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Effect of phosphate fertilization, phosphate-solubilizer and plant population on yield and quality of summer groundnut *(Arachis hypogaea)*

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ABSTRACT

A field experiment was conducted during the summer season of 1994 and 1995 to study the effect of phosphate fertilization, P- solubilizer and plant population on yield and quality of summer groundnut (*Arachis hypogaea* L.). The pod yield was significantly higher under 75 kg P_2O_5/ha application along with P-solubilizer and with a population density of 0.33 million plants/ha (30 cm x 10 cm). Similarly, higher protein percentage and oil content were also observed with 0.33 million/ha, P-solubilizer and 75 kg P_2O_5/ha.

Key words : Groundnut yield, Phosphate fertilizer, P-solubilizer, Protein, Oil

Groundnut is a very important oilseed crop in Maharashtra. Integrated nutrient management is an important aspect in groundnut, as it fetches promising yields. Among the major nutrients, phosphorus is one of the nutrients, which is required in large quantity, for the growth of groundnut. Phosphatic fertilizers are mainly imported and every increase in unit cost of phosphatic fertilizer increases the cost of cultivation and reduces the profit/ha (Gaur and Singh, 1982). Hence it is necessary to find out a technology to minimize the dose of phosphatic fertilizer through recent techniques by using bio-fertilizers. Keeping these points in view the present investigation was conducted to study the effect of phosphatic fertilizer with P-solubilizer along with different plant populations on the biometric parameters of summer groundnut and their further impact quality traits like protein content and oil content.

MATERIALS AND METHODS

The present investigation was conducted during the summer season of 1994 and 1995 at Agricultural College farm, Pune.

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The soil of the experimental field was sandy clay in texture, medium in available nitrogen, available phosphorus and high in available potash content. The groundnut was sown on 24 February 1994 and 19 January 1995. The experiment was laid out in factorially randomized block design with 9 treatments and 3 replications. The treatment comprised 4 levels of phosphorus (0, 25, 50 and 75 kg/ha), 2 levels of seed treatments (with and without P-solubilizer) and 3 levels of plant populations (0.33, 0.40 and 0.50 million/ha)

All the recommended dose of manures, nitrogen and potash were applied basal. Before sowing the seeds were inoculated with P-solubilizing microganisms *Aspergillus awamori* as per treatments. The entire dose of phosphate as per the treatment was applied at sowing through single superphosphate. The plant population densities 0.33, 0.40 and 0.50 million/ha were maintained at each of the 3 row spacings of 13 cm x 10 cm, 25 cm x 10 cm and 20 cm x 10 cm respectively

RESULTS AND DISCUSSION

Effect of phosphate fertilization

The dry pod yield and dry creeper yield increased significantly with 75 kg P_2O_5 compared with 0, 25 and 50 kg P_2O_5/ha during 1994 and 1995 (Table 1). Application of 25, 50 and 75 kg P_2O_5/ha increased the dry pod yield respectively by 14.14, 50.64 and 61.70% in 1994 and 15.35, 44.01 and 54.81% in 1995 compared with that of control. The results are in line with those of Patel and Patel (1987), Prasanthi and Rani Perumal (1992) and Singh *et al.*, (1994). This may be due to the fact that the important yield-contributing characters, viz. numbers of pod, numbers of kernels, weight of pods, weight of kernels and 1,000-kernel weight, significantly increased with the increased levels of P_2O_5 application (Table 1).

From the yield response curve, it could be concluded that the yield increased owing to application of each additional dose of P_2O_5/ha was not proportionate. The maximum economic returns were obtained with the application of 50 kg P_2O_5/ha and the optimum yield was realized with this level. Pooled data and creeper : pod ratio also showed a similar trend.

Further the protein and oil content increased significantly 75 kg P_2O_5/ha compared with 0, 25 and 50 kg P_2O_5. Similar effects were also observed by Patel *et al.* (1987) and Jana *et al.* (1990).

Effect of P-solubilizer

Application of P-solubilizer treatment significantly increased the dry pod and creeper yields over the treatment which did not receive P-solubilizer treatment. Application of P-solubilizer increased the dry pod yield by 10.26 and 9.80% in 1994 and 1995 and dry creeper yield by 10.34 and 10.05% in 1994 and 1995 respectively. Anbusezhiyan (1994) also reported similar effects on groundnut. The important yield-contributing characters, viz. number of pods, number of kernels and 1,000-kernel weight, were significantly higher with the application of P-solubilizer (Table 1). The pooled data also showed significant results, whereas creeper : pod ratio showed non-significant results.

Application of P-solubilizer significantly

Table 1. Yield-contributing characters of groundnut as influenced by different treatments

Treatment	Pods/ plant		Weight of pods/ plant (g)		Kernels/ plant		Weight of kernels/ plant		Kernels : pods ratio	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Phosphorus										
Control	9.856	9.917	9.961	10.078	16.875	18.872	6.869	7.551	1.702	1.600
25 kg P_2O_5/ha	12.289	12.406	12.508	13.472	21.011	23.083	8.716	9.574	1.707	1.631
50 kg P_2O_5/ha	15.433	15.711	15.668	17.089	27.711	25.611	11.655	10.622	1.785	1.857
75 kg P_2O_5/ha	16.288	16.578	16.464	18.028	29.333	26.450	12.366	10.951	1.786	1.908
CD (P = 0.05)	0.502	0.330	0.307	0.333	0.561	0.458	0.255	0.190	0.016	0.055
P-solubilizer										
With P-solubilizer	14.328	14.553	14.540	15.678	25.290	24.300	10.574	10.016	1.747	1.796
Without P-solubilizer	12.605	12.753	12.761	13.656	22.175	22.700	9.229	9.333	1.743	1.702
CD (P = 0.05)	0.214	0.233	0.217	0.235	0.397	0.324	0.180	0.135		0.039
Plant population										
0.33 million/ha (30 cm × 10 cm)	14.133	14.313	14.328	15.315	24.938	24.725	10.420	10.289	1.751	1.749
0.40 million/ha (25 cm × 10 cm)	13.312	13.529	13.463	14.428	23.404	23.350	9.759	9.558	1.743	1.753
0.50 million/ha (20 cm × 10 cm)	12.954	13.117	13.159	14.258	22.856	22.438	9.525	9.146	1.741	1.745
CD (P = 0.05)	0.262	0.285	0.266	0.288	0.486	0.396	0.220	0.165		

Table 2. Kernel weight (g), nodules/plant, pooled average of dry pod yield (q/ha), pooled average dry creepers yield (q/ha) and creepers : pod ratio

Treatment	1,000-kernel weight (g)		Nodules/plant		Dry pod yield (q/ha)*	Dry creepers yield (q/ha)*	Creepers : pod ratio (mean)
	1994	1995	1994	1995			
Phosphorus							
Control	402.522	404.294	54.889	55.956	18.68	17.25	0.914
25 kg P_2O_5/ha	410.739	411.439	64.633	65.037	21.44	20.18	0.926
50 kg P_2O_5/ha	426.394	427.783	76.278	77.500	27.49	25.45	0.934
75 kg P_2O_5/ha	433.206	434.464	77.833	80.556	29.52	27.45	0.937
CD (P = 0.05)	1.559	1.073	1.605	0.862	0.235	0.336	0.008
P-solubilizer							
With P-solubilizer	420.192	420.358	70.361	71.950	25.45	23.68	0.914
Without P-solubilizer	416.239	418.633	66.306	67.574	23.13	21.48	0.926
CD (P = 0.05)	1.103	0.758	1.135	0.609	0.134	0.235	
Plant population							
0.33 million/ha (30 cm × 10 cm)	420.000	420.963	70.583	71.887	24.91	23.19	0.930
0.40 million/ha (24 cm × 10 cm)	418.188	419.238	68.250	69.733	24.36	22.52	0.924
0.50 million/ha (20 cm × 10 cm)	416.458	418.287	66.167	67.667	23.58	22.03	0.929
CD (P = 0.05)	1.350	0.926	1.390	0.764	0.185	0.286	

*Pooled average

increased the protein and oil content. This was owing to additional phosphorus uptake, increased nitrogen content, which would have increased both the protein and oil content.

Effect of plant population

The plant population of 0.33 million plants/ha significantly increased the dry pod yield and creeper yield over 0.40 and 0.50 million plants/ha. These results confirm the findings of Biradar *et al.* (1988). The increase in the dry pod yield with the plant population of 0.33 million plants/ha was due to additional increase in kernels/pod, kernels/plant, 1,000-kernel weight and weight of kernels. The warm climate and clean sky in addition to maximum duration of light in the summer season would have increased the photosynthetic rates in the treatment where optimum plant population 0.33 million rates plants/ha was maintained.

The pooled data of 1994 and 1995 showed that the population of 0.33 million plants/ha significantly increased the dry pod and dry creeper yields over other plant population treatments.

Table 3. Protein, oil content of kernels and P uptake in groundnut at harvest under different treatments

Treatment	Protein content (%)		Oil content (%)		Phosphorus uptake (kg/ha)	
	1994	1995	1994	1995	1994	1995
Phosphorus						
Control	29.656	29.900	46.590	46.916	16.70	17.07
25 kg P_2O_5/ha	31.222	31.294	47.786	48.101	21.02	27.48
50 kg P_2O_5/ha	32.261	32.483	50.431	50.834	40.08	41.42
75 kg P_2O_5/ha	32.467	32.811	51.411	51.773	48.25	49.77
CD (P=0.05)	0.291	0.282	0.412	0.311		
P-solubilizer						
With P-solubilizer	31.708	31.897	49.716	50.055	34.87	37.59
Without P-solubilizer	31.094	31.347	48.393	48.754	28.17	30.27
CD (P=0.05)	0.209	0.199	0.291	0.220		
Plant population						
0.33 million/ha (30 cm × 10 cm)	31.904	32.104	49.273	49.627	33.11	36.38
0.40 million/ha (25 cm × 10 cm)	31.421	31.625	49.045	49.434	32.38	34.40
0.50 million/ha (20 cm × 10 cm)	30.879	31.138	48.846	49.157	29.04	31.01
CD (P=0.05)	0.251	0.244		0.269		

Protein percentage and kernel oil content increased with decrease in population. Protein yield and oil percentage were maximum with 0.33 million plants/ha. These results are in line with the findings of Kumthekar (1974).

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