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Response of potato (*Solanum tuberosum*) to sulphur-bearing fertilizers and their residual effect on greengram (*Phaseolus radiatus*) in lower Gangetic plains of West Bengal

S.S. MONDAL, S. MANDAL AND SITANGSHU SARKAR[1]

Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal 741 252

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ABSTRACT

A field experiment was conducted during 1994–95 and 1995–96 at Bidhan Chandra Krishi Viswavidalaya, Mohanpur, West Bengal, to study the effect of sulphur (S)-bearing fertilizers on potato *(Solanum tuberosum* L.), and their residual effect on greengram (*Phaseolus radiatus* L.). Soil incorporation of 72 kg S/ha through single superphosphate (SSP) resulted in significantly higher dry-matter production (901.60 g/m^2 at 105 days after planting) and potato tuber yield (270.6 q/ha) and its residual effect on the succeeding greengram gave highest dry-matter production (527.93 g/m^2 at harvest) and seed yield (12.38 q/ha). Application of S @ 108 kg/ha (through 3 parts SSP and 1 part K_2SO_4) gave significantly maximum large (> 100 g, 11.61 %) and medium (50–100 g, 26.39%) size tubers. Application of S @ 72 kg/ha (through SSP) to potato and its residual effect on the next greengram crop (in rotation) showed the highest net production value (3.35) in this potato–greengram sequence of lower Gangetic plains of West Bengal.

Key words : Potato, Greengram, Sulphur, Single superphosphate

In the lower Gangetic plains of West Bengal, the average intensity of cropping is more than 200%. In this system, potato is gaining importance (17.43% area and 21.4% production of national figure) and greengram is grown after harvest of potato. To boost the productivity of the system, till date only N, P, K fertilizers had been used to meet the nutrient requirement of potato grown in this region. The potato-growing districts of West Bengal are more or less deficient in sulphur due to various reasons, such as multiple cropping with higher sulphur removal, use of high analysis fertilizer containing no sulphur, non-return of crop residue to soil, decreased use of pesticidal sulphur. To get higher yield of crops, such deficient soil needs a judicious

Present address : [1]Central Research Institute for Jute and Allied Fibre, Barrackpore, West Bengal 743 101

and balanced fertilization with N, P, K and S. Therefore, an effort was made to study the yield potentiality of potato with particular reference to sulphur and its residual effect on productivity of greengram.

MATERIALS AND METHODS

The field experiment was conducted at the Instructional Farm, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, during 1994–95 and 1995–96. The trial was laid out in randomized block design with 7 treatments and 3 replications with 6 × 5 m plots. The soil was sandy loam with pH 7.2, having 0.051% total nitrogen, 22 kg/ha available phosphorus, 187 kg/ha available potassium and 8.4 ppm available sulphur. The average maximum temperature during the growing season of greengram was 37.81°C and 35.60°C in April of 1995 and 1996 respectively. The average minimum temperature during the growing season of potato was 10.10°C and 10.14°C in January 1995 and December 1996.

The average (of 2 years) rainfall during the growing season was 216.9 mm. The various NPK fertilizer dosed were same (N: P_2O_5: K_2O, 120 :100 : 100 kg/ha) for all the 7 treatments, only with variation in doses of sulphur ranging from 0 to 108 kg/ha with a multiple increase of 18 kg/ha from one treatment to the next treatment. The potato variety used was 'Kufri Jyoti' and the greengram variety 'Panna'. In all the cases the whole amount of P_2O_5, K_2O, S and half of N were applied basal. After first earthing up, one-fourth N and the remaining N at the time of second earthing up were applied to the potato crop. Greengram was grown on the residual fertility after harvest of potato. All other standard agronomic paractices for potato and greengram were followed. The potato tubers were graded into 3 groups according to their size (weight), viz. A (large) > 100 g; B (medium) 50–100 g and C(small) < 50 g. It was expressed in percentage of total number of tubers.

RESULTS AND DICUSSION

Total dry-matter production in potato

The total dry-matter production at 55, 80 and 105 days after planting varied significantly with different treatments (Table 1). At 55 days after planting, maximum total dry-matter production was observed in the treatment receiving 72 kg S/ha which was at par with the treatments receiving 36, 54, 90 and 108 kg S/ha. At 55 days dry-matter production was mininum where no S was applied. Similar trend of dry-matter production was observed at 80 and 105 days after planting. Highest dry-matter production was recorded at 80 and 105 days after planting in treatment receiving 72 kg S/ha. The lowest dry-matter production was recorded at 80 and 105 days after planting where no S was applied along with the same dose of NPK fertilizers. Addition of S in the treatments along with NPK fertilizers improved the total dry-matter production. This result corroborates with the findings of Sarkar *et al.* (1994).

Tuber bulking rate of potato

Tuber bulking rate differed significantly at 30–55, 55–80 and 80–105 days after planting with different treatments. Highest tuber bulking rate was recorded where the treatment received 72 kg S/ha and the

lowest was observed at 30–55, 55–80 and 80–105 days after planting in treatment receiving no S, but received full dose of N, P, K fertilizers. It was further observed that the tuber bulking was slow at 30–55 days after planting, then after 55 days after planting it increased to a maximum level up to 80 days after planting and subsequently reduced to the earlier tuber bulking rate values of 30–55 days after planting. Higher tuber bulking rate was due to the balanced nutrition of N, P, K and S treatments as compared to only N, P, K treatments. This result corroborates with the findings of Mondal *et al.* (1993) and Sarkar *et al.* (1994).

Potato tuber yield

The highest tuber yield was obtained with the treatment where 72 kg S/ha was applied along with 120 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha, which was at par with the treatments receiving 90 and 108 kg S/ha along with N, P, K fertilizers producing 263.4 and 256.9 q/ha of tubers respectively (Table 1). Lowest tuber yield was obtained from the treatment receving no S and with 120 kg N, 100 kg P_2O_5 and 100 kg K_2O. It clearly implies that S-bearing fertilizers has a significant effect on tuber yield of potato. Similar finding was reported by Anspok (1987).

Grades of potato

It was observed that percentage of large-size tubers (A) was increased significantly with the application of S. Highest percentage of large tubers was obtained from treatment where 108 kg S/ha was applied along with other N, P, K fertilizers and in contrast lowest percentage (4.41) of 'A' size tuber was obtained from treatment with no S (Table 1). Similar trend was observed for medium-size (B) tubers also, where highest percentage (26.39) of 'B' size tubers was obtained from treatment receiving 108 kg S/ha and lowest percentage (17.81) of 'B' size tubers was obtained from no S treatment. Percentage of small 'C' tubers was reduced with the application of S-bearing materials. Lowest percentage (62.00) of 'C' size tubers was obtained in treatment with 108 kg S/ha and such tubers were in highest percentage (77.78) from treatments receiving no sulphur.

Total dry-matter production in greengram

Total dry-matter production in greengram significantly differed in treatments where greengram was grown on residual fertility of potato with S-bearing fertilizers. The highest dry-matter production was recorded at 45 days and at harvest respectively in treatments where potato was fertilized with 72 kg S/ha. The lowest was observed at 45 days and at harvest where no S was applied in the preceding potato crop. Result indicated that the residual effect of high doses of balanced fertilizers of N, P_2O_5, K_2O and S was more pronounced on dry matter of greengram. This result supports the findings of Aulakh *et al.* (1977).

Yield components of greengram

There was no significant variation in number of greengram plants /m^2 grown on residual fertility after potato (Table 2).

But pods/plant differed significantly

Table 1. Effect of different nutrient-management treatments with sulphur-bearing fertilizers on total dry-matter accumulation, tuber bulking rate, tuber yield, grades of potato (mean data of 2 years)

Treatments* (S kg/ha)	Total dry-matter production (g/m^2)			Tuber-bulking rate (g/m^2/day)			Tuber yield (tonnes/ha)	Grades of potato (%)		
	55	80	105 DAP	30–55 DAP	55–80 DAP	80–105 DAP		Large (A) >100 g	Medium (B) 50–100 g	Small (C) <50 g
0	254.60	536.51	695.07	6.31	9.13	5.59	19.56	4.41	17.81	77.78
18	275.77	586.97	761.44	7.13	10.25	6.14	21.59	6.72	22.00	71.28
36	298.55	635.50	815.23	7.39	10.89	6.83	22.99	6.91	21.07	72.02
54	318.55	684.67	881.32	7.44	12.84	7.52	24.69	8.09	22.60	69.31
72	336.52	706.89	901.60	7.83	12.94	7.91	27.06	9.12	23.64	67.24
90	326.37	684.09	881.22	7.73	12.75	7.90	26.34	10.42	25.35	64.23
108	314.33	669.72	862.39	7.42	12.72	7.84	25.69	11.61	26.39	62.00
CD (P=0.05)	42.95	37.74	42.67	1.12	3.72	1.91	1.99	0.67	0.84	0.71

DAP = Days after planting, *all the treatments received 120 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha

with different treatments. Maximum pods/plant (12.4) were recorded where the preceding potato crop was fertilized with 72 kg S/ha along with 120 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha. Pods/plant from treatments receiving (potato) 36–108 kg S/ha was statistically at par with each other. Lowest number of pods/plant (8.7) was recorded in treatment with no S to potato.

There was no significant difference in sees/pod and 1,000-seed weight due to various treatment combinations. Highest seed/pod were recorded in treatment with 72 kg S/ha in potato and highest, 1,000-seed weight was obtained from treatment receiving 54 kg S/ha.

Seed yield of greengram

The residual effect of fertilizers (applied to potato) on greengram significantly influenced the seed yield (Table 2). Highest seed yield was obtained under the treatment where potato was fertilized with 72 kg S/ha along with 120 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha, followed by (at par) treatments receiving 54 and 90 kg S/ha (in potato). The lowest seed yield was obtained from treatment where no S was applied to potato but full dose of N, P_2O_5 and K_2O (120, 100, 100 kg/ha) was applied. The yield of greengram grown on residual fertility was improved significantly with the application of S to potato. It might be due to the fact that a considerable amount of S which was unutilized by potato, was utilized by the succeeding greengram. This result corroborates the findings of Karwarsa *et al.* (1984) and Naphade and Wankhade (1987).

Net production value in system

The aim of commercial farming is to fetch more profit per unit of investment. So the net production value (NPV), i.e. net profit per unit of total cost of cultivation, had been considered in potato–greengram sequence. It was found that highest net production value was calculated in treatment where potato was fertilized with 120 kg N, 100 kg K_2O and 72 kg S/ha and

Table 2. Residual effect of fertilizers applied to potato on total dry-matter production, yield components, seed yield of greengram (mena data of 2 years)

Treatments* (S kg/ha)	Total dry-matter			Yield components			Seed yield (kg/ha)	Net production value
	45 DAS	At harvest	Plants/ m^2	Pods/ plant	Seeds/ pod	1,000-seed weight (g)		
0	184	348	49.0	8.3	8.7	38.3	708	2.11
18	203	415	51.6	9.7	9.0	38.4	875	2.22
36	212	462	51.3	10.8	9.0	38.4	1,009	2.77
54	243	500	48.0	11.8	9.4	38.8	1,091	2.74
72	256	527	50.6	12.4	10.0	38.5	1,238	3.35
90	235	478	48.6	11.7	9.6	38.5	1,064	2.84
108	213	443	48.6	11.3	9.5	38.4	956	3.01
CD (P=0.05)	9	13	NS	1.87	NS	NS	206	

DAS=Days after sowing; NS=Not significant; * All the treatments received 120 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha

greengram was grown on residual fetility after potato.

It may be concluded that application of 120 kg N, 100 kg P_2O_5, 100 kg K_2O/ha along with 54–72 kg S/ha to potato and growing greengram in the residual fertility after potato in the S-deficient soil of lower Gangetic plains of West Bengal could be a better crop sequence, as it would provide more than 3 times profit per unit of investment (NPV 3.35) to the farmers.

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