BENEFIT OF FOLIAR PHOSPHORUS ON SPANISH PEANUTS IN RELATION TO GYPSUM APPLICATION AND P FERTILIZER RATES

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Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
July, 1983

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ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. Lawrence G. Morrill for his guidance, suggestions, support, and assistance throughout this study. Special appreciation is given to Dr. Lester Reed, Dr. David Weeks, and Dr. Dale Weibel for their advice and helpful suggestions. Special gratitude is expressed Dr. David Weeks for his guidance and assistance in the process of computer programs and data analysis.

Recognition and appreciation is given to my wife for her understanding, patience, and help throughout the study.

Finally, the author wishes to express his gratitude to my very close friends Mr. Shirmohamad Ardalan and Mr. Bahram Raoufi for their help in field work and for all those good times we had together.

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CHAPTER I

INTRNDUCTION

The world stock of protein is decreasing, and the oilseeds protein are expected to play an important role in supplementing protein in the future. Since peanuts are already an acceptable edible oilseed crop their protein may be a source tn prevent deficiencies of the future.

Balkcom (3) estimated a market for vegetable protein products of $92 million in 1972, to be worth $1.5 billion by 1980. Peanuts as human food occupy a unique position in the United States. In contrast with other countries where they are considered principally as a source of edible oil, in the United States only a fraction of the crop is pressdd for oil and most of this comes from the lower quality nuts.

One of the principle objectives in a research program concerned with the nutrition of peanuts is obtaining high yields with good kernel development by reducing the number of unfilled ovarian cavities and producing larger nuts. Thus, information on phosphorus (P) and calcium (Ca) effects on peanut quality, as well as the physiological processes which take place when peanut fruit develop are seen to be of vital importance.

It has been found that soils with considerable amorphous iron (Fe) and aluminum (Al) oxides-hydroxides prevent good recovery from P fertilization. The high Ca level of some soils has been implicated in reversion and retention reactions showing poor P fertilization dfficiency. Foth (15) indicates that the earth's crust contains about 1/10 percent phosphorus, and is frequently too low to support the maximum crop production.

The major problem in P uptake from soil by plants is the low solubility of many P compounds. This results in very low concentrations of available P in the soil solution at any time. An understaoding of P reactions in soils and the peanut physiological responses are seen as methods to increase peanut production and minimize P fertilizer losses and hence, costs.

Some farmers are applying high rates of gypsum ($CaSO_4 \cdot 2H_2O$) to the pegging zone of peanuts to furnish Ca needs and to improve soil conditions for harvesting and thereby increasing percent sound mature kernel (% SMK). On the other hand, by applying gypsum every yeas, they will build up the level of Ca in the soil wiich may result in a decrease in awailability of P and a reduction in total marketable product.

The objective of this study was to find out if a supplementary foliar application of P will compensate for a reduction of available P in the soil when gypsum is applied, due to phosphate reversion reactions or increase peanut yields by interaction with soil Ca and P.

CHAPTER II

LITERATURE REVIEW

The unique way in which the peanut obtains nutrients from the soil, and the need for some elements in large amounts, such as Ca, has resulted in confusion over the years. The grower must consider 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 uhe soil and coming from the shell of the developiog nut. This second root system seems to be more selective in nutrient uptake with large demand for calcium. The main root system functions as does the root system of most other plants, except it is generally more active deep in the soil (36, 39).

Calcium and Phosphorus Requirements for Peanuts and Their Effect on Quality and Yield

The peanut plant is unique compared to other field crops. Its fruiting behavior and morphology vary greatly from other crops and probably accounts for the differences in how the peanut plant utilizes applied nutrients. Peanuts are good P feeders and appear to obtain adequate P when the soil levels are less than optimum for many other crops. However, the most consistent yield increases from plant nutrients has been from P application (1). Phosphorus gives the peanuts a faster start. This helps in getting ahead of weeds as well as increasing the productive growth period for better maturity of nuts. P deficiency symptoms are not as definite in peanuts as with some other crops, but the entire plant is usually stunted.

Daughty and Cox (13) observed that Ca is vital io peanut production. Uniquely, Ca must be applied to two zones of absorption (the pegging and root zones). Adequate Ca reduces the occurrence of "pops" and unsound kernels. The pegging zone should contain more Ca than potassium (K). If K level is greater than Ca the yield will be decreased (44).

According to past research, gypsum ($CaSO_4 \cdot 2H_2O$) is the best source of Ca for peanuts. Peanuts are frequently grown in sandy soil or sandy loams with low cation exchange capacity. The peanut plant has a high demand for Ca in the pegging zooe at the time the nuts are setting and developing (22, 26). Research has indicated that gypsum will improve soil structure by promoting flocculation and granulation and will speed water penetration in puddled or dispersed and heavy soils, reducing crusting and sealing at the surface. Soils supplied with adequate Ca produce fruit with an increase in percent sound mature kernels (%SMK) (10, 33, 38).

Vanry and Vandiest (42) explained that P is involved in many plant functions. It serves as an energy storehouse for plant metabolism through the adenosine diphosphate-adenosine triphosphate (ADP-ATP) transformations. Phosphorus is a constituent of some proteins and is necessary for the growth of plants, as well.

Many investigators (4, 18, 34) explain that the deficiency of P may prevent other nutrients, such as nitrogen (N), from being absorbed by plants. Availability of P in the soil depends on the stage of soil weathering, pH, organic matter, soil texture, percentage of $CaCO_3$, and percentage of hydrated iron and aluminum oxides.

Archer (2) and Barrow (5, 6) studied the P reactions in soil and found that they are more complex than those of any other nutrient element. Both organic and inorganic forms of P can be found in soils and they are important to plants as sources of P. Under acid conditions, where the clay surface and the exchange complex contains active Al and Fe, these elements react with phosphate to form P compounds of low solubility. Phosphorus reversion in alkaline and calcareous soils is due to the formation of slightly soluble Ca-P complexs. When soils are high in $CaCO_3$ P may form $CO_3^{=}$-PO_4^{-} complexs rather than simple $CO_3(PO_4)_2$ (5, 6).

Taylor and Ellis (40) pointed out that the mechanism of P adsorption on soil and homogeneous soil mineral surfaces is not clearly defined in the literature. However, it is generally agreed that for the clay and sesquioxide mineral surfaces, phosphate ions replace exposed OH groups and/or other adsorbed anions (40). Whether the bonds between the phosphate ions and the Fe^{+3} and Al^{+3} atoms at colloid surfaces are ionic, covalent, or coordinate-covalent is not agreed upon.

Foliar Application of Nutrient Elements

Foliar spraying is an alternative to soil application for introduction of nutrients to plants. Because fertilizer salts can be taken up rapidly and metabolized by leaves, it is possible to fertilize crops specifically at periods of high nutrient demand during rapid vegetative growth or fruit development (19). Foliar application may be used when there is some difficulty or limitation in soil availability of plant nutrients. Garcia and Hanway (19) provided experimental and theoretical support for the idea that late-season foliar spray of fertilizers can increase yield in legumes. Their results are summarized in Tables I and II.

Malakondaiah and Rajeswararao (27) conducted an experiment on foliar application of P on peanuts under salt stress and observed that foliar nutrition induced significant increases in yield compared to the addition of fertilizer to the soil, especially under saline conditions. They observed that when P was sprayed on the leaves, there was an increase in accumulation of P in both control and salinized plants. They concluded that the depression in

TABLE I

EFFECTS OF FOLIAR APPLICATION BETWEEN DEVELOPMENTAL STAGE R5 AND R7 ON YIELD OF TWO SOYBEAN VARIETIES, EXPERIMENT 75-2

Soybean Cultivar	Soybean Yield Not Sprayed	Yield Increase From Spraying	Seed Size Not Spray	Seed Size Sprayed
	---------------kg/ha------------		---g/100 seeds---	
Corsoy	3540	1570	15.2	15.8
Amsoy	3850	1490	16.7	16.0

A total application of 96-9.6-28.8-4.8 kg of N-P-K-S respectively per hectare applied. Yield increases were significant at the 1% level.

TABLE II

EFFECT ON SOYBEAN YIELDS AT TIME OF FOLIAR APPLICATION OF A 10:1:3:0.5 N:P:K:S SOLUTIONS, EXPERIMENT 75-4

Total Foliar Application N	P	K	S	Time of Application	No. of Application	Yield Increase From Spraying
---------kg/ha------------						-kg/ha-
96	9.6	28.8	4.8	R5-R6.5	4	384
120	12.0	36.0	6.0	R4-R6.5	6	75
48	4.8	14.4	2.4	R6-R6.5	2	3
120	12.0	36.0	6.0	R5-R6	5	-33

uptake through the root system, either due to abnormal pH or due to physiological unavailability, had been overcome by facilitating absorption through the leaves. Accumulation of salts or sodium (Na^+) causes a decrease in the uptake of potassium (K^+) and Ca^{++} supply of P by foliar spray resulted in partial improvement of the depressing effect (27).

Greenway (20), and Neumann (30) studied foliar application of nutrients and pointed out that the plants can utilize water soluble nutrients through their foliage via foliar sprays. The nutrients enter the leaf cells by penetrating the cuticle of the leaf or through stomata. When problems of soil fixation or excessive leaching of nutrients exist, foliar application may well constitute the most effective means of fertilizer application.

Calvert and Smith (11) and Calvert (12) explained the use of foliar application of major nutrient elements in horticulture. They mentioned that considerable research had been focused on foliar application of fertilizer nutrients in horticulture and it is an established practice in many areas of the world. The foliar spraying of micronutrients like boron, copper, magnesium, and zinc to control the deficiencies of these elements is a common practice for citrus and other agronomic crops in California and Florida. More recently, studies have been conducted on the foliar spraying of major elements, N, P, and K. Calvert (12) mentioned that the use of a foliar spray of a major fertilizer element is not usually a substitute for ground fertilization, but may be a very significant supplement to it. He said, foliar spraying of fertilizer elements can increase the level of major fertilizer elements for short, critical periods.

Calvert (12) explained there are a number of reasons for occasional, and sometimes, extended short supply of major elements in plants, which lead to the need for supplemental spraying of horticultural and agronomic crops with N, P, or K. It may be practical to spray to overcome the interferences brought about by other fertilizer ions in the soil. For example, the adsorption of potassium from soil is often strongly influenced by soil conditions, such as high concentrations of Ca and Na, or other cations which reduce K uptake. Calvert found a foliar spray of KNO_3 was more effective in raising the K content of leaves than the equivalent amounts of K applied in the ground for citrus.

Gorde and Kibe (21) studied the effects of foliar and soil application of P fertilizer on Chinese mung beans (Phaseolus aures). They found significant increases of N, P, and K in P treated plants as compared with a control.

Bouma (7), and Patra (32) studied foliar application of P and N as urea polyphosphate and found that the total dry matter of the plant increased as compared with the control. Bouma pointed out that foliar feeding of P contributed to the recovery from P deficiency in subterranean clovers, especially when the availability of P applied to the root zone is not seriously restricted by soil conditions.

Wittwer and Teubner (43) investigated foliar absorption of mineral nutrients on bean plants. They reported that plants deficient in P absorbed foliar applied P more rapidly than those grown in P rich media.

Ohlrogge and Kamprath (31) were able to increase the yield of soybeans in Iowa from 3695 to 5225 kg/ha with foliar sprays. This was the largest yield increase they obtained from several experiments conducted over a two year period and represents the average for two indeterminate varieties. Their spray material was composed of potassium polyphosphate (0-26-25), K_2SO_4, $(NH_4)_2SO_4$, and urea in the same relative concentrations of N, P, K, and sulfur (S) found in the seed. The amounts of N, P, K, and applied S were 140, 14.5, 42, and 8.4 kg/ha, respectively, based on an expected yield increase of 1800 kg/ha.

Robertson et al. (35), and Nagel et al. (29) in Florida, studied the foliar fertilization of 'Cobb' soybeans to supply nutrients to the pods at a time when uptake from the soil was declining. Sources of materials, times of application, and rates were variables in their study. They did not observe a significant yield increase. They thought the most likely reason for failure to obtain a yield response was due to leaf burn.

Barel and Black (8) studied the suitability of 32 different P compounds for foliar applications by using a new technique in which predetermined quantities of P were applied to a fixed leaf area. They found the most successful compound for corn was ammonium triphosphate, $(NH_4)_2H_3P_3O_{10}$), which could be applied at 370 micrograms (ug) of P/cm^2 of leaf area without causing leaf damage. They found 66% of the applied P was absorbed within 10 days and 78% of the absorbed P was translocated to other tissues. Other compounds used successfully for foliar treatment of corn were ammonium tetrapolyphosphate, $(NH_4)_2H_4P_4O_{13}$, and phosphoryl triade, $(NH_2)_3PO$. Soybeans proved more sensitive than corn to foliar sprays and could, in general, tolerate only two-thirds to three-fourths the quantity (rates) successfully applied to corn. Ammonium tri- and tetrapolyphosphate, $(NH_4)_2H_3P_3O_{10}$ and $(NH_4)_2H_4P_4O_{13}$ could be applied at 220 ug of P/cm^2 soybean leaf area.

Process of Foliar Penetration and Absorption of Substances

For many years botanists have been looking for the mechanism by which various substances penetrate plant leaves. It has been generalized that any substance which is applied to or sprayed on a leaf surface is absorbed by the trichomes or glandular hairs and later excreted into the adjacent epidermal cells. The substance migrates through the chlorophyll-free tissue along the veins, where it finally is absorbed by elements of the vascular bundles (23).

Sharma and Vandenborn (38) and Leece and Kenworthy (25) point out that the cuticle is the first barrier to any foreign substance applied to the surface of the leaf. They studied the foliar penetration of herbicides and mention that partial removal of the surface wax with chloroform results in a 1.5 to 4-fold increase in herbicide penetration. The stomata are considered to be another primary pathway of foliar absorption (25, 38).

Dybing and Currier (14) studied foliar penetration by chemicals and found that cuticular penetration, with the exception of ^{32}P-Phosphate was slow. Stomatal penetration of aqueous solutions occurred rapidly if the proper concentration of an efficient surfactant was used. Biswas (9) studied absorption, diffusion and translocation of ^{14}C-labeled triazine herbicides in peanut leaves and observed that a surfactant almost always increased herbicide absorption.

Frankie (16) also investigated the mechanisms of foliar penetration of solutions and found that ectodesmata, fine structures in the outerwalls of epidermal cells, were directly related to foliar absorption.

Factors Affecting the Absorption and Translocation of Foliar Spray

Factors which affect absorption and subsequent translocation of the foliar applied phosphorus include: P concentrations of the spray, leaf surface (upper vs. lower), wetting agent, different P compounds (pH and cation), time, size of area sprayed, age and position of sprayed leaf, and P level of plant (17).

Koontz and Bidduiph (24) tested three methods (leaf vein injection, droplet, and spray application) and suggested for routine use spray application proved superior, and is the method which is best adapted for field use. He also determined effects of pH and associated cations on the absorption and translocation of P. Phosphoric acid (H_3PO_4) and the following three series of P compounds were used: 1. $NaH_2PO_4 \cdot H_2O$, $Na_2HPO_4 \cdot 7H_2O$, Na_3PO_4; 2. KH_2PO_4, K_2HPO_4, K_3PO_4 and 3. $NH_4H_2PO_4$, $(NH_4)_2HPO_4$. The results with the sodium and potassium compounds showed the 10 mM H_3PO_4 solution injured the sprayed leaves and only 4.7% of the applied P was translocated.

Fisher and Walter (17) investigated the effect of different P compounds on absorption and translocation and mentioned that the difference between P absorption from ammonium (NH_4^+) and K salts is small. The inclusion of glycerine in the spray solution increased P absorption over an extended period of time. Glycerine could conceivably increase P absorption because of its moisture conditioning and its spreader properties. There was no increase in P absorption detected by addition of urea or formamide to the spray solutions.

CHAPTER III

METHODS AND MATERIALS

Experiment I

This experiment was conducted at Caddo Research Station at Fort Cobb, Oklahoma. The field plot was initiated in 1964 and gypsum was applied to the plots only in 1965 and 1966 with yield and quality information collected for several years after.

No fertilizer or gypsum was applied in this experiment, only the residual effect was considered. Fourteen treatment combinations as shown in Table III were arranged in 14 plots, 6-91.44 cm rows X 18.29 m long, as a split-plot on strips experiment with four replications. The purpose of the experiment was to investigate the effect of foliar application of P on Spanish peanuts (*Arachis hypogea*) as a supplementary feeding to prevent any P deficiency which may occur due to P reversion in presence of high Ca levels.

Potassium monobasic phosphate (KH_2PO_4) with the concentration of 0.35 percent P was used as a foliar spray applied to the half of the plots which had received past gypsum treatments, and to one-half the plots which had not received gypsum (28, 41).

TABLE III

EXPERIMENTAL TREATMENT IDENTIFICATION

Treatment No.	Fertilizer Grade Past Application	Gypsum Status Residual	Foliar P Applied (0.35%)
1	0-0-0	-Gyp.	1/2 plot
2	0-0-0	+Gyp.	1/2 plot
3	0-0-80	-Gyp.	1/2 plot
4	0-0-80	+Gyp.	1/2 plot
5	0-80-0	-Gyp.	1/2 plot
6	0-80-0	+Gyp.	1/2 plot
7	0-80-80	-Gyp.	1/2 plot
8	0-80-80	+Gyp.	1/2 plot
9	40-0-0	-Gyp.	1/2 plot
10	40-0-0	+Gyp.	1/2 plot
11	40-0-80	-Gyp.	1/2 plot
12	40-0-80	+Gyp.	1/2 plot
13	40-80-0	-Gyp.	1/2 plot
14	40-80-0	+Gyp.	1/2 plot

Phosphorus spray was applied as a foliar spray with a small backpack hand sprayer, twice during the growing season (July 24, 1981 and August 15, 1981). The two center rows of the peanut plots were harvested and air dried. The yield per acre, % SMK, and total kernel content (TKC) were determined and the data analyzed statistically. The experiment of 1981 was repeated in 1982. Soil samples were taken in 1982 to monitor the levels of N, P, K, Ca, and pH. The major soil of the experiment is of the Cobb soil series--a minimum Reddish Prairie soil (fine-loamy, mixed, thermic, Udic Haplustalfs).

Experiment II

This experiment was performed at Stratford Agronomy Research Station without irrigation in 1981. Twelve treatment combinations, as shown in Table IV, were arranged in 12 plots, 6-91.44 cm rows X 18.29 m long, as a split-plot on strips experiment with four replications. The 12 treatments included three levels of applied P (0, 45, and 90 kg/ha) and four levels of gypsum (0, 336, 672, and 1009 kg/ha). Ground gypsum was applied as a top dressing to half of the plots within the four replications. Foliar P was applied to three rows of the six row plots. Three adjacent rows of each plot were selected randomly for foliar application of P. Therefore, each plot was divided into four subplots for treatments as follows: gypsum, gypsum plus foliar P, foliar P, and check. The foliar treatments

TABLE IV

EXPERIMENTAL TREATMENT IDENTIFICATION

Treatment No.	P Trt (kg/ha)	Gypsum Trt (kg/ha)
	(1981)	
1	0	0
2	45	0
3	90	0
4	0	336
5	45	336
6	90	336
7	0	672
8	45	672
9	90	672
10	0	1009
11	45	1009
12	90	1009
	(1982)	
1	--	1681 (1/4 plot)
2	--	1681 (1/4 plot)
3	--	1681 (1/4 plot)
4	--	336
5	--	336
6	--	336
7	--	672
8	--	672
9	--	672
10	--	1009
11	--	1009
12	--	1009

were the same for Experiment II as for Experiment I. Peanuts were harvested within each subplot and the data collected for statistical analysis as in Experiment I.

In 1982, the experiment was repeated. A new rate of gypsum (1681 kg/ha) was applied to one fourth of those plots (treatments 1, 2, 3) that did not receive gypsum in 1981. Potassium pyrophosphate ($K_4P_2O_7$) solution with 0.35 percent concentration of P was applied as a new foliar P source to one fourth of each main plot containing treatments 1, 2, and 3 for comparison with KH_2PO_4. The major soil of the experiment is of the Daugherty series (loamy-mixed, Thermic Arenic Haplustalfs).

Soil samples from all the plots were taken in 1982 to monitor the levels of N, P, K, Ca, and pH. Analyses were made according to Oklahoma State University Soil Testing Lab procedures and the results of the soil analyses for Experiments I and II are presented in the appendix.

The least significant differences (LSD) in this experiment related to the yield, % SMK, and TKC are calculated based on averaged means of foliar vs. not foliar (8 observations) or gypsum vs. not gypsum.

CHAPTER IV

RESULTS AND DISCUSSION

Stratford Experiment

When no P was applied to the soil, foliar P had significant effect on yield and TKC when 336 or 672 kg/ha gypsum was applied to the soil (OSL < 0.05). The yields were increased by as much as 404 kg/ha compared with no gypsum and no foliar spray (Table VI).

Yield of plots receiving foliar P were significantly different regardless of gypsum application rate (OSL < 0.05) (Tables VIII, IX, X). The application rate of 672 kg/ha gypsum gave better yields and equivalent % SMK as 1009 kg/ha gypsum and resulted in a higher TKC (Tables VI and VII). The highest yields were obtained when the combination of foliar P and 672 kg/ha gypsum were used. There was no significant interaction between foliar P and gypsum. The yield results are shown in Tables V through XIII and Figures 1 through 9.

Without applying foliar P yield was depressed when going from 672 kg/ha gypsum to 1009 kg/ha. The yield was increased when going from 336 kg/ha gypsum to 672 kg/ha (Tables VIII, IX, and X). The depressing effect of gypsum at the highest rate may be related to the effect of P reversion, since foliar P applied increased the yield and TKC significantly.

TABLE V

EFFECTS OF 336 KG/HA OF GYPSUM, 0 P FERTILIZER, AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0*	0*	4	803	75.50	606
0	1*	4	1147	73.50	843
1*	0	4	854	73.75	630
1	1	4	1149	75.50	867
	LSD**		162	NS	117

*0 indicates no gypsum or foliar; 1 indicates gypsum or foliar has been applied.

**See Methods and Materials for how LSD was calculated, NS indicates no significant difference.

TABLE VI

EFFECTS OF 672 KG/HA OF GYPSUM, 0 P FERTILIZER, AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	909	74.50	677
0	1	4	963	74.00	712
1	0	4	989	74.50	738
1	1	4	1313	75.75	994
	LSD		151	NS	110

TABLE VII

EFFECTS OF 1009 KG/HA OF GYPSUM, 0 P FERTILIZER, AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	786	74.50	586
0	1	4	948	75.00	711
1	0	4	907	74.75	678
1	1	4	1013	73.25	742
	LSD		NS	NS	NS

TABLE VIII

EFFECTS OF 336 KG/HA OF GYPSUM, 45 KG/HA P, AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	935	74.50	698
0	1	4	967	75.00	724
1	0	4	943	74.75	705
1	1	4	1185	75.50	895
	LSD		124	NS	NS

TABLE IX

EFFECTS OF 672 KG/HA OF GYPSUM, 45 KG/HA P, AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0	0	4	724	74.75	541
0	1	4	1027	73.75	758
1	0	4	1004	76.50	768
1	1	4	1298	74.50	967
	LSD		270	NS	203
LSD			110	NS	55

TABLE X

EFFECTS OF 1009 KG/HA OF GYPSUM, 45 KG/HA P, AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	825	74.25	612
0	1	4	971	74.75	727
1	0	4	972	75.75	737
1	1	4	1288	76.50	985
	LSD		115	NS	85
LSD			229	NS	185

TABLE XI

EFFECTS OF 336 KG/HA GYPSUM, 90 KG/HA P AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	753	74.00	557
0	1	4	1101	74.50	818
1	0	4	947	72.75	690
1	1	4	1328	72.25	951
LSD			72	NS	90

TABLE XII

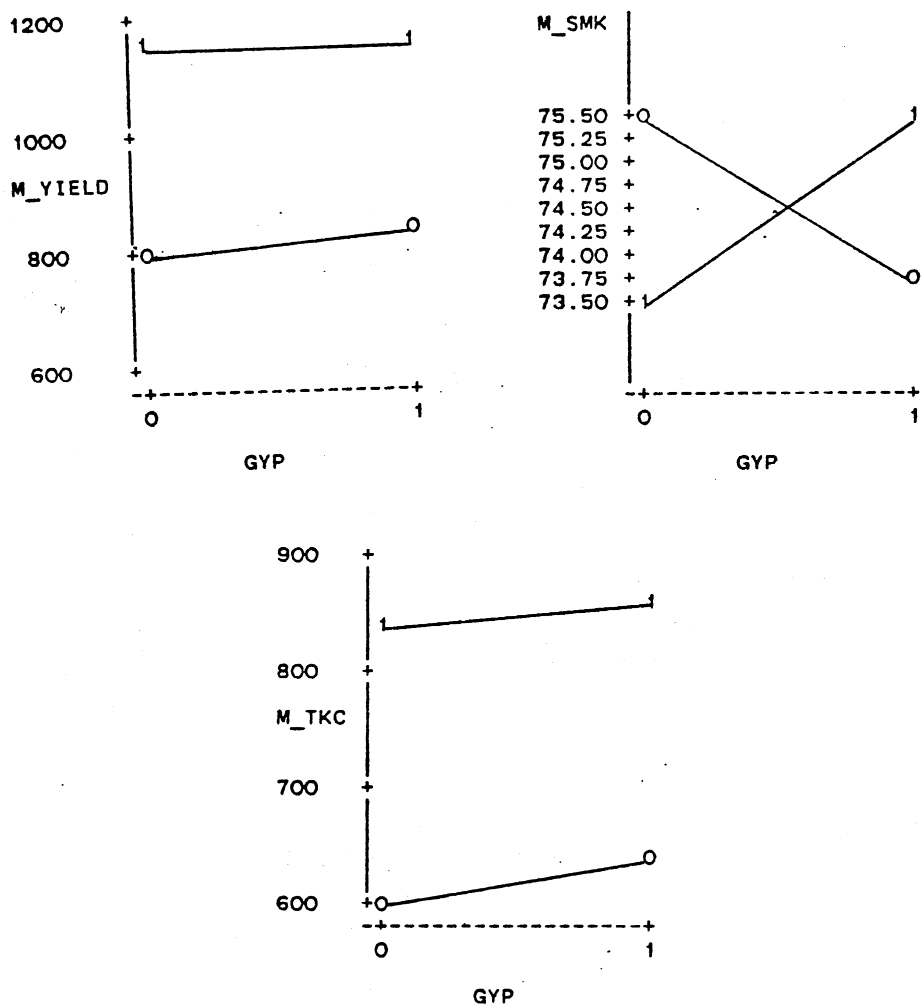
EFFECTS OF 672 KG/HA GYPSUM, 90 KG/HA P AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	839	73.00	614
0	1	4	1094	74.50	816
1	0	4	1055	75.50	796
1	1	4	1343	73.50	987
	LSD		157	NS	97

TABLE XIII

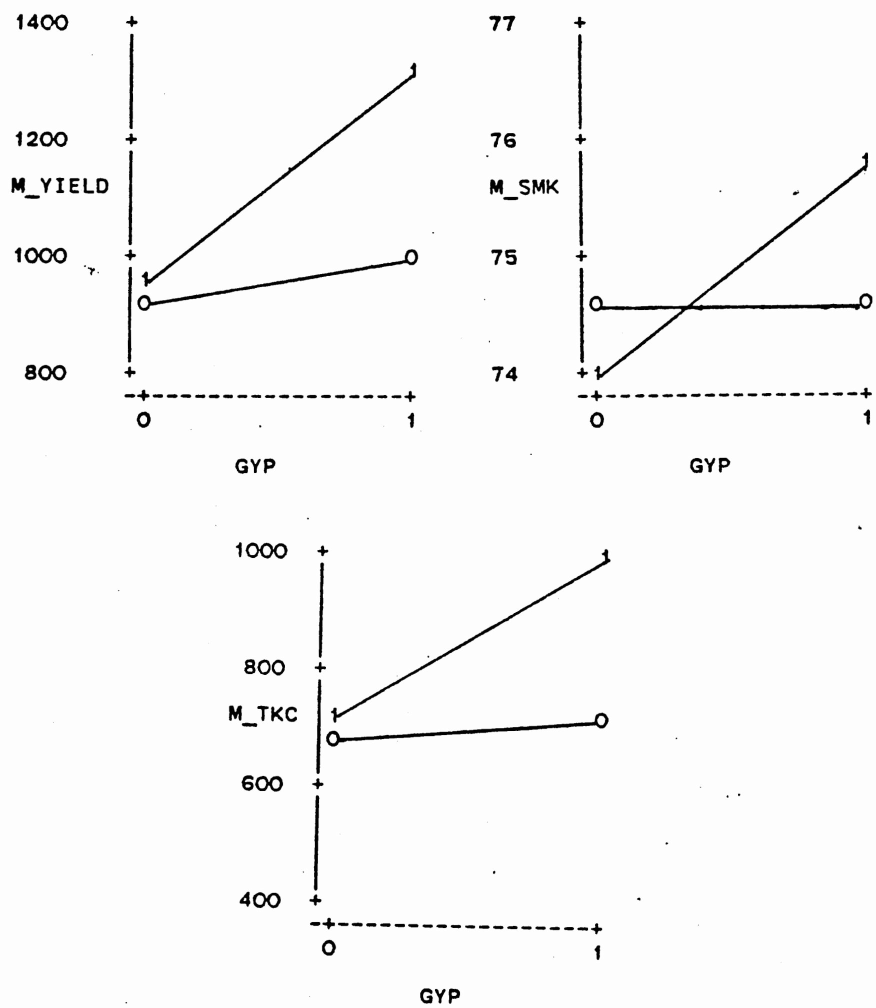
EFFECTS OF 1009 KG/HA GYPSUM, 90 KG/HA P AND FOLIAR APPLICATION OF KH_2PO_4 AS SPRAY ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1981)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	700	73.75	517
0	1	4	851	75.75	645
1	0	4	873	75.50	659
1	1	4	1336	74.50	996
	LSD		214	NS	161
LSD			158	NS	103



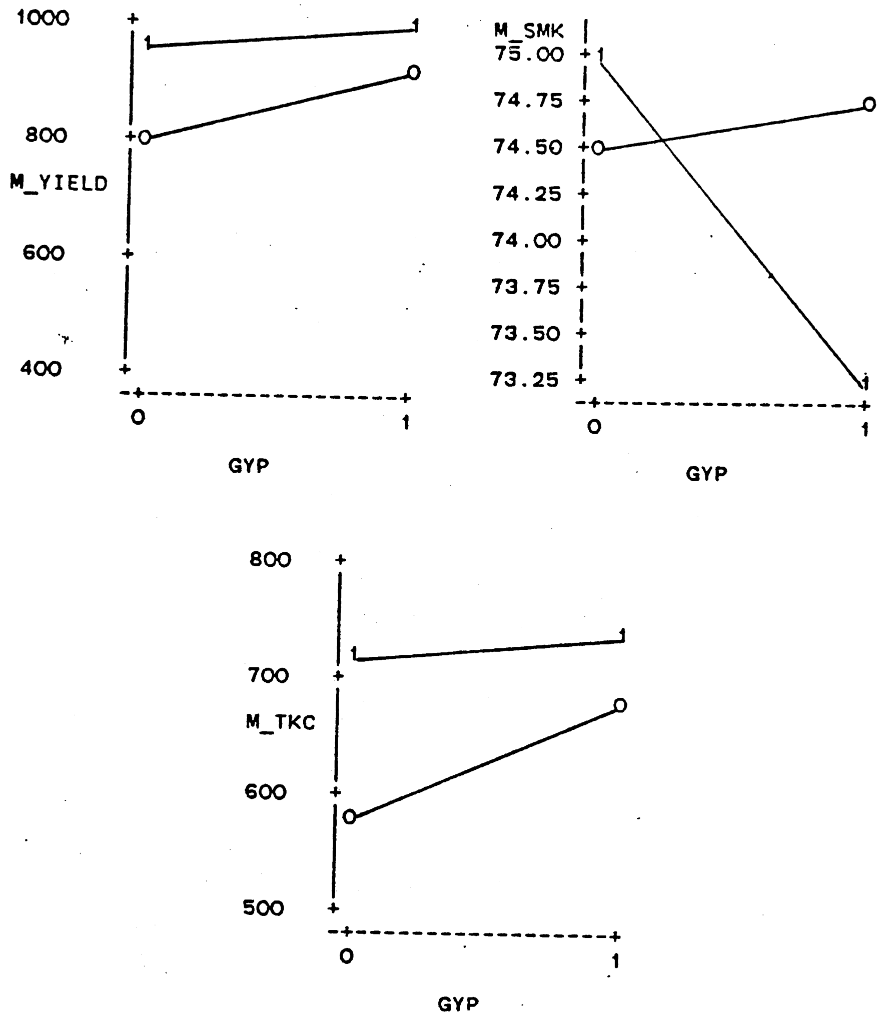
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 1. Effects of 336 kg/ha Gypsum and 0 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



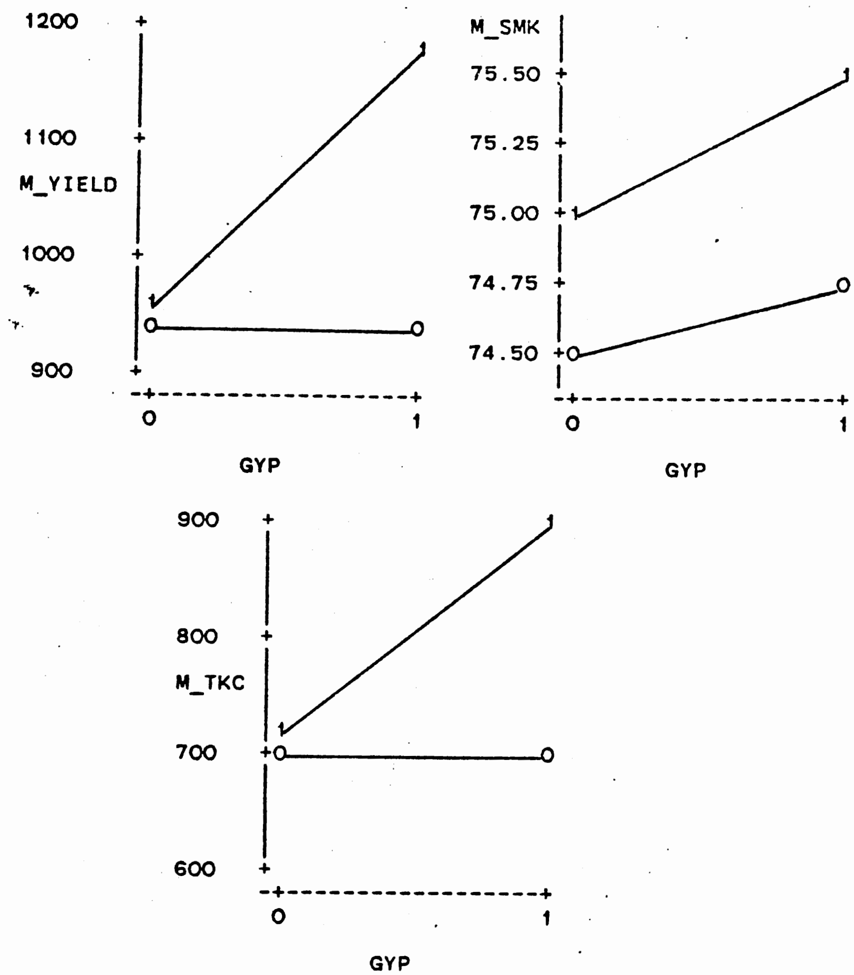
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 2. Effects of 672 kg/ha Gypsum and 0 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



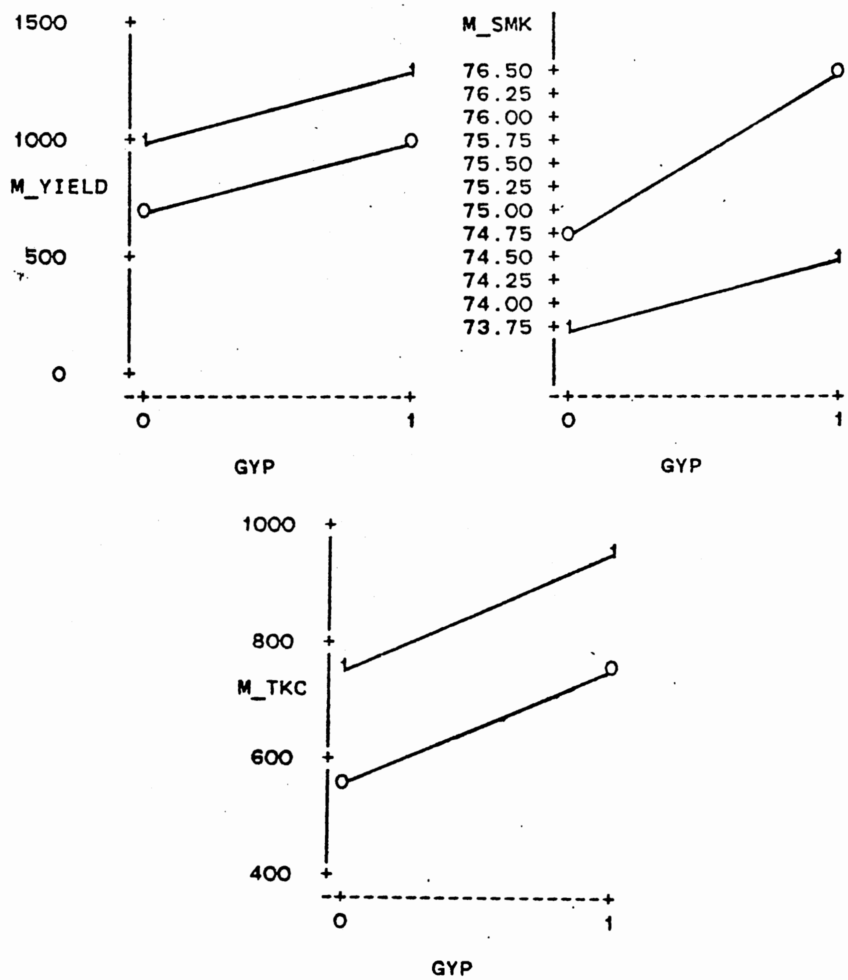
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 3. Effects of 1009 kg/ha Gypsum and 0 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



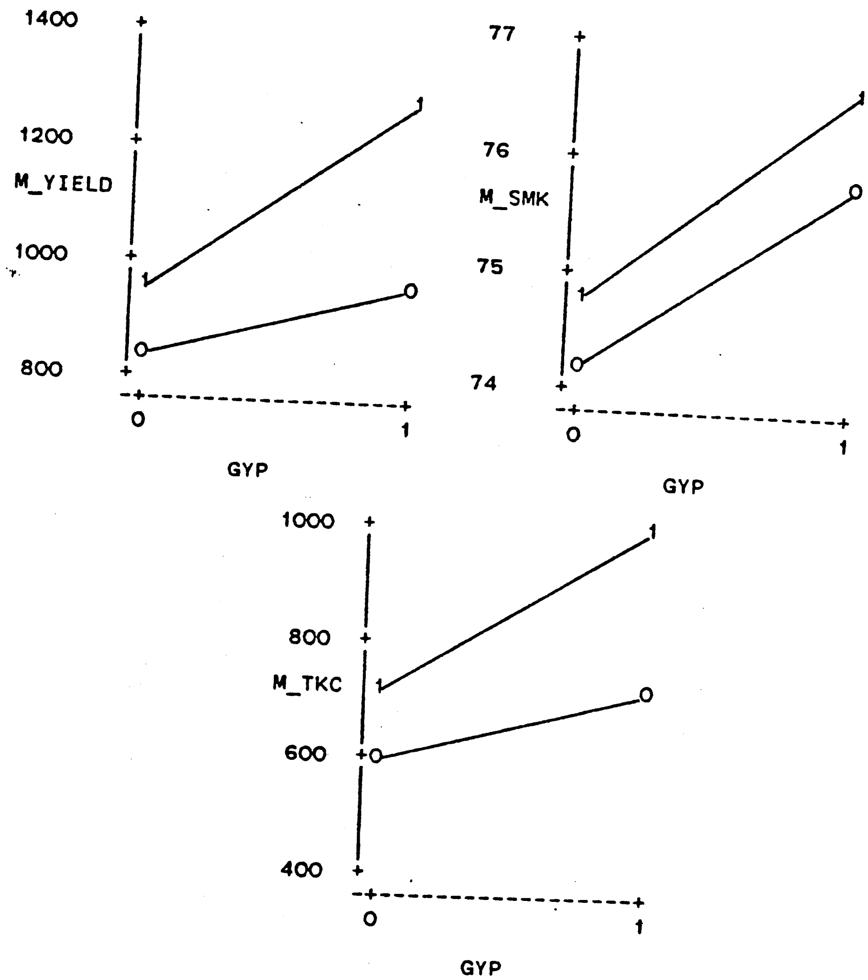
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 4. Effects of 336 kg/ha Gypsum and 45 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



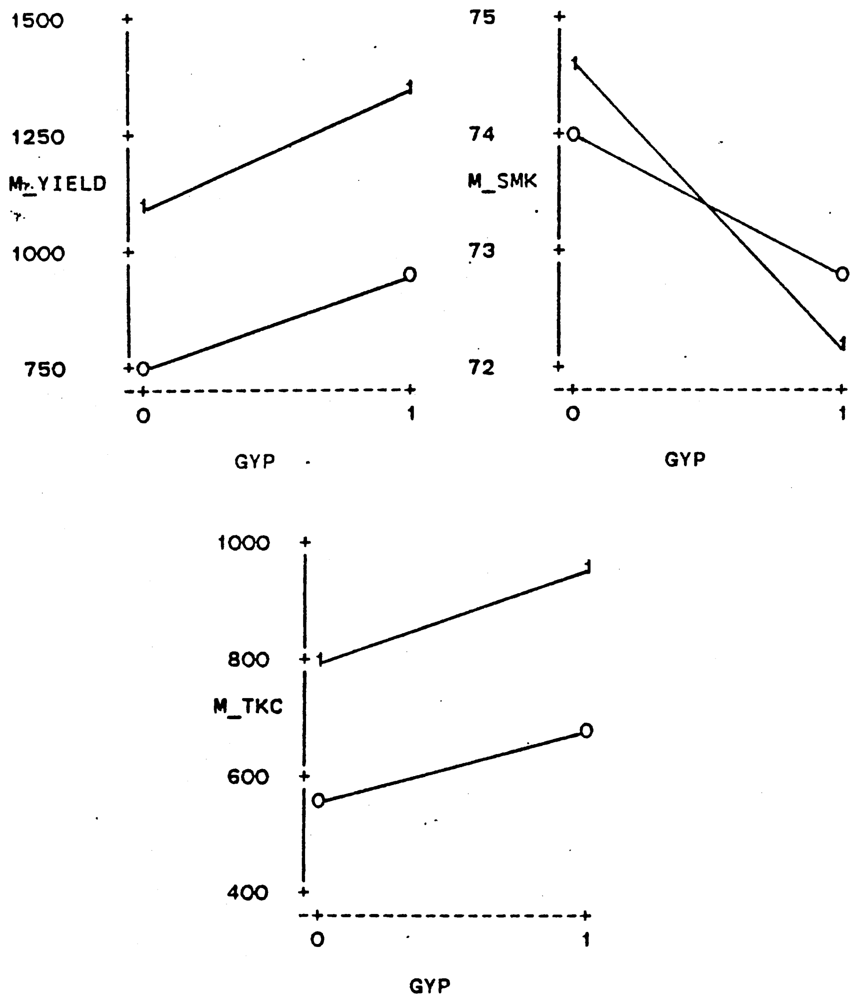
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 5. Effects of 672 kg/ha Gypsum and 45 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



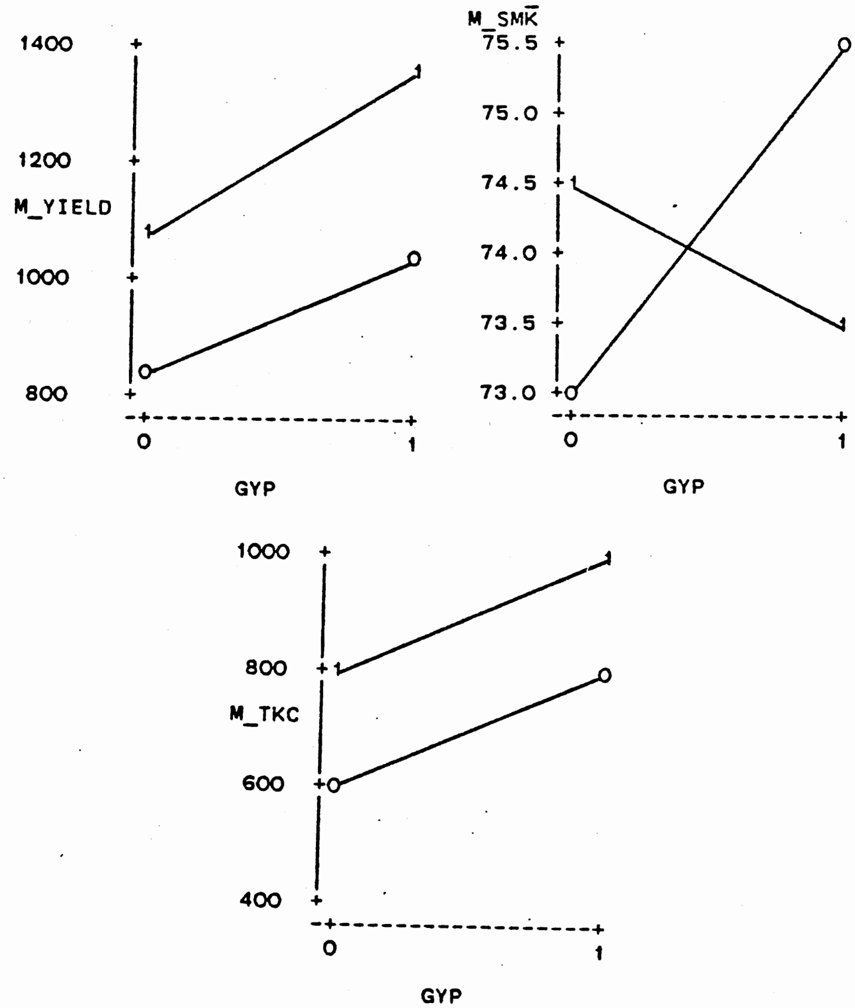
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 6. Effects of 1009 kg/ha Gypsum and 45 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



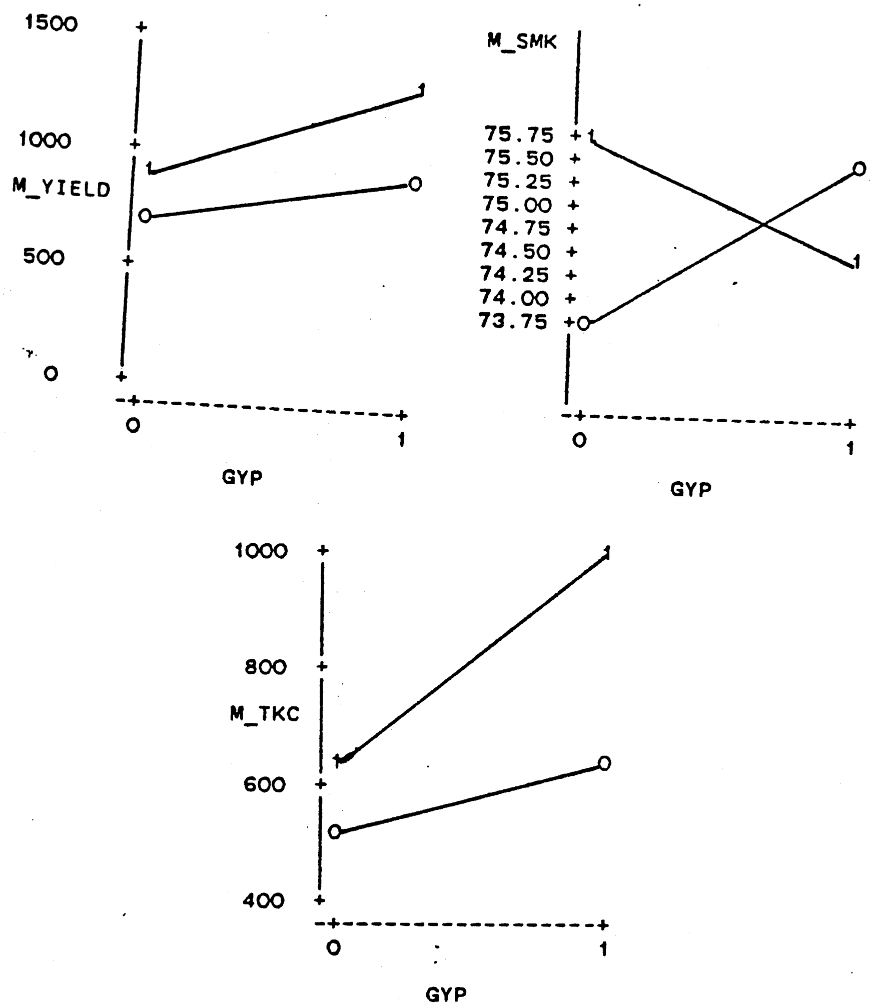
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 7. Effects of 336 kg/ha Gypsum and 90 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 8. Effects of 672 kg/ha Gypsum and 90 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).



0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 9. Effects of 1009 kg/ha Gypsum and 90 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1981).

Gypsum and foliar P treatments significantly affected yield and TKC when 90 kg/ha P were applied to the soil (Tables XI, XII, XIII). The combination of gypsum with foliar spray P when 1009 kg/ha gypsum was applied increased the yield by 483 kg/ha compared to gypsum alone (Table XIII). An inference might be drawn that gypsum blocked P uptake.

In 1982 the experiment was repeated. The combination of four levels of gypsum and three levels of phosphorus fertilizer, which make up the 12 treatments, were analyzed in relation to foliar spray P response. The data is presented in Tables XIV through XXII and in Figures 10 through 18.

The variables yield, % SMK, and TKC were significantly affected by foliar P application in some combination of foliar P with soil P fertilization rate and/or gypsum application. Gypsum had a significant effect only on % SMK (Tables XIV and XXII). The combination of gypsum and foliar spray of P treatment was superior in yield, % SMK, and TKC. Interactions between gypsum and foliar P were not significant for yield % SMK, and TKC (Tables XIV, XV, and XVI, also Figures 10, 11, and 12).

Yield response to foliar spray of P was significant but was not to gypsum at 336 kg/ha rate (Tables XIV, XV, XVI). However, the highest yield, % SMK, and TKC were obtained when a combination of gypsum and foliar P were applied (Tables XVII, XVIII, and XIX, also Figures 13, 14, and 15).

TABLE XIV

EFFECTS OF 336 KG/HA OF GYPSUM AND FOLIAR APPLICATION OF P ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS WHEN NO P WAS APPLIED TO THE SOIL (STRATFORD, 1982)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0*	0	4	536	57.50	308
0	1	4	855	62.25	532
1	0	4	684	61.25	419
1	1	4	900	64.50	581
	LSD		150	NS	120
LSD			NS	2.5	NS

*0 indicates no gypsum or foliar P; 1 indicates gypsum or foliar P has been applied.

TABLE XV

EFFECTS OF 672 KG/HA OF GYPSUM AND FOLIAR APPLICATION OF P ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS WHEN NO P WAS APPLIED TO THE SOIL (STRATFORD, 1982)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	604	60.50	365
0	1	4	779	59.25	462
1	0	4	649	59.50	386
1	1	4	812	65.00	528
	LSD		NS	1.00	NS

TABLE XVI

EFFECTS OF 1009 KG/HA OF GYPSUM AND FOLIAR APPLICATION OF P ON MEAN YIELD, % SMK, AND TKC OF SPANISH PEANUTS WHEN NO P WAS APPLIED TO THE SOIL (STRATFORD, 1982)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	616	60.25	371
0	1	4	842	64.75	545
1	0	4	809	58.50	473
1	1	4	942	66.00	622
	LSD		NS	3.7	NS

TABLE XVII

EFFECTS OF 45 KG/HA P AND 336 KG/HA GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS IN RELATION WITH FOLIAR SPRAY OF PHOSPHORUS (STRATFORD, 1982)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0	0	4	452	58.75	266
0	1	4	689	60.50	417
1	0	4	605	58.00	352
1	1	4	780	63.25	493
	LSD		170	2.8	92
LSD			69	NS	45

TABLE XVIII

EFFECTS OF 45 KG/HA P AND 672 KG/HA GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS IN RELATION WITH FOLIAR SPRAY OF PHOSPHORUS (STRATFORD, 1982)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0	0	4	540	59.00	319
0	1	4	934	60.25	442
1	0	4	669	58.00	405
1	1	4	863	65.00	561
	LSD		170	NS	NS

TABLE XIX

EFFECTS OF 45 KG/HA P AND 1009 KG/HA GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS IN RELATION WITH FOLIAR SPRAY OF PHOSPHORUS (STRATFORD, 1982)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0	0	4	755	56.25	425
0	1	4	856	62.25	533
1	0	4	842	59.25	499
1	1	4	1069	67.25	719
	LSD		70	NS	58

TABLE XX

EFFECTS OF 90 KG/HA P AND 336 KG/HA GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS IN RELATION WITH FOLIAR SPRAY OF PHOSPHORUS (STRATFORD, 1982)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0	0	4	689	56.25	388
0	1	4	825	60.00	495
1	0	4	684	62.00	424
1	1	4	1085	66.50	722
	LSD		254	NS	146

TABLE XXI

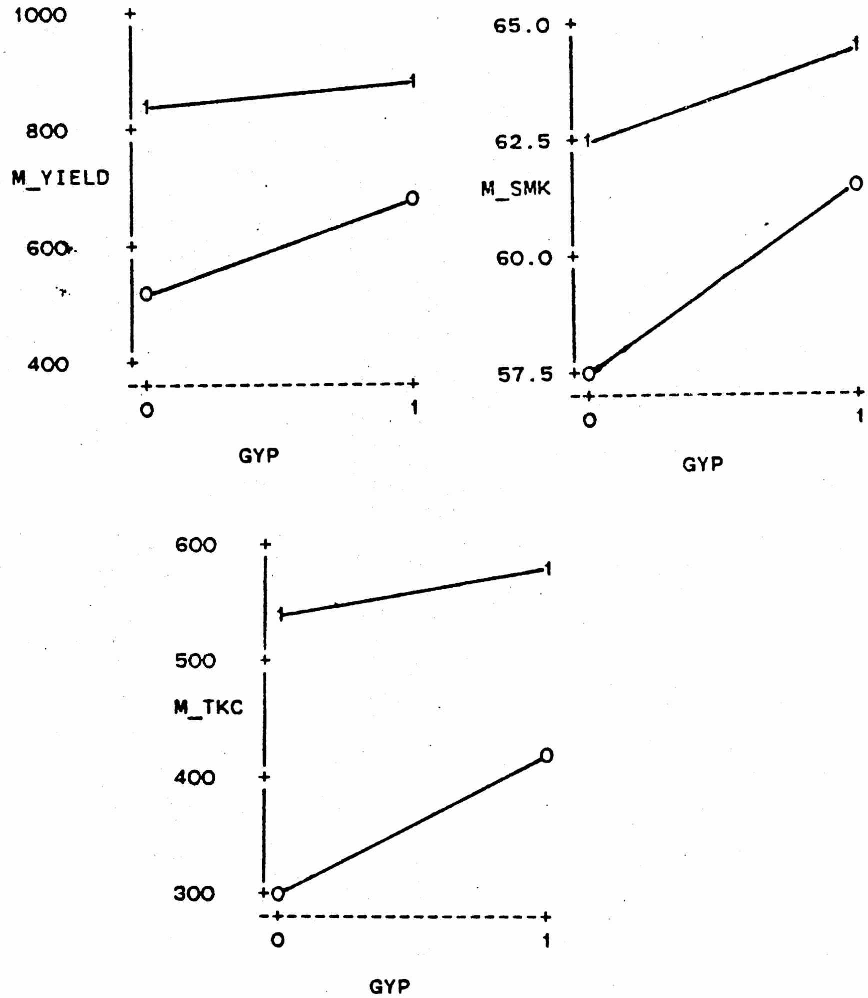
EFFECTS OF 90 KG/HA P AND 672 KG/HA GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS IN RELATION WITH FOLIAR SPRAY OF PHOSPHORUS (STRATFORD, 1982)

Treatment		No. of	Yield	SMK	TKC
Gypsum	Foliar P	Observations	kg/ha	%	kg/ha
0	0	4	703	59.00	415
0	1	4	800	62.25	498
1	0	4	688	61.25	421
1	1	4	993	64.00	636
	LSD		166	NS	103

TABLE XXII

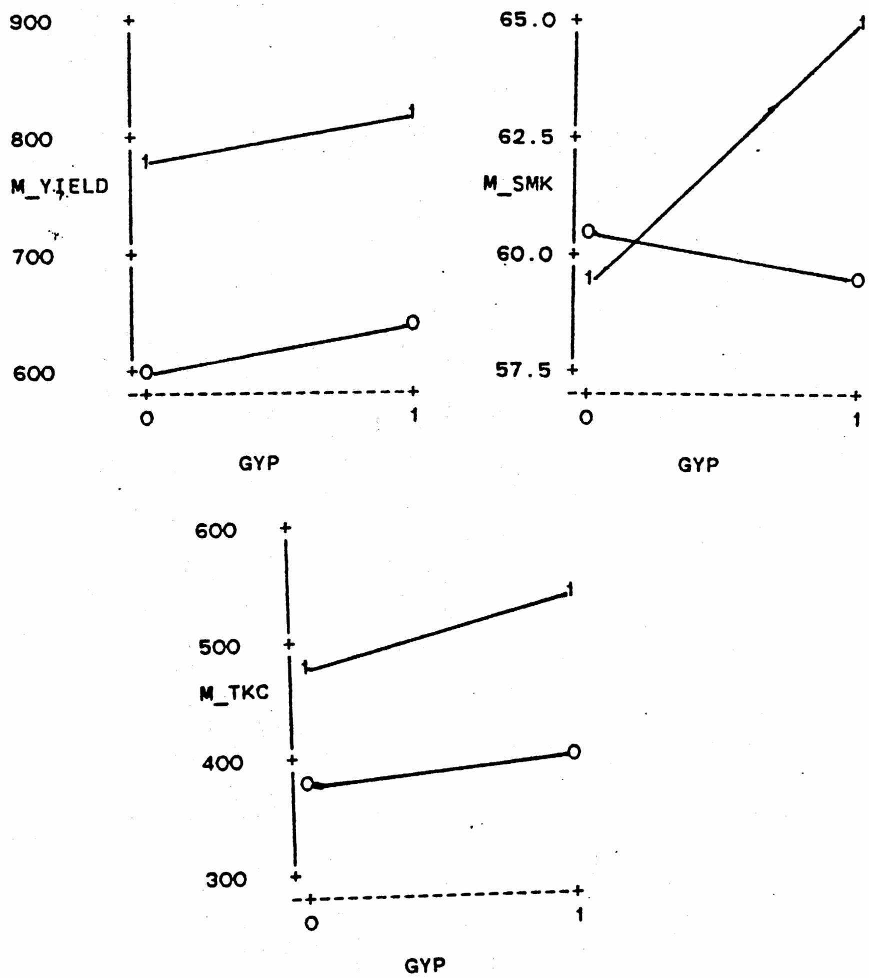
EFFECTS OF 90 KG/HA P AND 1009 KG/HA GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS IN RELATION WITH FOLIAR SPRAY OF PHOSPHORUS (STRATFORD, 1982)

Treatment					
Gypsum	Foliar P	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0	4	635	58.25	370
0	1	4	720	60.00	432
1	0	4	694	62.25	432
1	1	4	937	66.25	621
LSD			NS	4.6	NS



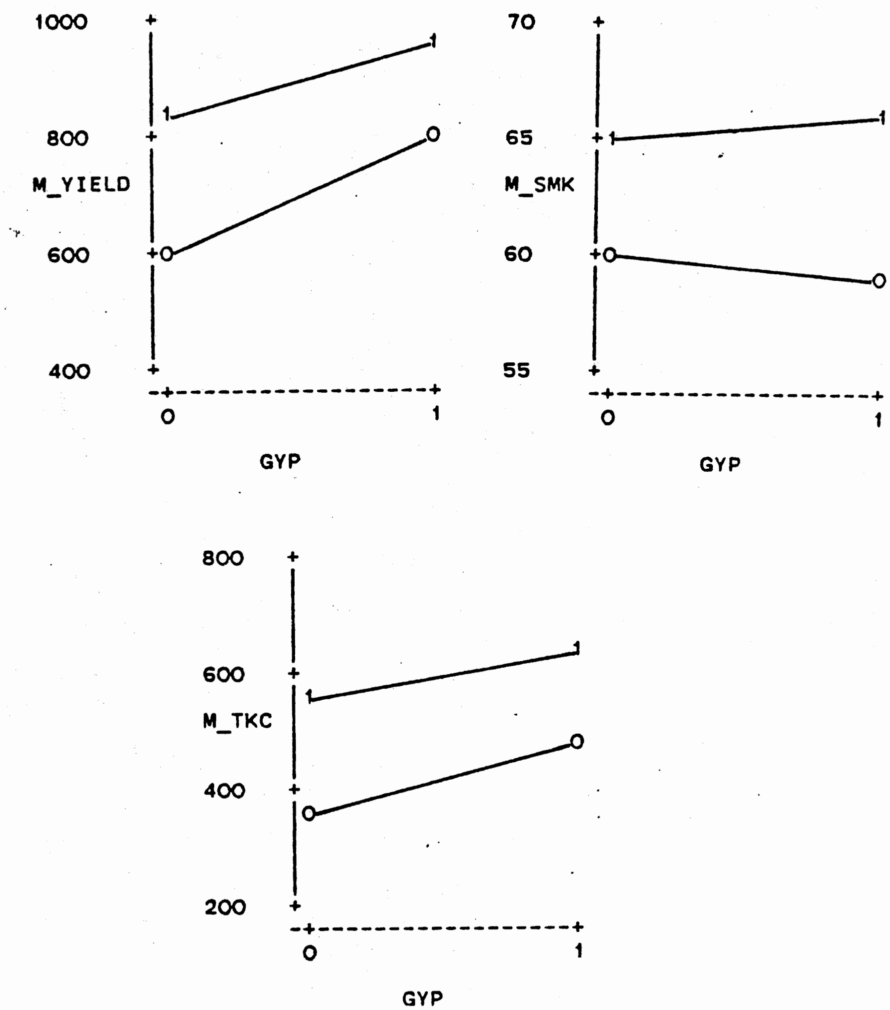
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 10. Effects of 336 kg/ha Gypsum and 0 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



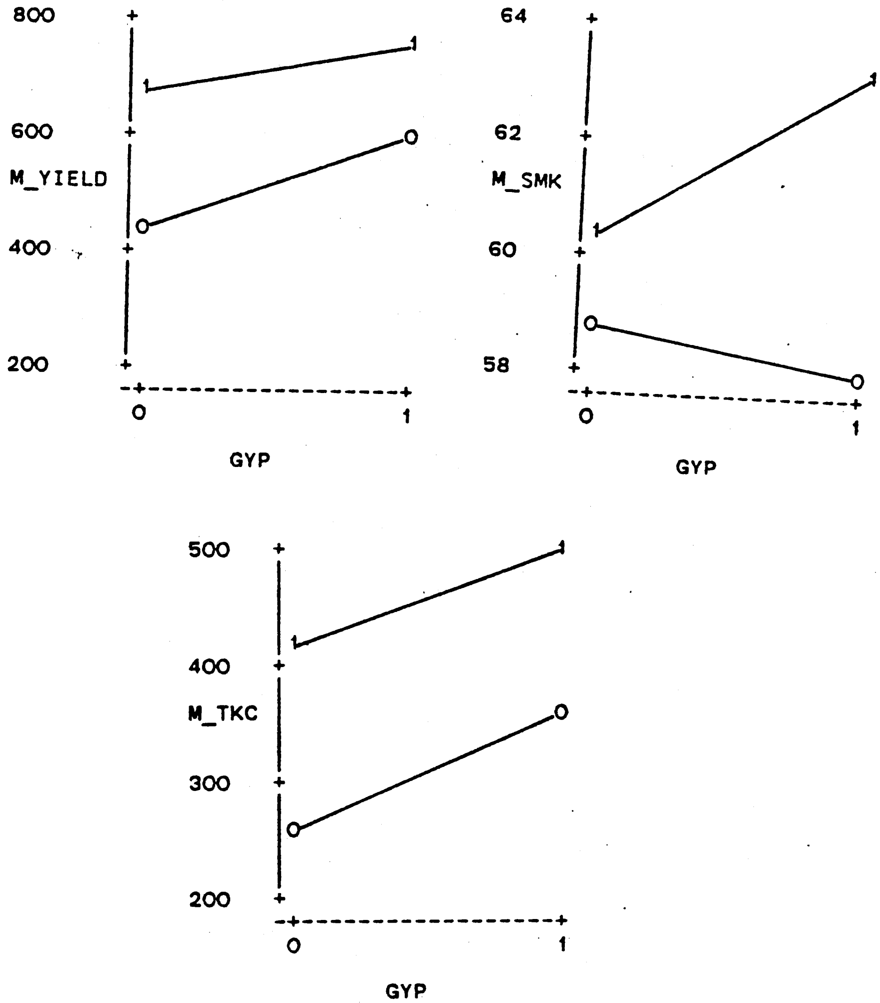
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 11. Effects of 672 kg/ha Gypsum and 0 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



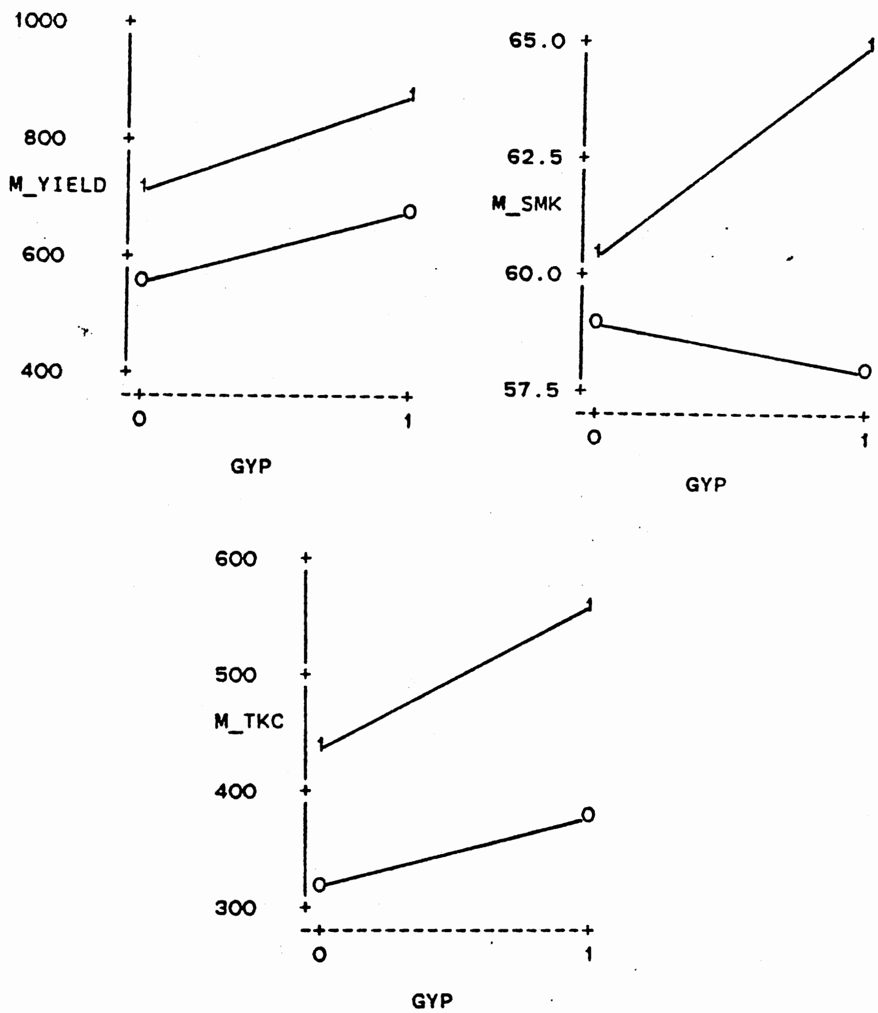
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 12. Effects of 1009 kg/ha Gypsum and 0 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



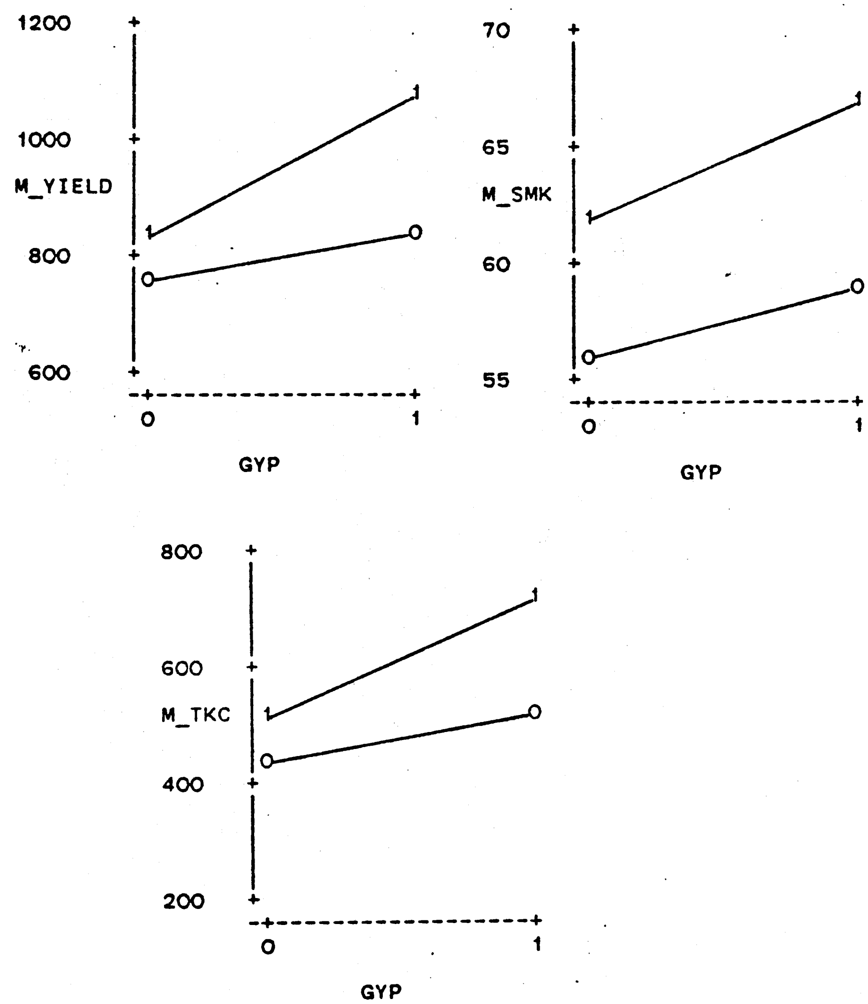
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 13. Effects of 336 kg/ha Gypsum and 45 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



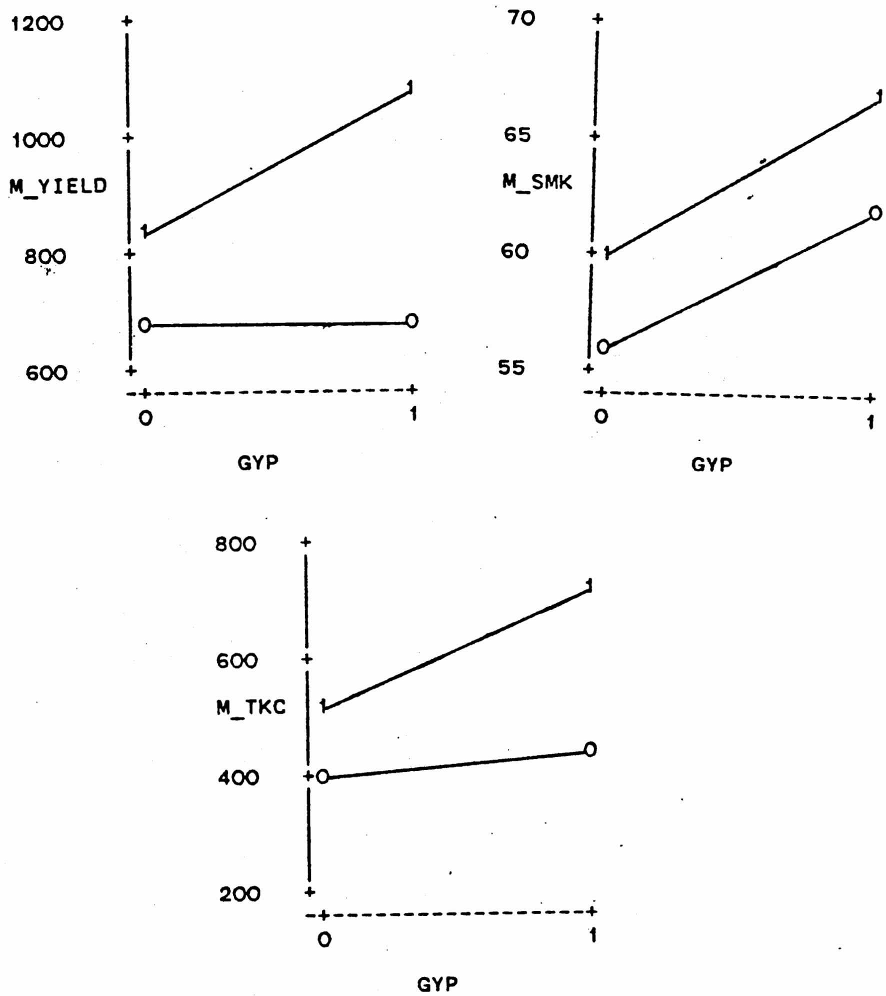
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 14. Effects of 672 kg/ha Gypsum and 45 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



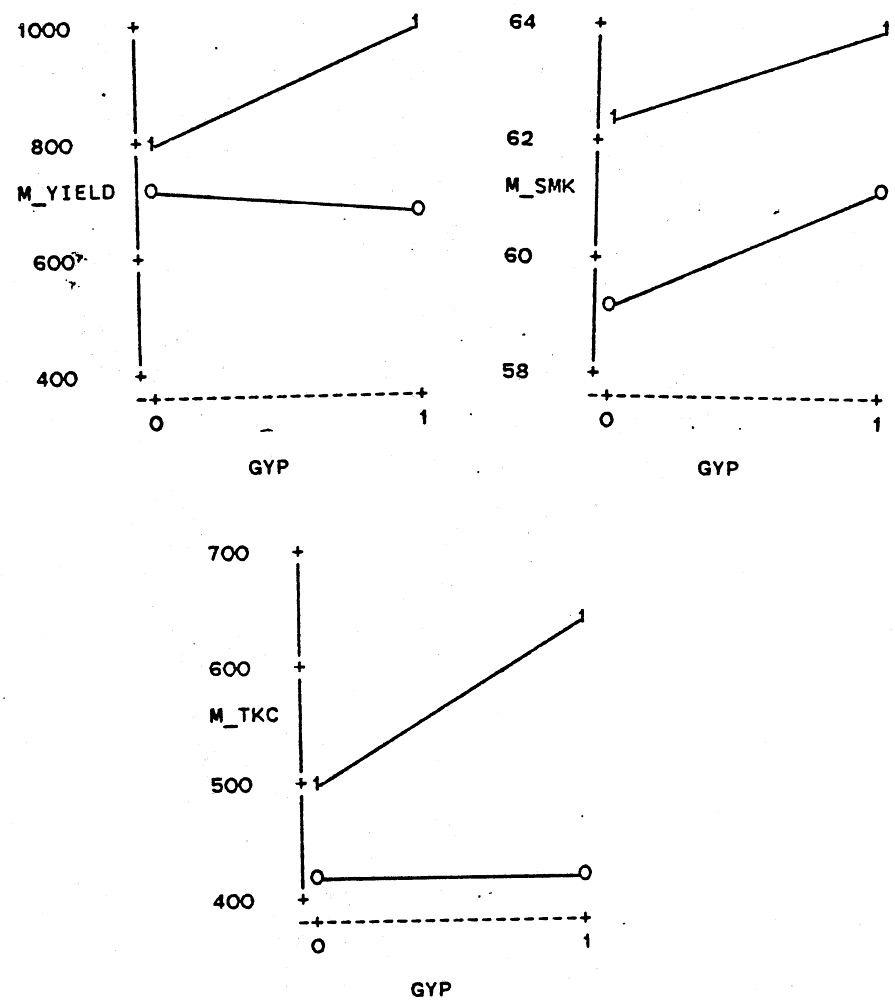
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 15. Effects of 1009 kg/ha Gypsum and 45 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



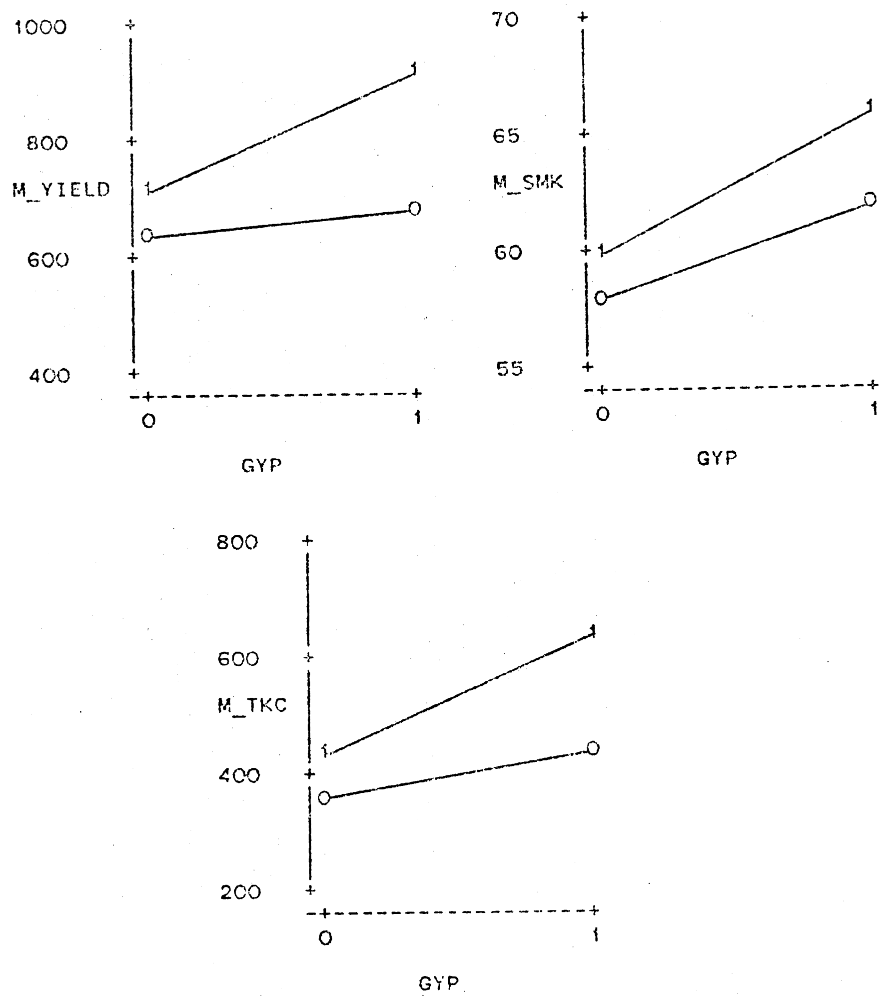
0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 16. Effects of 336 kg/ha Gypsum and 90 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 17. Effects of 672 kg/ha Gypsum and 90 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).



0 = no gypsum; 1 = gypsum (abscissa)
0 = no foliar; 1 = foliar P (line)
M = mean.

Figure 18. Effects of 1009 kg/ha Gypsum and 90 kg/ha P on Yield, % SMK, and TKC of Spanish Peanuts (Stratford, 1982).

At the P fertilizer rate of 90 kg/ha, foliar P increased yield significantly except for the gypsum rate of 1009 kg/ha (Table XXII). Percent SMK was not increased significantly by foliar P when gypsum rate was 336 or 672 kg/ha (Tables XX and XXI).

Foliar application of P increased the TKC significantly when P fertilizer rate was 90 kg/ha regardless of gypsum rate (OSL < 0.05) (Tables XX, XXI, and XXII, also Figures 16, 17, and 18).

According to the literature, gypsum will increase % SMK. This is basically confirmed by this study. Gypsum also increased yield at lower rates, at higher rates the yield was decreased regardless of P fertilizer rate.

In 1982 a new rate of gypsum (1681 kg/ha) was applied to 1/4 of the plots which did not receive gypsum in 1981. A new P compound for foliar P (potassium pyrophosphate, $K_4P_2O_7$) was applied to the other 1/4 of these plots to find out if there was a difference between KH_2PO_4 and $K_4P_2O_7$ at P concentration of 0.35 percent as a foliar P source. The combination of gypsum (1681 kg/ha) and foliar P (KH_2PO_4) increased the yield significantly only at 0 level of P fertilizer rate compared to the plot receiving only foliar P (KH_2PO_4) (Table XXIII).

Potassium phosphate (KH_2PO_4) as a foliar P gave better results on the yield and TKC of Spanish peanuts than $K_4P_2O_7$. There was no significant difference between the two P compounds as foliar spray when 90 kg/ha of P was applied to the soil (Table XXIV).

TABLE XXIII

EFFECTS OF 1681 KG/HA GYPSUM PLUS FOLIAR SPRAY P (KH_2PO_4) AND FOLIAR P (KH_2PO_4) WITH THREE RATES OF P TO THE GROUND ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1982)

P kg/ha	Gypsum + Foliar P (KH_2PO_4)	Foliar P (KH_2PO_4)	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	0*	1*	4	820	63.50	521
0	1	0	4	1047	64.00	670
45	0	1	4	837	62.00	519
45	1	0	4	892	66.50	593
90	0	1	4	810	62.50	506
90	1	0	4	928	64.75	601

*0 indicates no gypsum plus foliar P or foliar P has been applied and 1 indicates gypsum or foliar P has been applied.

LSD = 175 at 0.05.

TABLE XXIV

COMPARISON OF TWO DIFFERENT P COMPOUNDS USED AS FOLIAR SPRAYS (KH_2PO_4 and $K_4P_2O_7$) ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS (STRATFORD, 1982)

P kg/ha	KH_2PO_4	$K_4P_2O_7$	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
0	1*	0	4	820	63.50	521
0	0	1	4	600	64.00	384
45	1	0	4	837	62.00	519
45	0	1	4	677	63.00	426
90	1	0	4	810	62.50	506
90	0	1	4	827	62.50	517

*1 indicates the corresponding compound has been used as foliar spray with 0.35% concentration of P.

Fort Cobb Experiment

Foliar spray of P (KH_2PO_4) did not have a significant effect on yield, % SMK, and TKC of Spanish peanuts in 1981. Harsh weather at the time of sprayings, especially rainfall shortly after spraying may be the main cause for the foliar spray being ineffective. Previous gypsum treatment had a significant effect on % SMK, it increased % SMK from 63.23 to 65.35 percent (Tables XXV and XXVI).

TABLE XXV

EFFECTS OF RESIDUAL GYPSUM ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS (FORT COBB, 1981)

Gypsum Status	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
No gypsum	56	2666	63.23	1686
gypsum	56	2744	65.35	1793
LSD		NS	1.91	NS

TABLE XXVI

EFFECTS OF FOLIAR SPRAY P ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS (FORT COBB, 1982)

Foliar Status	No. of Observations	Yield kg/ha	SMK %	TKC kg/ha
No foliar	56	2390	68.00	1625
foliar	56	2799	70.00	1959
LSD		124	0.64	87

Foliar spray of P significantly affected the yield, % SMK, and TKC of Spanish peanuts at Fort Cobb in 1982. The yield increase due to foliar spray was 409 kg/ha, TKC increased by 334 kg/ha. A benefit to foliar P spray application is clear. Depending on the price of peanuts, the farmer may earn (net) from $60 to $110 per acre more by the use of a foliar P spray in combination with gypsum application.

There was no significant effect of residual gypsum on yield, and TKC of Spanish peanuts (OSL = 0.90) after 12 years at Fort Cobb.

Table XXVII shows the effect of foliar application P in relation to residual gypsum application and NPK fertilizer combination. The numbers are mean yield, mean % SMK, and mean TKC averaged over four replications. There were no significant differences between the seven N-P-K combinations in 1981. Different N-P-K combinations significantly affected the % SMk in 1982, the LSD based on 16 observations averaged over foliar and gypsum was 2.6.

TABLE XXVII

EFFECTS OF COMBINATION GYPSUM, NPK, AND FOLIAR SPRAY P ON YIELD, % SMK, AND TKC OF SPANISH PEANUTS (FORT COBB, 1982)

Gypsum	NPK Comb.	Foliar Spray	No. of Observ.	Yield kg/ha	SMK %	TKC kg/ha
0*	1**	0*	4	2726	67.0	1826
0	1	1	4	2940	70.0	2058
0	2	0	4	2262	69.3	1568
0	2	1	4	2840	69.8	1982
0	3	0	4	2819	65.0	1832
0	3	1	4	3276	68.8	2254
0	4	0	4	2576	68.0	1752
0	4	1	4	2769	70.5	1952
0	5	0	4	2029	68.8	1398
0	5	1	4	2452	69.3	1699
0	6	0	4	2041	70.5	1439
0	6	1	4	2526	71.3	1801
0	7	0	4	2669	66.3	1770
0	7	1	4	2755	69.0	1901
1	1	0	4	1913	66.8	1278
1	1	1	4	2562	67.0	1716
1	2	0	4	2619	70.8	1854
1	2	1	4	2812	72.0	2025
1	3	0	4	2269	66.5	1509
1	3	1	4	3033	69.8	2117
1	4	0	4	2191	67.8	1486
1	4	1	4	2633	70.5	1856
1	5	0	4	2591	68.8	1783
1	5	1	4	2790	71.3	1989
1	6	0	4	2660	68.3	1817
1	6	1	4	2964	72.0	2134
1	7	0	4	2497	69.5	1735
1	7	1	4	2833	70.5	1997

*0 indicates no gypsum or foliar application; 1 indicates there is gypsum or foliar spray.

**See Table III in Methods and Materials.

CHAPTER V

SUMMARY AND CONCLUSIONS

Two experiments were conducted at two locations (Fort Cobb and Stratford) to study the benefit of foliar spray P (0.35% solution of KH_2PO_4) in relation with gypsum application and P fertilizer rates on yield, % SMK, TKC of Spanish peanuts.

Four rates of gypsum (0, 336, 672, 1009 kg/ha) were applied in the Stratford experiments; residual effect of gypsum was considered in the Fort Cobb experiments. Two years data (1981, 1982) were collected for statistical analysis.

The following information was obtained from this study.

Stratford Experiment

1. Foliar application of P increased yield, % SMK and TKC of Spanish peanuts in many combinations with gypsum and P fertilization rates.

2. Gypsum application increased the % SMK. This result has been reported in the literature.

3. Yield response to gypsum generally increased up to 672 kg/ha, then decreased for the higher rate of gypsum (1009 kg/ha).

4. Combination of gypsum (672 kg/ha) and foliar application of P produced the highest yields and TKC.

Fort Cobb Experiment

1. Foliar application of P significantly increased yield, % SMK, and TKC of Spanish peanuts in 1982. There were no significant increases due to foliar spray P for yield, % SMK, and TKC in 1981. Unfavorable weather conditions is speculated as the cause.

2. Response of % SMK to residual gypsum was significant only in 1981.

General Conclusions

1. Since the foliar application of P in combination with gypsum application on Spanish peanuts in experimental plots show benefits of up to $110/acre, trials under farmer field conditions should be run. In addition, detailed analyses of soil levels of P and Ca and plnat content of P and Ca should be made. Undoubtably there are threshold levels of soil P and Ca beyond which foliar P applications will not show increases in net profit. However, many Oklahoma peanut farmers may benefit measurably by use of foliar P application.

2. The continued increase in yield when foliar P is applied to Spanish peanuts grown at higher soil P fertilization rates may lead to an impression that foliar P treatments will increase P uptake from the soil (see Table

XXIV). This suggestion should be viewed with caution since no direct measurements of soil P uptake were made. The effect might be the result of a larger leaf surface receiving foliar P in the higher P fertilized plots.

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TABLE XXVIII

SOIL TEST ANALYSIS FOR EACH PLOT AT FORT COBB, 1982

Trt.			Rep I					Rep II					Rep III					Rep IV				
No.	NPK	Gyp.	pH	N	P	K	Ca	pH	N	P	K	Ca	pH	N	P	K	Ca	pH	N	P	K	Ca
				*----lb/A-----					-----lb/A-----					-----lb/A-----					-----lb/A-----			
1	00-00-00	-	7.0	18	17	381	2792	7.1	14	17	297	2303	7.0	8	31	325	2307	7.0	5	16	303	2241
2	00-00-00	+	7.5	10	17	271	2337	6.5	25	42	394	2553	7.0	11	24	277	2051	7.0	6	14	296	1990
3	00-00-80	-	7.5	12	14	262	2106	7.2	12	11	358	2274	6.5	28	15	292	2085	7.0	14	12	347	2273
4	00-00-80	+	7.1	19	11	309	2272	7.3	10	21	286	2000	7.3	8	21	335	2151	7.0	8	11	370	2426
5	00-80-00	-	6.9	28	15	325	2509	7.1	21	17	305	2476	7.1	8	28	292	1998	6.9	15	16	293	2068
6	00-80-00	+	7.1	14	20	311	2274	7.0	18	14	297	2246	7.2	3	12	282	2065	6.9	8	28	301	1997
7	00-80-80	-	7.2	13	9	300	2329	7.3	10	16	304	2266	7.2	8	32	300	2180	7.0	9	16	298	2070
8	00-80-80	+	6.7	23	20	389	2519	7.2	12	21	298	2488	7.2	6	14	306	2092	6.9	9	22	345	2305
9	40-00-00	-	7.5	9	6	271	2141	7.1	12	8	300	2186	7.1	8	8	302	2306	7.0	11	16	331	2302
10	40-00-00	+	7.1	16	17	300	2310	6.6	28	32	332	2106	6.8	15	33	370	2223	7.1	6	8	330	2220
11	40-00-40	-	7.2	13	11	311	2446	7.4	11	7	281	2278	7.0	10	9	305	2222	7.1	8	16	338	2088
12	40-00-80	+	7.0	12	20	323	2198	7.1	13	11	316	2390	7.3	8	8	255	1986	7.1	6	43	348	2070
13	40-80-00	-	7.5	9	15	262	2161	7.1	12	20	282	2303	6.7	8	32	306	2066	7.0	6	19	303	2123
14	40-80-00	+	7.1	13	12	294	2293	7.3	12	18	315	2385	7.1	6	32	285	2057	7.0	10	22	304	2282

*To convert to kg/ha multiply by 1.1206.

TABLE XXIX

SOIL TEST ANALYSIS FOR EACH PLOT AT STRATFORD, 1982

Trt.			Rep I					Rep II					Rep III					Rep IV				
No.	P	Gyp.	pH	N	P	K	Ca	pH	N	P	K	Ca	pH	N	P	K	Ca	pH	N	P	K	Ca
				*----lb/A-----					-----lb/A-----					-----lb/A-----					-----lb/A-----			
1	0	0	5.4	1	59	230	981	5.6	0	39	276	1060	6.0	0	51	288	1115	5.4	0	49	258	734
2	40	0	5.3	1	73	267	988	5.1	0	59	283	1026	5.7	0	55	345	1400	5.6	0	48	304	1268
3	80	0	5.3	1	115	264	953	5.4	0	47	298	1167	5.3	0	46	309	1422	5.8	1	63	211	1265
4	0	300	6.1	2	47	234	1293	5.2	0	46	314	1063	5.2	0	58	315	1210	5.8	0	50	241	1184
5	40	300	5.9	4	67	282	1354	5.4	0	30	272	1071	5.9	0	55	265	1218	5.9	0	41	216	1250
6	80	300	5.2	3	104	268	852	5.7	0	39	244	1151	6.1	0	51	280	1174	5.5	0	60	330	1346
7	0	600	5.5	2	83	258	908	5.8	0	40	265	1141	5.5	0	45	299	1257	5.9	0	43	226	1224
8	40	600	5.5	0	61	250	940	5.8	0	58	266	966	5.8	0	45	260	1199	5.4	0	77	277	1016
9	80	600	5.5	3	86	264	1048	5.2	0	73	276	1121	5.5	0	59	311	1328	5.6	0	52	258	1222
10	0	900	5.6	2	65	300	1168	5.8	0	59	260	1081	5.4	0	44	306	1197	5.4	0	73	253	926
11	40	400	5.3	0	84	259	869	5.9	0	53	308	1090	5.8	0	37	271	1142	5.9	0	54	245	1182
12	80	900	5.7	6	87	238	1128	5.0	0	83	305	978	5.3	0	55	323	1329	5.5	0	44	282	1462
2**	40	-	5.3	0	101	255	920															
7	0	-	5.3	0	83	280	973															
12	80	-	5.6	2	82	253	1102															
2	80	-						5.1	0	105	260	839										
6	80							5.6	0	63	238	1168										
10								5.7	2	61	228	1132										
3	80												5.3	0	67	327	1347					
2	40												5.4	0	46	305	1397					

TABLE XXIX (Continued)

Trt. No.	P	Gyp.	Rep I					Rep II					Rep III					Rep IV				
			pH	N	P	K	Ca	pH	N	P	K	Ca	pH	N	P	K	Ca	pH	N	P	K	Ca
				-----lb/A-----					-----lb/A-----					-----lb/A-----					-----lb/A-----			
1	0												5.9	0	56	234	1244					
1																		5.5	0	63	222	647
2	40																	5.6	0	47	273	1256
3	80																	5.8	0	59	244	1117

*To convert to kg/ha multiply by 1.1206.

**These samples taken from second half of the plots which did not receive gypsum (gyp.).

1981 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	IKC
1	STRATFOR	1981	1	0	300	4	1	0	0	0	1206.89	75	905.16
2	STRATFOR	1981	1	0	300	4	0	1	0	0	720.55	72	518.79
3	STRATFOR	1981	1	0	300	4	0	0	1	0	1197.92	76	910.42
4	STRATFOR	1981	1	0	300	4	0	0	0	1	844.93	78	659.05
5	STRATFOR	1981	1	40	300	5	1	0	0	0	1260.67	78	983.33
6	STRATFOR	1981	1	40	300	5	0	1	0	0	862.86	74	638.52
7	STRATFOR	1981	1	40	300	5	0	0	1	0	914.41	76	694.95
8	STRATFOR	1981	1	40	300	5	0	0	0	1	.848.29	74	627.74
9	STRATFOR	1981	1	80	300	6	1	0	0	0	1233.78	72	888.32
10	STRATFOR	1981	1	80	300	6	0	1	0	0	1093.71	73	798.41
11	STRATFOR	1981	1	80	300	6	0	0	1	0	1153.10	75	864.82
12	STRATFOR	1981	1	80	300	6	0	0	0	1	803.47	73	586.53
13	STRATFOR	1981	1	0	600	7	1	0	0	0	1831.06	75	1373.30
14	STRATFOR	1981	1	0	600	7	0	1	0	0	1233.78	76	937.67
15	STRATFOR	1981	1	0	600	7	0	0	1	0	955.87	75	716.90
16	STRATFOR	1981	1	0	600	7	0	0	0	1	955.87	74	707.35
17	STRATFOR	1981	1	40	600	8	1	0	0	0	1140.77	74	844.17
18	STRATFOR	1981	1	40	600	8	0	1	0	0	925.62	77	712.72
19	STRATFOR	1981	1	40	600	8	0	0	1	0	887.52	75	665.64
20	STRATFOR	1981	1	40	600	8	0	0	0	1	627.54	74	464.38
21	STRATFOR	1981	1	80	600	9	1	0	0	0	1355.93	76	1030.50
22	STRATFOR	1981	1	80	600	9	0	1	0	0	1051.12	77	809.36
23	STRATFOR	1981	1	80	600	9	0	0	1	0	1227.06	78	957.10
24	STRATFOR	1981	1	80	600	9	0	0	0	1	1083.62	75	812.72
25	STRATFOR	1981	1	0	900	10	1	0	0	0	874.07	73	638.07
26	STRATFOR	1981	1	0	900	10	0	1	0	0	860.62	74	636.86
27	STRATFOR	1981	1	0	900	10	0	0	1	0	1078.02	76	819.29
28	STRATFOR	1981	1	0	900	10	0	0	0	1	862.86	73	629.89
29	STRATFOR	1981	1	40	900	11	1	0	0	0	1511.69	75	1133.77
30	STRATFOR	1981	1	40	900	11	0	1	0	0	968.20	75	726.15
31	STRATFOR	1981	1	40	900	11	0	0	1	0	911.05	72	655.95
32	STRATFOR	1981	1	40	900	11	0	0	0	1	782.18	70	547.53
33	STRATFOR	1981	1	80	900	12	1	0	0	0	1284.21	74	950.31
34	STRATFOR	1981	1	80	900	12	0	1	0	0	958.11	76	728.17
35	STRATFOR	1981	1	80	900	12	0	0	1	0	848.29	76	644.70
36	STRATFOR	1981	1	80	900	12	0	0	0	1	806.83	74	597.06
37	STRATFOR	1981	2	0	300	4	1	0	0	0	1027.59	75	770.69
38	STRATFOR	1981	2	0	300	4	0	1	0	0	961.47	73	701.88
39	STRATFOR	1981	2	0	300	4	0	0	1	0	1072.41	74	793.59
40	STRATFOR	1981	2	0	300	4	0	0	0	1	776.58	75	582.43
41	STRATFOR	1981	2	40	300	5	1	0	0	0	1027.59	72	739.86
42	STRATFOR	1981	2	40	300	5	0	1	0	0	914.41	75	685.81
43	STRATFOR	1981	2	40	300	5	0	0	1	0	1084.74	71	770.17
44	STRATFOR	1981	2	40	300	5	0	0	0	1	979.40	75	734.55
45	STRATFOR	1981	2	80	300	6	1	0	0	0	1320.07	72	950.45
46	STRATFOR	1981	2	80	300	6	0	1	0	0	968.20	75	726.15
47	STRATFOR	1981	2	80	300	6	0	0	1	0	1054.48	75	790.86
48	STRATFOR	1981	2	80	300	6	0	0	0	1	827.00	74	611.98
49	STRATFOR	1981	2	0	600	7	1	0	0	0	1033.19	76	785.23
50	STRATFOR	1981	2	0	600	7	0	1	0	0	878,55	72	632.56
51	STRATFOR	1981	2	0	600	7	0	0	1	0	923.37	75	692.53
52	STRATFOR	1981	2	0	600	7	0	0	0	1	776.58	75	582.43
53	STRATFOR	1981	2	40	600	8	1	0	0	0	1266.28	75	949.71
54	STRATFOR	1981	2	40	600	8	0	1	0	0	914.41	78	713.24
55	STRATFOR	1981	2	40	600	8	0	0	1	0	973.80	70	681.66
56	STRATFOR	1981	2	40	600	8	0	0	0	1	844.93	75	633.70

1981 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	TKC
57	STRATFOR	1981	2	80	600	9	1	0	0	0	1275.24	75	956.43
58	STRATFOR	1981	2	80	600	9	0	1	0	0	916.65	76	696.65
59	STRATFOR	1981	2	80	600	9	0	0	1	0	952.51	74	704.86
60	STRATFOR	1981	2	80	600	9	0	0	0	1	812.43	72	584.95
61	STRATFOR	1981	2	0	900	10	1	0	0	0	997.33	75	748.00
62	STRATFOR	1981	2	0	900	10	0	1	0	0	806.83	74	597.06
63	STRATFOR	1981	2	0	900	10	0	0	1	0	907.69	76	689.84
64	STRATFOR	1981	2	0	900	10	0	0	0	1	898.72	75	674.04
65	STRATFOR	1981	2	40	900	11	1	0	0	0	1287.57	79	1017.18
66	STRATFOR	1981	2	40	900	11	0	1	0	0	1069.05	77	823.17
67	STRATFOR	1981	2	40	900	11	0	0	1	0	1140.77	76	866.99
68	STRATFOR	1981	2	40	900	11	0	0	0	1	979.40	74	724.76
69	STRATFOR	1981	2	80	900	12	1	0	0	0	1236.02	74	914.66
70	STRATFOR	1981	2	80	900	12	0	1	0	0	878.55	75	658.91
71	STRATFOR	1981	2	80	900	12	0	0	1	0	860.62	77	662.68
72	STRATFOR	1981	2	80	900	12	0	0	0	1	588.31	71	417.70
73	STRATFOR	1981	3	0	300	4	1	0	0	0	1135.17	76	862.73
74	STRATFOR	1981	3	0	300	4	0	1	0	0	788.90	75	591.68
75	STRATFOR	1981	3	0	300	4	0	0	1	0	1140.77	69	787.13
76	STRATFOR	1981	3	0	300	4	0	0	0	1	764.25	74	565.54
77	STRATFOR	1981	3	40	300	5	1	0	0	0	1063.45	77	818.86
78	STRATFOR	1981	3	40	300	5	0	1	0	0	1006.30	76	764.79
79	STRATFOR	1981	3	40	300	5	0	0	1	0	875.19	75	656.39
80	STRATFOR	1981	3	40	300	5	0	0	0	1	838.21	73	611.89
81	STRATFOR	1981	3	80	300	6	1	0	0	0	1048.88	77	807.64
82	STRATFOR	1981	3	80	300	6	0	1	0	0	979.40	73	714.97
83	STRATFOR	1981	3	80	300	6	0	0	1	0	749.68	75	562.26
84	STRATFOR	1981	3	80	300	6	0	0	0	1	726.15	75	544.61
85	STRATFOR	1981	3	0	600	7	1	0	0	0	1146.37	75	859.78
86	STRATFOR	1981	3	0	600	7	0	1	0	0	1155.34	75	866.50
87	STRATFOR	1981	3	0	600	7	0	0	1	0	1135.17	73	828.67
88	STRATFOR	1981	3	0	600	7	0	0	0	1	968.20	73	706.78
89	STRATFOR	1981	3	40	600	8	1	0	0	0	1329.03	75	996.77
90	STRATFOR	1981	3	40	600	8	0	1	0	0	1298.78	77	1000.06
91	STRATFOR	1981	3	40	600	8	0	0	1	0	1167.67	77	899.10
92	STRATFOR	1981	3	40	600	8	0	0	0	1	860.62	75	645.47
93	STRATFOR	1981	3	80	600	9	1	0	0	0	1404.11	73	1025.00
94	STRATFOR	1981	3	80	600	9	0	1	0	0	1251.71	75	938.78
95	STRATFOR	1981	3	80	600	9	0	0	1	0	1015.26	74	751.30
96	STRATFOR	1981	3	80	600	9	0	0	0	1	770.97	74	570.52
97	STRATFOR	1981	3	0	900	10	1	0	0	0	997.33	72	718.08
98	STRATFOR	1981	3	0	900	10	0	1	0	0	791.14	74	585.45
99	STRATFOR	1981	3	0	900	10	0	0	1	0	920.01	73	671.61
100	STRATFOR	1981	3	0	900	10	0	0	0	1	602.88	73	440.10
101	STRATFOR	1981	3	40	900	11	1	0	0	0	1051.12	76	798.85
102	STRATFOR	1981	3	40	900	11	0	1	0	0	797.87	75	598.40
103	STRATFOR	1981	3	40	900	11	0	0	1	0	871.83	76	662.59
104	STRATFOR	1981	3	40	900	11	0	0	0	1	770.97	77	593.65
105	STRATFOR	1981	3	80	900	12	1	0	0	0	1153.10	75	864.82
106	STRATFOR	1981	3	80	900	12	0	1	0	0	812.43	77	625.57
107	STRATFOR	1981	3	80	900	12	0	0	1	0	824.76	75	618.57
108	STRATFOR	1981	3	80	900	12	0	0	0	1	686.93	73	501.46
109	STRATFOR	1981	4	0	300	4	1	0	0	0	1224.82	76	930.86
110	STRATFOR	1981	4	0	300	4	0	1	0	0	943.55	75	707.66
111	STRATFOR	1981	4	0	300	4	0	0	1	0	1176.63	75	882.47
112	STRATFOR	1981	4	0	300	4	0	0	0	1	824.76	75	618.57

1981 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	TKC
113	STRATFOR	1981	4	40	300	5	1	0	0	0	1386.18	75	1039.64
114	STRATFOR	1981	4	40	300	5	0	1	0	0	988.37	74	731.39
115	STRATFOR	1981	4	40	300	5	0	0	1	0	991 73	78	773.55
116	STRATFOR	1981	4	40	300	5	0	0	0	1	1074.66	76	816.74
117	STRATFOR	1981	4	80	300	6	1	0	0	0	1707.79	68	1161.30
118	STRATFOR	1981	4	80	300	6	0	1	0	0	746.32	70	522.42
119	STRATFOR	1981	4	80	300	6	0	0	1	0	1445.57	73	1055.27
120	STRATFOR	1981	4	80	300	6	0	0	0	1	656.67	74	485.94
121	STRATFOR	1981	4	0	600	7	1	0	0	0	1239.38	77	954.33
122	STRATFOR	1981	4	0	600	7	0	1	0	0	686.93	75	515.20
123	STRATFOR	1981	4	0	600	7	0	0	1	0	835.97	73	610.26
124	STRATFOR	1981	4	0	600	7	0	0	0	1	934.58	76	710.28
125	STRATFOR	1981	4	40	600	8	1	0	0	0	1454.54	74	1076.36
126	STRATFOR	1981	4	40	600	8	0	1	0	0	875.19	74	647.64
127	STRATFOR	1981	4	40	600	8	0	0	1	0	1078.02	73	786.95
128	STRATFOR	1981	4	40	600	8	0	0	0	1	561.42	75	421.07
129	STRATFOR	1981	4	80	600	9	1	0	0	0	1338.00	70	936.60
130	STRATFOR	1981	4	80	600	9	0	1	0	0	1000.70	74	740.51
131	STRATFOR	1981	4	80	600	9	0	0	1	0	1182.23	72	851.21
132	STRATFOR	1981	4	80	600	9	0	0	0	1	686.93	71	487.72
133	STRATFOR	1981	4	0	900	10	1	0	0	0	1182.23	73	863.03
134	STRATFOR	1981	4	0	900	10	0	1	0	0	1171.03	77	901.69
135	STRATFOR	1981	4	0	900	10	0	0	1	0	884.15	75	663.12
136	STRATFOR	1981	4	0	900	10	0	0	0	1	779.94	77	600.55
137	STRATFOR	1981	4	40	900	11	1	0	0	0	1302.14	76	989.62
138	STRATFOR	1981	4	40	900	11	0	1	0	0	1054.48	76	801.41
139	STRATFOR	1981	4	40	900	11	0	0	1	0	961.47	75	721.11
140	STRATFOR	1981	4	40	900	11	0	0	0	1	767.61	76	583.38
141	STRATFOR	1981	4	80	900	12	1	0	0	0	1671.94	75	1253.95
142	STRATFOR	1981	4	80	900	12	0	1	0	0	842.69	74	623.59
143	STRATFOR	1981	4	80	900	12	0	0	1	0	871.83	75	653.87
144	STRATFOR	1981	4	80	900	12	0	0	0	1	717.18	77	552.23

1982 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	TKC
1	S	82	1	0	300	4	1	0	0	0	936.82	64	599.57
2	S	82	1	0	300	4	0	1	0	0	649.95	60	389.97
3	S	82	1	0	300	4	0	0	1	0	1014.14	65	659.19
4	S	82	1	0	300	4	0	0	0	1	532.28	51	271.47
5	S	82	1	40	300	5	1	0	0	0	633.14	65	411.54
6	S	82	1	40	300	5	0	1	0	0	628.66	56	352.05
7	S	82	1	40	300	5	0	0	1	0	699.25	54	377.60
8	S	82	1	40	300	5	0	0	0	1	420.22	56	235.33
9	S	82	1	80	300	6	1	0	0	0	1186.72	67	795.10
10	S	82	1	80	300	6	0	1	0	0	848.29	64	542.91
11	S	82	1	80	300	6	0	0	1	0	1143.01	65	742.96
12	S	82	1	80	300	6	0	0	0	1	907.69	65	590.00
13	S	82	1	0	600	7	1	0	0	0	1280.85	71	909.40
14	S	82	1	0	600	7	0	1	0	0	811.31	65	527.35
15	S	82	1	0	600	7	0	0	1	0	1138.53	65	740.04
16	S	82	1	0	600	7	0	0	0	1	950.27	65	617.67
17	S	82	1	40	600	8	1	0	0	0	738.48	67	494.78
18	S	82	1	40	600	8	0	1	0	0	699.25	64	447.52
19	S	82	1	40	600	8	0	0	1	0	702.62	65	456.70
20	S	82	1	40	600	8	0	0	0	1	486.34	61	296.67
21	S	82	1	80	600	9	1	0	0	0	1061.21	63	668.56
22	S	82	1	80	600	9	0	1	0	0	775.46	62	480 78
23	S	82	1	80	600	9	0	0	1	0	667.88	60	400.73
24	S	82	1	80	600	9	0	0	0	1	617.45	58	358.12
25	S	82	1	0	900	10	1	0	0	0	1036.55	64	663.40
26	S	82	1	0	900	10	0	1	0	0	939.06	58	544.66
27	S	82	1	0	900	10	0	0	1	0	563.66	60	338.20
28	S	82	1	0	900	10	0	0	0	1	582.71	58	337.97
29	S	82	1	40	900	11	1	0	0	0	1834.42	71	1302.44
30	S	82	1	40	900	11	0	1	0	0	1586.77	68	1079.00
31	S	82	1	40	900	11	0	0	1	0	1169.91	68	795.54
32	S	82	1	40	900	11	0	0	0	1	1153.10	68	784.11
33	S	82	1	80	900	12	1	0	0	0	923.37	70	646.36
34	S	82	1	80	900	12	0	1	0	0	458.33	62	284.16
35	S	82	1	80	900	12	0	0	1	0	618.57	60	371.14
36	S	82	1	80	900	12	0	0	0	1	413.50	55	227.43
37	S	82	2	0	300	4	1	0	0	0	878.55	67	588.63
38	S	82	2	0	300	4	0	1	0	0	796.75	64	509 92
39	S	82	2	0	300	4	0	0	1	0	939.06	66	619.78
40	S	82	2	0	300	4	0	0	0	1	692.53	63	436.29
41	S	82	2	40	300	5	1	0	0	0	691.41	63	435.59
42	S	82	2	40	300	5	0	1	0	0	653.31	58	378.92
43	S	82	2	40	300	5	0	0	1	0	647.71	66	427.49
44	S	82	2	40	300	5	0	0	0	1	495.31	61	302.14
45	S	82	2	80	300	6	1	0	0	0	1017.50	65	661.38
46	S	82	2	80	300	6	0	1	0	0	807.95	63	509.01
47	S	82	2	80	300	6	0	0	1	0	621.93	52	323.41
48	S	82	2	80	300	6	0	0	0	1	544.61	46	250.52
49	S	82	2	0	600	7	1	0	0	0	670.12	64	428.88
50	S	82	2	0	600	7	0	1	0	0	541.25	55	297.69
51	S	82	2	0	600	7	0	0	1	0	571.51	57	325.76
52	S	82	2	0	600	7	0	0	0	1	347.39	63	218.65
53	S	82	2	40	600	8	1	0	0	0	1113.88	69	768.57
54	S	82	2	40	600	8	0	1	0	0	701.50	45	315.67
55	S	82	2	40	600	8	0	0	1	0	1043.28	63	657.27
56	S	82	2	40	600	8	0	0	0	1	710.46	65	461.80

1982 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	TKC
57	S	82	2	80	600	9	1	0	0	0	1086.98	66	717.408
58	S	82	2	80	600	9	0	1	0	0	450.48	65	292.813
59	S	82	2	80	600	9	0	0	1	0	1025.35	65	666.477
60	S	82	2	80	600	9	0	0	0	1	972.68	64	622.516
61	S	82	2	0	900	10	1	0	0	0	992.85	66	655.282
62	S	82	2	0	900	10	0	1	0	0	599.52	62	371.703
63	S	82	2	0	900	10	0	0	1	0	1094.83	69	755.430
64	S	82	2	0	900	10	0	0	0	1	623.05	57	355.141
65	S	82	2	40	900	11	1	0	0	0	1024.23	66	675.991
66	S	82	2	40	900	11	0	1	0	0	726.15	62	450.212
67	S	82	2	40	900	11	0	0	1	0	911.05	65	592.181
68	S	82	2	40	900	11	0	0	0	1	909.93	65	591.453
69	S	82	2	80	900	12	1	0	0	0	1129.56	66	745.513
70	S	82	2	80	900	12	0	1	0	0	832.61	62	516.216
71	S	82	2	80	900	12	0	0	1	0	717.18	63	451.826
72	S	82	2	80	900	12	0	0	0	1	583.83	62	361.976
73	S	82	3	0	300	4	1	0	0	0	937.94	62	581.524
74	S	82	3	0	300	4	0	1	0	0	625.29	60	375.177
75	S	82	3	0	300	4	0	0	1	0	773.21	57	440.732
76	S	82	3	0	300	4	0	0	0	1	630.90	56	353.303
77	S	82	3	40	300	5	1	0	0	0	973.80	67	652.447
78	S	82	3	40	300	5	0	1	0	0	686.93	60	412.157
79	S	82	3	40	300	5	0	0	1	0	782.18	64	500.594
80	S	82	3	40	300	5	0	0	0	1	562.54	62	348.776
81	S	82	3	80	300	6	1	0	0	0	973.80	67	652.447
82	S	82	3	80	300	6	0	1	0	0	596.16	58	345.772
83	S	82	3	80	300	6	0	0	1	0	518.84	63	326.868
84	S	82	3	80	300	6	0	0	0	1	584.95	54	315.875
85	S	82	3	0	600	7	1	0	0	0	738.48	65	480.009
86	S	82	3	0	600	7	0	1	0	0	720.55	62	446.738
87	S	82	3	0	600	7	0	0	1	0	879.67	63	554.193
88	S	82	3	0	600	7	0	0	0	1	711.58	62	441.180
89	S	82	3	40	600	8	1	0	0	0	760.89	60	456.532
90	S	82	3	40	600	8	0	1	0	0	681.32	61	415.608
91	S	82	3	40	600	8	0	0	1	0	535.65	52	278.536
92	S	82	3	40	600	8	0	0	0	1	347.39	52	180.641
93	S	82	3	80	600	9	1	0	0	0	832.61	61	507.890
94	S	82	3	80	600	9	0	1	0	0	609.61	53	323.091
95	S	82	3	80	600	9	0	0	1	0	801.23	61	488.750
96	S	82	3	80	600	9	0	0	0	1	635.38	57	362.167
97	S	82	3	0	900	10	1	0	0	0	712.70	64	456.129
98	S	82	3	0	900	10	0	1	0	0	634.26	56	355.185
99	S	82	3	0	900	10	0	0	1	0	905.44	64	579.485
100	S	82	3	0	900	10	0	0	0	1	586.07	64	375.087
101	S	82	3	40	900	11	1	0	0	0	549.09	63	345.929
102	S	82	3	40	900	11	0	1	0	0	472.89	54	255.362
103	S	82	3	40	900	11	0	0	1	0	856.14	55	470.876
104	S	82	3	40	900	11	0	0	0	1	476.25	48	228.602
105	S	82	3	80	900	12	1	0	0	0	708.22	64	453.260
106	S	82	3	80	900	12	0	1	0	0	673.48	62	417.558
107	S	82	3	80	900	12	0	0	1	0	572.63	56	320.671
108	S	82	3	80	900	12	0	0	0	1	636.50	58	369.170
109	S	82	4	0	300	4	1	0	0	0	844.93	65	549.206
110	S	82	4	0	300	4	0	1	0	0	665.64	61	406.038
111	S	82	4	0	300	4	0	0	1	0	693.65	61	423.127
112	S	82	4	0	300	4	0	0	0	1	289.11	60	173.469

1982 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	TKC
113	S	82	4	40	300	5	1	0	0	0	820.28	58	475.762
114	S	82	4	40	300	5	0	1	0	0	453.84	58	263.229
115	S	82	4	40	300	5	0	0	1	0	626.42	58	363.321
116	S	82	4	40	300	5	0	0	0	1	331.70	56	185.751
117	S	82	4	80	300	6	1	0	0	0	1162.06	67	778.582
118	S	82	4	80	300	6	0	1	0	0	482.98	63	304.277
119	S	82	4	80	300	6	0	0	1	0	1014.14	60	608.486
120	S	82	4	80	300	6	0	0	0	1	719.43	60	431.655
121	S	82	4	0	600	7	1	0	0	0	556.94	60	334.163
122	S	82	4	0	600	7	0	1	0	0	522.20	56	292.432
123	S	82	4	0	600	7	0	0	1	0	527.80	52	274.457
124	S	82	4	0	600	7	0	0	0	1	407.90	52	212.107
125	S	82	4	40	600	8	1	0	0	0	838.21	64	536.454
126	S	82	4	40	600	8	0	1	0	0	593.92	62	368.229
127	S	82	4	40	600	8	0	0	1	0	653.31	61	398.519
128	S	82	4	40	600	8	0	0	0	1	616.33	58	357.471
129	S	82	4	80	600	9	1	0	0	0	991.73	66	654.542
130	S	82	4	80	600	9	0	1	0	0	915.53	65	535.095
131	S	82	4	80	600	9	0	0	1	0	704.86	63	444.060
132	S	82	4	80	600	9	0	0	0	1	586.07	57	334.062
133	S	82	4	0	900	10	1	0	0	0	1027.59	70	719.313
134	S	82	4	0	900	10	0	1	0	0	1062.33	58	616.151
135	S	82	4	0	900	10	0	0	1	0	805.71	66	531.770
136	S	82	4	0	900	10	0	0	0	1	671.24	62	416.168
137	S	82	4	40	900	11	1	0	0	0	866.22	69	597.694
138	S	82	4	40	900	11	0	1	0	0	583.83	53	309.431
139	S	82	4	40	900	11	0	0	1	0	487.46	61	297.351
140	S	82	4	40	900	11	0	0	0	1	481.86	44	212.018
141	S	82	4	80	900	12	1	0	0	0	988.37	65	642.440
142	S	82	4	80	900	12	0	1	0	0	810.19	63	510.422
143	S	82	4	80	900	12	0	0	1	0	970.44	61	591.968
144	S	82	4	80	900	12	0	0	0	1	905.44	58	525.158

1982 STRATFORD RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	IND1	IND2	IND3	IND4	YIELD	SMK	TKC
1	S	82	1	0	1500	1	1	0	0	0	1039.92	66	686.345
2	S	82	1	0	1500	1	0	1	0	0	943.55	66	622.740
3	S	82	1	0	1500	1	0	0	1	0	766.49	64	490.554
4	S	82	1	0	1500	1	0	0	0	1	620.81	64	397.320
5	S	82	1	40	1500	2	1	0	0	0	925.62	69	638.675
6	S	82	1	40	1500	2	0	1	0	0	787.78	61	480.547
7	S	82	1	40	1500	2	0	0	1	0	916.65	67	614.156
8	S	82	1	40	1500	2	0	0	0	1	704.86	64	451.109
9	S	82	1	80	1500	3	1	0	0	0	1067.93	67	715.514
10	S	82	1	80	1500	3	0	1	0	0	944.67	61	576.246
11	S	82	1	80	1500	3	0	0	1	0	770.97	67	516.552
12	S	82	1	80	1500	3	0	0	0	1	1035.43	62	641.969
13	S	82	2	0	1500	1	1	0	0	0	942.42	62	584.303
14	S	82	2	0	1500	1	0	1	0	0	547.97	60	328.784
15	S	82	2	0	1500	1	0	0	1	0	690.29	61	421.077
16	S	82	2	0	1500	1	0	0	0	1	643.22	52	334.477
17	S	82	2	40	1500	2	1	0	0	0	884.15	69	610.066
18	S	82	2	40	1500	2	0	1	0	0	726.15	66	479.258
19	S	82	2	40	1500	2	0	0	1	0	906.57	60	543.939
20	S	82	2	40	1500	2	0	0	0	1	695.89	64	445.371
21	S	82	2	80	1500	3	1	0	0	0	979.40	65	636.613
22	S	82	2	80	1500	3	0	1	0	0	918.89	65	597.280
23	S	82	2	80	1500	3	0	0	1	0	991.73	64	634.708
24	S	82	2	80	1500	3	0	0	0	1	835.97	63	526.660
25	S	82	3	0	1500	1	1	0	0	0	894.24	62	554.428
26	S	82	3	0	1500	1	0	1	0	0	368.68	61	224.893
27	S	82	3	0	1500	1	0	0	1	0	742.96	64	475.493
28	S	82	3	0	1500	1	0	0	0	1	255.50	55	140.523
29	S	82	3	40	1500	2	1	0	0	0	804.59	62	498.846
30	S	82	3	40	1500	2	0	1	0	0	366.44	64	234.519
31	S	82	3	40	1500	2	0	0	1	0	684.69	55	376.578
32	S	82	3	40	1500	2	0	0	0	1	583.83	57	332.785
33	S	82	3	80	1500	3	1	0	0	0	848.29	65	551.391
34	S	82	3	80	1500	3	0	1	0	0	764.25	64	489.119
35	S	82	3	80	1500	3	0	0	1	0	740.72	53	392.580
36	S	82	3	80	1500	3	0	0	0	1	646.59	63	407.349
37	S	82	4	0	1500	1	1	0	0	0	1312.22	66	866.067
38	S	82	4	0	1500	1	0	1	0	0	540.13	69	372.689
39	S	82	4	0	1500	1	0	0	1	0	1080.26	65	702.168
40	S	82	4	0	1500	1	0	0	0	1	993.97	65	646.082
41	S	82	4	40	1500	2	1	0	0	0	954.75	66	630.136
42	S	82	4	40	1500	2	0	1	0	0	829.24	61	505.839
43	S	82	4	40	1500	2	0	0	1	0	839.33	66	553.957
44	S	82	4	40	1500	2	0	0	0	1	737.35	58	427.666
45	S	82	4	80	1500	3	1	0	0	0	818.04	62	507.184
46	S	82	4	80	1500	3	0	1	0	0	679.08	60	407.450
47	S	82	4	80	1500	3	0	0	1	0	736.23	66	485.915
48	S	82	4	80	1500	3	0	0	0	1	720.55	61	439.533

1981 FORT COBB RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	YIELD	SMK	TKC
1	FORTCOBB	1981	1	1	0	1	1980.10	57.5	1138.56
2	FORTCOBB	1981	1	1	0	0	3145.52	64.0	2013.14
3	FORTCOBB	1981	2	1	0	1	2929.25	64.5	1889.37
4	FORTCOBB	1981	2	1	0	0	2793.66	62.5	1746.03
5	FORTCOBB	1981	3	1	0	1	3118.63	60.0	1871.18
6	FORTCOBB	1981	3	1	0	0	2630.05	66.0	1735.83
7	FORTCOBB	1981	4	1	0	1	2331.97	64.5	1504.12
8	FORTCOBB	1981	4	1	0	0	2251.29	65.0	1463.34
9	FORTCOBB	1981	1	2	1	1	3491.79	65.0	2269.66
10	FORTCOBB	1981	1	2	1	0	3525.41	65.0	2291.51
11	FORTCOBB	1981	2	2	1	1	2874.34	63.5	1825.21
12	FORTCOBB	1981	2	2	1	0	3308.01	66.0	2183.29
13	FORTCOBB	1981	3	2	1	1	2603.15	69.5	1809.19
14	FORTCOBB	1981	3	2	1	0	2738.75	66.0	1807.57
15	FORTCOBB	1981	4	2	1	1	1654.01	67.5	1116.45
16	FORTCOBB	1981	4	2	1	0	2656.94	64.0	1700.44
17	FORTCOBB	1981	1	3	0	1	3416.71	60.5	2067.11
18	FORTCOBB	1981	1	3	0	0	2684.96	50.0	1342.48
19	FORTCOBB	1981	2	3	0	1	3552.30	65.5	2326.76
20	FORTCOBB	1981	2	3	0	0	3012.17	64.7	1948.88
21	FORTCOBB	1981	3	3	0	1	3336.03	68.0	2268.50
22	FORTCOBB	1981	3	3	0	0	2278.18	62.5	1423.86
23	FORTCOBB	1981	4	3	0	1	1980.10	63.0	1247.46
24	FORTCOBB	1981	4	3	0	0	2196.38	20.0	439.28
25	FORTCOBB	1981	1	4	1	1	2196.38	65.0	1427.64
26	FORTCOBB	1981	1	4	1	0	2983.04	69.0	2058.30
27	FORTCOBB	1981	2	4	1	1	2597.55	68.0	1766.33
28	FORTCOBB	1981	2	4	1	0	3097.34	68.0	2106.19
29	FORTCOBB	1981	3	4	1	1	2929.25	65.0	1904.01
30	FORTCOBB	1981	3	4	1	0	2847.44	69.0	1964.74
31	FORTCOBB	1981	4	4	1	1	2358.86	73.5	1733.76
32	FORTCOBB	1981	4	4	1	0	2494.46	65.5	1633.87
33	FORTCOBB	1981	1	5	0	1	2549.36	64.0	1631.59
34	FORTCOBB	1981	1	5	0	0	2549.36	63.0	1606.10
35	FORTCOBB	1981	2	5	0	1	2386.88	65.0	1551.47
36	FORTCOBB	1981	2	5	0	0	3389.81	62.5	2118.63
37	FORTCOBB	1981	3	5	0	1	3661.00	64.0	2343.04
38	FORTCOBB	1981	3	5	0	0	2251.29	57.5	1294.49
39	FORTCOBB	1981	4	5	0	1	3118.63	66.5	2073.89
40	FORTCOBB	1981	4	5	0	0	2305.07	65.0	1498.30
41	FORTCOBB	1981	1	6	1	1	2060.78	63.0	1298.29
42	FORTCOBB	1981	1	6	1	0	2874.34	65.0	1868.32
43	FORTCOBB	1981	2	6	1	1	2386.88	66.0	1575.34
44	FORTCOBB	1981	2	6	1	0	3525.41	60.0	2115.24
45	FORTCOBB	1981	3	6	1	1	3009.93	64.5	1941.41
46	FORTCOBB	1981	3	6	1	0	2305.07	65.5	1509.82
47	FORTCOBB	1981	4	6	1	1	2494.46	77.5	1933.20
48	FORTCOBB	1981	4	6	1	0	3036.83	58.0	1761,36
49	FORTCOBB	1981	1	7	0	1	1871.40	68.0	1272.55
50	FORTCOBB	1981	1	7	0	0	2711.85	67.5	1830.50
51	FORTCOBB	1981	2	7	0	1	2305.07	64.5	1486.77
52	FORTCOBB	1981	2	7	0	0	2693.92	65.0	1751.05
53	FORTCOBB	1981	3	7	0	1	2576.26	66.0	1700.33
54	FORTCOBB	1981	3	7	0	0	2711.85	70.5	1911.86
55	FORTCOBB	1981	4	7	0	1	1382.82	64.0	885.01
56	FORTCOBB	1981	4	7	0	0	3634.11	65.0	2362.17

1981 FORT COBB RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	YIELD	SMK	TKC
57	FORTCOBB	1981	1	8	1	1	2331.97	60.0	1399.18
58	FORTCOBB	1981	1	8	1	0	2331.97	64.5	1504.12
59	FORTCOBB	1981	2	8	1	1	2413.77	65.0	1568.95
60	FORTCOBB	1981	2	8	1	0	3036.83	66.0	2004.31
61	FORTCOBB	1981	3	8	1	1	3200.43	69.5	2224.30
62	FORTCOBB	1981	3	8	1	0	2440.67	66.0	1610.84
63	FORTCOBB	1981	4	8	1	1	2603.15	61.0	1587.92
64	FORTCOBB	1981	4	8	1	0	2765.64	69.0	1908.29
65	FORTCOBB	1981	1	9	0	1	2413.77	64.5	1556.88
66	FORTCOBB	1981	1	9	0	0	3172.42	65.0	2062.07
67	FORTCOBB	1981	2	9	0	1	3064.84	64.5	1976.82
68	FORTCOBB	1981	2	9	0	0	2115.69	64.0	1354.04
69	FORTCOBB	1981	3	9	0	1	3074.93	66.5	2044.83
70	FORTCOBB	1981	3	9	0	0	2006.99	66.0	1324.62
71	FORTCOBB	1981	4	9	0	1	1898.30	61.5	1167.45
72	FORTCOBB	1981	4	9	0	0	2549.36	62.5	1593.35
73	FORTCOBB	1981	1	10	1	1	2169.48	63.0	1366.77
74	FORTCOBB	1981	1	10	1	0	3172.42	63.5	2014.49
75	FORTCOBB	1981	2	10	1	1	2684.96	65.5	1758.65
76	FORTCOBB	1981	2	10	1	0	2820.55	66.5	1875.67
77	FORTCOBB	1981	3	10	1	1	3471.62	56.5	1961.46
78	FORTCOBB	1981	3	10	1	0	2711.85	64.0	1735.59
79	FORTCOBB	1981	4	10	1	1	2196.38	68.0	1493.54
80	FORTCOBB	1981	4	10	1	0	2494.46	63.0	1571.51
81	FORTCOBB	1981	1	11	0	1	2251.29	65.0	1463.34
82	FORTCOBB	1981	1	11	0	0	2305.07	65.5	1509.82
83	FORTCOBB	1981	2	11	0	1	2169.48	64.5	1399.32
84	FORTCOBB	1981	2	11	0	0	2331.97	65.0	1515.78
85	FORTCOBB	1981	3	11	0	1	3443.60	63.5	2186.69
86	FORTCOBB	1981	3	11	0	0	3254.22	65.0	2115.24
87	FORTCOBB	1981	4	11	0	1	2331.97	63.0	1469.14
88	FORTCOBB	1981	4	11	0	0	2331.97	71.0	1655.70
89	FORTCOBB	1981	1	12	1	1	3471.62	64.5	2239.19
90	FORTCOBB	1981	1	12	1	0	2358.86	64.5	1521.47
91	FORTCOBB	1981	2	12	1	1	3416.71	71.0	2425.86
92	FORTCOBB	1981	2	12	1	0	2494.46	66.0	1646.34
93	FORTCOBB	1981	3	12	1	1	2793.66	68.0	1899.69
94	FORTCOBB	1981	3	12	1	0	3064.84	69.0	2114.74
95	FORTCOBB	1981	4	12	1	1	3091.74	61.0	1885.96
96	FORTCOBB	1981	4	12	1	0	2765.64	63.0	1742.35
97	FORTCOBB	1981	1	13	0	1	2305.07	64.0	1475.25
98	FORTCOBB	1981	1	13	0	0	2603.15	65.5	1705.07
99	FORTCOBB	1981	2	13	0	1	2576.26	64.5	1661.69
100	FORTCOBB	1981	2	13	0	0	3118.63	66.5	2073.89
101	FORTCOBB	1981	3	13	0	1	3498.51	62.0	2169.08
102	FORTCOBB	1981	3	13	0	0	3227.33	63.5	2049.35
103	FORTCOBB	1981	4	13	0	1	2684.96	59.0	1584.12
104	FORTCOBB	1981	4	13	0	0	2820.55	62.5	1762.84
105	FORTCOBB	1981	1	14	1	1	2929.25	60.5	1772.20
106	FORTCOBB	1981	1	14	1	0	2630.05	64.5	1696.38
107	FORTCOBB	1981	2	14	1	1	3118.63	66.5	2073.89
108	FORTCOBB	1981	2	14	1	0	2874.34	64.5	1853.95
109	FORTCOBB	1981	3	14	1	1	2549.36	64.0	1631.59
110	FORTCOBB	1981	3	14	1	0	2522.47	64.0	1614.38
111	FORTCOBB	1981	4	14	1	1	2278.18	65.0	1480.82
112	FORTCOBB	1981	4	14	1	0	2413.77	63.5	1532.75

1982 FORT COBB RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	YIELD	SMK	TKC
1	F	82	1	1	0	1	3111.91	65	2022.74
2	F	82	1	1	0	0	2940.45	58	1705.46
3	F	82	2	1	0	1	2512.39	72	1808.92
4	F	82	2	1	0	0	2340.93	70	1638.65
5	F	82	3	1	0	1	3597.13	70	2517.99
6	F	82	3	1	0	0	3482.82	67	2333.49
7	F	82	4	1	0	1	2540.40	73	1854.49
8	F	82	4	1	0	0	2141.47	73	1563.27
9	F	82	1	2	1	1	1855.71	66	1224.77
10	F	82	1	2	1	0	1599.10	66	1055.40
11	F	82	2	2	1	1	1855.71	66	1224.77
12	F	82	2	2	1	0	1826.58	67	1223.81
13	F	82	3	2	1	1	4110.36	67	2753.94
14	F	82	3	2	1	0	2368.95	64	1516.13
15	F	82	4	2	1	1	2426.10	69	1674.01
16	F	82	4	2	1	0	1855.71	70	1299.00
17	F	82	1	3	0	1	2141.47	69	1477.61
18	F	82	1	3	0	0	2197.50	69	1516.27
19	F	82	2	3	0	1	2911.32	70	2037.92
20	F	82	2	3	0	0	2711.85	67	1816.94
21	F	82	3	3	0	1	3139.92	72	2260.74
22	F	82	3	3	0	0	2141.47	74	1584.69
23	F	82	4	3	0	1	3167.94	68	2154.20
24	F	82	4	3	0	0	1998.03	67	1338.68
25	F	82	1	4	1	1	2711.85	71	1925.41
26	F	82	1	4	1	0	2368.95	71	1681.95
27	F	82	2	4	1	1	3054.76	72	2199.42
28	F	82	2	4	1	0	2540.40	72	1829 09
29	F	82	3	4	1	1	2797.02	73	2041.82
30	F	82	3	4	1	0	2767.88	72	1992.88
31	F	82	4	4	1	1	2682.72	72	1931.56
32	F	82	4	4	1	0	2797.02	68	1901.97
33	F	82	1	5	0	1	3226.21	66	2129.30
34	F	82	1	5	0	0	2682.72	61	1636.46
35	F	82	2	5	0	1	3625.14	71	2573.85
36	F	82	2	5	0	0	2711.85	67	1816.94
37	F	82	3	5	0	1	3625.14	70	2537.60
38	F	82	3	5	0	0	3368.52	67	2256.91
39	F	82	4	5	0	1	2626.69	68	1786.15
40	F	82	4	5	0	0	2511.26	65	1632.32
41	F	82	1	6	1	1	3711.43	65	2412.43
42	F	82	1	6	1	0	2368.95	65	1539.82
43	F	82	2	6	1	1	2740.99	72	1973.51
44	F	82	2	6	1	0	2826.15	71	2006.57
45	F	82	3	6	1	1	2283.78	69	1575.81
46	F	82	3	6	1	0	2112.33	61	1288.52
47	F	82	4	6	1	1	3396.54	73	2479.47
48	F	82	4	6	1	0	1769.43	69	1220.90
49	F	82	1	7	0	1	2455.23	72	1767.77
50	F	82	1	7	0	0	2226.63	71	1580.91
51	F	82	2	7	0	1	2997.60	70	2098.32
52	F	82	2	7	0	0	2597.55	65	1688.41
53	F	82	3	7	0	1	3054.76	74	2260.52
54	F	82	3	7	0	0	2997.60	69	2068.35
55	F	82	4	7	0	1	2569.54	66	1695.89
56	F	82	4	7	0	0	2483.25	67	1663.78

1982 FORT COBB RAW DATA

OBS	LOCATION	YEAR	REP	TREATMNT	GYPSUM	FOLIAR	YIELD	SMK	TKC
57	F	82	1	8	1	1	3226.21	71	2290.61
58	F	82	1	8	1	0	2654.70	65	1725.56
59	F	82	2	8	1	1	1883.73	67	1262.10
60	F	82	2	8	1	0	1769.43	68	1203.21
61	F	82	3	8	1	1	2798.14	72	2014.66
62	F	82	3	8	1	0	1912.86	69	1319.88
63	F	82	4	8	1	1	2625.57	72	1890.41
64	F	82	4	8	1	0	2426.10	69	1674.01
65	F	82	1	9	0	1	1940.88	66	1280.98
66	F	82	1	9	0	0	1883.73	65	1224.42
67	F	82	2	9	0	1	3225.09	70	2257.56
68	F	82	2	9	0	0	2084.32	72	1500.71
69	F	82	3	9	0	1	2226.63	74	1647.71
70	F	82	3	9	0	0	2084.32	71	1479.86
71	F	82	4	9	0	1	2417.13	67	1619.48
72	F	82	4	9	0	0	2064.15	67	1382.98
73	F	82	1	10	1	1	2997.60	72	2158.28
74	F	82	1	10	1	0	2654.70	68	1805.20
75	F	82	2	10	1	1	3139.92	71	2229.34
76	F	82	2	10	1	0	3054.76	71	2168.88
77	F	82	3	10	1	1	3282.24	70	2297.57
78	F	82	3	10	1	0	2997.60	67	2008.40
79	F	82	4	10	1	1	1741.41	72	1253.82
80	F	82	4	10	1	0	1655.13	69	1142.04
81	F	82	1	11	0	1	2940.45	72	2117.13
82	F	82	1	11	0	0	2597.55	70	1818.29
83	F	82	2	11	0	1	2141.47	71	1520.44
84	F	82	2	11	0	0	1854.59	72	1335.31
85	F	82	3	11	0	1	2597.55	71	1844.26
86	F	82	3	11	0	0	1998.03	70	1398.62
87	F	82	4	11	0	1	2426.10	71	1722.53
88	F	82	4	11	0	0	1712.28	70	1198.59
89	F	82	1	12	1	1	3167.94	73	2312.59
90	F	82	1	12	1	0	3054.76	70	2138.33
91	F	82	2	12	1	1	2854.17	74	2112.08
92	F	82	2	12	1	0	2569.54	70	1798.68
93	F	82	3	12	1	1	2892.27	73	2111.36
94	F	82	3	12	1	0	2730.90	73	1993.56
95	F	82	4	12	1	1	2940.45	68	1999.51
96	F	82	4	12	1	0	2283.78	60	1370.27
97	F	82	1	13	0	1	2911.32	67	1950.58
98	F	82	1	13	0	0	1940.88	66	1280.98
99	F	82	2	13	0	1	2311.80	68	1572.02
100	F	82	2	13	0	0	1341.36	66	885.30
101	F	82	3	13	0	1	3283.36	71	2331.18
102	F	82	3	13	0	0	3283.36	67	2199.85
103	F	82	4	13	0	1	2512.39	70	1758.67
104	F	82	4	13	0	0	2512.39	66	1658.47
105	F	82	1	14	1	1	2455.23	71	1743.22
106	F	82	1	14	1	0	2739.87	70	1917.91
107	F	82	2	14	1	1	3368.52	74	2492.71
108	F	82	2	14	1	0	2483.25	70	1738.27
109	F	82	3	14	1	1	2854.17	66	1883.75
110	F	82	3	14	1	0	2283.78	68	1552.97
111	F	82	4	14	1	1	2654.70	71	1884.84
112	F	82	4	14	1	0	2483.25	70	1738.27

VITA

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Doctor of Philosophy

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