FERTILITY REQUIREMENTS OF FIELD CORN GROWN ON SANDY SOILS FOLLOWING A FALL CROP OF UNSTAKED TOMATOES

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Surveys conducted to evaluate production problems of unstaked tomatoes grown on the sandy soils of the Florida lower east coast and adjacent areas have indicated a definite need for diversification to include "field crops which do not harbor the same diseases and insects as do tomatoes" (4). Current interest in the utilization of old vegetable land in the tomato producing areas for cattle production has prompted investigation of the use of pastures in a tomato rotation program (3). An expanding cattle industry, which follows well-fertilized and improved pastures, creates an increasing need for supplemental feeds, including field corn.

Experiments with other vegetable crops (1) involving an intensive fertilization program have indicated that relatively large amounts of residual fertilizer may remain after harvesting the crop. Soil tests have shown that this is also true with tomato crops, to which as much as 3000 pounds per acre of mixed fertilizer may have been applied, along with perhaps some extra nitrogen and potassium. A fall crop of tomatoes is normally harvested early enough for the growth of field corn during a time when heavy rains which may leach some of the residual fertilizer are least apt to occur. For this reason, experiments have been conducted on Immokalee fine sand at Indian River Field Laboratory to determine possibilities of growing an economical crop of field corn in the spring following a fall crop of tomatoes and the necessary fertilizer needed to supplement that remaining as residual from the preceding crop.

Methods

Experiment 1. The first experiment was conducted during the spring of 1952 on an Immokalee fine sand that had received 2,500 pounds of basic slag and 1,200 pounds of hydrated lime per acre prior to the tomato crop. The preceding fall crop of tomatoes received a uniform application of 2,500 pounds per acre of 4-8-8 fertilizer plus 200 pounds of 15-0-14. Three weeks after the tomatoes were transplanted to the plots eight inches of rain fell in a 27 hour period and the area was covered with water for about 36 hours. Rainfall during the remainder of the crop period was about normal and a fair yield of tomatoes was obtained. After completion of the tomato harvest, the beds were leveled and the area disced thoroughly in preparation for seeding the corn on February 12.

Fertilizer treatments consisted of three levels each of N, P_2O_5 and K_2O in a 3x3x3 factorial design with two replications. Nitrogen levels were 30, 60 and 90 pounds of N per acre. For the 30-pound level all the nitrogen was applied as a side dressing. For the 60-pound level one-half the nitrogen was applied at planting time and one-half side dressed. For the 90-pound level one-third was applied at planting and the balance side dressed in two applications. Initial nitrogen applications were derived one-third each from castor pomace, ammonium sulfate and nitrate of soda. Side dress applications were derived one-half each from ammonium sulfate and nitrate of soda. Phosphate levels were 0, 30 and 60 pounds per acre of P_2O_5 derived from 20 percent superphosphate, all applied in the mixed fertilizer at planting time. Potash levels consisted of 0, 40 and 80 pounds per acre of K_2O derived from sulfate of potash. For the 40-pound level all the potash was applied at planting. For the 80-pound level one-half was applied at planting and the balance side dressed in a single application.

The corn seed were drilled in rows 42 inches apart laid off in a direction perpendicular to that of the preceding tomato rows. The plants were thinned to an average spacing of 10 to 11 inches in the row. Each plot contained three rows of Big Joe and two rows of Dixie 18. Initial applications of fertilizer were made in bands two inches below the soil surface and five inches to each side of the drill.

Soil samples were collected from each plot just prior to planting. Analyses averaged as follows: pH, 5.83; acid soluble Ca, Mg, and

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K, 770, 105 and 60 pounds per acre, respectively; water soluble P, 22 pounds per acre; and moisture equivalent, 4.55 percent. Variations between sub-blocks were less than 20 percent for all tests except phosphorus which ranged from 14 to 32 pounds per acre.

The corn was sprayed four times with one quart of 25 percent DDT emulsion in 100 gallons of water for the control of bud worms while the corn was young. Manganese and zinc were included in the bud worm sprays. The crop was harvested June 27.

Experiment 2. The second experiment was conducted during the spring of 1953 following a fall crop of tomatoes that had received a uniform application of 2500 pounds per acre of 4-8-8 fertilizer plus 800 pounds of 15-0-14. Basic slag had been applied at the rate of 3000 pounds per acre prior to the tomato crop and 800 pounds of hydrated lime applied afterward. Rainfall during the period occupied by the tomato crop was somewhat above normal, amounting to approximately 38 inches with 20 inches occurring during October. Most of the 15-0-14 was applied after the heavy October rains had ceased.

The corn experiment was laid out in a randomized block, split plot design with six replications. Treatments consisted of three levels of nitrogen from three sources with the nine nitrogen treatments made with and without applications of K_2O. Nitrogen levels were 40, 80, and 120 pounds N per acre. For the 40-pound level, one-half was side dressed at thinning time and one-half when the crop was "laid-by." For the 80 and 120-pound levels, one-fourth was applied at planting, one-fourth at thinning and one-half at "lay-by." The nitrogen sources included in the experiment were nitrate of soda, ammonium nitrate and urea which represented all nitrate nitrogen, one-half nitrate and one-half ammonia nitrogen, and all soluble organic nitrogen, respectively. Potash levels were 0 and 50 pounds K_2O per acre derived from muriate of potash.

The corn, Big Joe variety, was planted in 42 inch rows on February 5. Most of the operations carried out during growth of the crop were similar to those used for experiment 1.

Soil samples collected from each plot just prior to planting showed the following average analysis: pH, 5.90; acid soluble K, 56 pounds per acre; water soluble P, 28 pounds per acre; and moisture equivalent, 5.15 percent. These values are similar to those of experiment 1.

Results and Discussion

Differences in plant growth became evident very early during the progress of experiment 1. A series of height measurements was made 37 days after seeding and the averages with respect to treatment are recorded in Table 1. All the growth response was due to nitrogen applications. Since the last 30-pound application for the 90-pound level was made after the height measurements were taken, there was no difference in growth at that stage between the 60 and 90-pound levels. The superiority of the 90-pound treatment level was very evident at a later stage of growth. Figure 1 indicates the relative difference at the roasting ear stage between the 30 and 90-pound nitrogen treatment levels.

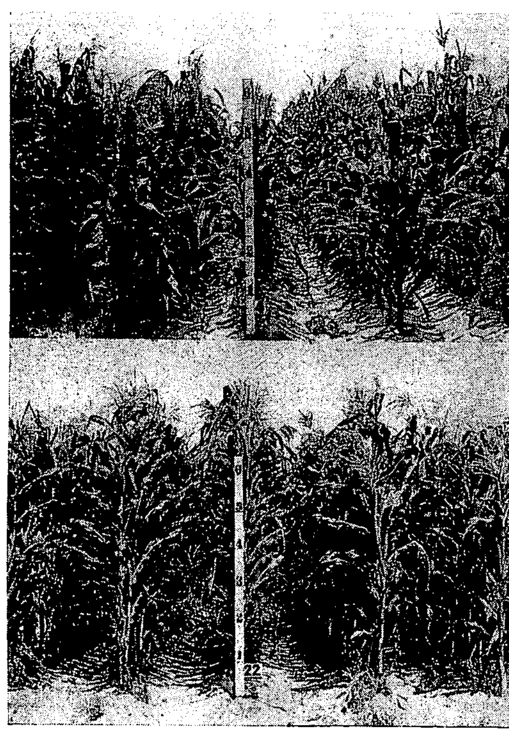

Figure 1. Response to soil applications of nitrogen of field corn growing on Immokalee sand following a crop of unstaked tomatoes.
Upper Plate—30 pounds N per acre.
Lower Plate—90 pounds N per acre.

It is evident from the average yields recorded in Table 1 that the observed growth differences resulted in similar yield differences with respect to nitrogen treatments. Yields for both varieties increased significantly up to the highest level of nitrogen treatment. Big Joe variety yielded higher than Dixie 18 at all the treatment levels for N, P_2O_5 and K_2O. There were no yield responses with respect to phosphate or potash treatments. Failure to obtain response to the phosphate or potash treatment is as should be expected from the residual levels present in the soil as indicated by soil tests, 22 and 60 pounds per acre of water soluble phosphorus and acid soluble potassium, respectively. Experiments conducted on peaty muck soils near Belle Glade (2) have failed to show increases in field corn yields beyond P and K levels of 6 and 60 pounds, respectively, as determined by soil tests. Further evidence of the sufficiency of the residual phosphate and potash levels is evident from the tissue test data recorded in Table 2. Previous experiments (2) with field corn have

Table 1. Relative Growth Rates as Determined by Height Measurements and Yields of Field Corn with Respect to N, P_2O_5 and K_2O Treatments.

Experiment 1.

	Fertilizer Treatment	Height[1] of Plants, Inches	Yield, Bu. Per A.[2] Big Joe Variety	Dixie 18 Variety
A	N lbs. per A.			
	30	14.3	46.4	41.2
	60	19.9	53.3	50.1
	90	20.2	65.9	59.4
	L.S.D.(19:1)	1.5	7.4	8.6
B	P_2O_5 lbs. per A.			
	0	17.9	53.8	49.6
	30	18.1	53.7	48.5
	60	18.5	58.2	52.5
	L.S.D.(19:1)	Not signif.	Not signif.	not signif.
C	K_2O lbs. per A.			
	0	18.0	56.9	48.6
	40	18.0	57.6	52.1
	80	18.4	51.2	50.0
	L.S.D.(19:1)	not signif.	not signif.	not signif.

1. Average of 5 measurements per plot on each of the two varieties made 37 days after seeding, and when only 60 lbs. of N had been applied to the plots to receive a total of 90 pounds.

2. In terms of U. S. No. 2 ear corn.

Table 2. Tests* for P and K on Fresh Stalk Tissue Samples of Corn Plants Averaged According to Treatment

Experiment 1

	Fertilizer Treatment	P, percent oven-dry	K, percent oven-dry
A	N lbs. per A.		
	30	0.325	8.64
	60	0.340	7.92
	90	0.292	7.65
	L.S.D.(19:1)	not signif.	0.46
B	P_2O lbs. per A.		
	0	0.271	7.97
	30	0.305	8.10
	60	0.380	8.14
	L.S.D.(19:1)	0.049	not signif.
C	K_2O lbs. per A.		
	0	0.311	7.45
	40	0.315	8.28
	80	0.333	8.18
	L.S.D.(19:1)	not signif.	0.46

* Samples collected 37 days after planting.
Extracted in Waring Blendor with 0.5 N Acetic Acid.
Made dry weight determinations on separate samples.

indicated that tissue tests above 0.12 percent for phosphorus and 5.0 percent for potassium are sufficiently high to induce maximum yields of field corn. All fresh tissue samples collected during this experiment averaged well above these theoretical threshold values. It is interesting to note that potassium in the tissue extract decreased significantly with an increase in the amount of nitrogen applied.

The high residual level of phosphate which resulted in no response to applications of this element was no doubt due in part to the basic slag applications made to the plot area in order to correct the initially low pH values of these soils. However, analyses made on similar soil types from other vegetable locations indicate that the applied superphosphate in the mixed fertilizer contributed to about half of this residual level, which was several times the optimum level found in previous experiments.

Treatments for the second experiment were chosen on the basis of soil tests for residual phosphate and potash as compared to the results from experiment 1. Residual phosphorus level, 28 pounds per acre, was higher than that for experiment 1 and indicated no possibility of phosphate response. The average residual potassium level, 56 pounds per acre, compared favorably with the 60 pounds residual level for experiment 1. However, on the basis of previous experiments conducted on peaty muck soil (2), 56 pounds per acre is a borderline level and there was some possibility of a potash response. Hence, nitrogen sources at three levels were investigated with and without additional potash. Because the maximum nitrogen response was not obtained in experiment 1, a higher maximum rate of application was chosen for experiment 2, 120 pounds N per acre as compared to 90 pounds.

Average yields of corn from the various treatments are recorded in Table 3. Again the only significant responses were to rates of nitrogen applied. The response of 120 over the 80-pound level was greater for all nitrogen sources than the response of 80 over the 40-pound level. Since all the nitrogen applied at the lowest level was side dressed—while that applied at the two higher levels was applied one-fourth with planting and the remainder side dressed—it seems evident that the side dressed nitrogen was more effective in promoting a yield response than that applied when the crop was planted. There were no significant differences between any of the nitrogen sources. As in experiment 1, the level of nitrogen to give maximum response was apparently not reached. No response was obtained to the 50 pounds per acre of applied potash.

Weather conditions which influence the incidence of disease and other growth factors may ultimately determine the economy of applying extra nitrogen. Based on nitrogen at a cost of 18 cents per pound and No. 2 ear corn at a selling price of $1.20 per bushel, the 60 pounds of applied nitrogen to the Big Joe variety in experiment 1 grossed a return of $23.40 per acre for $10.80 invested. On the same basis the 80 pounds of applied nitrogen in experiment 2 gave an average re-

Table 3. Yields of Field Corn, Bushels per Acre of U. S. No. 2 Ear Corn, from Various Nitrogen and Potash Treatments Following a Fall Crop of Tomatoes

Experiment 2

Nitrogen Source	K_2O Applied lbs./A	Nitrogen Rate, lbs. N. per A. 40	80	120	Source Average***
Nitrate of Soda	0	41.6	42.7	49.6	44.6
"	50	40.6	44.9	48.2	44.6
Average*		41.1	43.8	48.9	44.6
Ammonium Nitrate	0	41.0	47.4	54.8	47.7
" "	50	37.3	46.3	54.4	46.0
Average*		39.1	46.9	54.6	46.9
Urea	0	46.4	48.5	52.4	49.1
"	50	42.8	42.2	50.8	45.3
Average*		44.6	45.4	51.6	47.2
Rate Average	0	43.0	46.2	52.2	47.1
	50	40.2	44.5	51.1	45.3
Average**		41.6	45.3	51.7	46.2

* Differences highly signif. L.S.D.(19:1) = 5.2; (99:1) = 7.0
** Differences highly signif. L.S.D.(19:1) = 3.4; (99:1) = 4.8
*** Difference not significant

turn of $12.12 per acre for an expenditure of $14.40. In experiment 1 the 60 pounds per acre application of N gave 6.9 bushels more corn than 30, whereas, 90 pounds nitrogen produced 12.6 bushels more than 60. Likewise, in experiment 2 the 80 pounds per acre application of N gave 3.7 bushels more corn than 40, whereas, 120 pounds N produced 6.4 bushels more than 80. Thus, in both experiments, the second increment of applied nitrogen produced approximately twice as much yield increase as the first increment. In both experiments the highest applications of nitrogen were applied with a higher percentage as a side dress. This indicates a much higher return from the side dressed nitrogen than from that applied at time of seeding.

The leaf blight disease caused by *Helminthosporium turcicum*, Pass. was present, being most severe during the second experiment. The higher incidence of this disease is probably one of the major factors which contributed to the over-all lower yields of the second experiment and the smaller response to increments of applied nitrogen. Measurements made by Dr. J. F. Darby, Assistant Plant Pathologist, Indian River Field Laboratory, on the severity of this disease in the first experiment did not establish any relationship between fertilizer treatment and disease incidence. The need for varieties and hybrids with more resistance to helminthosporium leaf blights is recognized and an attempt is being made to meet this need through an extensive breeding, selection and testing program being conducted by the agronomists and pathologists of the Experiment Station. Better adapted varieties may yield more bushels of corn for a given amount of applied nitrogen.

Conclusions

With the presently accepted fertilizer program for unstaked tomatoes growing on the sandy soils of the Florida lower east coast, a satisfactory yield of field corn as a spring crop following a fall crop of tomatoes may be obtained by applying up to 120 pounds per acre of soluble nitrogen. Most of the nitrogen should be side dressed in 2 or more applications. The tomato crop may be expected to have left sufficient residual phosphate and potash to produce maximum yields of corn.

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THE TRAINING OF RETAIL STORE PRODUCE HANDLERS IN HANDLING VEGETABLES

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"Nothing sells merchandise like good merchandise." That is a statement that is known to be true by all good retailers. It is here that our great vegetable industry is weakest. So much of our produce that is offered to the consumer is not good merchandise. I know that most retailers can improve their techniques but they canot sell quality produce when quality merchandise is unavailable to them. Who is at fault? There is room for improvement throughout the entire industry.

Our vegetable producers cannot prosper unless they can find profitable sales for their products. Unless it is guaranteed that good quality merchandise is placed in the hands of the retailer, it is impossible to ever expect maximum profitable sales.

When it comes to the point of retail food sales, we find that the majority of the nation's food supply is being sold by independent