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Influence of Phosphorus, Molybdenum and Rhizobial Seed * Inoculation on Growth and Grain Yield of Redgram

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Field experiments with 0, 25 and 50 kg. P_2O_5/ha with and without rhizobiel seed inoculation and seed and soil application of sodium molybdate were tried on the yield and yield attibutes of redgram. The results revealed that P fertilization significantly increased the plant height, number of primary branches, dry matter production, pod number, pod weight per plant and grain yield of redgram. Rhizobial seed inoculation and molybdenum nutrition did not show any significant increase on the above characters.

The lack of response of tropical grain legumes to fertilizers may be mainly due to deficiency of trace elements and poor nodulation for want of appropriate strain of rhizobium (Hallsworth, 1972). Among the pulse crops, redgram (*Cajanus Cajan. L*) occupies a major area with high yields in India. Among the several environmental factors affecting N fixation, the usefulness of P for legume is very critical. Application of P to pulese with rhizobial inoculation improves yield and quality of grains with atmospheric N fixation resulting in restoration of soil fertility (Kalyan *et al.*, 1976). It is also observed that application of molybdenum along with P and rhizobial inoculation can improve the nutrient pattern of pulses. So an investigation was undertaken to study the influence of different P levels with rhizobial seed inoculation and seed and soil application of sodium molybdate on grain yield of redgram.

MATERIAL AND METHODS

Field experiments on phosphorus and molybdenum nutrition with rhizobial seed inoculation in redgram were conducted at 'F' and 'C' blocks of wetlands of Tamil Nadu Agricultural University Farm, Coimbatore in summer and kharif 1978 respectively. The characteristics of the experimental fields are presented in Table I. Redgram Co 3 a high yielding, medium in duration (135 days) was chosen for the study. Three levels of P viz., 0 (P0), 25 (P1) and 50 (P2) kg P_2O_5/ha were tried on main plot treatments. The sub-plots inclueded five treatments viz., (i) soaking the seeds in water for 30 minutes (S1), (ii) dry

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seed treatment of 1 per cent sodium molybdate (S2), (iii) seed treatment with 1 per cent sodium molybdate solution (S3), (iv) soil application of 0.5 kg (S4) and (v) 1.0 kg sodium molybdate/ha (S5). The experiments were laid out in split plot design and the treatments were replicated thrice.

For inoculating the seeds with rhiozbium, bacterial culture was thoroughly mixed with seeds and dried during the previous evening. On the succeeding day seeds were treated with sodium molybdate as per the schedule. Seeds were sown in lines drawn 60 cm apart adopting a sapcing of 30 cm between plants. The plants were thinned on 15th day after sowing retaining one healthy plant per hill. Cultural practices commonly followed in the University farm were adopted. Adequate profylactic p ant protection measures were taken. Redgram pods were harvested from the net area of each plot separately after removing the border rows and dried in the sun. The grains were removed by threshing and the yield was recorded for each plot at 12 per cent moisture content. The data collected were subjected to statistical scrutiny and the inference drawn are diacussed in this paper.

RESULTS AND DISCUSSION

i) **Plant height :** Phosphorus application in general had a favourable influence on plant height in all the growth stages in both summer and kharif seasons (Table II). Since the soil available P status was medium in the experimental site, redgram responded to P application by putting forth better growth. Increase in plant height due to P application was also reported by Kurup and Kaliappan (1969) in redgram.

ii) **Number of primary branches :** Phosphorus fertilization significantly increased the number of primary branches per plant over no P in both the seasons. (Table III). Phosphorus application which resulted in increased N uptake might be the probable reason for better growth and ultimately the increase in number of primary branches per plant. Sewa Ram and Gajendra Giri (1973) also observed the same in redgram. Both seed inocultion of rhizobium and sodium molybdate application had not attained the level of significance in increasing the number of primary branches.

iii) **Dry matter production :** Phosphorus nutrition had a significant influence in increasing the dry matter of redgram from 75th day onwards till harvest in both the season (Table IV). The increased values for growth components as plant height and number of primary branches due to P application might have resulted in increased DMP. Soundarajan (1978) also observed increase in DMP in redgram for applied P in medium P soils.

iv) **Pod number and pod weight per plant :** Number of pods per plant and pod weight were found to be significantly increased by P application in both the seasons (Table IV). Among the levels of P tested viz., 25 and 50 kg P_2O_5/ha, there was no much difference. The higher pod number for increased P dose indicates that pod development in redgram depends to a greater extent on P availability. Increase in pod number per plant in redgram was also observed by Manjhi *et al* (1973). Seed treatment with rhizobial inoculation and seed and soil application of sodium molybdate gave no appreciable differences among these treatments,

v) **Grain Yield :** Phosphorus fertilization significantly increased the grain yield of redgram in both the seasons (Table V). However, the difference in yield between 25 and 50 kg P_2O_5/ha was not significant. This shows that an application of 25 kg P_2O_5/ha would be sufficient for redgram in soils of medium P status. Better growth, DMP, and increased values for yield components would have increased the grain yield. Favourable response to P application in increasing the grain yield of redgram was also reported by Veerasamy *et al.* (1976).

Rhizobial seed inoculation has only numercial increase in grain yield over no inoculation in both the seasons, but this was not significant. Ramiah (1978) also reported inconsistent increase in grain yields of redgram due to rhizobial seed inoculation owing to several reasons under field conditions.

Even though the soil application of 0.5 and 1.0 kg sodium molybdate/ha had given only a marginal yield increase over other treatments, the differences were not significant. The soil status of available Mo (0.047 ppm) was found to be sufficient for redgram. Dalal and Quilt (1977) also observed that applied Mo (0.25 kg/ha) had no effect on redgram grain yield.

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TABLE I Chemical Properties of the Soil of the Experimental Fields

Properties	Summer '78	Kharif '78
Available N (kg/ha)	270 (low)	297 (medium)
Available $P_2 O_5$ (Kg/ha)	18.4 (medium)	20.0 (medium)
Available $K_2 O$/ (kg/ha)	520 (high)	547 (high)
Available Mo (ppm)	0.047	0.047
pH (1 : 2 Soil-water-suspension)	7.5	7.4

TABLE II Effect of Phosphorus, Molybdenum and Rhizobial Seed Inoculation on Plant Height

(Mean values — cm)

Treatments	Summer '78 Days after sowing				Kharif '78 Days after sowing			
	45	75	105	135	45	75	105	135
P0	65.2	105.4	134.4	136.0	71.8	112.0	140.2	140.9
P1	68.2	108.2	136.7	142.1	72.3	117.1	145.0	145.4
P2	66.1	111.8	142.0	144.2	74.6	116.2	147.4	149.1
S. E.	0.8	1.2	1.7	2.0	0.9	1.0	1.2	1.7
C. D. (P = 0.05)	N. S.	3.7	5.4	6.2	2.8	3.2	3.7	5.3
I0	66.3	107.6	136.9	139.8	72.0	114.5	142.6	144. 1
I 1	66.7	109.3	138.6	141.7	73.4	115.7	145.7	146.1
S. E.	0.7	1.0	1.4	1.6	0.7	0.8	1.0	1.4
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.
S1	66.6	109.1	136.1	140.5	71.8	113.6	143.7	144.4
S2	65.6	108.3	138.4	141.0	72.8	116.5	144.2	146.2
S3	67.1	108.0	137.6	140.2	73.5	115.3	143.1	144.7
S4	66.7	108.1	138.9	140.7	72.2	114.9	144.5	145 3
S5	66.5	109.0	137.6	141.5	74.1	115.1	145.4	145.0
S. E.	0.8	1.1	1.5	0.7	0.8	1.0	1.5	1.6
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S	N. S.	N. S.	N. S.	N. S.

TABLE III Effect of Phosphorus, Molybdenum and Rhizobial Seed Inoculation on Number of primary Branches per plant

Treatments	Summer '78				Kharif '78			
	Days after sowing				Days after sowing			
	45	75	105	135	45	75	105	35
P0	4.87	14.63	17.07	20.16	4.85	15.81	18.65	21.78
P1	4.91	15.40	17.67	21.41	5.18	16.78	19.90	23.05
P2	5.09	16.06	18.42	22.03	5.50	17.41	20.45	23.67
S. E	0.24	0.31	0.29	0.37	0.34	0.39	0.41	0.50
C. D. (P = 0.05)	N. S.	0.98	0.91	1.17	N. S.	1.26	1.29	1.58
I0	4.90	15.00	17.46	20.86	5.04	16.32	19.22	22.31
I1	5.02	15.73	17.98	21.54	5.30	17.02	20.12	23.35
S. E.	0.20	0.25	0.24	0.30	0.28	0.32	0.34	0.41
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.
S1	4.95	14.93	17.32	21.14	5.08	16.28	18.90	22.12
S2	4.84	15.29	17.75	20.82	4.93	16.62	19.65	23.05
S3	4.78	15.38	17.44	21.06	5.01	16.49	19.40	22.58
S4	5.15	15.44	18.21	21.31	5.36	17.12	0.02	23.10
S5	5.06	15.78	17.86	21.66	5.47	16.84	0.38	23.30
S. E.	0.18	0.37	0.35	0.41	0.29	0 34	0.39	0.46
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.

N. S. : Not significant

TABLE IV Effect of Phosphorus, Molybdeum and Rhizobial Seed Inoculation on Dry matter Production (Mean values — Kg/ha)

Treatments	Summer '78				Kharif '78			
	Days after sowing				Days after sowing			
	45	75	105	135	45	75	105	135
P0	319	1825	4462	6050	445	1648	4109	5655
P1	334	1887	4617	6388	462	1814	5088	6761
P2	354	1928	4670	6466	493	2039	5308	7109
S. E.	14	28	43	52	16	33	45	64
C. D. (P = 0.05)	N. S.	87	136	163	N. S.	102	143	200
I0	330	1857	4555	6275	451	1802	4748	6379
I1	342	1903	4610	6347	483	1865	4923	6638
S. E.	12	23	35	42	13	27	37	52
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	117	163
S1	330	1869	4557	6266	452	1794	4789	6443
S2	336	1878	4643	6296	470	1819	4819	6509
S3	329	1854	4582	6315	461	1834	4836	6490
S4	350	1918	4602	6327	472	1854	4877	6540
S5	333	1881	4630	6350	480	1868	4860	6560
S. E.	11	25	30	34	13	29	39	54
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S

N. S. : Not significant

TABLE V Effect of Phosphorus, Molybdenum and rhizobial seed inoculation on pod number per plant and pod weight per plant

Treatment	Pod number per plant		Pod weight per plant	
	Summer '78	Kharif '78	Summer '78	Kharif '78
P0	177	193	38.4	44.5
P1	232	253	45.9	52.4
P2	240	263	47.8	54.8
S. E.	4.0	2.9	2.8	3.1
C. D. (P = 0.05)	12.6	9.2	8.8	9.8
I0	213	233	43.1	49.1
I1	219	240	45.0	52.1
S. E.	3.3	2.4	2.3	2.5
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.
S1	207	228	42.8	49.1
S2	217	238	43.4	49.8
S3	213	233	44.2	50.8
S4	220	243	44.6	51.6
S5	224	240	45.1	51.7
S. E.	12.2	10.6	1.6	1.8
C. D. (P = 0.05)	N. S.	N. S.	N. S.	N. S.

N. S. : Not significant

TABLE VI Effect of Phosphorus, Molybdenum and Rhizobial Seed Inoculation on Grain yield of Redgram (Mean Values – Kg/ha)

Summer 1978

Treatments	S1	S2	S3	S4	S5	I0	I1	Mean
P0	1035	1030	1049	1060	1053	1015	1075	1045
P1	1289	1311	1228	1321	1315	1271	1342	1307
P2	1332	1334	1326	1351	1354	1324	1355	1339
I0	1203	1212	1205	1226	1220	—	...	1213
I1	1234	1238	1242	1261	1260	...	...	1247
Mean	1219	1225	1224	1244	1240	...	...	...

	S. E.	C. D. (P = 0.05)
P	25.28	79.64
I	20.64	N. S.
P at I	35.75	N. S.
S	24.79	N. S.
S at P	43.26	N. S.
P at S	46.22	N. S.
S at I	35.32	N. S.
I at S	37.74	N. S.

N. S. : Not significant

TABLE VII Effect of Phosphorus, Molybdenum and Rhizobial Seed inoculation on Grain Yield of Redgram (Mean Values — Kg/ha)

Kharif 1978

Treatments	S1	S2	S3	S4	S5	I0	I1	Mean
P0	1110	1118	1120	1139	1133	1094	1153	1124
P1	1385	1376	1374	1401	1394	1363	1409	1386
P2	1399	1390	1405	1436	1430	1387	1437	1412
I0	1274	1272	1271	1299	1292	...	...	1282
I1	1322	1317	1328	1352	1345	...	...	1333
Mean	1298	1295	1300	1325	1319	...	...	...

	S. E.	C. D. (P = 0.05)
P	27.06	85.26
I	22.10	N. S.
P at I	38.27	N. S.
S	36.65	N. S.
S at P	63.48	N. S.
P at S	62.90	N. S.
S at I	51.83	N. S.
I at S	51.36	N. S.

N. S.: Not Signific