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Response to Phosphorus and Potassium Fertilizers on Soybeans (Glycine max L. Merr.) along Coastal Lands of Guyana

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INTRODUCTION

Response of nitrogen, phosphorus and potassium on soybeans in Guyana was studied by Chesney (1969) on Arakaka clay loam soil and by Shukla (1969) on Noverwagt clay and on Inki clay soils. The experiment carried out at C.A.S., in Spring 1969 on Onverwagt clay soil, showed a moderate though statiscally non-significant yield response to NPK applied at a rate of 22.4 + 44.8 + 44.8 kg ($N + P_2O_5 + K_2O$)/ha. Nitrogen or phosphorus alone did not give any appreciable yield response. Response to phosphate was obtained on Arakaka clay loam soil. On the same soil a significant effect due to nitrogen and potassium was not obtained.

The present investigations were undertaken to find out the main effects of P and K and interaction PK on the yield of two high yielding varieties of Soybeans (240664 and F62/3977).

MATERIALS AND METHODS

Some of the physical and chemical properties of the top 15 cms. soils collected from the experimental fields of the Central Agricultural Station (C.A.S.) and the Central Horticultural Station (C.H.S.) are given in Table I.

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Table 1. Some chemical and physical properties of the top 15 cm. soils of experimental fields

Site	Soil type	pH	Total N %	Org. C %	Truog P_2O_5 (ppm.)	Ex. cations m.e/100g. soil		
						Ex.K.	Ex. Ca.	Ex. Mg.
C.A.S.	Onver-wagt clay	6.9	0.12	1.1	1.9	0.38	6.1	9.5
C.H.S.	Inki clay	5.0	0.20	3.7	5.1	0.46	3.0	3.8

The randomised block design with four replications was used for the purpose of experiments at both the place. The treatments used were as follows: -(1) Control (2) 34 kg P_2O_5/ha (P_1) (3) 68 kg P_2O_5/ha (P_2) (4) 34 kg K_2O/ha (K_1) (5) 68 kg K_2O/ha (K_2) (5) 68 kg P_2O_5/ha + 34 kg k_2O/ha (P_2K_1). Triple superphosphats and muriate of potash were used as sources of phosphorus and potassium respectively. The experiments were done in the season of Spring 1970. At C.H.S., experiments were carried out both with varieties 240664 and F62/3977, while at C.A.S., experiment with only one variety - F62/3977 could be done.

Before planting pre-emergent weedicide, dacthal was applied at a rate of 2,27 kg per 136 litres of water.

As lime was applied to previous crop, no lime was applied to the present crop. Inocculated seeds were sown in row widths of 45.7 cms. (18") with 2 seeds per hole, 15.2 cms. (6") apart within the row. All fertilizer was applied in single application, 5,0 cms. (2") below and 7.6 cms, (3") away from the seed, within the row at the planting time, Seeding was done 1" (2.54 cms.) below the soil. Sevin W.P. was used whenever needs for the control of leaf

cutting insects. A net area of 49.1 sq. metres at C.A.S. and 18.9 sq. metres at C.H.S. was harvested for the purpose of recording grain yield. The yield of winnowed soybean at 12% moisture is reported.

RESULTS AND DISCUSSION

The yield of soybean, variety 240664, is reported in Table 2. The analysis of variance is given in Table 3.

Table 2. Yield of soybean variety 240664 in kg/ha at C.H.S. in Spring, 1970

Treatment No.	Treatment	Block I	II	III	IV	Treatments means +
1	Control	3241	3066	3504	3395	3301.5 a
2	34kg P_2O_5/ha (P_1)	4161	3767	4271	4402	4150.2 b
3	68kg P_2O_5/ha (P_2)	3833	3416	3110	3351	3427.5 ac
4	34kg K_2O/ha (K_1)	3329	3526	2869	2628	3088.0 a
5	68kg K_2O/ha (K_2)	3066	3570	2957	3088	3170.2 a
6	68kg P_2O_5 + 34 kg K_2O/ha (P_2K_1)	3811	3942	3614	3811	3794.5 bc

+ Treatments followed by the same letter in the column do not differ significantly at 5% according to Duncan's multiple range test.

Table 3. Analysis of variance of data in Table 2

Source of variation	d.f.	SS	MS	Observed F
Treatments	5	3327688,8	665537,7	7,95**
Block	3	136600,66	45533,55	
Error	15	1255719,9	83714,66	
Total	23	4720009,4		

**Significant at 1% C.V. = 8,29% Standard error (means) = 144.66

The result show the significant effect of phosphate added at a rate of 34 kg P_2O_5/ha (P_1), and of 68 kg P_2O_5/ha (P_2) together with 34 kg K_2O/ha (K_1) on soybean yield. It is important to note here, that, treatment differences between P_1 and P_2K_1 themselves were not found significant.

Table 4: Yield of soybean variety F 62/3977 in kg/ha at C.H.S. in Spring, 1970

Treatment No.	Treatment	Blocks I	II	III	IV	Treatment means +
1	Control	2190	2278	2519	2738	2431,2 a
2	34kg P_2O_5/ha (P_1)	2081	31979	3657	3570	3126.2 b
3	68kg P_2O_5/ha (P_2)	2453	2628	2891	3176	2787.0 ab
4	34kg K_2O/ha (K_1)	2847	2212	2628	2847	2633.5 ab
5	68kg K_2O/ha (K_2)	2935	2343	2519	2819	2654,0 ab
6	68kg P_2O_5/ha + 34 kg K_2O/ha (P_2K_1)	3066	2957	3241	3416	3170,0 b

+Treatments followed by the same letter in the column do not differ significantly at 5% according to Duncan's multiple range test.

Table 5. Analysis of variance of data in table 4

Source of variation	d.f.	SS	MS	Observed F
Treatments	5	1714088.9	342817.78	3,22*
Block	3	1076662.3	358887.4	
Error	15	1593688,0	106245.86	
Total	23	4384439.2		

* Significant at 5% C,V, = 11.6% Standard error (means) = 162.97

The yield of dried soybean, variety F 62/3977, as found at C.H.S. along with analysis of variance are reported in tables 4 and 5. The trend of the treatment effects is the same as noted with the variety 240664 at C.H.S. Accordingly the treatment means of P_1 and P_2K_1 were only found to be significantly different (at 5%) from control as tested by Duncan's multiple range test.

Table 6. Yield of soybean variety F 62/3977 in kg/ha at C,A.S. in Spring, 1970

Treatment No.	Treatment	Blocks I	II	III	IV	Treatment means
1	Control	1638	1953	2259	2385	2058.7 a
2	34kg P_2O_5/ha (P_1)	2250	2385	2538	2610	2445.7 b
3	68kg P_2O_5/ha (P_2)	2709	2331	2736	2808	2646.0 b
4	34kg K_2O/ha (K_1)	1710	1836	2385	1926	1964.2 a
5	68kg K_2O/ha (K_2)	1845	2007	2412	2025	2072,2 a
6	68kg P_2O_5 + 34kg K_2O/ha (P_2K_1)	2835	2295	2988	2502	2655,0 b

Treatments followed by the same letter in the column do not differ significantly at 5% according to Duncan's multiple range test.

Table 7. Analysis of variance of data in table 6

Source of variation	d.f.	SS	MS	Observed F
Treatments	5	1957959.0	391591.8	10.0**
Block	3	692037.0	230679.0	
Error	15	587195.9	39146.39	
Total	23	3237191.9		

**Significant at 1% C.V. = 8.57% Standard error (means) = 98.92

At C.A.S. P_1, P_2 and P_2K_1 gave significant effect over control (Tables 6 and 7). The main effects of K_1 and K_2 were found non-significant.

Miyasaka et al. (1964) found response to phosphorus applied to soybean on a poor soil derived from the Botucatu sandstone. No significant response was obtained to N or K. Tewari (1965) reported highest yields of soybean in his experiment from 20 lb./acre each of N and P_2O_5. No response was found due to K. De Mooy (1965) found soybean varieties to respond significantly to K but not to P. Small differential effects were observed among varieties. In East Pakistan, triple superphosphate at rates of up to 200 lb. per acre significantly increased dry weight of leaves and stems, and yield of seed (Islam, 1964). Dunphy, Kurtz and Howell (1966) found that more fertilizer responsive varieties tended to be the high yielding ones. Anthony (1967) and, Maples and Keogh (1969) found response to fertilizer P and K. There was no significant interaction between the effects of P and K on yields but P application in some cases intensified K - deficiency symptoms (Maples and Keogh, 1969). At Beaumont in Texas, phosphorus gave no response in comparison to positive effect noted with potash. But, at a higher level of 120 lb. - K_2O/acre, bean yields were increased only on supplying additional amount of phosphate (Wood, 1969).

SUMMARY

Phosphate applied at rates of 34 kg P_2O_5/ha (P_1) and/or, 68kg P_2O_5/ha (P_2) on soybean, varieties 240664 and F62/3977 increased soybean yield significantly. On further additon of 34 kg K_2O/ha to 68 kg P_2O_5/ha, the yield obtained was not statistically different as compared to P_1 or P_2.

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