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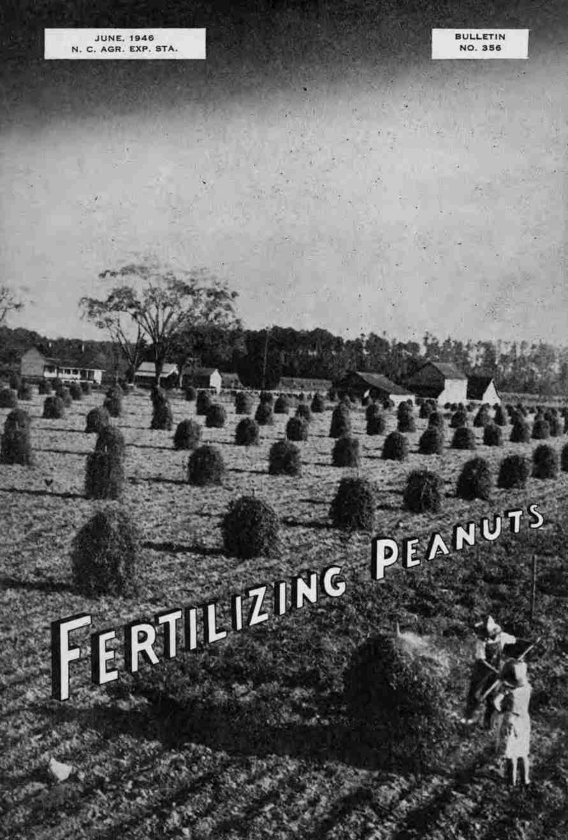

FERTILIZING PEANUTS

CONTENTS

Photograph on cover page, courtesy J. K. Coggin.

FERTILIZER RECOMMENDATIONS

To meet calcium requirements

The soil must be moderately well supplied with calcium for the production of good yields of large type peanuts. One of the best means of accomplishing this is by the wise use of lime. If this is not done, then it is necessary to use other means of supplying calcium.

On soils low to medium in calcium, add at least 400 pounds of landplaster to the foliage at early blooming stage. On soils high in calcium the landplaster is not necessary. The calcium level of the soil can be determined best by having the soil analyzed. Usually a soil is low in calcium if many "pops" have been noticed in previous peanut crops. It is probably high in calcium if good quality nuts have been obtained in past years without calcium additions.

To meet potash and phosphate requirements

A good crop of peanuts removes from the soil 60 to 100 pounds of potash per acre and about 20 pounds of phosphoric acid. In spite of this the yield of peanuts is seldom increased by direct application of nitrogen, phosphate or potash and their use is not recommended. To take care of the potash removed by the peanut crop, however, *additional potash* should be applied to *other crops* in rotation with peanuts. This can be accomplished by the use of high potash fertilizers or liberal potash top-dressing on other crops in the rotation. If this is done peanuts produce just as well with no fertilizers. Where this practice is impractical (for example, if peanuts are grown several years in succession) apply 100 pounds of muriate of potash per acre on top of the row about the time that the peanuts break through the ground.

FERTILIZING PEANUTS IN NORTH CAROLINA

by

W. E. COLWELL, N. C. BRADY, and J. FIELDING REED[1]

INTRODUCTION

The problem of maintaining fertility on peanut soils is two-fold: (a) the peanut crop must be supplied with the fertilizing materials that result in high yields of good quality nuts; and (b) this fertilization program must be adjusted to insure high yields of other crops in the rotation.

In 1938, an enlarged research program was started by the North Carolina Agricultural Experiment Station to help growers in solving these problems. Field experiments were conducted throughout the peanut producing area of the state, and laboratory and greenhouse studies were made. This is the second report to be made on the work and presents results obtained through 1944.[2]

The field experiments were carried out in cooperation with individual growers, and at the Upper Coastal Plain Branch Station. In these experiments the effects of various fertilizer materials upon the yield and quality of peanuts were determined. Different fertilizer treatments were added to various small plots within each field. The treatments were replicated several times to take soil variation into account. Peanuts were planted, cultivated, and harvested by methods corresponding as nearly as possible to those used in ordinary farm practice.

CALCIUM AS AN ELEMENT OF MAJOR IMPORTANCE IN PEANUT PRODUCTION

For years many peanut farmers in North Carolina have followed the practice of adding landplaster to peanuts. In most of the earlier field tests, however, this material did not give a profitable response.

In 1942, experiments were conducted with landplaster on soils of very low calcium level. Yields were increased about four-fold and the number of pops was greatly reduced. Since landplaster is a hydrated calcium sulfate, the only two constituents that might be expected

[1] Professor of Agronomy, Research Assistant Professor of Agronomy, and Professor of Agronomy, respectively.

[2] Only the results considered of immediate practical value are presented here. For more detailed information the reader is referred to the scientific articles cited at the end of this report. Methods of obtaining yield and quality measurements are also discussed in these articles.

to be responsible for this are the calcium and the sulfate. Therefore an investigation was undertaken to determine which of these elements was responsible for the beneficial effects of landplaster. Large type peanuts were grown under field conditions on a soil of low fertility. The sulfates of potassium and magnesium were used in comparison with calcium sulfate (landplaster). The materials were added on top of the row on July 5 when the peanuts were in early bloom.

The results of this study are presented in Figure 1. They show that calcium sulfate was the only salt to result in an increase in kernel development and yield. The other two salts which

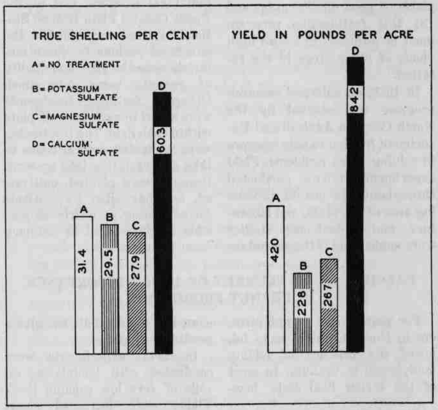

Figure 1. Calcium sulfate (landplaster) increased yield and shelling percentage of peanuts, but other sulfate materials were not helpful.

Field weights of peanuts are corrected to pounds per acre shelling 60 per cent large and medium kernels. Thus all yields are on a common basis.

For determination of true shelling percentage, all the peanuts were removed by hand from about 20 plants taken from each plot at digging time. Each peanut was opened separately and the number of well filled peanuts and the number of pops were determined. The large and medium kernels were separated and weighed and the "true shelling percentage" determined.

also contained sulfate did not improve either quality or yield.

It is concluded, therefore, that calcium is the element responsible for the beneficial effects obtained from the use of landplaster on low calcium soils.

Importance of Calcium Content of the Soil

Since calcium is necessary for proper development of kernels, soils very low in calcium would be expected to produce peanuts with a high percentage of pops. Also, peanuts growing on soils high in calcium would not be expected to respond to additions of this element, whether it be supplied by landplaster or by any of the other calcium carriers commonly used.

Experiments were set up to determine the effect of the calcium level of the soil on the response obtained from added calcium. The calcium levels of the soils used varied from two hundred to slightly over two thousand pounds of available lime[3] per acre. In these experiments, calcium was supplied by landplaster applied to the foliage at the rate of 400 pounds per acre. Applying on the foliage was simply a means of getting the landplaster on the top of the row.

On the soils high in calcium the response from landplaster was very slight. For example, at the Upper Coastal Plain Branch Station, where the soil contained approximately 2200 pounds of available lime per acre, there was no increase in yield from landplaster. On soils lower in calcium, yields were increased by landplaster. At one location where the soil contained only 210 pounds of lime per acre, landplaster increased the yield more than five-fold. In general, when the soil calcium was equivalent to more than 1200 pounds of available lime per acre, there was no benefit from landplaster applications. On the other hand, when there was less than 600 pounds of available lime per acre, the yields obtained without landplaster were only 20 to 40 per cent as large as when landplaster was added.

The effect of soil calcium on the filling of peanuts is shown in Figure 2. On soils high in calcium, landplaster has had very little effect in improving quality. However, on soils lower in calcium, addition of this material has greatly increased the filling of the peanuts.

The amount of available calcium in the soil is important in determining whether or not large type peanuts will respond to added calcium. It is suggested that soil tests be made from time to time in order to determine

[3] Amount expressed as the equivalent amount of calcium carbonate.

if additional calcium is necessary.[4]

Placement of Calcium

In the work already discussed, landplaster was added to the foliage at the early blooming stage. Thus the material was added to the zone of the soil in which fruit development takes place. At two locations comparisons of this practice of applying landplaster with that of applying it at the same rate (400 pounds per acre) in the row at the time of planting were made. The soils selected for the study were known from previous experience to produce low yields without added calcium. The results are presented in Table 1. Landplaster placed in the row at planting time did not meet the calcium requirements of the peanuts as well as did the later applications made on the row.

[4] Free soil testing service is provided for farmers by the Soil Testing Laboratory, North Carolina Department of Agriculture.

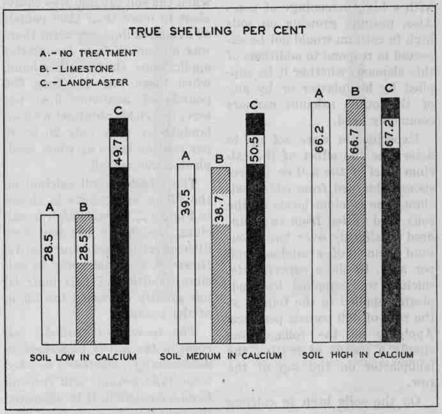

Figure 2. On soils low in calcium landplaster results in better filled peanuts, but on soils higher in calcium landplaster has very little effect on quality.

Table 1. Comparisons between two practices of applying landplaster.

Landplaster treatment	True shelling per cent	Corrected yield Lbs/A
CLB, Norfolk f.s.l. (1942)		
None	24.9	364
In row	40.5	878
On foliage	53.0	1595
MLW, Kalmia l.s. (1943)		
None	31.7	410
In row	31.9	334
On foliage	60.3	842

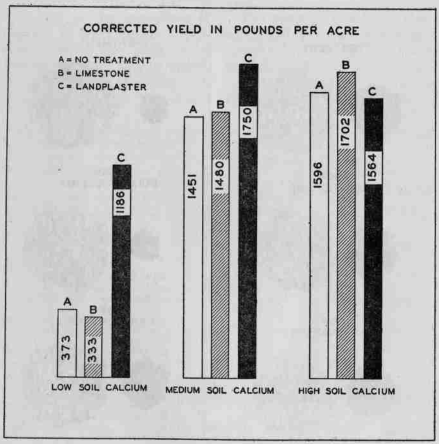

Figure 3. The level of calcium in the soil is important in determining whether landplaster will increase yield or not. On soils of lower calcium content landplaster is better than limestone in the row.

The effects of landplaster applied on the foliage at the early blooming stage were compared also with those obtained from dolomitic limestone applied in the row at the time of planting. The rate in each case was 400 pounds per acre. Data in Figures 2 and 3 illustrate the results obtained from these comparisons. On soils very low in calcium, the limestone treatment did not meet the calcium requirement of the peanuts as well as did landplaster.

Evidently a supply of available calcium to the developing pegs is of extreme importance in the elimination of pops. This is further illustrated in Figures 4 and 5. An equal number of peanuts was shelled from various treatments. The pile of empty shells is about the same size in all cases, but the piles of good nuts vary according to soil treatment. Calcium in the pegging zone has exerted its beneficial effect by *reducing the number of pops or causing more peanuts to fill.* But where the level of calcium in the soil was high, the shelling percentage was already high and calcium had no effect.

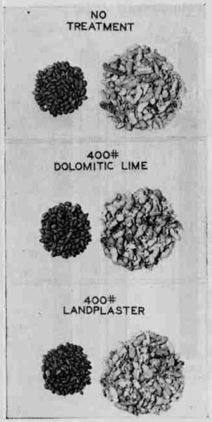

Figure 4. On a soil high in calcium neither landplaster nor limestone increased shelling percentage.

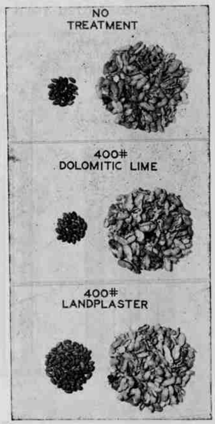

Figure 5. On a soil low in calcium, application of landplaster on the foliage resulted in a higher shelling percentage than dolomitic limestone in the row.

Comparisons of Practices Used to Supply Calcium To Peanuts

In view of the importance of calcium to good filling of peanuts, a study was made to determine which of several practical methods of supplying calcium would be best. The experiments were located on soils known to be low in calcium. Landplaster and several types of lime were added at different periods and at different rates. To provide accurate comparisons the rates were chosen on the basis of chemical analysis to supply definite amounts of the element calcium. For this reason the pounds per acre of the various materials are not in round numbers.

The materials along with their rates and times of application are listed in Table 2. The yields at each of the two locations are also presented. It will be noted that at one location (D. J. Ray)

Table 2. Yield and shelling percentage of Virginia Bunch peanuts as affected by different calcium and magnesium carriers. (1944.)

TREATMENT			LOCATION	
Method and time of application of materials and rate in lbs/A.	To supply: Calcium	To supply: Magnesium	D. J. Ray Yields lbs/A.	J. F. McNair Yields lbs/A.
	lbs. CaO/A	lbs. MgO/A		
No treatment	—	—	74	889
Broadcast February 15				
Dolomitic limestone 1974 lbs.	600	430	928	1515
Calcitic limestone 1074 lbs.	600	—	1174	2008
Dolomitic limestone 1316 lbs.	400	286	533	1541
In row at planting—April 25				
Dolomitic limestone 658 lbs.	200	—	415	843
On row at emergence—May 14				
Landplaster 640 lbs.	200	—	1644	1468
Burnt lime 200 "	200	—	808	1289
Dolomitic limestone 658 "	200	143	570	1011
Calcitic limestone 358 "	200	—	907	1618
Magnesium carbonate 300 "	—	143	47	694
{Magnesium carbonate 300 " + Calcitic limestone 358 "}	200	143	843	1574
On foliage July 7				
Landplaster 600 lbs.	200	—	1209	1907

the soil was capable of producing only 74 pounds per acre without treatment, whereas the other (J. F. McNair) produced 889 pounds per acre without treatment. In spite of this difference in soils, however, the response to soil treatment was essentially the same at both locations. The principal indications of this study are as follows:

(1) Ground limestone broadcast in February was a good source of calcium; in both cases the dolomitic limestone was inferior to calcium limestone—the same amount of calcium being supplied by the two materials.

(2) Dolomitic limestone applied in the row at planting was not satisfactory.

(3) Magnesium carbonate alone was not beneficial.

(4) Yields produced by landplaster were among the highest. This was true even though the soils were very low in magnesium as well as calcium.

The Proportion of "2-Kernel Size" Fruit as Affected by Calcium

Samples of peanuts were obtained from the various tests and classified into those capable of containing (a) three kernels, (b) two kernels, and (c) one kernel. The effect of different

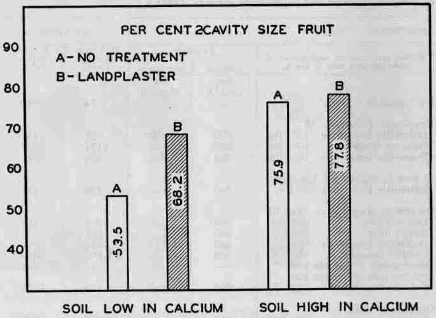

Figure 6. On soils of low calcium level, the addition of calcium increased the percentage of 2-cavity size fruit.

treatments on the proportion of fruit in each of the three size groups was determined at eight locations.

Since there were very few 3-kernel fruit, the effect of treatment may be shown by the percentage of the fruit in either the two or the one-kernel size group. Data from two experiments showing the effect of treatment on the percentage of the fruit of two-kernel size are shown in Figure 6.

The results show that landplaster used on soils low in calcium increased the proportion of the fruit which are of two-kernel size. *Thus, on such soils calcium has been shown to be beneficial not only in decreasing pops but also in increasing the number of possibilities for kernel development.*

POTASH IN PEANUT PRODUCTION

A serious problem on peanut soils is readily recognized when one considers (a) the low potash content of most peanut soils and, (b) the heavy removal of potash by a crop of peanuts. When the hay and nuts of a crop yielding 1,500 pounds of nuts per acre are removed, for example, around 75 pounds of potash are lost. This quantity of potash is equivalent to that contained in 750 pounds of a 10 per cent potash fertilizer.

The effects of potash applications on peanuts, however, generally have not been favorable. Only small increases in yield have been noted in both practical production and experimental work.

Effect of Potash on Yield

The effect of potash additions on the yield of peanuts at fourteen locations was determined during 1942, 1943, and 1944. The differences in yield resulting from potash additions were small. However, two facts were apparent from the results:

(1) Potash increased yields only when the calcium requirements of the plants were met. This is shown by the data from one location in Figure 7. Without added calcium potash tended to decrease yield. With added calcium, however, the yield was increased 231 pounds, by the use of potash.

(2) Only on soils *extremely* low in potassium was there a significant increase in yield from the additions of potash. This is illustrated by the data obtained from two locations presented in Figure 8. The soil low in potash contained only 38 pounds available potash per acre. The potash level of the other soil was somewhat higher, 94 pounds per

acre. Only on the soil of the lower potash level was a yield response obtained. A pronounced response in vegetation was noted at this location as well as at three others where the potash level of the soil was very low.

The effect of potash on true shelling percentage was determined on peanuts from the fourteen experiments referred to above.

In general, it was found that potash did not aid in kernel development. In some cases potash had a slightly unfavorable effect on kernel development. This is illustrated by shelling percentage values presented in Figures 7 and 8. Potash increased yields at some locations even though shelling percentage was not increased. *It is apparent, therefore, that where potash has resulted in increased yields, it is through its effect on plant size rather than on kernel development.*

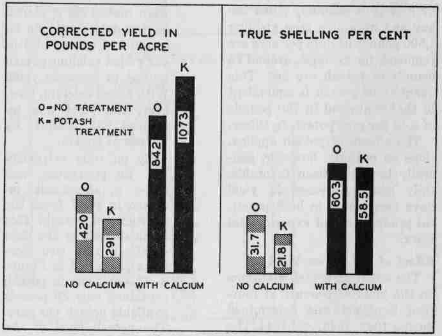

Figure 7. On soil low in potash the yield of peanuts is increased by additions of potash, provided the calcium needs are met.

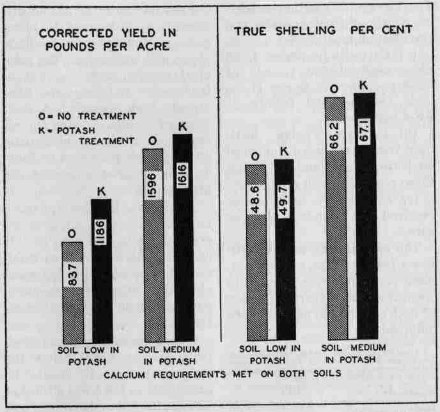

Figure 8. Potash increases the yield of peanuts only where the soil is low in potash.

EFFECTS OF POTASH, NITROGEN, AND PHOSPHATE IN ROTATION EXPERIMENTS

In fertilizing peanuts the needs of other crops in the rotation must be taken into consideration. It is not enough to know that peanuts may not respond to added potash on soils of moderate potash level. Consideration must be given to such factors as the large removal of potash by a crop of peanuts. This loss is reflected by other crops in the rotation which are more sensitive to a lack of potash.

To study the problem of peanut fertilization in a definite rotation system, five rotation experiments located in the main peanut producing area of the state were initiated in 1938.[5]

[5] These experiments were initiated by E. R. Collins and J. J. Skinner (USDA). The peanut data for the years 1938-41, inclusive, were obtained by E. R. Collins, H. D. Morris, and B. S. Chronister.

The three-year rotation consisted of the following crops and fertilization treatments:

(a) Cotton[6]—In Series I, 36 plots received 600 pounds of 6-8-8 per acre; In Series II, 36 plots received 600 pounds of 6-8-4 per acre.

(b) Peanuts—Twelve fertilizer treatments were compared on both series I and II, giving three replications on each series.

(c) Soybeans[7] — Both series received 200 pounds 2-12-6 per acre.

The experiments were in progress for six years, or two complete rotation cycles. Each crop was grown each year and yields of both cotton[8] and peanuts were obtained.

Peanuts were fertilized differently with respect to nitrogen, phosphate, potash, limestone, and landplaster. The principal results from the use of landplaster and limestone have already been discussed. A summary of results showing the effects of nitrogen, phosphate, and potash is presented in Table 3. Only six-year averages are given.

At only one location was there any evidence that nitrogen increased yields, and even in this case the increase was so small that its importance is questionable. At all other locations, nitrogen was found to have little effect.

Phosphate additions had no effects on peanut yields over the six-year period. It should be noted that to the crops a total of 72 pounds of phosphoric acid was

[6] Location ENE, 300 pounds of 4-16-16 and 300 pounds 4-16-8 for Series I and II, respectively. Location UCP, 600 pounds 6-8-6 and 600 pounds 6-8-12 for the two series.

[7] Corn grown some years in certain of the experiments.

[8] Cotton data, obtained by others, will be reported elsewhere.

Table 3. Six-year average yields and average increases from nitrogen, phosphate, and potash at five locations.[1]

Locations	Check Yields Lbs/A	Increase or decrease from—		
		Nitrogen[2]	Phosphate[2]	Potash[2]
(HSE) Dunbar-Lenoir f.s.l. Garysbury	668	133	56	−21
(ENE) Dunbar-Lenoir f.s.l. Tyner	1470	26	−34	40
(JGS) Wickham s.l. Scotland Neck	1373	78	−71	1
(WAT) Ruston s.l. Woodard	1356	41	27	−9
(UCP) Norfolk f.s.l. Rocky Mount	1462	−22	−17	92

[1] Increase from nitrogen obtained by subtracting yields of PK plots from NPK plots. Phosphate and potash treatments made singly.

Nitrogen: 6 pounds N per acre, applied in the row.

Phosphate: 24 pounds P_2O_5 per acre from 16 per cent superphosphate, applied in the row.

Potash: 24 pounds K_2O per acre 1940-1943 inc., 12 pounds 1938-1939 inc., applied in the row.

[2] In no case was the increase or decrease in yield of any significance.

supplied to each cycle of the rotation. This relatively heavy phosphate fertilization together with the low phosphate requirement of peanuts may explain the lack of response.

Potash applied either directly to the peanuts or as extra potash to the cotton did not increase peanut yields significantly. A comparison was made between the practice of fertilizing peanuts with potash and that of adding that same amount as additional potash to cotton in the rotation. Cotton yields were better when cotton received the extra potash. These experiments have indicated that the most practical way to maintain yields and to maintain the level of soil potassium is by heavy potash fertilization of other crops in rotation with peanuts.

FERTILIZING VARIOUS VARIETIES

This report has so far been concerned only with the large seeded varieties, Virginia Bunch and Jumbo Runner. In certain sections of the state, smaller seeded types are grown.

A study was undertaken during 1943 and 1944 to determine the effects of different supplies of calcium, potash, and nitrogen on four varieties of peanuts differing widely in type and size. The experiments were located on light sandy soils very low in both calcium and potash.

Results from Calcium and Potash

The four varieties used were: (a) Virginia Bunch, (b) N. C. Runner, (c) Spanish 2B,[9] and (d) White Spanish. The fertilizer treatments in 1943 were (a) no treatment, (b) landplaster, (c) landplaster plus potash and, (d) limestone plus potash. The experiments were conducted at four locations. The effects of fertilizer treatments on the yields of all four varieties at one location are shown in Figure 9. The results from the other locations are quite similar and are available elsewhere (6).

The most outstanding fact shown by this study was the marked difference in the calcium requirements of the four varieties. Virginia Bunch responded to landplaster more than any of the other varieties. N. C. Runner and Spanish 2B also responded to calcium but to a smaller degree. Essentially no response was obtained from the use of calcium on the White Spanish variety.

Without the use of supplementary calcium on soils low in this element, Virginia Bunch

[9] A strain of Improved Spanish larger in seed size than White Spanish.

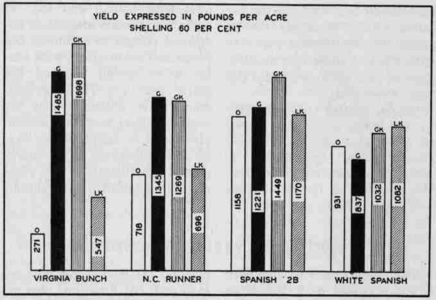

Figure 9. On a soil low in calcium, yield and shelling percentage of Virginia Bunch and N. C. Runner are increased by calcium additions, but the Spanish type peanuts are not benefited by calcium.

O —No treatment.
G —400 lbs. landplaster on foliage at early bloom.
GK—400 lbs. landplaster on foliage at early bloom and 90 lbs. muriate of potash at emergence.
LK—400 lbs. dolomitic limestone in row and 90 lbs. muriate of potash at emergence.

failed more completely than any of the other varieties. When properly supplied with calcium, however, its yields compared favorably with those of the other three varieties. White Spanish proved to be the surest crop for it yielded reasonably well with all treatments.

There were no varietal differences in the response to added potash. Yield increases were small compared to those obtained from added calcium. A vegetative response to potash was noted for all varieties.

In a fertilizer program for peanuts, calcium requirements of the variety used must be taken into consideration. *In the production of small seeded varieties, less attention need be given to the calcium supply, but for large seeded types the calcium supply is of utmost importance.*

Results from Nitrogen

The effects of three different rates of nitrogen on the yield of the same four varieties were studied at two locations in 1944. Treatments were: No nitrogen, 6, 12, and 24 pounds of nitrogen per acre. The nitrogen was applied as ammonium nitrate and was mixed in the row at planting time. The results for all four varieties at one location are shown in Figure 10. The results from the other location were very similar.

There was no yield response to nitrogen applied at any of the rates to any of the four varieties. Stand counts showed no harmful effect from any of the rates of nitrogen. The soils at the two locations were Norfolk sand and Norfolk loamy sand. These are light sandy soils ordinarily considered to be in a relatively low level of fertility and on which a nitrogen response is pronounced for crops such as cotton or corn. In the case of peanuts a vegetative response to nitrogen was noted for all varieties. Yield increases, however, were very small and the results are in agreement with those from nitrogen in the rotation tests.

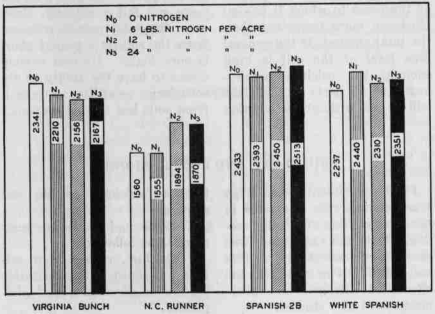

Fig. 10. On a sandy soil nitrogen additions did not greatly increase the yield of any of the four varieties.

INTERPRETING FERTILIZER RESPONSE

Calcium

Abundant vine growth takes place on soils containing only 200 pounds of available lime per acre. However, a relatively high concentration of available calcium is required in the fruiting medium for good development of nuts. Even here, the total amount of calcium necessary is not large. The concentration of available calcium, the period of time in which it is made available to the plant, and the portion of the plant to which it is supplied are more important than the total amount. If the general lime level of the soil is high enough, the calcium requirements of all parts of the plant will be met without the addition of soluble materials. When the soil calcium level is low, the high concentration needed in the fruiting zone can be supplied by localized placement of landplaster or some other easily soluble calcium material.

Potash

It is misleading merely to say that peanuts have a high potash requirement. High yields of both hay and nuts may be obtained on a soil so low in potash that certain other crops grown on the same soil fail completely. However, the total potash removed from the soil by a peanut plant is very high. Its root system seems to have the ability to absorb large quantities of potash from soils low in this element.

SUMMARY AND CONCLUSIONS

Field experiments with large type peanuts were conducted in the Coastal Plain of North Carolina. Particular attention was given to the effects of calcium and potash but on some soils the effects of nitrogen and phosphate were also studied.

Other field experiments were conducted to determine the comparative response of Virginia Bunch and the smaller seeded varieties, N. C. Runner, Spanish 2B, and White Spanish to additions of calcium, potash, and nitrogen.

The principal results are summarized as follows:

1. Calcium, rather than sulfate, was shown to be responsible for the beneficial effects of landplaster.
2. The calcium content of the soil determined to a large degree whether or not additional calcium was necessary for normal kernel development.
3. On soils low in calcium, landplaster applied to foliage at early bloom:
   (a) Increased kernel development and decreased pops.
   (b) Increased the number of fruit of the 2-kernel size and decreased those of the 1-kernel size.
4. On soils of low calcium level the use of dolomitic limestone or landplaster in the row did not meet the calcium requirements.
5. Broadcast applications of ground limestone were beneficial in meeting the calcium requirements. Calcitic limestone was more satisfactory for peanuts than dolomitic limestone.
6. Potash tended to reduce the quality of peanuts but slightly increase yields after the calcium supply was met when the level of soil potash was extremely low.
7. Peanuts grown in rotation with cotton and soybeans yielded the same when the cotton received all the potash fertilization as they did when half the total potash was added to each crop.
8. Additions of either nitrogen or phosphate had little effect on peanut yields.
9. For small seeded varieties, particularly White Spanish, a supply of calcium much lower than that necessary for Virginia Bunch was found to be sufficient for kernel development.

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THE AGRICULTURAL EXPERIMENT STATION
OF THE
NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING
AND
NORTH CAROLINA DEPARTMENT OF AGRICULTURE, COOPERATING
L. D. BAVER, DIRECTOR
STATE COLLEGE STATION
RALEIGH