Agric. Sci. Digest., 38 (1) 2018 : 27-31
Print ISSN:0253-150X / Online ISSN:0976-0547

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com

Response of black gram [*Vigna mungo* (L.) Hepper] to spacing and fertilizer doses under rainfed conditions

Renthunglo Tungoe, T. Gohain* and Noyingthung Kikon

Department of Agronomy, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Dimapur-797 106, Nagaland, India.

Received: 03-08-2017 Accepted: 15-02-2018 DOI: 10.18805/ag.D-4659

ABSTRACT

A field experiment was conducted during the *kharif* season of 2012 to study the response of black gram [*Vigna mungo* (L.) Hepper] to different spacing and fertilizer doses under rainfed conditions. Maintaining a wider spacing of 30×10 cm (S_2) was found to increase uptake of nutrients P and K by the crop resulting in significantly higher number of leaves, branches and pods per plant respectively, thereby registering the highest grain and stover yields of 730 kg/ha and 1382 kg/ha respectively. Among the fertilizer dose, F_2 ($N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha) was found to increase the availability of NPK by the crop resulting in significantly superior growth attributes viz., plant height, number of leaves and branches/plant and leaf area index (LAI) ultimately recording maximum number of pods/plant, test weight and grain yield of 725 kg/ha. Whereas, the fertilizer dose F_3 ($N_{20}P_{50}K_{30}$) was found to record the highest stover yield of 1362 kg/ha.

Keywords: Black gram, Fertilizer doses, Growth and yield, Nutrient uptake, Spacing.

INTRODUCTION

The average productivity of black gram/ urdbeancontinues to be low mainly due to its cultivation under poor management and without proper and adequateinputs. Inherent yield potential of black gram can be realized by adopting input intensive management practices. Suitable sowing time, variety and plant population are important non-cash inputs to achieve synchronous maturity and higher productivity of urdbean. Optimum plant density and planting geometry are important factors for optimizing grain yields in black gram. Planting density affects growth, developmental, carbohydrate production and partition and ultimately the yield of a crop. Maintaining optimum spacing and population density per unit area provides conditions such as maximum light interception, photosynthetic activity, assimilation and accumulation of more photosynthates, which facilitates luxuriant crop growth and better plant canopy area and hence they produce more seed yield with best quality traits (Mazumdar *et al*. 2007). Black gram is mostly cultivated on marginal lands in mono/ mixed cropping system without any fertilizers under rainfed conditions with results in generally low yields compared to its yield potential. The yield potential of the crop can be realized and this yield gap can be minimized through adequate and balance supply of plant nutrients. Rathore *et al*. (2010) reported significantly superior growth characters, yield attributing traits and seed and straw yield with application of 100% recommended fertilizer doses. The use of organic manures along with synthetic fertilizers has great significance for maintenance of soil fertility, physical condition and biological activity. Soil fertility was improved significantly with farmyard manure used either alone or in combination with NPK over that of initial soil status (Singh *et al.* 2001). The integrated application of FYM with chemical fertilizer improves bulk density, water holding capacity and CEC of the soil and also increases the availability of native soil nutrients and chemical fertilizers due to release of organic acids and microbial products during their decomposition. Keeping in view the above facts the present investigation was conducted to study the response of black gram under different spacing and fertilizer dose treatments under rainfed conditions.

MATERIALS AND METHODS

A field experiment was conducted during the *kharif* season of 2012 in the experimental farm of School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Nagaland. The soil was sandy loam and well drained recording medium content of available N (313 kg/ha), P (13 kg/ha) and K (190 kg/ha) respectively with pH of 4.7 and organic carbon of 1.15%. The experiment was conducted in randomized block design (RBD) with three replications comprising of three spacings *viz*., S_1 (20×10 cm), S_2 (30×10 cm) and S_3 (45×10 cm) and four fertilizer doses *viz*., F_0/Control ($N_0P_0K_0$), F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha), F_2 ($N_{10}P_{40}K_{20}$ + FYM@5 t/ha) and F_3 ($N_{20}P_{50}K_{30}$). Field preparation was done during the last week of June 2012. Well decomposed FYM @ 10 and 5 t/hawas uniformly broadcasted over the plots marked F_1 and F_2

*Corresponding author's e-mail: tankeswar1968@gmail.com

respectively and incorporated 15 days before sowing. Nitrogen, Phosphorous and Potassium in the form of Urea, SSP and MOP were applied @ 5: 20: 10 kg/ha for treatment F_1, 10: 40: 20 kg/ha for treatment F_2 and 20:50: 30 kg/ha for treatment F_3. For all the treatments F_1, F_2 and F_3, starter dose of N and full dose of P and K were applied at the time of sowing as basal application in furrows below the seed. The crop was sown on the 30th of June 2012 wherein, black gram variety T-122 was line sown manually maintaining spacings of 20×10 cm, 30×10 cm and 45×10 cm as per treatment allocation. Inorder to increase the pH of the soil liming was done 15 days before sowing. Need based intercultural operations, pest and disease management were maintained uniformly for all the plots. Necessary biometric observations were recorded to study the response of the crop to the various treatments. The seed and stover samples were analysed for % NPK content. After harvesting the crop, soil samples were collected to determine the effect of fertilizer doses on the nutrient status of the experimental field. The data collected during the course of the investigation were analysed statistically following standard techniques.

RESULTS AND DISCUSSION

Growth attributes: Effect of spacing on various crop growth attributes are presented in Table 1. Narrow spacing S_1(20×10 cm) was found to record the highest plant height as compared to wider spacings of S_2 (30×10 cm) and S_3 (45×10 cm) at all the stages of growth. Taller plants observed under narrow spacings could be due to lack of enough space for lateral growthresulting in vertical growth (Rajput *et al.* 1993) or due to competition between plants for light. Number of leaves/plant and branches/plant was found to be significantly higher under wider spacing with spacing S_3 recording the maximum values for both the parameters and narrow spacing S_1 recording the lowest values for both. This may be attributed to more horizontal growth and plant canopy area under wider spacing due toless plant population density and competition compared tothose in closer spacing (Bahadur and Singh, 2005).The highest leaf area index (LAI) and crop growth rate (CGR) were recorded under narrow spacing $S_1$and the lowest LAI and CGR were recorded under S_3followed by S_2 this could be due to higher population densities under S_1as compared to comparatively lower population densities under S_2 andS_3. Biswas *et al.* (2002) also reported higher LAI and CGR under higher planting density.Fertilizer doses were also found to record significant variations on crop growth attributes (Table 1). Significantly higher plant height and number of leaves/plant wererecorded under F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha) and F_2 ($N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha)at different stages of observations whereas, the lowest plant height and number of leaves/plant wereconstantly recorded under F_0 (control) which may be due to higher availibility of N under treatments F_1 and F_2.The height of a plant depends on nutrient especially on nitrogen (Ferdous, 2001). Increased number of leaves/ plant and plant height in forage maize due to application of nitrogen was

Table 1: Growth attributes of black gram as affected by different spacing and fertilizer doses.

Treatments	Plant height(cm)		Number of leaves/plant		Number of branches/plant		LAI		CGR (g/m²/day)	
	28 DAS	42 DAS	28 DAS	35 DAS	28 DAS	42 DAS	28 DAS	35 DAS	28 DAS	42 DAS
Spacing										
S_1 (20×10 cm)	33.23	80.27	8.03	15.48	2.46	3.88	0.73	0.84	0.24	0.64
S_2 (30×10 cm)	31.63	73.95	8.85	16.12	3.00	4.53	0.61	0.73	0.11	0.54
S_3 (45×10 cm)	30.13	71.70	10.28	18.63	3.48	4.78	0.45	0.54	0.10	0.44
SEm ±	0.183	0.139	0.142	0.14	0.203	0.155	0.006	0.007	0.003	0.006
CD (P=0.05)	0.622	0.472	0.483	0.476	0.690	0.527	0.020	0.023	0.010	0.020
Fertilizer doses										
F_0 - Control ($N_0P_0K_0$)	26.11	53.98	7.38	13.16	2.16	3.62	0.52	0.65	0.08	0.42
F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha)	33.09	81.31	9.02	18.04	2.96	4.47	0.62	0.72	0.16	0.54
F_2 ($N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha)	33.78	83.71	10.04	18.29	3.71	4.89	0.62	0.73	0.17	0.58
F_3 ($N_{20}P_{50}K_{30}$)	33.67	82.22	9.78	17.49	3.09	4.62	0.62	0.71	0.18	0.62
SEm ±	0.211	0.161	0.163	0.161	0.234	0.179	0.007	0.008	0.003	0.007
CD (P=0.05)	0.717	0.547	0.554	0.547	0.796	0.609	0.020	0.027	0.010	0.023

DAS- Days after sowing, LAI- Leaf area index, CGR-Crop growth rate

also reported by Gasim (2001).The treatments F_1, F_2 and $F_3(N_{20}P_{50}K_{30})$ were at par with respect to number of branches/ plant and recorded significantly higher values over control treatment F_0. Vairavan (2011) also reported that the number of branches/plant were significantly increased by the application of recommended dose of chemical fertilizers in combination with FYM. LAI was also found to be significantly higher under treatments F_1, F_2 and F_3, which were at par, as compared to control treatment F_0. Significantly higher LAI under fertilizer treatments F_1 and F_2 may be attributed to higher number of leaves and branches recorded under those treatments.The significant rise in growth parameters noticed under higher fertilizer levels may be attributed to greater uptake of nutrients by the plants favouring better cell division, elongation, amino acid and protein synthesis resulting in superior expression of various crop growth attributes compared to unfertilized treatment. Increase in growth parameters under higher fertilizer levels was also reported by Kumar *et al*. (2004). Significantly higher CGR was recorded under the treatment F_3 followed by F_2 and F_1whereas, the lowest CGR was recorded under control treatment F_0 which could be attributed to the superior crop growth observed under the treatments F_1, F_2 and F_3.

Yield attributes and yield: Spacing and fertilizer doses were found to record considerable variations in the yield and yield attributes of the crop (Table-2).The different spacing treatments did not register any significant effect on the number of seeds/ pod and length of pods however, number of pods/plant, test weight and grain and stover yield were significantly affected. Significantly higher number of pods/ plant and the highest grain and stover yield of 730 kg/ha and 1382 kg/ha were recorded under S_2(30×10 cm) which could be due to optimum plant population resulting in reduced competition and higher availibility of growth resources leading to higher growth, development and favourable crop yield. Biswas *et al.* (2002) also reported that a spacing of 30×10 cm showed optimum plant density for maximum seed yield. Kabir and Sarkar (2008) also reported that spacing of 30×10 cm gave the highest number of pods/plant, the highest grain yield and the highest stover yield. The spacing S_3 (45×10 cm) was at par with S_2 with respect to number of pods/ plant and recorded significantly higher stover yields over S_1which could be attributed to significantly higher number of branches and leaves recorded under the treatment S_3. The highest test weight was recorded under treatment S_1 which also recorded significantly higher grain yield compared to S_3. Higher grain yields under narrow spacing S_1 could be due to comparatively higher plant population under the treatment. Shamsi (2010) also reported that increased plant number compensated for decrease of yield components. Harvest index did not register any significant variation across the different spacing tested.The different fertilizer doses also failed to produce any significant effect on number of seeds/pod and pod length however, significant variation on number of pods/plant, test weight, grain and stover yield were recorded. Maximum number of pods/plant, test weight and grain yield of 725 kg/ha were recorded under $F_2(N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha). The highest stover yield of 1362 kg/ha was obtained from $F_3(N_{20}P_{50}K_{30})$ which also recorded significantly higher test weight compared to F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha) and F_0 (control) whereas, F_1 was also found to record significantly higher grain yield over both F_3 and F_0. The lowest number of pods/plant, test weight, grain yield and stover yield were recorded under F_0(control). Superior yield attributes and grain yields obtained under fertilizer doses F_2 and F_1could be due to optimum doses of NPK under those treatments, compared to the rest of the treatments, resulting in higher nutrient availbility and uptake by the crop thereby exhibiting superior yield and yield attributes, rathore *et al.* (2010) also reported significantly higher growth characters, yield attributing traits (number of clusters and pods per plant) and seed and straw yield with application of 100% RDF. Inclusion of organic source i.e., FYM under the treatments F_1 and F_2 may also be attributed for superior grain yields under those treatments.Vairavan (2011) reported that application of recommended dose of NPK in combination with FYM at 5 t/ha recorded higher growth, yield attributes and yield of *rabi* black gram

Table 2: Yield attributes and yield of black gram as affected by different spacing and fertilizer doses.

Treatments	Number of seeds/pod	Pod length(cm)	Number of pods/plant	Test weight(g)	Grain yield(kg/ha)	Stover yield(kg/ha)	Harvest index (%)
Spacing							
S_1 (20×10 cm)	7.52	4.86	80.87	36.16	665	1246	34.83
S_2 (30×10 cm)	7.78	4.85	90.17	34.14	730	1382	34.62
S_3 (45×10 cm)	7.63	4.83	89.58	35.57	579	1295	34.66
SEm ±	0.135	0.1	0.559	0.234	0.127	0.277	0.372
CD (P=0.05)	NS	NS	1.902	0.796	0.432	0.942	NS
Fertilizer doses							
F_0 - Control ($N_0P_0K_0$)	7.62	4.66	72.47	34.13	571	1199	34.34
F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha)	7.67	4.94	87.69	34.51	713	1345	34.68
F_2 ($N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha)	7.76	4.90	96.02	36.65	725	1326	35.33
F_3 ($N_{20}P_{50}K_{30}$)	7.53	4.87	91.31	35.85	625	1362	34.46
SEm ±	0.156	0.121	0.646	0.27	0.147	0.32	0.429
CD (P=0.05)	NS	NS	2.198	0.918	0.500	1.088	NS

compared to other treatment combinations.Significantly higher number of pods/plant and test weight recorded under F_2 and F_3 could be due to increased availibility of N under these treatments. Whereas, significantly higher straw yield obtained under F_3 could be due to higher doses of N and P resulting in pronounced vegetative growth. Hussain *et al.* (1996) also reported that N and P application had significant influence on the straw yield of mung bean cultivars.Harvest index did not register any signification variations among the different fertilizer doses.

Seed and stover nutrient content: Spacing treatments did not have any significant effect on the nitrogen content of both seed and stover though significant variationsin phosphorus content of seed and potassium content of both seed and stover were recorded (Table-3). The phosphorous content in seed was found to be significantly higher in wider spacings $S_2$and S_3, which were at par,compared to narrow spacing S_1. While, in case of potassium content both seed and stover recorded higher potassium content under wider spacings of S_2 and S_3 compared to narrow spacing S_1. Optimum/lower plant densities under wider spacing S_2 and S_3may have resulted in less competition and higher P and K uptake and dry matter accumulation whereas, higher competition for growth resources under narrow spacing S_1 may have resulted in reduced P and K content of seed and stover. Malagi (2008) also reported that wider row spacing resulted in maximum total uptake and content of NPK. The NPK content in seed and stoverwas significantlyhigher under different fertilizer levelscompared to control F_0(Table 3). Significantly higher P and K content in seed was recorded under F_2 and F_3 respectively while, with respect to N content F_1, F_2 and F_3 were at par with each other. In case of stover, the highest N and P content was recorded under F_3 while, K content was highest under F_1. Significantly higher NPK content recorded under F_1, F_2 could be due to optimum fertilizer doses along with enhanced uptake of NPK due to application of FYM. Shrikant *et al.* (2000) also reported increased uptake of NPK due to application of organic matter. Whereas, application of high doses of NPK under F_3 could be attributed for high uptake of nutrients under the treatment.

Soil fertility at harvest: Compared to the control treatment F_0, soil organic carbon and NPK were found to be significantly higher with the application of different fertilizer dosesviz., F_1, F_2 and F_3except for soil pH which did not record any significant variation across the different treatments (Table 4). The highest organic carbon was recorded under the treatment F_2 followed by F_1 while, soil available NPK was found to be significantly higher under

Table 3: Effect of spacing and fertilizer doses on NPK content of seed and stover.

Treatments	Seed			Stover		
	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
Spacing						
S_1 (20×10 cm)	3.35	0.13	1.24	1.93	0.18	2.32
S_2 (30×10 cm)	3.37	0.15	1.61	1.90	0.18	2.36
S_3 (45×10 cm)	3.47	0.15	1.52	1.96	0.17	2.73
SEm ±	0.079	0.004	0.012	0.068	0.005	0.102
CD (P=0.05)	NS	0.013	0.040	NS	NS	0.347
Fertilizer doses						
F_0 - Control ($N_0P_0K_0$)	2.88	0.12	1.26	1.13	0.14	1.85
F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha)	3.61	0.14	1.39	2.09	0.16	2.86
F_2 ($N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha)	3.44	0.16	1.47	1.93	0.20	2.63
F_3 ($N_{20}P_{50}K_{30}$)	3.66	0.14	1.72	2.55	0.20	2.54
SEm ±	0.091	0.004	0.014	0.079	0.005	0.118
CD (P=0.05)	0.309	0.013	0.047	0.268	0.017	0.401

Table 4: Effect of spacing and fertilizer doses on fertility status of the soil after harvest.

Treatments	pH	Organic Carbon (%)	Available N(kg/ha)	Available N(kg/ha)	Available N(kg/ha)
Spacing					
S_1 (20×10 cm)	4.82	1.37	350.19	14.19	245.96
S_2 (30×10 cm)	4.74	1.43	360.64	14.12	248.34
S_3 (45×10 cm)	4.83	1.40	350.19	14.64	244.67
SEm ±	0.024	0.036	10.172	0.243	4.126
CD (P=0.05)	0.081	NS	NS	NS	NS
Fertilizer doses					
F_0 - Control ($N_0P_0K_0$)	4.79	1.23	313.60	13.44	197.44
F_1 ($N_5P_{20}K_{10}$ + FYM@ 10/t ha)	4.79	1.52	369.35	14.53	259.74
F_2 ($N_{10}P_{40}K_{20}$ + FYM@ 5 t/ha)	4.80	1.61	369.35	15.24	263.66
F_3 ($N_{20}P_{50}K_{30}$)	4.81	1.24	362.38	14.64	264.46
SEm ±	0.028	0.041	11.746	0.281	4.764
CD (P=0.05)	NS	0.139	39.966	0.956	16.209

the treatments F_1, F_2 and F_3 as compared to F_0 (control) however, no significant variations were recorded among the three former treatments.Significantly higher soil organic carbon and NPK recorded under F_1 and F_2 could be due to application of FYM under those treatments. The fertility of soil increases if the soil contains more organic matter, application of manures either of plant or animal origin increases organic matter in the soil and thereby the fertility of the soil is increased (Das, 2009). The unfertilized treatment F_0gave the lowest pH, organic carbon and soil NPK due to exclusion of nutrient dose.

CONCLUSION

Based on the findings of the investigation it may be concluded that for optimum growth and seed yield performance of black gram under rainfed conditions, maintaining a wider spacing of 30×10 cm along with application of fertilizer dose of $N_{10}P_{40}K_{20}$ + FYM @5 t/ha is the best management practice to increase the availibility and utilization of nutrients by the crop whereas, for stover yields a higher fertilizer dose of $N_{20}P_{50}K_{30}$ may be used along with a wider spacing of 30×10 cm.

REFERENCES

Bahadur, A. and Singh, K.P. (2005). Optimization of spacing and drip irrigation scheduling in indeterminate tomato. *The Indian Journal of Agricultural Sciences*, **75**: 563-565.

Biswas, D.K., Haque, M.M., Hamid, A., Ahmed, J.U. and Rahman, M.A. (2002). Influence of plant population density on growth and yield of two blackgram varieties. *Journal of Agronomy,* **1**: 83-85.

Das, P.C. (2009). Fertility management of cultivable soils. Manures and fertilizers. Kalyani publishers, New Delhi. pp. 200-202.

Ferdous, A.K.M.(2001). Effects of nitrogen and phosphorus fertilizers on nutrient uptake and productivity of edible-podded pea. M.Sc. Thesis, Department of Agronomy, BSMRAU.

Gasim, S.H. (2001). Effect of nitrogen, phosphorus and seed rate on growth, yield and quality of forage maize (*Zea mays* L.). M.Sc. Thesis, Faculty of Agriculture, University of Khartoum.

Hussain, R., Imtiaz, M., Ahmad, G., Ramzan, M. and Chaudhary, G.A. (1996). Response of mungbean to NP fertilizers under rainfed conditions of Punjab. *Pakistan Journal of Soil Science,* **11**: 95–8.

Kabir, M.H. and Sarkar, M.A.R. (2008). Seed yield of mung bean as affected by variety and plant spacing in Kharif-1 season. *Journal of Bangladesh Agricultural University,* **6**: 239-244.

Kumar, M., Sinha, K.K. and Roysherma, R.P. (2004). Effect of organic manure, NPK and boron application on the productivity of French bean in sandy loam soil of North Bihar. *Indian Journal of Pulse Research,* **17**: 42-44.

Malagi, S.C. (2008). Effect of spacing and fertilizer levels on crop growth and seed yield in lablab bean (*Lablab purpureus* L.). *Karnataka Journal of Agricultural Science,* **21**: 440-443.

Mazumdar, S.N., Moninuzzaman, M., Rahman, S.M.M. and Basak, N.C. (2007). Influence of support systems and spacing on hyacinth bean production in the eastern hilly area of Bangladesh. *Legume Research,* **30**: 1-9.

Rajput, M.J., Alam, S.M. and Mangharher, A.M. (1993). Effect of row spacing on the growth and yield of mung bean. *Pakistan Journal of Agricultural Research,* **14**: 159-161.

Rathore, D.S., Purohit, H.S. and Yadav, B.L. (2010). Integrated phosphorus management on yield and nutrient uptake of urdbean under rainfed conditions of southern Rajasthan. *Journal of Food Legumes,* **23**: 128-131.

Shamsi, K. (2010). The effect of sowing date and row spacing on yield and yield components of Hashem chick pea variety under rainfed condition. *African Journal of Biotechnology*, **9**: 007-011.

Shrikant, K., Shrinivasmurthy, C.A., Siddaramappa, R. and Ramakrishnaparam. (2000). Direct and residual effect of enriched composts, FYM, vermicompost and fertilizers on properties of an alfisol. *Journal of the Indian Society of Soil Sciences,* **48**: 496-499.

Singh, G., Wade, L.J., Singh, B.B., Singh, R.K. and Singh, V.P. (2001). Nutrient management in semi- deep water (30-50 cm) rice (*Oryza sativa)* and its effect on succeeding lentil (*Lens culinaris*) crop. *Indian Journal of Agronomy,* **46**: 12-16.

Vairavan, K. (2011). Integrated nutrient management in *rabi* black gram. *Madras Agricultural Journal,* **98**: 367-369.