RESPONSE OF *RHIZOBIUM LEGUMINOSARUM* INOCULATION WITH SULPHUR AND MICRONUTRIENTS ON GROWTH CHARACTERISTICS OF BLACKGRAM (*VIGNA MUNGO* (L.) HEPPER)

Brijesh Kumar Rathi, Anuj Kumar and Sudhir Kumar

Department of Botany, J.V. College, Baraut, (Bagphat)

Abstract: A field trial was conducted during the kharif season of 2002 and 2003 at the research farm of J.V. College, Baraut, to find out the role of *Rhizobium* with sulphur and micronutrients viz. Zn, Mo and B on the cultivar PU-19 and PDU-1 of blackgram. Application of *Rhizobium* along with S @ 60 kg/ha, Zn @ 4 kg/ha, B @ 0.6 kg/ha and Mo @ 0.1 kg/ha significantly increased the growth characteristics in both the cultivar of blackgram. Plant height, number of branches, number of leaves and leaf area increased to a great extent by the application of *Rhizobium* along with sulphur and micronutrients.

Keywords: Blackgram, height, branches and leaves

INTRODUCTION

Blackgram is one of the important tropical grain legume, it is used as a major source of protein, essential amino acid, carbohydrate and fat. Blackgram seeds have 56.7 to 63.7% carbohydrate, 18.1 to 24.6% protein and about 1.6% lipid content. Blackgram is also a good source of phosphorous, calcium, iron and vitamins, especially water soluble vitamins (Srivastava and Ali, 2004). Moreover blackgram has unique characteristics of maintaining and restoring soil fertility through their deep and well spread soil system and biological nitrogen fixation.

In spite of having large area under pulses, India's position in average productivity and growth of blackgram has not been satisfactory. There are many agro-ecological, biological, socio-economic and management related constraints that are responsible for poor growth of blackgram. Non-availability of proper biofertilizer, inadequate use of macro and micro nutrients are some of the important factors responsible for poor growth of blackgram.

Usually grain legumes are growth on marginal lands and poor growth in such soil are due to the lack of effective and specific strain of *Rhizobium* in rhizosphere. So presence of efficient and specific strain of *Rhizobium* in rhizosphere is one of the most important requirement for proper growth and development of grain legumes (Subba Rao and Tilak, 1977). During the recent year, due to intensive agriculture and use of sulphur free high analysis fertilizer, there has been a steady decline in the sulphur status of the soil leading to its deficiency (Tandon, 1986), So application of sulphur is necessary in a balanced fertilizer programme for achieving sustainable growth in blackgram. The deficiency of micronutrients in diverse crop culture from different eco-edaphic condition has widely been reported (Anderson, 1964). Among the micronutrients Zn, Mo and B are the most important. Their deficiency badly affects various growth parameters in blackgram. Present investigation was therefore, initiated to work out the effect of *Rhizobium*, sulphur and micronutrients on various growth parameters of blackgram.

MATERIAL AND METHOD

A field trial was conducted during kharif season of 2002 and 2003 at the research farm of J.V. College, Baraut. Uniform basal dosage of nitrogen in form of urea (20 kg/ha) and potassium in the form of potash (40 kg/ha) were applied before sowing. The seeds were first inoculated with *Rhizobium* and sulphur and micronutrients were applied at the time of sowing. The sulphur was used as gypsum @ 60 kg/ha, Zn as zinc sulphate @ 4 kg/ha, B as borax @ 0.6 kg/ha and Mo as sodium molybdate @ 0.1 kg/ha. The treatment comprised *Rhizobium* alone and in combination with sulphur, Zn, B and Mo. The crop was sown in first fortnight of July using genotype PU-19 and PDU-1. The experiment was laid out in randomized block design replicated thrice. Each treatment was accommodated in $3.0x1.5m^2$ plot with row to row distance 30 cm and plant to plant 15 cm. Three plants from each plot were randomly taken and observation for plant height, number of branches / plant, number of leaves / plant and leaf area were recorded at 30, 40, 50 days after sowing (DAS) and at harvest. The data of both years were pooled together and statistically analyzed by adopting appropriate method of "Analysis of Variance" as described by Panse and Sukhatme (1967).

Table-1- Effect of rhizobium inoculation with sulpher and micronutrients on plant height (cm^2) of blackgram

Treatments	30 DAS			40 DAS			50 DAS			At Harvest		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
control	21.88	19.35	20.62	27.48	25.54	27.51	31.04	28.44	29.74	41.02	38.96	39.99
rhizobium	26.28	24.45	25.37	31.56	29.49	30.53	36.63	34.24	35.44	37.19	44.51	40.85
R+ Mo+ B	26.88	24.97	25.93	31.89	29.91	30.91	37.11	34.72	35.91	47.95	45.53	46.74
R + Zn + Mo	27.09	25.54	26.32	32.53	30.64	31.61	37.52	35.41	36.46	48.44	45.81	47.12
R + Zn + B	27.48	26.02	26.77	32.88	31.07	31.98	37.96	36.13	37.05	48.95	46.56	47.76
R+Zn+Mo+B	27.92	26.43	27.18	33.38	31.52	32.45	38.42	36.72	37.57	49.47	47.21	48.34
R + S	28.14	27.01	27.57	33.91	31.96	32.94	38.82	36.91	37.87	49.91	47.66	48.79
R+ S +Mo	28.54	27.53	28.03	34.37	32.43	33.41	39.66	37.56	38.61	50.31	48.35	49.33
R + S + B	28.99	27.93	28.46	34.89	32.91	33.91	40.38	38.33	39.36	50.99	49.15	50.07
R + S +Zn	29.28	28.25	28.77	35.23	33.21	34.22	40.84	38.95	39.91	51.68	49.85	50.77
R + S +Mo + B	29.56	28.71	29.13	35.56	33.59	34.58	41.35	39.48	40.42	52.23	50.28	51.26
R + S + Mo+ Zn	30.02	28.96	29.49	36.06	33.91	34.98	41.81	40.31	41.05	52.57	50.67	51.62
R + S + Zn + B	30.51	29.17	29.84	36.64	34.25	35.45	42.15	40.84	41.51	53.18	51.11	52.15
R+S+Zn+Mo+B	31.12	29.51	30.32	37.07	34.65	35.86	42.95	41.14	42.05	54.19	52.01	53.11
Mean	28.12	26.71	-	33.82	31.79	-	39.04	37.08	-	49.15	47.69	-
CD at 5%												
Variety	0.462			0.607			0.536			0.788		
Treatments	1.221			1.606			1.418			2.085		
V x T	1.727			2.272			2.006			2.949		

Table-2- Effect of rhizobium inoculation with sulpher and micronutrients on number of branch/plant of blackgram

Treatments	30 DAS			40 DAS			50 DAS			At Harvest		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
control	-	-	-	1.33	0.83	1.08	2.01	1.51	1.75	2.67	2.33	2.51
rhizobium	0.17	0.17	0.17	2.17	1.66	1.92	3.17	2.83	3.01	3.67	3.17	3.42
R+ Mo+ B	0.49	0.17	0.33	2.17	1.66	1.92	3.33	2.83	3.08	3.67	3.17	3.42
R + Zn + Mo	0.49	0.49	0.49	2.17	2.01	2.09	3.51	3.17	3.34	4.01	3.51	3.75
R + Zn + B	0.49	0.49	0.49	2.51	2.17	2.34	3.67	3.17	3.42	4.01	3.51	3.75
R + Zn + Mo+B	0.83	0.67	0.75	2.51	2.17	2.34	3.67	3.17	3.42	4.16	3.51	3.83
R + S	0.83	0.67	0.75	2.51	2.33	2.42	3.67	3.33	3.51	4.33	3.83	4.08
R+ S +Mo	0.83	0.67	0.75	2.51	2.51	2.51	3.83	3.33	3.58	4.51	3.83	4.17
R + S + B	0.83	1.01	0.92	2.83	2.66	2.75	4.01	3.51	3.75	4.67	3.83	4.25
R + S +Zn	1.01	1.01	1.01	2.83	2.66	2.75	4.02	3.51	3.75	4.67	4.17	4.42
R + S +Mo + B	1.17	1.01	1.09	3.17	2.83	3.01	4.16	3.67	3.92	5.01	4.51	4.75
R + S + Mo+Zn	1.17	1.01	1.09	3.51	2.83	3.17	4.16	3.67	3.92	5.01	4.51	4.75
R + S + Zn + B	1.51	1.51	1.51	3.51	3.17	3.34	4.16	3.67	3.92	5.16	4.66	4.91
R+S+Zn+Mo+B	1.83	1.51	1.67	3.51	3.5	3.51	4.16	3.67	3.92	5.33	5.01	5.17
Mean	0.83	0.74	-	2.66	2.36	-	3.68	3.22	-	4.35	3.82	-
CD at 5%												
Variety	0.018			0.044			0.061			0.072		
Treatments	0.049			0.117			0.157			0.191		
V x T	0.069			0.164			0.222			0.268		

Table-3- Effect of rhizobium inoculation with sulpher and micronutrients on number of leaves/plant of blackgram

Treatments	30 DAS			40 DAS			50 DAS			At Harvest		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
control	6.33	5.33	5.83	8.66	8.16	8.41	15.5	14.33	14.91	12.5	11.66	12.08
rhizobium	7.33	6.16	6.74	9.16	9.16	9.16	16.01	15.01	15.51	13.16	12.5	12.83
R+ Mo+ B	7.66	6.51	7.08	9.51	9.52	9.51	16.83	15.33	16.08	13.66	13.01	13.33
R + Zn + Mo	7.83	6.66	7.24	10.01	10.16	10.08	17.51	16.16	16.83	14.01	13.66	13.83
R + Zn + B	8.17	6.83	7.51	11.16	10.66	10.91	18.16	17.01	17.58	14.66	14.16	14.41
R + Zn + Mo+B	8.17	7.51	7.83	11.33	11.01	11.16	18.66	17.33	18.01	15.16	14.51	14.83
R + S	8.51	7.83	8.16	11.83	11.51	11.66	19.33	17.66	18.51	15.66	15.16	15.41
R+ S +Mo	8.83	8.16	8.49	12.16	12.01	12.08	20.16	18.51	19.33	16.51	15.01	16.01
R + S + B	9.01	8.66	8.83	12.66	12.52	12.58	20.51	19.16	19.83	17.16	15.83	16.49
R + S +Zn	9.33	9.01	9.16	13.16	12.83	13.01	20.83	20.16	20.51	17.66	16.33	16.99
R + S +Mo +B	9.83	9.33	9.58	14.01	13.16	13.58	21.99	20.83	21.41	18.01	17.16	17.58
R + S + Mo+Zn	10.17	9.51	9.83	14.83	13.83	14.33	22.66	21.33	22.01	18.66	17.51	18.08
R + S + Zn + B	10.8	9.83	10.31	15.33	14.33	14.83	23.16	22.01	22.58	19.5	17.83	18.66
R+S+Zn+Mo+B	11.16	10.16	10.66	15.66	14.66	15.16	23.83	22.5	23.16	19.83	18.51	19.16
Mean	8.79	7.96	-	12.97	11.67	-	19.65	18.37	-	16.15	15.23	-
CD at 5%												
Variety	0.175			0.264			0.314			0.287		
Treatments	0.464			0.698			0.831			0.759		
V x T	0.657			0.987			1.174			1.074		

Table-4- Effect of rhizobium inoculation with sulpher and micronutrients on number of leaf area/plant (cm^2) of blackgram

Treatments	30 DAS			40 DAS			50 DAS			At Harvest		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
control	110.26	106.64	108.5	267.01	356.62	311.81	504.4	482.76	493.6	315.63	320.06	317.84
rhizobium	160.51	146.75	153.6	337.45	316.93	327.19	580	548.04	563.99	357.39	341.05	349.22
R+ Mo+ B	163.16	152.52	157.8	348.74	324.09	336.41	594.6	568.57	581.61	369.86	349.41	359.63
R + Zn + Mo	172.11	158.38	165.3	357.81	335.32	346.56	613.4	580.75	597.05	380.07	361.17	370.62
R + Zn + B	181.28	164.93	173.1	370.01	346.71	358.35	628.1	614.94	621.5	394.84	376.92	385.08
R + Zn + Mo+B	187.76	173.31	180.5	377.58	357.69	367.63	644	638.49	641.23	406.94	393.03	399.99
R + S	197.51	181.05	189.3	391.03	367.83	379.43	662.2	656.01	659.12	419.64	400.48	410.06
R+ S +Mo	206.59	187.68	197.1	403.79	378.23	391.01	674.7	675.37	675.05	433.66	409.81	421.73
R + S + B	214.33	193.29	203.8	417.09	389.68	403.38	694.1	691.37	692.73	443.81	418.75	431.28
R + S +Zn	221.47	202.99	212.2	427.41	400.17	413.79	710	707.36	708.66	452.08	429.27	440.67
R + S +Mo+B	231.48	210.72	221.1	440.01	417.25	428.63	729.1	716.16	722.65	463.37	443.89	453.63
R + S + Mo+Zn	240.71	225.41	233.1	450.35	423.85	437.11	746	730.28	738.13	474.07	451.84	462.55
R + S + Zn + B	250.21	236.89	243.5	460.58	434.87	447.72	763.1	739.21	751.14	486.01	464.21	475.11
R+S+Zn+Mo+B	254.19	242.77	248.5	477.11	449.34	448.22	782	750.91	766.43	496.06	480.87	488.46
Mean	199.4	184.52	-	394.71	381.32	-	666.1	650.02	-	420.96	402.91	-
CD at 5%												
Variety	3.51			7.267			12.95			8.901		
Treatments	7.992			16.517			28.45			19.996		
V x T	28.18			120.26			368.8			178.175		

RESULTS AND DISCUSSION

Data revealed that inoculation of *Rhizobium* attained significantly more plant height, number of branches / plant, number of leaves / plant and leaf area / plant over uninoculated control. The effect of *Rhizobium* in combination with sulphur was significant in comparison to *Rhizobium* alone and control, but was non-significant over *Rhizobium* plus all the micronutrients. The inoculation of *Rhizobium* along with sulphur and all the micronutrients attained significantly more plant height, number of branches / plant, number of leaves / plant and leaf area than *Rhizobium* with sulphur and *Rhizobium* plus all micronutrients (Table – 1, 2,3,4). The cv. PU-19 has more plant height, no. of branches, no. of leaves per plant and leaf area than cv. PDU-1.

The level of improvement in the growth attributes due to *Rhizobium*, sulphur and micronutrients was significant. Increase in plant height, branches/plant leaves/plant and leaf area due to *Rhizobium* inoculation was attributed to higher light absorption and photosynthetic activities at all the growth stage. Sulphur in the form of gypsum play important role in increasing the crop height, superiority of gypsum in increasing the height and other growth attributes might be attributed to the readily available form of sulphate, which was easily taken up by the crop and easily metabolised, which in turn might have induced the growth. The increase in these growth attributes with the application of micronutrients may be expected, as micronutrients like Zn play an important role in the production of IAA, a growth hormone and tryptophan, a precursor of auxin. The number of leaves and leaf area declined at the time of harvesting, because at the time of harvesting there were more translocation of photosynthates towards the pods and grains as compard to leaves, which results in leaf senescence. These findings are in conformity with those obtained by Kumar *et al.* (1999) and Singh and Yadav (1997).

REFERENCES

Anderson, O.E. 1964. Micronutrients and Crops. *Georgia Agric. Sta. Bull* **126** : 33-41.

Kumar, P.; Saraf-C.S.; Subhash, C. and Rowal, S., 1999. Performance of greengram and blackgram as influenced by weed management and sulphur fertilization. *Ann. Agril. Res.* **20 (1)** : 69-72.

Singh, U. and Yadav, D.S. 1997, Economics of summer green-gram cultivation as influenced by S and Zn level. *legume Res.* **23 (1)** : 67-68.

Srivastava , G.C. and Ali, M. 2004. Nutritional quality of common pulses. *Hindu survey of Indian Agri.* **pp:** 33-37.

Subba Rao , M.S. and Tilak, K.U.B.R. 1977. *Rhizobium* culture, their role in pulse production, Souvenier Bell Directorate of pulses, Deptt. of Agri., Gov. of India, Lucknow. **pp:** 31-34.

Tondon, H.L.S. 1986. Sulphur research and development in Indian agriculture. *Ferti. News.* **31**: 9-16.