K	0-18	0.175 b	2.33 a
F-value***		2.75	0.49
C.V. (%)		12.50	8.20

*All values are the means of three replications

**Means within a column having different letters are significantly different at the 5% level

***F-values required are 2.27 and 3.24 at the 5% and 1% levels, respectively

Root growth was affected by the various nutrient treatments, but it proved virtually impossible to recover all of the root system. No data were therefore given on the peanut roots.

None of the reproductive or vegetative characteristics of Starr peanuts were affected by treatment (Table IV).

Total kernel yield expressed either as the number of kernels held on a 15/64 x 3/4 inch screen or as the air dry weight of the kernels held on the same size screen was not significantly affected by treatment. Although no significant differences were observed between treatment means, it was interesting to note that the highest peanut yield was produced when potassium was the only nutrient added and the lowest yield was produced when no potassium was added. The number of kernels produced per pot and the weight of kernels produced per pot are shown in Table VI.

Reproductive efficiency was determined by computing the percentage of flowers producing pegs, the percentage of flowers producing fruit, and the percentage of pegs producing fruit. None of these components of reproductive efficiency was significantly affected by treatment (Table IV).

There was considerable variation between replications for the variables measured. Possibly the variations between the reproductive and vegetative characteristics of each individual peanut plant was as great as the variation due to each individual treatment.

Experiment II

The omission or addition of calcium from the sand culture mediums in separated rooting and fruiting containers had varied effects on

TABLE VI

MEAN KERNEL YIELD AND SIZE DISTRIBUTION*

Treatment		Kernels held on a 15/64 x 3/4 inch screen		Total weight of kernels
Nutrient Added	Placement	Number	Weight(g.)	(g./pot)
P, Ca	0-6	143.1	56.4	65.75
P, Ca	0-12	116.2	46.2	52.80
P, Ca	6-12	132.6	52.0	58.06
P, Ca	0-18	144.3	57.1	64.13
P, Ca	0-18	103.3	40.8	48.16
Ca	0-12	105.4	41.6	48.57
Ca	0-18	112.6	44.6	51.90
P	0-6	140.7	55.8	61.93
P	0-12	109.1	43.0	51.63
P	6-12	136.3	53.6	62.86
P	0-18	130.0	51.4	59.30
K	0-18	150.0	59.0	68.93
F-value**		1.54	1.59	1.46
C.V. (%)		18.42	18.04	18.91

*All values are the means of three replications

**F-values required are 2.27 and 3.24 at the 5% and 1% levels, respectively selected vegetative and reproductive characteristics of Starr peanuts.

The dry weight of the peanut leaves and stems was not significantly affected by calcium treatments. The number of flowers produced per pot was not significantly different among treatments (Table VII).

As the peanut plant produces many of its pegs close to the basal stem, some problem of diverting the pegs to enter their respective fruiting zone was introduced. A few pegs from each peanut plant had to be removed to prevent pegging in the rooting zone. Since the number of pegs removed was small, and was essentially the same for every plant, it was assumed that this had no effect on data presented. Most of the pegs produced above the circular sleeve could be diverted to peg in their respective fruiting zone when the pegs reached sufficient length.

The number of pegs produced per pot was significantly higher when additional calcium was added to the rooting zone. The omission of calcium from the fruiting zone had no effect on peg production. The percentage of flowers producing pegs was not significantly effected by the various calcium treatments (Table VII).

The number of fruit per pot and the percentage of pegs producing fruit were significantly higher when a complete nutrient solution was added to both the rooting and fruiting containers. The number of fruit and the percentage of pegs producing fruit were not significantly different when the rooting zone received a complete nutrient solution or complete plus additional calcium, if the fruiting zone contained a minus calcium nutrient solution (Table VII).

Kernel yield expressed as the air dry weight of unshelled nuts or as the air dry weight of shelled nuts was significantly higher when a complete nutrient solution was added to the rooting and fruiting

TABLE VII

MEAN VEGETATIVE AND REPRODUCTIVE CHARACTERISTICS OF STARR PEANUTS AS EFFECTED BY VARIOUS CALCIUM TREATMENTS IN SEPARATE ROOTING AND FRUITING CONTAINERS*

Treatment** Root Zone	Treatment** Fruit Zone	Dry weight of leaves and stems (g./pot)	No. flowers per pot	No. pegs per pot	Flowers producing pegs (%)	No. fruit per pot	Pegs producing fruit (%)
C	C	7.19 a***	52.0 a	25.4 a	49.26 a	14.2 b	55.76 b
C	-Ca	7.39 a	53.0 a	26.0 a	49.14 a	7.2 a	27.60 a
C + Ca	-Ca	7.55 a	59.6 a	31.8 b	53.30 a	9.0 a	28.26 a
F-value****		.80	3.63	8.54	1.73	18.50	35.14
C.V. (%)		59.15	8.86	9.70	7.95	18.66	16.63

*All values are the means of five replications

**C represents a complete nutrient solution; -Ca represents a complete nutrient solution with the absence of calcium; C + Ca represents a complete nutrient solution plus additional calcium

***Means within a column having different letters are significantly different at the 5% level

****F-values required are 4.46 and 8.05 at the 5% and 1% levels respectively containers. There were no significant differences between kernel yield when a complete or complete plus calcium nutrient solution was added to the rooting zone, if the fruiting zone contained a minus calcium nutrient solution. Additional calcium in the rooting zone appeared to have some effect on size distribution of kernels. Kernel yield and size distribution of kernels are shown in Tables VIII and IX.

Although some workers have indicated that Spanish peanuts are less exacting in their demands for calcium in the fruiting zone than the large-seeded type peanuts (14, 27), these data suggest that Starr peanuts need calcium in the fruiting zone for proper development of fruit.

The leaves and shells of the peanut plant were analyzed for total calcium and the results are shown in Figure 3 and Table X. The calcium content of the leaves was significantly higher when additional calcium was added to the rooting zone. Omission of calcium from the fruiting zone caused a reduction in the total calcium content of the peanut leaves, when the rooting zone received a complete nutrient solution. This was thought to be due to an extra demand on the calcium supply. The calcium content of the peanut shells was significantly higher when both the rooting and fruiting zones received a complete nutrient solution. Additional calcium in the rooting zone did not increase the calcium content of the peanut shells.

TABLE VIII

MEAN KERNEL YIELD*

Treatment: Root Zone	Treatment: Fruit Zone	Air dry weight of unshelled nuts (g./pot)	Air dry weight of shelled nuts (g./pot)
C	C	5.47 b**	4.03 b
C	-Ca	0.77 a	0.36 a
C + Ca	-Ca	1.62 a	1.08 a
F-values***		29.68	25.23
C.V. (%)		46.15	42.74

*All values are the means of five replications

**Means within a column having different letters are significantly different at the 5% level

***F-values required are 4.46 and 8.05 at the 5% and 1% levels, respectively

TABLE IX

SIZE DISTRIBUTION OF KERNELS*

Treatment		Number of kernels	Percent of total
Root Zone	Fruit Zone		
		Held on a 15/64 x 3/4" screen	
C	C	10.0	65.80
C	-Ca	0.0	0.00
C + Ca	-Ca	1.8	27.70
		Held on a 12/64 x 3/4" screen	
C	C	3.0	19.73
C	-Ca	1.4	36.84
C + Ca	-Ca	2.2	33.84
		Passed through a 12/64 x 3/4" screen	
C	C	2.2	14.47
C	-Ca	2.4	63.16
C + Ca	-Ca	2.5	38.46

*All values are the means of five replications

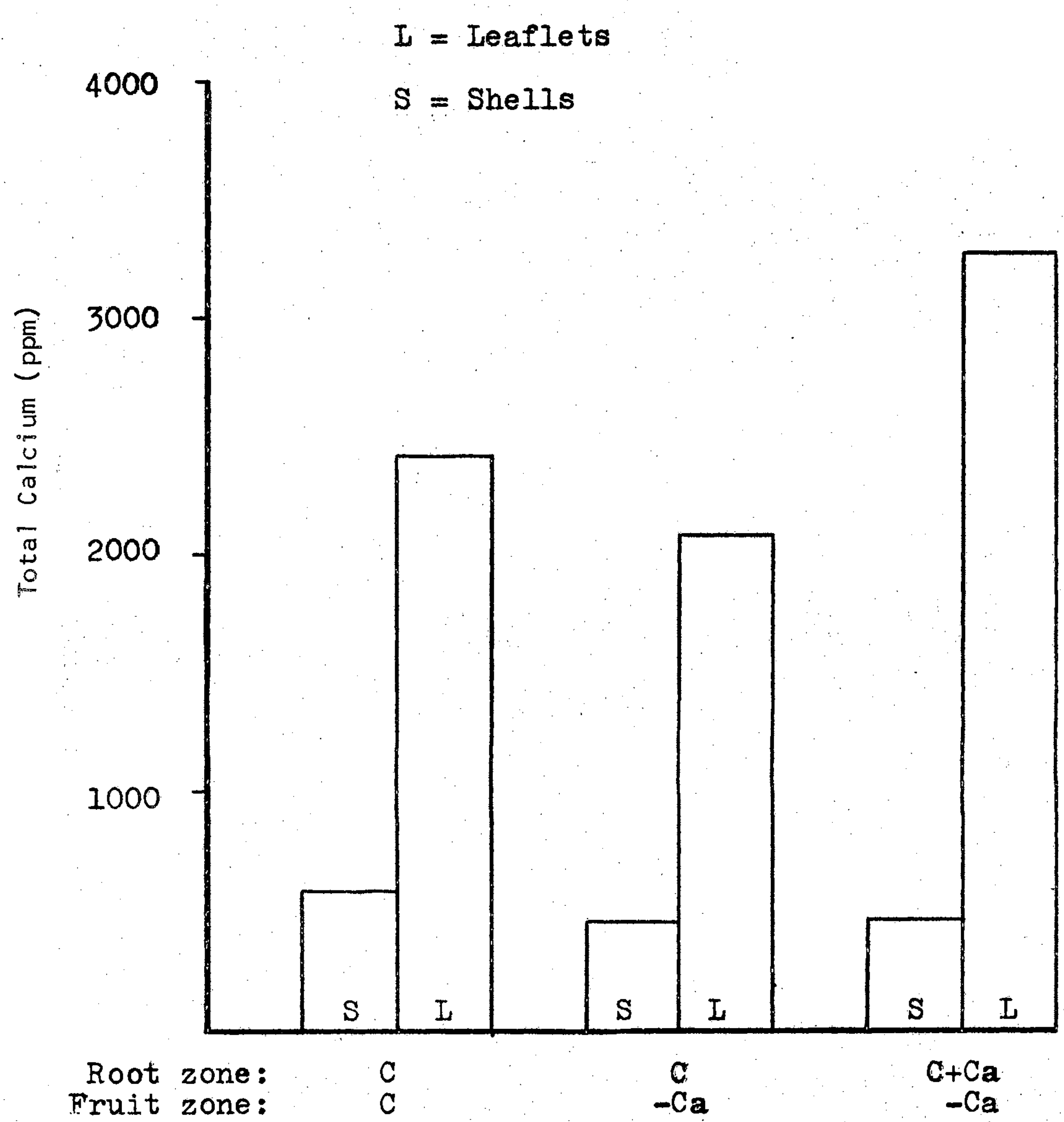

Figure 3. Total calcium content of peanut plant parts

TABLE X

TOTAL CALCIUM CONTENT OF PEANUT PLANT PARTS*

Treatment		Total Calcium (%)	
Root Zone	Fruit Zone	Shells	Leaves
C	C	0.0575 b**	0.242 a
C	-Ca	0.0450 a	0.219 a
C + Ca	-Ca	0.0465 a	0.329 b
F-values***		4.96	6.63
C.V. (%)		13.73	6.10

*All values are the means of five replications

**Means within a column having different letters are significantly different at the 5% level

***F-values required are 4.46 and 8.05 at the 5% and 1% levels, respectively

CHAPTER V

SUMMARY AND CONCLUSIONS

Selected vegetative and reproductive characteristics of Starr peanuts, as affected by application of certain nutrients placed at various intervals in the soil, were studied in an outside pot experiment (Experiment I). None of the vegetative or reproductive characteristics measured were significantly affected by any treatment. Total phosphorus content of the peanut leaves was the only variable measured that presented a significant difference.

The response of Starr peanuts to various calcium treatments in separate rooting and fruiting containers was studied in a greenhouse experiment (Experiment II). A complete nutrient solution, added to both the rooting and fruiting zones, significantly increased: (1) percentage of pegs producing fruit (2) number of kernels per plant (3) weight of kernels per plant and (4) total calcium content of the peanut shells. Additional calcium, added to the rooting zone when the fruiting zone received a minus calcium nutrient solution significantly increased: (1) number of pegs per plant and (2) total calcium content of the peanut leaves. When calcium was omitted from the fruiting zone and the rooting zone received a complete nutrient solution fruit production was definitely limited. Additional calcium in the rooting zone did not increase kernel yield significantly.

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