EFFECT OF FERTILIZER PLACEMENT METHODS AND TIME OF APPLICATION ON YIELD AND GRADE OF PEANUTS

By

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CHAPTER I

INTRODUCTION

In Oklahoma peanuts generated a yearly average income of 40,000,000 dollars during the three-year period of 1975-1977. Peanuts produce the highest crop value per hectare of any crop grown in the state, although they rank fifth in total crop value. Approximately 48,564 allotted hectares exist in Oklahoma (30).

Spring fertilization of peanuts is the most common time for application, although research by Hallock (14) and others (23, 35, 47, 48) have pointed to benefits from indirect or applications previous to planting. Fall fertilization could take advantage of better weather conditions as well as an increased fertilizer supply.

Different methods of fertilizer applications, such as seed placement, banding, broadcast, broadcast plowdown, broadcast-disked, and foliar applications have been researched for various crops, including peanuts with varying results.

Although work has been carried out in Oklahoma concerning time and placement of applications of various fertilizers (30, 51), more research was thought to be needed in this area.

Two experiments were initiated to study the effect of time and placement of fertilizer on peanut yields and grades.

Other than our specific fertility treatments, both studies were managed by the cooperator as part of his field.

CHAPTER II

REVIEW OF LITERATURE

Peanut fertility studies have produced numerous conflicts in the literature concerning the specific benefits from applied nutrients. Brady et al. (8) attributes these differences to the complexity of the peanut fruiting system. Further examination of this system, along with other morphological-physiological characteristics, is of importance.

Morphology and Physiology

Roots of mature peanut plants (*Arachis hypogaea L.*) may extend 0.9 to 1.2 meters deep (13). This tap-rooted legume has many lateral branch roots as well. Nodules are abundant on the mature plant when sufficient and specific bacteria are present. Gregory et al. further state that peanut roots have no true epidermal layers and thus a noticeable absence of root hairs.

Gregory et al. (13) describe the leaves of (*A. hypogaea*) to be pinnate in form and obovate to elliptical in shape. They add that stomata are present on the dorsal as well as the ventral surface of the leaf.

Smith (46) describes the peg of a peanut plant to be an elongation of the ovary itself and not a gynophore (an ovary stalk). The geotropic elongation occurs until the peg enters the soil to a depth of from 2-7 cm. At this point, the horizontal-positioned pod begins to form.

The fruiting organ (peg plus pod) has been shown to absorb calcium phosphorus, cobalt, sulfur, molybdenum, and lithium (20).

Ca-K Antagonism

Research by Colwell and Brady (12) in the forties has pointed to the significance of Ca in the fruiting zone. These researchers, as well as many others, have reported the competition between Ca and K for absorption by the fruiting organ.

Mehlich (27) stated three important concepts to remember concerning peanut nutrition: (1) the rooting and fruiting zones have different nutritional needs, (2) the fruiting organ must absorb the majority of its own Ca, (3) there must be a nutritional balance in the fruiting zone. He explains that Ca application to the fruiting zone contributed to the highest average overall fruit fill percentages. K application in the absence of Ca was found to increase shoot growth at the expense of quality mature fruit (10). Harris (19) explained that although low levels of K may limit yield, added K did not produce a better quality fruit. He found the best top growth was obtained when distilled water or nutrient solution minus Ca was supplied to the fruit zone and a complete solution was supplied to the root zone. Yields of nuts were consistently reduced where top growth was enhanced. This is not to say K should be disregarded in peanut nutrition. Without K application at some point in the fertility program, K deficiencies will occur (43).

When the peg enters the soil, no further Ca nourishment from the "mother plant" is experienced by the peg (19). Scarsbrook and Cope (43) state that Ca cannot be absorbed by the roots and translocated to the fruit in sufficient quantities to produce good yields. Hallock (14) and others (8, 27) have suggested high available soil K levels in the fruiting zone may compete with Ca for pod absorption although high levels of K can be partially reduced by further Ca additions (12). Levels of available soil K from fertilizer applications, however, have remained quite high inspite of Ca applications and leaching of soils (11, 14, 49).

Mehlich (27) in North Carolina found a balance of Ca, K, and Mg to be the solution to the Ca-K antagonism. A Ca/Mg ratio of 5 and a Ca/K ratio of 12.5 were found to be optimum in light-textured soils. He adds that a supplemental application of Ca to the fruiting zone should be made for highest yields. Lime (672 to 896 kg/ha CCE) and K (33.6 kg/ha) were found to be the critical levels for peanut production, however, a singular application of either nutrient when both are deficient produces little effect on yield (20, 41).

Seasonal Effects on P and K Fertilization

Nelson and Uhland (35) reported that fall application of fertilizer to spring-planted crops was just as effective as spring applications in some parts of the nation. On warmer, sandier soils, reports of losses from fall fertilization have resulted (26). Application of fertilizer in the fall subjects the nutrients to a longer period in which certain climatic, textural, and topographic influences can affect their residual availability (35).

Fall P applications have become an accepted practice on many crops (35). Phosphorus has very little mobility in the soil, thus, leaching is not a problem. Loss of extractable P may result due to microbial blooms, high organic matter content, or soil clays which trap P in the interlayers of their lattice structure (50). Phosphorus may also combine with other nutrients such as Ca or Zn to form relatively insoluble precipitates (39, 44, 45, 48). Any reversion or tie-up of P will take place fairly rapidly after either fall or spring applications and will probably occur before plants are ready to absorb significant amounts (32). Olsen (36) stated P applications differ very little in effectiveness in most cases with respect to time.

Many reports of P build-up are discussed in the literature (38, 48, 49). Forty to sixty percent of applied P may be retained in a well-limed soil (50). Residual P has even been found in sandy soils where P movement rarely exceeds 46 cm in depth (11, 44, 48, 49).

Fall K applications would not only subject K to fixation on some soils, but also enhance any leaching properties of a soil (35). Fixation of K on light-textured soils, however, is probably not a problem (48, 49). Nelson et al. (32) explain increased K mobility in sandy soil could lead to significant leaching following fall fertilization, especially in high rainfall areas. However, Lutrick (26), reported K applied at the rate of 224 kg K_2O/ha did not move below the 15-30 cm zone in a 108 cm rainfall area. In fact, on limed plots, K applied at the rate of 112 kg/ha, K_2O did not move below 15 cm in a loamy fine sand.

Many authors (14, 16, 48, 49, 50) have reported the application of K in the fall, preferably in combination with a cover or rotation crop, to be a desirable practice for peanuts. Incorporated K could move down into the rooting zone and provide a more uniform distribution. This would decrease any chance of absorptive competition between K and Ca during pod uptake. Direct K application to "Jumbo" runner peanuts in previous well-fertilized soil was found to compete with Ca for uptake by the peg, while both P and K fertilizations produced no significant yield increase during a five-year period (14).

Fertilizer Placement

Bray's (9) concepts of nutrient mobility place vital importance on the root absorption areas. Nitrogen, he states, is highly mobile in the soil and, as such, is very efficiently mined by the whole rooting system. Phosphorus, rather immobile, is primarily absorbed by root surfaces in small zones surrounding the root. Renewal of this zone is highly dependent on mass flow and diffusion as well as rate of release from the renewal source. Potassium, falling between N and P in mobility, is highly available to the root surface, but availability, he states, is limited by distance from the surface since it must first be displaced from one exchange site to another closer to the surface of the root. Bray concludes that banding or close placement would benefit the more immobile nutrients due to increased concentration and resulting solubility.

According to Salter (42), one disadvantage of row placement is salt injury or higher osmotic potential in the band causing cells of young plants to plasmolize. The higher osmotic potential may also interfere with water imbibition by the seed. Advantages, he states, include rapid early growth, early maturity, and greater efficiency in high fixing soils. He recommends small portions of fertilizer be placed, with the majority broadcast on sandy soils when legumes are grown.

Nelson et al. (32) reported higher radioactive P uptake by corn when P was banded compared to P broadcast. However, they found no significant yield increases of the banded method over the broadcast method of placement. Apparently, banded treatments supply a concentrated zone close to the root surface and thus produce an early vegetative response (18).

Climatic conditions, such as cool, wet weather, have been reported to favor band placement of P and K. Dry and hot conditions have been reported to favor broadcast incorporated applications (15, 17, 18, 25, 52). Ketcheson (25), working with corn plants under greenhouse conditions, found accumulations of dry matter from banded applications of P to be higher at 13° C than 20° C when compared to mixed placement. Barber (1) reported no difference between broadcast, incorporated, or band placement on yields when applied to a rotation of corn, soybeans, alfalfa, and wheat. Apparently, higher rainfall or irrigated conditions cause K^+ to become more active in soil solution and easier for plants to absorb. Dry conditions influence plants to remove K from lower, wetter portions of the profile where K is more concentrated. When the K fixing power of soil is low, band and broadcast placement of K produce similar yield results (3). Ham et al. (18) reported row-placed P decreased yields of soybeans when compared to the check plots for 2 consecutive years under a 60 cm rainfall regime. They further stated that yield was not related to plant height.

Bray (9) states that since plants vary in their rooting habits and their abilities to remove nutrients from the soil, then fertility patterns must also change from specie to specie for the most beneficial effects. Barber (2) found corn and soybean nutrient assimilation to vary considerably with time. Influx of P in corn steadily declines with age. When corn plants are young, the roots absorb 3 to 4 times as much P and K as young soybean plants. Soybean plants were found to have 1/5 of the root length density in 0-15 cm soil zone as corn plants. However, when soybeans reached 50 to 80 days growth, influx of P increases considerably. Soybean roots absorb 8 to 10 times as much P compared to corn roots in this period. This data, he states, indicates a need for the entire rooting zone to be fertilized rather than banding close to the soybean plant. This increased area would supply the soybean with adequate nutrients through the 50-80 day growth period.

Nelson and Stanford (33) state that placement of multinutrient liquid or solid fertilizer would essentially produce the same effects as single nutrient carriers as long as their solubilities were of a similar order. In practice, any consideration to use of multinutrient liquid fertilizers should include comparisons of cost per pound of nutrient with any actual convenience (34).

Thompson and Robertson (47) found peanut yields to respond inconsistently to placement of P and K fertilizers on a well-managed, loamy fine sand. No differences in corn yields were produced between banded and broadcast placement on a Muscatine loam (52). Welch et al. (52) reasoned that P absorption must have been indirectly related to previous fertility status. In any event, as native fertility is increased by fertilizer applications, differences in time and methods of placement will become smaller (35).

Foliar Fertilization

Foliar fertilization is not a new idea. It has been practiced since 1844 when Fe salts were first applied to plants (54). Foliar fertilization is an accepted practice in many tree and vegetable crops, while its use on field crops has met with mixed success (53).

Most all parts of plants can absorb nutrients to some degree, but the majority of foliar-applied nutrients enter the plant through the leaf surface (53). Nutrients enter through the wax platelets which combine to form the cuticle of the leaf. Entry may also take place through imperfections in the leaf as well as through stomatal openings (53).

Wittwer et al. (54) reported nutrient absorption to be enhanced by presence of stomata due to the large number of ectodesmata present around the guard cells. Ectodesmata, they explain, provide an additional pathway for nutrients after cuticle penetration has occurred. They add that humidity not only increased nutrient entry by causing the wax platelets of the cuticle to spread apart, but it also produces more turgid leaves and thus more ectodesmatal openings for translocation.

Wittwer and Teubner (53) state that leaf cuticles are more permeable to cations than anions. Nitrogen uptake was heavily dependent on humidity. Potassium absorption was more rapid than P uptake. Haynes and Goh (22) report N and P must be complexed by sugars before they can be assimilated by the leaf. Active aborption is responsible for K entry into the leaf.

Boynton (7) reported wetting agents, or surfactants to decrease the angle of contact of solution droplets and enhance uptake through the stomata and cuticle.

Ramon and Hanway (38), using a N, P, K, S foliar spray on soybeans, reported yield increases which were primarily due to increased number of pods filled. They proposed that, during the latter stages of plant growth, a net decrease in nutrients occurs in the leaves. Apparently, roots lose out to the developing seed for outgoing photosynthate from the leaves. Roots then begin to die and less nutrients are translocated to the leaves. They state that, since the supply of nutrients to the leaves has been disrupted, an accompanying loss in yield of beans takes place. They purport the optimum ratio of nutrients to be 10:1:3:0.5 for N, P, K, and S, respectively. They further state that all four nutrients must be applied or no increase in yields would result since the ratios of these nutrients are similar to those of seed contents. Optimum time of spray was between R5 - R7 growth stages (from full bloom to appearance of pods in plant tops with lower pods beginning bean fill).

Robertson et al. (39), using rates of 28-2.9-8.4-1.2 kg/ha (N-P-K-S) with 1 to 5 sprayings, could not produce any yield increase. They reported 15% of the crop canopy to be burned by the first application alone. They explained that foliar applied nutrients produced little nourishment to the plant since sprayed leaves fell off.

Boote et al. (6) proposed that if foliar fertilization benefits plants by prolonging the nutrient source to the leaves and delaying the onset of senescence, then photosynthesis must occur for a longer period of time to make up for sugars and energy lost to nutrient uptake by the leaf. Their findings do not support this theory and in fact, no significant yield, seed number, or photosynthetic period increases were measured on 'Bragg' soybeans.

Nagel et al. (31) working with a TVA formulated NPKS solution found yield decreases resulting from leaf injury. They attributed these losses to leaf reductions and yet some treatments had no injury or yield increases. Nagel et al. rejected the early morning, high humidity theory of foliar fertilization enhancement. They propose evening applications to be advantageous due to a surplus carbohydrate supply which the plant could trade for leaf uptake of nutrients.

Keogh and Maples (24) using banded rates of 0, 28, and 56 l/ha of 9-7.9-7.5 (N-P-K) with two subsequent foliar applications (37 l/ha of 9-7.9-7.5 at first bloom and 37 l/ha of 15-2.2-4.2 at pod swell) failed to produce any significant yield increases of soybeans. Location differences ranged from no differences to significant decreases in yield from their other experiment involving foliar applied N-P-K-S. Leaf damage was increased with number of sprayings. Results from N-P-K foliar and row placed studies produced no injury by first bloom in 1978. Although row placed treatments produced taller plants, no significant increases in yields were obtained.

Tucker and Westerman (51), working with the TVA N-P-K-S formulation, found yield of Spanish peanuts to decrease with each additional spraying due to leaf injury.

Barel and Black (4), conducting screening trials for foliar P compounds, state that no P compounds capable of supplying substantial quantities of P without leaf injury were available previous to 1979. Orthophosphoric acid, a widely-used compound, produces leaf injury when applied at rates greater than 0.5% P. They state that young plants can only tolerate a 2 to 3 kg/ha accumulative rate. They suggest usage of tripoly and tetrapolyphosphate as possible foliar P compounds for corn. Soybeans produced significant yield increases only at the 18% statistical level of confidence. Orthophosphate decreased yields causing 10% leaf damage after the first spraying (5). Parker and Boswell (37), using K-polyphosphate, NH_4-polyphosphate, urea, and KCl as sources of N-P-K-S at the 28-2.9-9.5-1.7 kg/ha rate, found foliar applications to decrease yields and cause leaf injury for almost all treatments. The most severe leaf burn on soybean plants occurred with three foliar doses of K-polyphosphate. They found N levels due to foliar spray to increase only in seeds, P levels to increase only in leaves, while K levels were not affected.

Fertility Effect on Quality of Peanuts

Hallock (15) explains low soil Ca and high rates of K in the fruiting zone provide a more optimum growth medium for both (*Pythium myriotylum*) and (*Rhizoctonia solani*), pathogens causing podrot disease in peanuts. Moore and Wills (28) found no correlation between level of Ca applied to the soil and degree of pod breakdown by podrot pathogens.

Hallock and Garren (16) reported 3360 kg of gypsum/ha (a high rate) consistently reduced pod breakdown and increased SMK grades. K_2SO_4 and KCl were found to produce negative effects on both podrot and SMK when applied at higher rates. With gypsum application, sound mature fruit shells increased from 3% to 13% in Ca content and yield increased more than 560 kg/ha.

Micronutrients

Peanut field experiments have often shown only small responses to micronutrient fertilizers and many have resulted in no significant increases in yield (11, 23, 33, 40). Jones et al. (23) reported the "shotgun" or mixture approach for supplying micronutrients complicated results. They propose use of only the needed micronutrients. Scarsbrook and Cope (43) report positive responses using micronutrient mixtures. Yield increases of peanuts were not coupled with improved fruit quality, however. Morrill and Chrudimsky (29) found no significant increases in yield from soil applications of Zn, Mn, B, Fe, and Mg when applied in the presence of 45-90-90 (N-P-K-kg/ha). When applied foliarly, these nutrient applications injured the leaves and produced inconsistent yields.

"Hollow heart" disease in peanuts has been effectively reduced by B additions by several researchers (21, 30). Boron levels of 0.6-1.1 kg/ha have proven effective in increasing yields of Spanish peanuts.

CHAPTER III

METHODS AND MATERIALS

Experiment I

On December 3, 1978, this experiment was established on the Keeton farm (irrigated), 1.6 kilometers west of Willis, Oklahoma. The experiment was designed to determine the effect and/or differences of fall and spring applied P, K, and P+K applications on the yield and quality of Florunner peanuts. A randomized complete block design with four replications was used. Plot size was 4-91 cm rows in width and 30.5 meters in length, utilizing 6.1 m alleys.

Four treatments (Table I) were applied using a Barber, 3-pt. spreader. Phosphorus (29 kg/ha) and/or potassium (56 kg/ha) were applied separately and in combination. Sources of P and K were concentrated superphosphate and KCl, respectively. A blanket application of 84 kg/ha N as ammonium nitrate was applied to facilitate growth of a winter rye cover crop. All fertilizer applications were disked-in prior to planting the rye.

On March 30, 1979 (Table I), phosphorus and potassium were applied at the same rates and combinations as in the fall. Sources and methods used were also the same. An additional treatment of sterilized steer manure (4480 kg/ha) was hand applied as a separate treatment.

TABLE I

SEASONAL APPLICATION RATES OF P, K, AND MANURE

	Time of Application	
Treatments	Fall, Dec. 3, 1978	Spring, Mar. 30, 1979
	------------Kg/ha	--------------
Check	0	0
Manure	0	4480
P	29	29
K	56	56
P + K	29 + 56	29 + 56

On May 29, 1979, plots were planted to Florunner peanuts at the rate of 112 kg/ha. A John Deere flex-planter Model 71 was used in all planting operations.

Although plots received some chemical weed control by the cooperator, competition with yellow nutsedge (Cyperus esculentus) was evident. A blanket application of approximately 67 kg/ha K_2O was mistakenly applied to the entire study by the cooperator in the Spring of 1979.

The plots were harvested on October 17, 1979, using a digger-inverter. The alleys were cleared previous to digging and the two center rows were taken for harvest. Visual podrot ratings, from 1 (least affected) to 10 (most affected), were given to each plot at this time. Rains required an extra turning operation using the digger-inverter minus the undercuts. One plot was lost due to winds that accompanied the rains. High winds caused partial windrow losses on some plots. Peanuts were weighed and sacked in the field, using a sacking attachment on a Long PTO-driven combine (1900 rpm). Two-minute waiting periods were allowed for nut clearance from the combine between each plot.

Statistical analyses were run on yield, podrot, and grades using the SAS GLM procedure. Yields were averaged to 22.9 m of row. Samples from each plot were sent to the Oklahoma Federal-State Inspection Service to be graded for sound mature kernels (SMK), sound splits (SS), total sound mature kernels (TSMK), other kernels (OK), total kernels (TK), and % hulls (HU).

Experiment II

On March 29, 1979, a second experiment was initiated on the Dougherty loamy fine sand at the Keeton farm. This experiment was designed to measure the effect of band, broadcast, and foliar methods of application of fertilizers on peanut grades and yields. A randomized complete block design, with four replications and 15 treatments was used in this study (Table II). Plot size was four 91 cm rows in width and 18.3 meters in length. Alleys of 3.1 meters between blocks within replications and 6.1 m alleys between replications were used. Soil samples were obtained from a composite of twenty cores (0-15 cm depth) from each plot. Soil samples were analyzed by the Oklahoma State University Soil and Water Service Laboratory. Overall means of the various soil properties and nutrients are shown in Table III.

The Spanish peanut variety 'Tamnut 74' was planted at a rate of 67 kg/ha. A John Deere two-row planter equipped with rolling disk

TABLE II

TREATMENT SOURCES FOR BAND, BROADCAST, AND FOLIAR APPLICATIONS

Treatment	Source		Placement		Foliar	
No.	N - P - K	Micro	Band	B'cast	Micro	N-P-K
1	0-0-0	0	0	0	0	0
2	"	+	+	0	+	0
3	3-7.9-15	0	+	0	0	0
4	"	0	+	0	0	+
5	"	+	+	0	0	0
6	"	+	+	0	+	+
7	9-7.9-7.5	0	+	0	0	0
8	"	0	+	0	0	+
9	"	+	+	0	0	0
10	"	+	+	0	+	+
11	10-8.7-8.3	0	0	+	0	0
12	"	+	0	+	+	0
13	18-20-0	0	0	+	0	0
14	"	+	0	+	+	0
15	"	+	0	+	+	0

TABLE III

MEAN SOIL TEST VALUES[†]

		Soil Test Index							
pH	B.I.	NO$_3$-N[‡]	P	K	Ca	Mg	Fe	Zn	Mn
		kg/ha					ppm		
6.75	6.8	11.3	334	530	618	60	17.4	4.3	47.7

[†] Each value represents the mean of 20 cores/plot X 60 plots

[‡] (0-15 cm) zone

openers facilitated simultaneous planting and band applications of fertilizer. A 57-liter steel container was mounted on the planter to hold liquid fertilizers. A five-roller PTO pump in combination with a two-row manifold with outlets behind the openers, was used for band placement. The band was placed approximately 5 cm beside and 5 cm below the seed.

Macronutrient sources (Table IV) for band placement were 3-7.9-15 or 9-7.9-7.5 (N-P-K) applied at a rate of 56 l/ha. These sources were applied alone or in combination with a mixture of five micronutrients. Keybar^R liquid EDTA chelated sources were used for Cu and Zn. FeNaHEDTA and $MnNa_2EDTA$ (Hampshire^R) liquid chelates were used as sources for Fe and Mn, respectively. Solubor^R was used as the B source. Rates are shown in Table V.

Broadcast-disk applications had sources of 10-8.7-8.3 and 18-20-0 for macronutrients. These sources were applied with a 3-pt Barber spreader at rates of 67.2 and 96.3 kg/ha, respectively. These rates were applied alone and in combination with the previously mentioned micronutrients. Na Ferric EDDHA, Cu EDTA, Na_2Mn EDTA, and Na_2Zn EDTA Sequestrene^R chelates were used as sources for Fe, Cu, Mn, and Zn, respectively. These micronutrients were mixed with 26.5 l of water and applied with a 3½ m spray boom in combination with a 5-roller PTO pump. Both macronutrients and micronutrients were disked-in before planting.

Foliar applications of 18.7 l/ha of 3-7.9-15 and 9-7.9-7.5 were applied to the appropriate band treatments (Table VI). Micronutrients

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Keybar^R and Hampshire^R, Sequestrene^R, and Solubor^R are product names and are not affiliated or endorsed by Oklahoma State University.

TABLE IV

SOIL APPLIED FERTILIZER TREATMENTS

Source	Banded Rates			Source	B'cast Rates		
N - P - K	N	P	K	N - P - K	N	P	K
	----kg/ha---				-----kg/ha-----		
-	0	0	0	-	-	-	-
3-7.9-15	2.4	6.1	11.8	10-8.7-8.3	6.7	5.8	5.6
9-7.9-7.5	6.7	5.8	5.6	18-20-0	17.0	19.0	0

TABLE V

MICRONUTRIENT RATES

Soil Applied Rates†					Sprays	Foliar Rates‡				
Fe	Cu	Mn	Zn	B§		Fe	Cu	Mn	Zn	B
----------kg/ha----------						------------kg/ha------------				
0	0	0	0	0	0	0	0	0	0	0
0.17	0.22	0.15	0.17	0.72	3	.085	.011	.075	.085	0.36

† Banded Source: Keybar^R and Hampshire^R liquid chelates - B'cast source: Sequestrene^R dry chelates.

‡ 3 applications - 3X for accumulative foliar amounts

§ Source: Solubor^R

were applied separately and in combination with one-half the rate of the banded micronutrient mixture. Three applications were applied. No macronutrients were applied foliarly to the broadcast treatments, while micronutrients were applied at the same rate as the foliar applications on the banded treatments. Sequestrene was used as the source of micronutrients for foliar applications on all broadcast treatments. All foliar applications were applied at approximately 2800 g/cm^2.

TABLE VI

FOLIAR APPLICATIONS[†]

On Banded Treatments						On B'cast Treatments			
Source		Rates				Source		Rates	
N - P - K	Micro	N	P	K	Micro[††]	N-P-K	Micro	N P K	Micro[††]
		---kg/ha---						kg/ha	
-	Key-Hamp[‡]	0	0	0	0/+	-	Sequ[§]	0 0 0	0/+
3-7.9-15	"	0.8	2.0	3.9	"				
9-7.9-7.5	"	2.2	1.9	1.9	"				

[†] 3 applications - July 16, August 13, and October 3, 1979
[‡] Keybar and Hampshire liquid chelates
[§] Sequestrene dry chelates
[††] Complete mixture or none

On October 10, 1979, the alleys were cleared. Digging operations were completed and the two center rows were prepared for combining.

Rains delayed the combining until October 25, and during the drying period 13 of 60 plots were completely blown away by high winds. Extreme care was taken to carefully identify portions of each plot that were not damaged by wind. The resulting undamaged harvest rows were measured, combined, and yields were adjusted to 12.2 meter row lengths. Yields and peanut grades were analyzed statistically using the SAS GLM procedure.

CHAPTER IV

RESULTS AND DISCUSSION

Since missing plots were experienced in both studies, analyses were made using the unbiased error mean square produced during the GLM procedure. Bias is recognized in the data, however, it is upwards in nature. In other words, for significant differences to occur in these data, differences must be larger than from data with no missing plots.

Experiment I

Fall and spring treatments of phosphorus, potassium and manure were applied to Florunner peanuts. Yield, sound mature kernel percentage, and total sound mature kernel percentage are shown in Table VII.

Yield of the combination treatment of P and K in the spring produced the only significant difference in yield from that of the check plot. Since an extra application of K_2O was mistakenly applied in the spring to all plots, K levels on spring treatment plots had approximately 112 kg/ha directly applied. K levels may have been interfering with Ca uptake by the pod. A noticable numerical decrease in yield is evident in the fall application of K as well. When fall application of P, K, and P + K were compared to their spring counterpart (Table VIII) using single degree of freedom comparisons, only the combination comparison was significant. Similar findings of K competition with Ca were found by Hallock (14).

TABLE VII

FALL VS SPRING FERTILIZATION EFFECTS ON YIELD AND GRADE†

Source	Rate	Time	Yield	SMK	TSMK
	kg/ha		kg/ha	-------%------	
Check			3,508	67.7	68.4
Phosphorus	29	Fall	3,408	70.0	71.5
Potassium	56	Fall	2,800	68.8	70.3
P + K	29 + 56	Fall	3,400	65.8	67.0
Phosphorus	29	Spring	3,812	70.5	72.0
Potassium	56	Spring	2,979	64.8	66.3
P + K	29 + 56	Spring	2,276	67.3	68.5
Manure	4,480	Spring	3,121	68.8	70.3
LSD (.05)			1.084	NS	NS

† All values are the means of four replications

TABLE VIII

EFFECT OF FALL VS SPRING APPLICATIONS ON YIELD OF FLORUNNER PEANUTS

Treatment	Rate	Yield	F
	--------kg/ha-------		
P - Fall	29	3,408	
P - Spring	29	3,812	0.67
K - Fall	56	2,800	
K - Spring	56	2,979	0.13
P + K - Fall	29 + 56	3,400	
P + K - Spring	29 + 56	2,276	5.15*

* Significance at (.05) level

Sound mature kernel and total sound mature kernel percentages were unaffected by treatments (Table VII). Sound splits were significantly lower in the check plot (Table IX).

TABLE IX

FALL VS SPRING FERTILIZATION EFFECTS ON PODROT AND GRADE†

Source	Rate	Time	‡Podrot	SS	OK	TK	HU
	kg/ha			%			
Check			3.3	0.67	8.83	77.3	22.8
Phosphorus	29	Fall	2.3	1.50	6.50	77.5	22.0
Potassium	56	Fall	3.5	1.50	7.75	78.0	22.0
P + K	29 + 56	Fall	3.5	1.25	9.50	76.5	23.5
Phosphorus	29	Spring	4.3	1.50	6.75	78.8	21.3
Potassium	56	Spring	5.0	1.50	9.50	75.8	24.3
P + K	29 + 56	Spring	2.8	1.25	8.50	77.0	23.0
Manure	4480	Spring	3.0	1.50	8.00	78.3	21.8
LSD (.05)			NS	0.78	NS	2.9	3.0

† All values are means of four replications

‡ Visual severity of infestation rating 1 to 10-(most severe)

Podrot ratings of 1 (least affected) to 10 (most affected) were analyzed in Table IX. Differences were not detected for time or source. These results support the non-significant effects on OK (other kernels) since podrot-affected kernels would fall into this category.

Total kernel (TK) and hull (HU) percentage grades were found to be significantly different. Most of the grade variation was produced by the Spring P and K applications. Spring P produced the highest TK%. Spring K produced the lowest TK% and thus the highest percent hulls.

Loan values for peanuts are based on the TSMK and OK grades. If the loan value based on the sample grade is multiplied by the yield (/ha basis), a weighted mean from each treatment can be obtained. When gross returns for the Fall vs. Spring Experiment are compared (Table X), both P applications produced a numerical increase. K applications in both the Fall and the Spring showed a numerical decrease in gross returns. The only significant different return from that of the check at the .05 level was a decrease in returns from the Spring P+K application.

TABLE X

EFFECT OF TIME OF APPLICATION OF P AND K ON GROSS RETURNS FROM FLORUNNER PEANUTS†

Treatment		TSMK		OK		1979 LOAN VALUE	YIELD	GROSS RETURNS
		%	se	%	se	$/metric ton	metric ton/ha	$/ha
Check		68	6	9	3	455.60	3.508	1598.00
Fall	P	72	4	7	2	478.51	3.408	1630.00
"	K	70	3	8	2	467.05	2.801	1308.00
"	P+K	67	7	10	4	450.65	3.400	1532.00
Spring	P	72	5	7	3	478.51	3.812	1824.00
"	K	66	3	10	2	444.16	2.980	1323.00
"	P+K	69	5	9	3	462.10	2.276	1051.00
Manure		70	5	8	4	467.05	3.121	1457.00
LSD (.05)						--	--	396.00

† All values represent means of four replications

Experiment II

Broadcast-disk, banded and foliar applications were evaluated in this study. These methods of fertilizer application were tested for their effects on yield, and percentage SMK, SS, TSMK, OK, TK, and HU.

Yields (Table XI) were the only significant variables in this study when the F-protected LSD was used. Yields from broadcast application of 17-19-0 (N-P-K kg/ha) produced the only significantly higher yield than the check plot. The 17-19-0 kg/ha plus micronutrients (broadcast-disk) with additional foliar micronutrients (Trt. 14, 15) were the lowest yielding treatments. Total micronutrient rates for these treatments were (.43, .55, .38, .43, and .18 kg/ha) for Fe, Cu, Mn, Zn, and B, respectively. Apparently these levels of micronutrients were too high.

When effects of micronutrients and foliar applications (Table XII) were analyzed, no significant source variation was found for Micro, Foliar, or their interaction when 3-7.9-15 was the source of N-P-K. However, when these same effects (Table XIII) were analyzed, using 9-7.9-7.5 as the source of N-P-K, significantly lower yields were obtained as a result of foliar fertilization. These results are similar to those of Keogh and Maples (24) in Eastern Arkansas. They found foliar applications reduced yields of soybeans even though no foliar injury was observed.

Using single degree of freedom comparisons (Table XIV), no difference was observed between banded and broadcast-disk applications at the same N-P-K rates. Apparently, 10-8.7-8.3 broadcast-disk is just as effective as the 9-7.9-7.5 banded liquid source. When the diammonium phosphate (17-19-0 kg/ha) treatment was compared to all other treatments,

TABLE XI

EFFECT OF METHOD OF PLACEMENT AND FOLIAR FERTILIZATION ON YIELD, SMK, AND TSMK OF SPANISH PEANUTS†

Treatments			Placement		Foliar				
No.	N - P - K	Micro	Band	B'cast	Micro	NPK	Yield	SMK	TSMK
	kg/ha						kg/ha	------%-----	
1	0-0-0	0	0	0	0	0	2,069	61.0	69.0
2	"	+	+	0	+	0	1.479	60.0	66.0
3	2.4-6.1-11.8	0	+	0	0	0	1,944	63.2	68.6
4	"	0	+	0	0	+	1,339	62.0	68.3
5	"	+	+	0	0	0	1,976	62.5	69.4
6	"	+	+	0	+	+	1,543	61.0	68.8
7	6.7-5.8-5.6	0	+	0	0	0	1,807	61.8	68.0
8	"	0	+	0	0	+	1,440	60.8	68.9
9	"	+	+	0	0	0	2,428	65.5	71.5
10	"	+	+	0	+	+	1,343	62.8	71.3
11	"	0	0	+	0	0	2,292	61.2	68.6
12	"	+	0	+	+	0	2,257	61.0	69.0
13	17-19-0	0	0	+	0	0	2,902	62.5	70.1
14	"	+	0	+	+	0	1,120	57.0	64.2
15	"	+	0	+	+	0	1,188	61.5	68.6
LSD (.05)							886	--	--
F							**	NS	NS

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† All values are means of four replications

**Significant (.01) level

a highly significant difference was obtained. The all-banded vs. all-broadcast comparison was also made and no significant difference was found. Non-foliar treatments were found to be more effective as a method of application than foliar treatments.

TABLE XII

EFFECTS OF MICRONUTRIENTS AND FOLIAR FERTILIZATION ON YIELD (N-P-K) SOURCE: 3-7.9-15

Source of variation	DF	MS	F
Micro	1	57152.76	-
Foliar	1	1078896.54	-
Micro X Foliar	1	28502.79	-

TABLE XIII

EFFECTS OF MICRONUTRIENTS AND FOLIAR FERTILIZATION ON YIELD (N-P-K) SOURCE: 9-7.9-7.5

Source of variation	DF	MS	F
Micro	1	307769.82	-
Foliar	1	2200673.35	*
Micro X Foliar	1	557204.19	-

* Significant (.05) level

TABLE XIV

COMPARISONS OF METHOD OF PLACEMENT ON YIELD OF SPANISH PEANUTS

Comparison	F
6.7-5.8-5.6 ≅ 6.7-5.8-5.6 (Banded) (Broadcast)	1.29
17-19-0 > All others (Broadcast)	14.19**
Banded ≅ Broadcast	2.19
Micro ≅ Non-Micro	3.07
Non-Foliar > Foliar	22.83**

** Significant at (.01) level

On these low-fixing sandy soils with previous high fertility history, there seems to be little difference between band or broadcast-disk applications at low rates of application. The increased yield effect from the 17-19-0 kg/ha treatment cannot be fully explained. However, an increased rate of N and P combined with no K additions to impede Ca uptake, may have contributed to this increase.

No significant difference on any grade variable was observed in this study. The possibility that the unbiased conservative error mean square from SAS GLM procedure and thus the F-test may have been responsible and should be pointed out (Table XV).

When gross returns are compared for the placement study (Table XVI) no foliar treatment produced more return than the check plot.

TABLE XV

EFFECT OF METHOD OF PLACEMENT AND FOLIAR FERTILIZATION ON SS, OK, TK, AND HU OF SPANISH PEANUTS†

Treatments			Placement		Foliar					
No.	N - P - K	Micro	Band	B'cast	Micro	NPK	SS	OK	TK	HU
	kg/ha						----	----	% ----	----
1	0-0-0	0	0	0	0	0	8.00	4.50	73.5	26.5
2	"	+	+	0	+	0	6.03	6.58	72.6	27.4
3	2.4-6.1-11.8	0	+	0	0	0	5.39	4.98	73.5	26.5
4	"	0	+	0	0	+	6.25	6.25	74.5	25.5
5	"	+	+	0	0	0	6.90	4.60	74.0	26.0
6	"	+	+	0	+	+	7.75	5.25	74.0	26.0
7	6.7-5.8-5.6	0	+	0	0	0	6.25	4.75	72.8	27.3
8	"	0	+	0	0	+	7.06	5.31	73.2	26.8
9	"	+	+	0	0	0	6.03	3.58	75.1	24.9
10	"	+	+	0	+	+	8.50	3.50	74.8	25.5
11	"	0	0	+	0	0	7.39	4.64	73.2	26.8
12	"	+	0	+	+	0	8.03	5.08	74.1	25.9
13	17-19-0	0	0	+	0	0	7.56	3.61	73.7	26.3
14	"	+	0	+	+	0	7.26	7.63	71.9	28.2
15	"	+	0	+	+	0	7.05	4.98	73.5	26.5
LSD (.05)							--	--	--	--
F							NS	NS	NS	NS

† All values are means of four replications

TABLE XVI

EFFECT OF METHOD OF PLACEMENT AND FOLIAR FERTILIZATION ON GROSS RETURNS FROM SPANISH PEANUTS†

Trt. No.	Placement		Foliar		TSMK		OK		1979 LOAN VALUE	YIELD	GROSS RETURNS
	Band	B'cast	Micro	NPK							
					%	se	%	se	$/metric	ton/ha	$/ha
1	0	0	0	0	69	4	5	3	458.14	2.069	947.00
2	+	0	+	0	66	5	7	3	441.63	1,479	653.00
3	+	0	0	0	69	2	5	1	458.14	1.944	890.00
4	+	0	0	+	68	3	6	2	453.15	1.339	606.00
5	+	0	0	0	69	4	5	3	458.15	1.976	905.00
6	+	0	+	+	69	3	5	1	458.14	1.543	706.00
7	+	0	0	0	68	4	5	2	451.61	1.807	816.00
8	+	0	0	+	69	3	5	2	458.14	1.440	659.00
9	+	0	0	0	72	1	4	1	476.17	2.428	1156.00
10	+	0	+	+	71	1	4	1	469.70	1.343	630.00
11	0	+	0	0	69	3	5	1	458.14	2.292	1050.00
12	0	+	+	0	69	1	5	1	458.14	2.257	1034.00
13	0	+	0	0	70	1	4	1	463.12	2.902	1343.00
14	0	+	+	0	64	1	8	1	430.13	1.120	481.00
15	0	+	+	0	69	2	5	1	458.14	1.158	544.00
LSD (.05)											374.00

† All values represent means of four replications

Significant reductions in returns were experienced with treatments 14 and 15 as a result of foliar applied micronutrients. When equal rates of N-P-K (banded or broadcast-disk) were compared, no significant differences in returns were observed. The broadcast-disk application of DAP at the 17-19-0 kg/ha rate produced a significantly higher return of $396.00 over the check plot.

CHAPTER V

SUMMARY AND CONCLUSIONS

The effects of time and placement methods on yield and grade of peanuts were the primary objective of these two studies.

Spring fertilization with P + K decreased the yields of Florunner peanuts significantly. The percent total kernels was also decreased by the addition of K in the spring.

The yields from either broadcast-disk or banded placements of small quantities of N-P-K were not found to be significantly different.

The yield from the 17-19-0 broadcast-disk treatment was significantly better than all other treatments. This level of fertility was the recommended rate based on the O.S.U. soil test index values. The obvious higher rate of N and P with no applied K may have contributed to its superiority.

Foliar fertilization of peanuts tended to decrease yields throughout the study.

No differences on grade variables due to method of fertilizer application were detected in this study.

Gross returns were highest from P applications in the spring or fall. Application of K alone or in combination produced lower returns than the check plot regardless of time.

Returns were not significantly affected by method of placement (banded or broadcast) when rates used were the same. Foliar fertilization failed to produce a higher gross return than the check for all treatments.

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