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PERFORMANCE OF CLUSTER BEAN GENOTYPES AS INFLUENCED BY CROP GEOMETRY AND FERTILIZER LEVELS

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SUMMARY

A field experiment was conducted at Dryland Research Area, CCS Haryana Agricultural University, Hisar (Haryana), India during rainy season (*Kharif*) of 2018. Two cluster bean genotypes (X-10 and HG 2-20) were grown in two crop geometries (30 cm ×10 cm and 45 cm × 10 cm) at three fertilizer levels (75, 100 and 125 per cent RDF) with split plot design in three replicates to find out the suitable genotype, crop geometry and fertilizer dose for kharif season. Among the genotypes, no significant difference was observed for seed yield. However, the seed yield of HG 2-20 was 6.07 per cent higher over X-10. Maximum B : C ratio (1.16) was fetched in HG 2-20 followed by X-10. Among different crop geometries, highest seed yield (473.9 kg/ha) was recorded at 45 cm × 10 cm which was significantly higher over 30 cm × 10 cm. Maximum B : C ratio (1.17) was fetched with the crop geometry 45 cm × 10 cm which was significantly superior over 30 cm ×10 cm. Among fertilizer levels, highest seed yield (653.76 kg/ha) was recorded with the application of 125 per cent RDF which was on a par with 100 per cent RDF. The seed yield recorded with 125 % RDF was 0.55 and 12.75 per cent higher over 100 and 75 per cent RDF, respectively. However, maximum B : C ratio (1.16) was fetched with the application of 100 per cent RDF which was on a par with 125 per cent RDF. In nutshell, the crop geometry 45 cm × 10 cm and 100 per cent recommended dose of fertilizer (basal application of 40 kg P_2O_5+20 kg N/ha) were found to be suitable for both the genotypes.

Key Words : Cluster bean, crop geometry, fertilizer levels, seed yield, harvest index and economics

Cluster bean (*Cyamopsis tetragonoloba* L.) belonging to family Fabaceae is an important rainy season crop which is popularly known as Guar. Its roots are deep and well developed, mainly cultivated as rainfed crop in arid and semi arid regions during rainy season and is suitable for light to medium textured soils, with no water logging. Cluster bean crop thrives well in rainfall range of 250-450 mm with 3-4 spells, temperature range of 25-40°C, relative humidity values of 50-65 per cent, and longer warmer days with 8-9 hours sunshine, particularly at maturity (Kumar, 2014). It is an arid legume grown for seed, vegetable, green fodder and green manuring etc. It provides nutritional concentrate and fodder for cattle and adds to the fertility of soil by fixing considerable amount of atmospheric nitrogen (Singh and Usha, 2003). It can fix approximately 37-196 kg atmospheric nitrogen per hectare per year in soil. Sometimes it is used in reclamation of saline and alkaline soils (Mahata *et al*., 2009). It is an important commercial crop also, as its seeds are the source of high quality galactomannan gum and its guar meal is rich in protein (40-45%) which is used as animal feed (Panchta *et. al*., 2016). Its gum is used as an emollient, softening agent, flocculent and stabilizer. This gum can also be used in hydraulic fracturing and a wide range of other industries such as production of cosmetics, paper, textiles, detergents and food products (Gresta *et al*., 2014). India is the major producer of the guar gum in the world, enabling its exports to more than 60 countries. India is also the major exporter of guar gum to the world; it exports other forms of Guar products to a large number of countries. The country has exported 5,13,211.91 MT of guar gum to the world for the worth of Rs. 4,707.10 crores during the year 2018-19 (Anonymous 2020). Top five export destinations during 2018-19 were USA, People's Republic of China (PRC), Russia, Norway and Germany.

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Cluster bean is generally cultivated as rainy season (***kharif***) crop in Haryana. The selection of the varieties depends on its earliness, as the crop has to mature and to be harvested timely (Panchta *et. al*., 2017). The selection of suitable genotype, crop geometry (to ensure optimum plant population) and optimum nutrient application has influence on seed yield of cluster bean. The objective of the experiment was to find out suitable genotype, crop geometry and fertilizer dose for cluster bean in *kharif* season.

MATERIALS AND METHODS

The field experiment was conducted during *kharif* 2018 at Dry Land Research Farm, CCS Haryana Agricultural University, Hisar, (Haryana, India) (29° 10' N of 75° 46' E, at an average elevation of 215.2 m above mean sea level). The site experiences semi-arid and sub-tropical climate with hot dry summer and severe cold winter. Average annual rainfall was about 450 mm, 75 % of which is received in three months (July to September) during the south-west monsoon. Figure 1 represents the weekly weather parameters *i.e.* temperature (^{o}C), relative humidity (%) and rainfall (mm) during the study. The soil of the experimental field was loamy sand in texture, slightly alkaline in reaction (pH 7.5), low in available nitrogen (124.8 kg/ha), medium in available phosphorus (11.0 kg/ha) and medium in potassium (195.5 kg/ha). The experiment was laid out in split plot design with two genotypes (X-10 and HG 2-20) and two crop geometries (30 cm × 10 cm and 45 cm × 10 cm) in main plot and three fertilizer levels in sub-plot (75%, 100% and 125% RDF) in three replicates. As per treatment, full dose of phosphorus and nitrogen was applied at the time of sowing. The 100 per cent recommended dose of fertilizer (RDF) was 40 kg P_2O_5/ha + 20 kg N/ha. Diammonium phosphate (DAP) and urea fertilizers were used as a source of P_2O_5 and N nutrients, respectively. The sowing was manually on 5 July 2018. All the other standard agronomic practices were followed uniformly in all the treatments as per the package of practices for *kharif* crops of CCS Haryana Agricultural University, Hisar, India (Anonymous, 2013). Harvest index was calculated by dividing economic yield (seed yield in kg) by biological yield (kg). Economics was worked out based on the prevailing market prices of inputs and outputs in the local market. Benefit : Cost (B C ratio) was worked out by dividing gross returns (Rs./ha) by cost of cultivation (Rs./ha). Data were analyzed by using OPSTAT software available at CCS Haryana Agricultural University website (Sheoran *et. al*., 1998). The results are presented at five per cent level of significance (P=0.05) for making comparison between treatments.

RESULTS AND DISCUSSION

Genotypes : Among genotypes the higher plant stand/m row length was recorded in X-10, which was significantly higher over HG 2-20 (Table 1). However, significantly higher number of branches/plant, pods/plant and 1000-seed weight were recorded

TABLE 1

Performance of cluster bean genotypes at different crop geometries and fertilizer levels during ***kharif*** 2018

Genotypes	Plant stand/mrl	Plant height (cm)	No of branches/ plant	No of pods/ plant	Seed/ pod	1000-seed weight (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
X-10	11.17	100.46	5.67	32.61	6.02	19.40	609.43	2207.02	21.69
HG 2-20	10.57	100.96	6.28	35.65	6.17	19.86	646.43	2234.71	22.46
S. Em±	0.17	1.72	0.08	0.42	0.13	0.08	11.64	52.04	0.35
C. D. (P=0.05)	0.58	NS	0.27	1.44	NS	0.29	NS	NS	NS
Crop geometries									
30 cm × 10 cm	10.83	101.12	5.52	32.43	5.33	19.28	595.34	2151.71	21.70
45 cm × 10 cm	10.91	100.32	6.43	35.83	6.85	19.98	660.53	2290.02	22.45
S. Em±	0.17	1.72	0.08	0.42	0.13	0.08	11.64	52.04	0.35
C. D. (P=0.05)	NS	NS	0.27	1.44	0.43	0.29	40.16	NS	NS
Fertilizer Levels									
75% RDF	10.08	96.56	5.56	32.03	5.64	19.35	579.84	2087.74	21.76
100% RDF	11.11	99.31	5.92	34.67	6.17	19.63	650.21	2226.87	22.59
125% RDF	11.42	106.28	6.44	35.69	6.47	19.91	653.76	2347.99	21.88
S. Em±	0.30	1.72	0.08	0.56	0.17	0.13	12.85	51.52	0.62
C. D. (P=0.05)	0.89	5.16	0.25	1.68	0.52	0.39	38.52	154.48	NS

TABLE 2

Economics of cluster bean genotypes at different crop geometries and fertilizer levels during ***kharif*** 2018

Genotypes	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit : Cost
X-10	25624.84	27457.08	1832.24	1.07
HG 2-20	25624.84	28858.37	3877.70	1.16
C. D. (P=0.05)	-	NS	1700.64	0.07
Crop geometries				
30 cm × 10 cm	25624.84	26811.38	1508.63	1.06
45 cm × 10 cm	24980.67	29504.06	4201.31	1.17
C. D. (P=0.05)	-	1700.77	1700.64	0.07
Fertilizer Levels				
75% RDF	24801.45	26093.47	1292.02	1.05
100% RDF	25302.76	28974.54	3671.78	1.15
125% RDF	25804.06	29405.17	3601.11	1.14
C. D. (P=0.05)	-	1272.73	1272.73	0.05

in HG 2-20 as compared to X-10. Whereas, plant height, seeds/pod and seed yield were not affected significantly by the genotypes. The differential behavior of these genotypes could be explained solely by variation in their genetic constituent (Meena *et al.*, 2014). No significant difference was observed among genotypes in respect of gross returns. However, significantly higher net returns (Rs. 3877.70/ha) and benefit cost ratio (1.16) was recorded in HG 2-20 as compared to X-10 (Table 2).

Crop geometry : Higher number of branches/ plant, pods/plant, seeds/pod, 1000-seed weight and seed yield were recorded with crop geometry of 45 cm × 10 cm as compared to that with 30 cm × 10 cm (Table 1). However, plant stand/m row length and plant height were not affected significantly among crop geometries. Both the genotypes being the branched genotypes performed better at 45 cm row to row

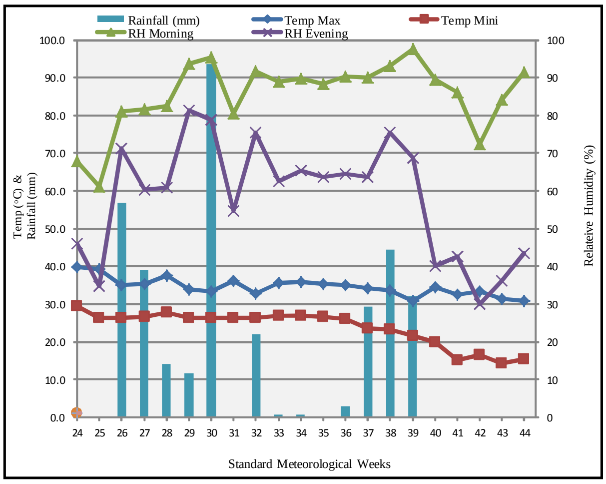

Fig. 1. Weekly weather parameters during the crop season.

spacing. Satpal *et al*. (2018) also reported significantly higher seed yield of cluster bean sown at 45 cm row to row spacing than that of 30 cm and 22.5 cm. Significantly higher gross returns, net returns and benefit cost ratio were recorded with crop geometry 45 cm × 10 cm than 30 cm × 10 cm (Table 2).

Fertilizer levels : Among fertilizer levels, significantly highest plant height and number of branches/plant were recorded with 125% RDF (Table 1). Highest plant stand/mrl, no. of pods/plant, seeds/ pod, 1000 seed weight, seed yield and straw yields were also recorded with 125% RDF but were on a par with 100% RDF. The seed yield of guar recorded with the application of 125 % RDF was 0.55 and 12.75 per cent higher over 100 and 75 per cent RDF, respectively. Similarly the straw yield recorded with the application of 125 % RDF was 5.44 and 12.47 per cent higher over 100 and 75 per cent RDF, respectively. Result agreed with the finding of Anuradha *et al*., (2017). Significantly highest gross returns were observed with 125% RDF which was on a par with 100% RDF. However, highest net returns and benefit cost ratio (Rs. 3671.78/ha and 1.15, respectively) were observed with 100% RDF which were on a par 125% RDF (Table 2). This clearly indicate that 100% RDF (40 kg P_2O_5/ ha + 20 kg N/ha) was the economic optimum dose for cluster bean. The seed yield response to fertilizer application has been represented in figure 2 which clearly indicate that 100% RDF was the optimum fertilizer dose for cluster bean.

Interaction effect : Interaction between genotypes × crop geometries, genotypes × fertilizer levels, crop geometries × fertilizer levels and

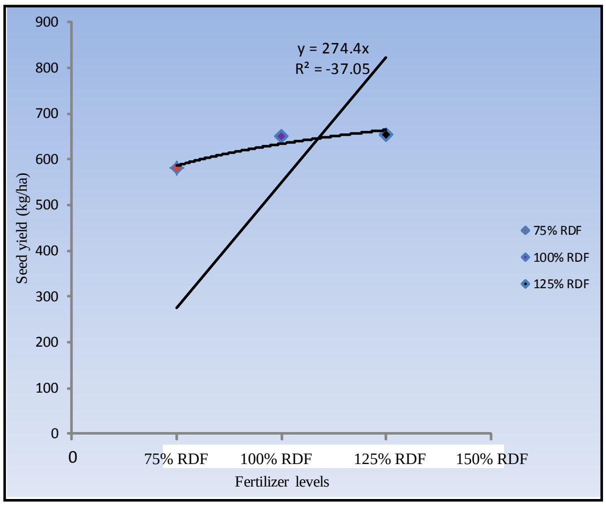

Fig. 2. Yield response to fertilizer application.

genotypes × crop geometries × fertilizer levels was found to be non-significant for seed yield.

CONCLUSION

The performance of the genotype HG 2-20 was on a par with X-10 in terms of seed yield. The crop geometry 45 cm × 10 cm and 100 per cent recommended dose of fertilizer (basal application of 40 kg P_2O_5/ha + 20 kg N/ha) were found to be suitable for both the genotypes.

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