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Effect of Different Doses of Fertilizers at Different Ages on Some Root Characters, Nodules and Yield Components in Blackgram [*Vigna mungo* (L.) Hepper]

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Abstract: Effect of different combinations of nitrogen (N), phosphorus (P) and potassium (K) on six characters namely Root Length (RL), Root Fresh Weight (FRW), Root Volume (RV), Nodule Number (NN), Nodule Weight (NW) and Pod Fresh Weight (PFW) were studied in three lines such as Line-2, Line-16 and Line-18 of blackgram. Analysis of variance showed that all the three lines are different from each other for each of the characters. Factorial analysis showed that N and P after 15 days of sowing, N and K after 30 days of sowing, NPK after 60 days of sowing and P, NP and NK after 75 days of sowing had significant effect on root length. N and NK after 30 and 90 days of sowing and N after 45 and 75 days of sowing had significant effect on root fresh weight. For root volume, N after 45 and 75 days of sowing and N and NK after 90 days of sowing had significant effect. N after 15 days of sowing, PK after 30 days of sowing, P after 45 days of sowing, K and NP after 60 days of sowing, K after 75 days of sowing and NK after 90 days of sowing found to be significantly effective for nodule number. The character nodule weight also affected by K, NP and NK after 15 days of sowing, by P after 30 days of sowing, by N, P, K, PK and NPK after 60 days of sowing and by P, NP and PK after 90 days of sowing. Only P found to be significantly effective for pod fresh weight at an age of 75 days.

Key words: Blackgram, fertilizers, root characters, nodules, yield component

INTRODUCTION

Blackgram [*Vigna mungo* (L.) Hepper] also known as mushkalai, urbean or blackbean is one of the most important pulse crop, belongs to the family Leguminosae. It has bean cultivated all over the world, mainly in South Western Asia, Egypt, Europe, India, Pakistan, Bangladesh, Nepal and China as a winter crop. In Bangladesh, blackgram is fourth most important pulse crop, contributing about 13.30% of total pulses and used for various purposes i.e., green pods as vegetables, seeds as dhal and green plants as fodders. Seeds of blackgram contains about 9.7% water, 32.4% protein, 1% fates, 57% carbohydrates, 3.8% fibers and 4.8% ash (Purseglove, 1968) and also rich in minerals and vitamin-B. The caloric value of blackgram is same as that of rices (Anonymous, 1966). Like other leguminous crop, blackgram play a vital role in maintaining the nitrogen balance in the soil. It possesses nodules on its roots, containing nitrogen fixing bacteria *Rhizobium* sp. which fixes nitrogen in symbiotic association with the plant and release a significant amount for plant growth and development.

The different chemical fertilizers affect the growth and development of blackgram. In Bangladesh, blackgram is cultivated as a low yielding rainfed kharif crop with poor field management condition. On this ground, it is need to increase the yield of blackgram by means of adopting improved agronomic management practices. Among all practices, fertilization is an important one, because the soils of Bangladesh are very much deficient in important nutrient element. Knowledge on the effect of fertilizers would be helpful to use fertilizer efficiently for the proper growth and development of the crop, which in turn may influence the yield contributing characters. Therefore, in the present investigation the effects of different doses of fertilizers (N, P and K and their combinations) were studied on some root characters, nodules and one yield component, at different ages of blackgram.

MATERIALS AND METHODS

The materials for the present study comprised 3 blackgram lines (Line-2, Line-16 and Line-18) supplied from Biometrical Genetics Laboratory, Department of Genetics and Breeding, University of Rajshahi, Bangladesh. Seeds were grown in 12×18 inch polyethylene bags each of which contained 50% sand, 12.5% cow dung, 12.5% loam, 12.5% saw dust, 12.5%

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ash and with one of the fertilizer doses prepared by either sole nitrogen (N) or phosphorus (P) or potassium (K) or in combination of two or all of them. Therefore, in the present investigation eight combinations of N, P and K were used. These are as follows:

i) Dose-1: (No fertilizer), ii) Dose-2: Urea (1.5 g bag^{-1}), iii) Dose-3: TSP (4 mg bag^{-1}), iv) Dose-4: MP (1.5 mg bag^{-1}), v) Dose-5: Urea (1.5 g bag^{-1})+TSP (4 mg bag^{-1}), vi) Dose-6: Urea (1.5 g bag^{-1})+MP (1.5 mg^{-1} bag), vii) Dose-7: TSP (4 mg bag^{-1})+MP (1.5 mg bag^{-1}) and viii) Dose-8: Urea (1.5 g^{-1} bag)+TSP (4 mg bag^{-1})+MP (1.5 g bag^{-1}).

For each treatment 6 bags were taken and in each bag 3 plants were grown. The experiment was carried out from 25th September to 23rd December 2000 in the garden of 3rd science building of Rajshahi University. Data were recorded after every 15 days starting from seeding up to 90 days comprising 6 stages. The collected data were analyzed following biometrical techniques development by Mather (1949) based on the mathematical model of Fisher *et al.* (1932) and by Fisher (1935).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) showed that line (L) item was significant for all the characters, which indicated that there was a real difference among the lines studied. The items dose (D) and stage (S) showed significance when tested against within error for all the characters except Fresh Pod Weight (PFW). The analysis further showed that the lines were significantly interacted with fertilizer doses for the characters root length (RL) and pod fresh weight (PFW) and with stages for all the characters except pod fresh weight (PFW). The interaction item D×S showed the same result as L×S. Again, all characters showed significant interaction between lines, doses and stages except pod fresh weight (PFW).

The factorial analysis in the present investigation deals with the effects of different doses of N, P and K fertilizer at different ages of plant growth and development (Table 2). The significance of dose item for RL indicated that the character was affected by different fertilizer doses, in which N after 15 and 30 days of sowing, K after 30 days of sowing, P after 15 and 75 days of sowing and NP and NK after 75 days of sowing. For the character RFW, though the dose item was non-significant at all stages except last stage in the analysis of variance, the factorial analysis revealed that individual doses were significant at most of the stages for this character. N and NK at 2nd stage, only N at 3rd and 5th stages and N and NK at last stage were found to be significant for RFW, which indicated that N fertilizer alone and its combination with K had significant effect for this character at ages from 30 to 90 days. Similar result was also observed for other root character such as RV, in which the effect of only N was observed to be significant after 45, 75 and 90 days of sowing and the effect of NK dose was found to be significant only after 90 days of sowing. Effect of other doses was noted to be non-significant for this character. Therefore, the root characters such as RFW and RV affected mostly by N fertilizer and in combination with K fertilizer at most of the ages of blackgram plant. Paul (1990) in his experiment with rapeseed and turnip, found that high N treated plants had lower leaf area and total dry weight up to 25 days after sowing but after that period leaf area and dry weight were increased significantly by increasing N level. Torofder *et al.* (1993) also observed significant effect of N fertilizer in increase the root length of wheat. Buttery (1969) studied soyabean and observed that NPK fertilizer was effective in increase final plant weight mainly by delaying the fall in NAR and CAR. Clayton *et al.* (1997) found that starter N enhanced dry matter production of fieldpea at the flat pod stage.

The nodule character, NN was significantly affected by one or two fertilizer doses at each of the stages. Effect of N after 15 days of sowing, effect of P alone after 45 days of sowing and in combination with N after 60 and 90 days of sowing found to be significant for NN. Other fertilizer such as K was effective on this character alone after 60 and 75 days of sowing, in combination with P after 30 days of sowing and in combination with N after 90 days of sowing. The remaining nodule character i.e., NW was also observed to be affected significantly by most of the fertilizer doses as one or two doses showed significance at each stage for this character. Effect of N alone was found to be significant after 60 days of sowing. The fertilizer P alone affects this character after 30, 60 and 90 days of sowing, in combination with N after 15 and 90 days of sowing and in combination with K after 60 and 90 days of sowing. The fertilizer K also effective for this character alone after 15 and 60 days of sowing and in combination with N after 15 days of sowing. NPK item found to be significant at 4th stage which indicated that the fertilizer dose NPK significantly effective for NW after 60 days of sowing. Hossain (1977) found that N in combination with P and/or K produced little amount of nodules at early stage of their growth, while at latter stages NP treated plant produced high amount of nodules and at final stage NPK treated plant showed to improved nodule content in blackgram. Chawdhary *et al.* (1998) recorded that after application of P up to 75 kg ha^{-1} progressively and significantly increased nodulation in mungbean.

For the yield component PFW, only P item was found to be significant at 5th stage, which indicated that yield of balckgram affected by P fertilizer when the age of plant

Table 1: Mean squares in the analysis of variance for six characters of blackgram

Items	df	RL	RFW	RV	NN	NW	df	PFW
Replication	2	3.5290^{NS}	10.6420**	11.3230**	5834.5165**	0.1172**	2	36.4501^{NS}
Line (L)	2	882.2536**	29.3275**	24.8443*	6078.4887**	0.0683*	2	65.6570*
Dose (D)	7	136.2443**	9.3017**	7.5681**	3983.0993**	0.0584**	7	31.3031^{NS}
Stage (S)	5	5811.9451**	208.0072**	174.3570**	60274.2149**	0.8686**	1	25.3244^{NS}
L×D	14	138.3766**	3.8935^{NS}	3.3710^{NS}	836.1974^{NS}	0.0125^{NS}	14	63.6163**
D×S	35	91.0227*	4.0284*	4.3333**	2324.3397**	0.0587**	7	23.3194^{NS}
L×S	10	213.4982**	5.6424*	5.1727*	2971.5467**	0.0718**	2	22.1820^{NS}
L×D×S	70	88.2645**	2.6160*	2.7391*	1816.7510*	0.0272*	14	9.1168^{NS}
Within Error	288	57.6210	2.5554	2.5458	1187.3519	0.0207	96	19.6434*

and ** indicated significance at 5 and 1% level, respectively and^{NS} indicated non-significance

Table 2: Mean square of factorial analysis at six stages in six characters of blackgram

Character	Item	df	1st stage	2nd stage	3rd stage	4th stage	5th stage	6th stage
Root Length (RL)	Dose	7	56.2410*	110.7117**	25.5685^{NS}	124.2992^{NS}	214.4107*	60.1278^{NS}
	N	1	225.4272**	203.8517**	21.1250^{NS}	135.1642^{NS}	147.3472^{NS}	107.5556^{NS}
	P	1	102.7222*	106.7017^{NS}	14.0450^{NS}	84.6084^{NS}	308.3472*	72.0000^{NS}
	K	1	0.8450^{NS}	212.01**	48.6756^{NS}	7.5725^{NS}	245.6860^{NS}	26.8989^{NS}
	NP	1	8.6806^{NS}	0.1750^{NS}	8.6806^{NS}	0.0475^{NS}	300.1250*	32.0000^{NS}
	NK	1	10.2756^{NS}	89.6684^{NS}	1.0756^{NS}	78.4378^{NS}	333.6806*	56.8889^{NS}
	PK	1	43.8672^{NS}	41.0267^{NS}	19.6356^{NS}	133.7975^{NS}	95.6800^{NS}	18.0000^{NS}
	NPK	1	1.8689^{NS}	121.5500^{NS}	65.7422^{NS}	430.4667*	70.0139^{NS}	107.5556^{NS}
	Error	48	21.8067	30.2912	78.3492	76.7930	72.7361	65.7500
Root Fresh Weight (RFW)	Dose	7	0.0124^{NS}	0.6667^{NS}	4.5592^{NS}	3.5185^{NS}	5.6475^{NS}	15.0447*
	N	1	0.0141^{NS}	1.5187*	19.9175**	0.6070^{NS}	31.9920**	46.0240**
	P	1	0.0334^{NS}	0.0782^{NS}	4.7911^{NS}	0.5957^{NS}	0.9540^{NS}	1.5269^{NS}
	K	1	0.0100^{NS}	0.1669^{NS}	0.0035^{NS}	13.4778^{NS}	0.0412^{NS}	0.0744^{NS}
	NP	1	0.0001^{NS}	0.0111^{NS}	1.0370^{NS}	5.9002^{NS}	2.6881^{NS}	0.0048^{NS}
	NK	1	0.0263^{NS}	1.5738*	0.0483^{NS}	3.7397^{NS}	0.0554^{NS}	35.9340*
	PK	1	0.0001^{NS}	0.3608^{NS}	0.3217^{NS}	0.0197^{NS}	0.0030^{NS}	16.4595^{NS}
	NPK	1	0.0032^{NS}	0.9575^{NS}	5.7953^{NS}	0.2899^{NS}	3.8014^{NS}	5.2894^{NS}
	Error	48	0.0099	0.3603	2.2826	4.1604	3.1684	5.4218
Root Volume (RV)	Dose	7	0.0081^{NS}	1.0379*	3.6686^{NS}	3.9827^{NS}	5.3108^{NS}	15.2268*
	N	1	0.0110^{NS}	1.6959^{NS}	15.4939*	1.6501^{NS}	29.1848**	36.5513*
	P	1	0.0210^{NS}	0.1850^{NS}	3.1250^{NS}	0.3335^{NS}	0.0139^{NS}	0.0313^{NS}
	K	1	0.0001^{NS}	0.2800^{NS}	0.9300^{NS}	13.2441^{NS}	0.0939^{NS}	2.0335^{NS}
	NP	1	0.0031^{NS}	0.4592^{NS}	1.3889^{NS}	7.0939^{NS}	2.0605^{NS}	0.9568^{NS}
	NK	1	0.0045^{NS}	1.5576^{NS}	0.8450^{NS}	3.8365^{NS}	0.3500^{NS}	37.4113*
	PK	1	0.0171^{NS}	1.6170^{NS}	0.4672^{NS}	0.8493^{NS}	0.0053^{NS}	21.6701^{NS}
	NPK	1	0.0000^{NS}	1.4706^{NS}	3.3800^{NS}	0.8712^{NS}	5.4670^{NS}	7.9335^{NS}
	Error	48	0.0125	0.4435	2.5099	3.7231	3.1337	5.4524
Nodule Number (NN)	Dose	7	229.6825*	819.9921*	4373.4206^{NS}	7645.4206*	1644.2837^{NS}	891.9980*
	N	1	512.0000*	624.2222^{NS}	186.8889^{NS}	3120.5000^{NS}	1378.1250^{NS}	217.0139^{NS}
	P	1	68.0600^{NS}	107.5556^{NS}	18947.5556**	6272.0000^{NS}	1932.3472^{NS}	276.1250^{NS}
	K	1	288.0000^{NS}	1027.5556^{NS}	320.8989^{NS}	18432.0000*	6142.0139*	558.6806^{NS}
	NP	1	102.7222^{NS}	840.5000^{NS}	264.5000^{NS}	20000.0000**	276.1250^{NS}	539.0139*
	NK	1	107.5556^{NS}	16.0556^{NS}	1860.500^{NS}	3.5556^{NS}	15.1250^{NS}	2058.6806*
	PK	1	280.0556^{NS}	3120.5000**	3556.0556^{NS}	589.3889^{NS}	1711.150^{NS}	503.3472^{NS}
	NPK	1	249.3889^{NS}	3.5556^{NS}	5477.5556^{NS}	5100.5000^{NS}	55.1250^{NS}	91.1250^{NS}
	Error	48	93.5833	132.1800	2593.8194	2639.1111	1067.0972	398.3194
Nodule Weight (NW)	Dose	7	0.0019*	0.0321^{NS}	0.0239^{NS}	0.1543**	0.0448^{NS}	0.0944**
	N	1	0.00055^{NS}	0.00077^{NS}	0.00959^{NS}	0.1382*	0.0131^{NS}	0.0015^{NS}
	P	1	0.00065^{NS}	0.11123*	0.00206^{NS}	0.1867*	0.1223^{NS}	0.1508*
	K	1	0.00577**	0.01100^{NS}	0.00019^{NS}	0.2547*	0.0780^{NS}	0.0872^{NS}
	NP	1	0.0030**	0.06337^{NS}	0.04707^{NS}	0.1144^{NS}	0.0373^{NS}	0.1162*
	NK	1	0.00173*	0.02205^{NS}	0.06643^{NS}	0.0009^{NS}	0.0599^{NS}	0.0195^{NS}
	PK	1	0.00015^{NS}	0.00042^{NS}	0.1320^{NS}	0.1551*	0.0006^{NS}	0.2766**
	NPK	1	0.00137^{NS}	0.01596^{NS}	0.02876^{NS}	0.2301**	0.0025^{NS}	0.0044^{NS}
	Error	48	0.0004	0.0252	0.0176	0.0313	0.0279	0.0221
Pod Fresh Weight (PFW)	Dose	7					47.7832*	6.8392^{NS}
	N	1					0.9264^{NS}	30.0325^{NS}
	P	1					233.6059**	4.8646^{NS}
	K	1					13.6059^{NS}	7.1839^{NS}
	NP	1					21.6822^{NS}	0.1239^{NS}
	NK	1					63.1744^{NS}	0.9296^{NS}
	PK	1					0.9765^{NS}	0.1113^{NS}
	NPK	1					0.4311^{NS}	4.6284^{NS}
	Error	48					18.63	20.6503

*and** indicated significance at 5 and 1% level, respectively and ^{NS} indicated non-significance.1st stage, 2nd stage, 3rd stage, 4th stage, 5th stage and 6th stage indicated after 15, 30, 45, 60, 75 and 90 days of sowing, respectively

was 75 days. Walley and Hnatowich (1999) studied chickpea and found that seed yield significantly responded to P_2O_5 was side banded at a rate of 40 kg ha^{-1}. Sharma *et al*. (2001) also recorded significant effect of P on seed yield and biological yield in green gram.

Study of the effects of different fertilizers in the present investigation revealed that root characters of blackgram responded mainly to N fertilizer and its combination with K, while P and K and their combinations with each other and with N influenced nodulation. Use of N and K was found not to be important for yield PFW, while use of P appeared to be effective in increasing yield of blackgram.

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