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Evaluation of Clusterbean (*Cyamopsis tetragonoloba* L.) Varieties for Koshi Region of Bihar

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ABSTRACT

Background: Field experiment was conducted under In-house Project of the University during *kharif* seasons of 2015 and 2017 for evaluation of clusterbean varieties for *Koshi* Region of Bihar.

Methods: The experiment was conducted by using randomized complete block design with three replications. Observations were recorded on different agronomic parameters including, plant height, dry matter accumulation, days to maturity, number of pods per plant, number of grains per pod, test weight, grain yield, biological yield and harvest index. Economics of crop was also calculated to find out the economic feasibility for the farmers.

Result: Result revealed that the significantly taller plants along with higher dry matter accumulation was observed under clusterbean variety Bundel Guar-2 (BG-2). Clusterbean variety Gujarat Guar-2 (GG-2) taken least number of days to maturity, however, highest number of days to maturity was taken by RGC-986 and BG-1. Significantly higher number of pods per plant was observed under RGC-1033. HG-365 resulted into significantly higher number of grains per pod and BG-1 recorded significantly higher test weight. RGC-1033 proved significantly better in terms of grain yield, harvest index and net returns. In terms of stover and biological yield BG-2 proved significantly superior.

Key words: Clusterbean, Economics, Guar, Varieties, Yield.

INTRODUCTION

Clusterbean or guar (*Cyamopsis tetragonoloba*) is an important cash crop in rainfed, especially in semi-arid and arid regions of India. This crop is drought tolerant, warm weather and deep rooted annual legume. It grows well in soils of low fertility in the arid and semi arid areas of the tropics and subtropics. India alone contributes more than 80% of global guar production followed by 15% in Pakistan. Its cultivation in India is concentrated to north-western states namely Rajasthan, Gujarat, Haryana and Punjab. Rajasthan is the leading state in terms of area and production of clusterbean in India. In India this crop covers an area of 3.47 million hectares with an annual production of 1.31 million tonnes and productivity of 378 kg/ha (GOI 2020). Guar (cluster bean) was grown in India indigenously as fodder, feed, food and cover crops mainly in complex, diverse, risky and under-invested rainfed (arid and semi-arid) regions. Clusterbean is grown for different purposes, such as vegetables, green fodder, green manure and seed. It is also used in oil wells, mining industries, explosives and other industrial applications (Undersander *et al*., 2006). On the other hand, guar is considered as an excellent soil improvement crop, like other legumes, with respect to available nitrogen which improve yield of succeeding crops.

This crop is mainly grown for production of gum. Clusterbean have a large endosperm that contains galactomannon gum, a substance which forms a gel in water and is known as guar gum having main commercial value. Approximately 90% of total guar produce is used for production of commercial guar gum and rest is used for culinary purposes and cattle feed etc. It has been estimated that on the whole-seed basis, guar seed contains about 30.7% gum. Larger use of guar gum derivatives in drilling and exploration of shale gas created upheaval in volatility of its global prices and future trading after 2011. As a consequence, there has been a 75% jump in exports from India (Grestaa *et al.* 2013). Among all the agricultural export commodities, guar has become the highest foreign exchange earner of ₹ 212.87 billions followed by Basmati rice during the year of 2012-13. About 81.2% of guar products export value was earned from USA followed from China (6.4%) and Germany (1.7%). Today Guar is one of the significant foreign exchange earners of the country. The export value of guar products, mainly guar gum in 2011-12 and 2012-13 jumped by 5.62 and 1.29 times over the previous years (GOI 2018). In Bihar, it is commonly grown for fodder and seeds to feed the cattle. Although cluster bean is a minor crop in Bihar but due to its better and finer guar gum qualities, it is considered as an important cash crop under changing climate scenario for industrial gum

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production and for several pharmaceutical and nutraceutical products. Considering the importance of cluster bean, there is prime need for its popularization. Despite of huge scope of its cultivation in Bihar state, no work has been done for evaluation of suitable cultivars for the state. By keeping these facts in view, the present project has been formulated to introduce this crop in Koshi region of Bihar for imparting sustainability in the production system especially where rice-wheat and rice-maize cropping systems are predominant.

MATERIALS AND METHODS

A field experiment was conducted at Research Farm of Regional Research Sub-Station, Jalalgarh (Bihar) during *kharif* seasons of 2015 and 2017 under In-house project "Identification of suitable varieties of clusterbean for Koshi region of Bihar". The experiment consisted of nineteen varieties of clusterbean (M-83, RGr-12-1, RGC-471, RGC-936, RGC-986, RGC-1002, RGC-1003, RGC-1017, RGC-1031, RGC-1033, RGC-1038, RGC-1055, HG-2-20, HG-365, HG-563, Bundel Guar-1, Bundel Guar-2, Gujarat Guar-1 and Gujarat Guar-2) collected from different State Agricultural Universities and ICAR Institutions of India. The experiment was laid out in randomized block design with three replications. A common dose of 20 kg N, 40 kg P_2O_5, 40 kg K_2O and 5.0 kg Zn/ha were applied as basal dose at the time of sowing. The crop was sown at 30 x 10 cm spacing using seed rate of 20 kg/ha. The crop was grown with recommended package of practices (Singh *et al.* 2020).

Five plants were selected randomly from each plot, tagged permanently and used for measurement of plant height and yield attributes. Dry matter accumulation was measured from the randomly selected five plants from each plot. The samples were first air dried for some days and then dried in oven at 65°C till constant weight. Ten pods from each plot were selected to count number of grains per pod. A random sample of grain was taken from the produce of the net plot to measure 1,000-grains weight. The weight of the thoroughly sun-dried harvested produce from net area of each plot was recorded separately before threshing for total biomass yield. After proper drying harvested produce were threshed separately and weighed for grain yield. Economics of different treatments were worked out by taking into account the cost of inputs and income obtained from output based on the prevailing market price. Statistical analysis of the data was carried out using standard analysis of variance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth parameters

Growth parameters of clusterbean *viz*., plant height, dry matter accumulation and days taken to maturity were significantly varied among different varieties of crop (Table 1). Fodder type clusterbean variety Bundel Guar 2 (BG 2) produced significantly taller plant (166.2 cm) than the other varieties used for evaluation. However, the significantly lowest plant height was recorded under clusterbean variety

Table 1: Growth parameters and yield attributes of different clusterbean verities in Koshi region of Bihar (Pooled data of two years).

Variety	Plant height (cm)	Dry matter accumulation (g/plant)	Days to maturity	Number of pods per plant	Number of grains per pod	Test weight (g)
V_1 = M 83	96.0	19.36	123	26.3	5.10	35.1
V_2 = RGr 12-1	124.3	22.80	123	37.0	6.00	36.0
V_3 = RGC 471	140.0	25.57	130	32.6	5.53	35.2
V_4 = RGC 936	131.0	21.56	123	30.1	5.91	31.7
V_5 = RGC 986	135.2	27.97	130	30.6	5.82	36.2
V_6 = RGC 1002	138.5	26.91	123	33.3	6.21	36.3
V_7 = RGC 1003	131.9	23.33	122	35.5	6.20	33.5
V_8 = RGC 1017	136.0	22.68	123	33.8	5.58	35.3
V_9 = RGC 1031	148.3	29.05	128	35.5	6.08	35.0
V_{10} = RGC 1033	138.7	26.16	122	40.0	6.42	35.2
V_{11} = RGC 1038	128.0	23.96	122	38.7	5.86	33.5
V_{12} = RGC 1055	123.8	29.41	123	36.7	6.09	34.0
V_{13} = HG 2-20	133.7	30.13	122	37.8	6.29	34.9
V_{14} = HG 365	138.5	26.21	122	37.8	6.59	34.7
V_{15} = HG 563	134.8	23.73	121	44.8	5.85	34.0
V_{16} = BG 1	145.7	31.59	132	26.6	5.81	37.8
V_{17} = BG 2	166.2	32.27	130	30.7	5.72	35.1
V_{18} = GG 1	145.2	26.50	121	33.2	5.72	36.1
V_{19} = GG 2	128.2	24.10	121	32.2	6.22	36.7
SEm±	4.36	1.73	0.23	2.74	0.26	0.19
LSD (P=0.05)	12.30	4.89	0.65	7.71	0.73	0.54

Table 2: Yield and economics of different clusterbean verities in Koshi region of Bihar (Pooled data of two years).

Variety	Grain yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Net returns (₹/ha)	B:C ratio
V_1 = M 83	818	4516	18.3	3823	0.15
V_2 = RGr 12-1	1829	6879	26.9	40283	1.57
V_3 = RGC 471	1580	8015	19.7	31252	1.22
V_4 = RGC 936	1330	6157	21.6	22250	0.87
V_5 = RGC 986	1380	7920	17.6	24071	0.94
V_6 = RGC 1002	1624	6922	23.3	32816	1.28
V_7 = RGC 1003	1634	6162	26.5	33165	1.29
V_8 = RGC 1017	1591	6965	23.2	31704	1.23
V_9 = RGC 1031	1740	7864	22.1	37033	1.44
V_{10} = RGC 1033	2279	7808	29.1	56370	2.20
V_{11} = RGC 1038	1525	5993	25.5	29343	1.14
V_{12} = RGC 1055	1779	7898	22.7	38454	1.50
V_{13} = HG 2-20	2125	8276	25.7	50876	1.98
V_{14} = HG 365	2039	6907	29.3	47692	1.86
V_{15} = HG 563	1969	6864	28.7	45533	1.77
V_{16} = BG 1	1181	8450	14.0	16826	0.66
V_{17} = BG 2	1474	9816	15.1	27537	1.07
V_{18} = GG 1	1712	8171	20.9	36023	1.40
V_{19} = GG 2	1578	6473	24.4	31284	1.22
SEm±	97.5	388.0	0.55	3495	0.14
LSD (P=0.05)	274.8	1093.8	1.54	9852	0.39

Note: Cost of cultivation was ₹ 25785/ha.

M 83. The another fodder type variety *i.e*. Bundel Guar 2 (BG 2) produced significantly higher dry matter accumulation (32.27 g/plant) over other varieties of clusterbean except Bundel Guar 1, HG 2-20, RGC 1055, RGC 1031 and RGC 986. Clusterbean varieties namely HG 563, Gujarat Guar-1 and Gujarat Guar-2 taken significantly least number of days to maturity as compared to other varieties grown under experiment, whereas, significantly maximum number of days to maturity was taken by Bundel Guar 1 (BG 1). The significance difference in different growth parameters between different varieties might be due variation in genetic makeup and differential behaviour under different climatic conditions. The results of the present study are in the close conformity with the findings of Garg *et al.* (2003), Kumar *et al.* (2018), Muniswamy *et al.* (2022) and Patel *et al.* (2022).

Yield attributes and yield

Performance of different clusterbean varieties were also differed significantly in terms of yield attributes and yield (Table 1 and 2). Clusterbean variety HG 563 being at par with RGC 1033, RGC 1038, HG 2-20 and HG 365 and recorded significantly higher number of pods per plant (44.8) over rest of the varieties. Significantly higher number of grains per pod (6.59) was recorded under HG 365 over RGC 1038, HG 563, RGC 986, BG 1, GG 1, BG 2, RGC 1017, RGC 471 and M 83. However, fodder type variety of clusterbean BG 1 produced significantly bolder grains along with test weight of 37.8 g as compared to all other varieties used for evaluation. Whereas, significantly smaller grains with test weight of 31.7 g was produced by RGC 936. As like growth parameters yield attributes were also varied significantly between different varieties of clusterbean could be attributed due to variation in genetic makeup and differential environmental behaviour. The findings of Meena *et al.* (2016), Muthuselvi *et al.* (2018), Muniswamy *et al.* (2022) and Teja *et al.* (2022) support the results of the present study.

Clusterbean variety RGC 1033 produced significantly higher grain yield of 2279 kg/ha over all other varieties except HG 2-20 and HG 365. With respect to total biomass/ biological yield, fodder type variety of clusterbean i.e. Bundel Guar 2 (BG 2) proved significantly better over all other varieties grown for evaluation. It produced 9816 kg/ha total biomass yield. However, HG 365 recorded significantly higher Harvest Index (29.3%) followed by RGC 1033 (29.1%) and HG 563 (28.7%) over the remaining varieties. The significant improvement in grain and biological yield under particular variety is might be due to higher value of growth parameters and yield attributes under respective variety. Similar findings were also reported by Reddy *et al.* (2017), Rajamanickam (2019), Muniswamy *et al.* (2022), Patel *et al.* (2022) and Teja *et al.* (2022).

Economics

Economics of clusterbean crop was also varied significantly between different varieties tested for evaluation under present study (Table 2). Wherein, clusterbean variety RGC 1033 fetched significantly higher net returns of ₹ 56370/ha

followed by HG 2-20 (₹ 50876/ha) and HG 365 (₹ 47692/ha) as compared to all other varieties tested for evaluation. Similarly, RGC 1033 gave significantly higher B:C ratio (2.20) followed by HG 2-20 (1.98) and HG 365 (1.86) over the rest of the varieties. Higher net returns under particular variety might be due to more returns from higher grain yield as compared to cost involved for production. Results of the present study corroborate with the findings of Priyadarshini *et al.* (2017) and Rajamanickam (2019).

CONCLUSION

On the basis of two years study, it can be inferred that clusterbean variety RGC 1033 proved significantly better in terms of growth, yield and economics followed by HG 2-20 for *Koshi* region of Bihar. Therefore, clusterbean varieties RGC 1033 and HG 2-20 can be recommended for inclusion under package of practices for farmers of Koshi region of Bihar.

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