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Phosphorus and plant population management in groundnut (*Arachis hypogaea*)–fenugreek (*Trigonella foenum-graecum*) cropping system

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ABSTRACT

A field experiment was conducted on the phosphorus and plant population management in groundnut (*Arachis hypogaea* L.)–fenugreek (*Trigonella foenum-graecum* L.) cropping system during 1994–95 in summer season on medium black soils at Pune, Maharashtra. An application of 75 kg P_2O_5/ha, with the treatment of P-solubilizer to seeds before sowing and sowing the crop at 30 cm × 10 cm spacing with 330,000 plant population/ha significantly increased the growth, dry matter, yield attributes and yield of grounnut over rest of the treatments. However, a dose of 50 kg P_2O_5/ha with P-solubilizer and sowing at the distance of 30 cm × 10 cm with 333,000 plant population/ha was found to be economical in groundnut. In the second trial as a catch crop and as a residual effect to test the fertility of soil, the green fenugreek yield (tonnes/ha) increased significantly due to application of 75 kg P_2O_5/ha given to previous crop over rest of the treatments.

Key words : Groundnut–fenugreek cropping, Phosphorus, Plant population, P-solubilizer

Groundnut being important oilseed and legume play dual role in the Indian cropping system. Similar is the case with fenugreek because it is important green vegetable and also improves soil fertility. Therefore, both these crops are important in view of sustainable agriculture. The introduction of short-duration varieties of groundnut and short-duration catch crop of fenugreek can be grown and harvested only in 1 season. This will make it possible to boost the production potential in Vertisols in summer season under irrigated conditions. Therefore the present investigation was undertaken to study phosphorus and plant population management in groundnut–fenugreek cropping system.

MATERIALS AND METHODS

The first trial was laid out in factorial randomized block design with 3 replications. The treatments included phosphorus

levels (0, 25, 50 and 75 kg P_2O_5/ha), P-solubilizer (with and without P-solubilizer) and plant population (30 cm × 10 cm = 333,000 plants ha, cm 25 cm × 10 cm, 400, 000 plants/ha; 20 cm × 10 cm = 500, 000 plants/ha. The experimental soil was fairly levelled and medium black in nature. The soil was medium in available nitrogen (290 kg/ha) and phosphorus (29 kg/ha) and rich in available potash (412 kg/ha). The soil pH was 8.0, EC 0.21 mhos/cm. All recommended doses of manure, nitrogen and potash were supplied as basal dose before sowing. The *Aspergillus awamori* (P-solubilizer micro-organisms) was inoculated with the seeds as per the treatments. The source of phosphorus was single superphosphate. The groundnut crop ('TAG 24') was sown on 24 February 1994 and harvested on 19 June 1994 in the first year, while in the second year it was sown on 19 January 1995 and harvested on 15 May 1995. The crop of fenugreek ('Pusa Early Bunching') was grown to test the residual soil fertility and sown in the first year on 21 June 1994 and harvested on 22 July 1994. However, in the second year the fenugreek was sown on 17 May 1995 and was harvested on 19 June 1995.

RESULTS AND DISCUSSION

Groundnut

Effect of P on growth attributes: The maximum increase in height, spread, number of branches, number of leaves and leaf area/plant was recorded with the application of 75 kg P_2O_5/ha (Table 1). The application of 75 kg P_2O_5/ha significantly produced more height and spread over 50 kg, 25 kg P_2O_5/ha and the control. However, an application of 50 kg P_2O_5/ha was found at par in increasing branches/plant with 75 kg P_2O_5/ha and significantly superior to 25 kg P_2O_5/ha and the control. The leaves and leaf area/plant were significantly increased due to 75 kg P_2O_5/ha over rest of the treatments. The treatment of application of 50 kg P_2O_5/ha significantly increased the leaves and leaf area/plant over 25 kg P_2O_5/ha and control.

Effect of P on yield attributes, dry pod and creeper yield: Application of 75 kg P_2O_5/ha was found significantly superior to 50 kg P_2O_5/ha, 25 kg P_2O_5/ha and the control in increasing yield-contributing characters, dry pod and creeper yields. And an application of 50 kg P_2O_5/ha was found significantly superior to 25 kg P_2O_5/ha. Similarly, an application of 25 kg P_2O_5/ha was significantly superior to the control. These results confirm the findings of Sabale (1986) and Patil *et al.* (1987).

Effect of P-solubilizer on growth, yield attributes and yield: Inoculation of seeds with P-solubilizers showed significant increase in growth characters such as plant height, spread, number of branches, number of leaves, leaf area (dm^2). Similarly, the growth-contributing characters and finally the dry pod and creeper yields over the treatment without P-solubilizer inoculation in both the years. This was due to better availability of phosphorus in inoculated treatment. These results are in confirmation with the results of Anbusezhiyan (1994).

Effect of population on growth, yield attributes and yield: Spacing of 30 cm × 10 cm significantly increased all the growth parameters except the number of leaves and leaf area during 1995 over rest of the

Table 1. Height, spread, branches, leaves and leaf area/plant of groundnut as affected by P, P-solubilizer and plant population (during 1994–95)

Treatment	Height (cm)		Spread (cm)		Branches/plant		Leaves/plant		Leaf area	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Phosphorus										
Control	11.28	11.35	24.20	24.47	8.12	8.15	65.84	68.75	6.64	7.04
25 kg P_2O_5/ha	12.03	12.07	26.25	26.61	8.95	8.98	69.77	73.56	7.11	7.57
50 kg P_2O_5/ha	12.70	12.75	28.60	28.98	9.84	9.85	76.76	81.41	7.86	8.34
75 kg P_2O_5/ha	12.97	13.06	29.05	29.47	9.85	9.88	79.27	84.22	8.16	8.64
CD (P=0.05)	0.11	0.17	0.31	0.24	0.09	0.14	0.41	0.44	0.04	0.07
P solubilizer										
With P-solubilizer	12.05	12.66	27.62	27.95	9.38	9.42	74.46	78.76	7.60	8.06
Without P-solubilizer	11.99	11.95	26.90	26.68	9.00	9.00	71.36	75.21	7.28	7.72
CD (P=0.05)	0.08	0.12	0.22	0.17	0.06	0.10	0.29	0.31	0.03	0.05
Plant population										
30 cm × 10 cm = 330,000	12.44	12.51	27.40	27.72	9.36	9.40	73.25	77.34	7.48	7.92
25 cm × 10 cm = 400,000	12.21	12.27	26.90	27.27	9.15	9.17	72.88	77.01	7.42	7.88
20 cm × 10 cm = 500,000	12.09	12.13	26.77	27.16	9.07	9.07	72.60	76.61	7.41	7.80
CD (P=0.05)	0.10	0.14	0.27	0.21	0.08	0.12	0.36	0.38	0.03	0.06
Grand mean	12.25	12.31	27.02	27.38	9.19	9.21	72.91	76.98	7.44	7.89

Table 2. Effect of phosphorus, P-solubilizer and plant population on pods/plant, pod weight/plant, 1,000-kernel weight, dry pod yield and creeper yield of groundnut (1994–95)

Treatment	No. of pods/ plant		Weight of pods/ plant		1,000-kernel weight (g)		Dry pod yield (q/ha)		Creeper yield (q/ha)	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Phosphorus										
Control	9.86	9.92	9.96	10.08	402.52	404.29	17.81	19.54	16.44	18.04
25 kg P_2O_5/ha	12.29	12.41	12.51	13.47	410.24	411.44	20.33	22.54	19.00	21.21
50 kg P_2O_5/ha	15.43	15.71	15.67	17.09	426.39	427.78	26.86	28.14	25.28	25.63
75 kg P_2O_5/ha	16.29	16.58	16.46	18.03	433.21	434.46	28.80	30.25	27.07	27.82
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD (P=0.05)	0.31	0.33	0.31	0.33	1.56	1.07	0.87	1.21	0.82	1.16
P. solubilizer										
With P-solubilizer	14.33	14.55	14.53	15.68	420.19	420.36	24.59	26.29	23.03	24.29
Without P-solubilizer	12.61	12.75	12.76	13.66	416.24	418.63	22.30	23.93	20.87	22.67
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD (P=0.05)	0.21	0.23	0.22	0.24	1.10	0.76	0.62	0.85	0.57	0.82
Plant population										
30 cm × 10 cm	14.13	14.31	14.33	15.32	420.00	420.96	23.88	25.95	22.40	24.00
25 cm × 10 cm	13.31	13.53	13.46	14.43	418.19	419.24	23.67	25.05	22.08	22.89
20 cm × 10 cm	12.95	13.12	13.16	14.06	416.46	418.21	22.79	24.37	21.36	22.64
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD (P=0.05)	0.26	0.29	0.29	0.32	1.35	0.93	0.75	1.06	0.70	1.01
Grand mean	13.47	13.65	15.08	23.73	418.22	419.50	23.45	25.11	21.95	23.18

Table 3. Height, number of leaves/plant, dry matter and green weight and green yield of fenugreek as influenced by treatments during 1994–95

Treatment	Height (cm)		Leaves/ plant		Dry matter (g/plant)		Green weight (g/plant)		Green yield (tonnes/ha)	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Phosphorus levesl										
Control	11.28	11.36	10.48	10.61	0.25	0.27	0.64	0.66	5.00	5.05
25 kg P_2O_5/ha	11.93	12.05	11.96	12.05	0.46	0.51	0.85	0.87	6.58	6.65
50 kg P_2O_5/ha	13.10	13.26	14.55	14.66	0.70	0.71	1.04	1.08	8.15	8.20
75 kg P_2O_5/ha	13.55	13.63	15.87	15.94	0.74	0.77	1.15	1.18	8.88	8.98
CD (P=0.05)	0.38	0.43	0.79	0.82	0.05	0.05	0.06	0.07	0.48	0.53
P. solubilizer										
With P-solubilizer	12.63	12.76	13.54	13.61	0.56	0.59	0.93	0.98	7.38	7.42
Without P-solubilizer	12.30	12.39	12.90	13.02	0.52	0.55	0.91	0.92	6.92	7.00
CD (P=0.05)	0.30	0.30	NS	NS	NS	NS	0.05	0.05	0.34	0.37
Plant population										
30 cm × 10 cm = 330,000	12.38	12.47	12.87	13.04	0.58	0.59	0.94	0.96	7.21	7.25
25 cm × 10 cm = 400,000	12.47	12.61	13.33	13.54	0.51	0.53	0.93	0.92	7.00	7.01
20 cm × 10 cm = 500,000	12.55	12.64	13.25	13.37	0.52	0.58	0.92	0.97	7.25	7.35
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

spacings. Similarly, 30 cm × 10 cm spacing was found significantly superior for all the yield attributes in both the years. However, the spacings of 30 cm × 10 cm and 25 cm × 10 cm were at par in increasing the dry pod and creeper yields except creeper yield during 1995. This was mainly attributed to optimum plant population. These results are in accordance with the results of Agasimani *et al.* (1984).

Fenugreek

Residual effect of P : The height, number of leaves, dry matter/plant, green weight/ plant and green weight/ha were affected significantly by a residual effect of applied P to the previous crop (Table 3). An application of 75 kg P_2O_5/ha to the preceding groundnut showed residual fertility by increasing significantly the green yield /ha of fenugreek over rest of the levels. While 50 kg P_2O_5/ha increased the green yield/ha over application of 25 kg P_2O_5/ha and the control. Similarly, 25 kg P_2O_5/ha increased significantly the green yield over the control, thus, exhibiting the residual effect of phosphorus. These results are similar to the results reported by Bhati (1993).

Effect of P-solubilizer : Inoculation of seeds of fenugreek with P-solubilizer treatment significantly increased the height, green weight /plant and green yield over the treatment without P- solubilizer.

Effect of plant population: Plant population treatments of previous crop did not make any significant difference in growth, dry matter and yield of fenugreek as residual effect (Table 3).

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