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Examine how clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.) branching habit and bearing pattern are inherited.

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Research Article

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Abstract

The goal of the current research was to determine how two traits—branching behaviour and bearing pattern—were inherited in the F₂ segregating population of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]. F₁ seeds from three distinct crossings and clusterbean parents, namely F₅ × RGC-1066, PNB × CAZG-16-10-3, and IDB-29-2 × BSL (11×15), comprised the original experimental material. The segregating progenies were grown at a distance of 20 cm between plants and 50 cm between rows. Every F₂ segregating plant in a cross was tagged, and observations were made on a regular basis until the phenotype was confirmed. The chi square approach was used in the statistical study to determine the genetic ratio's goodness of fit for the various gene actions implicated in these segregating populations. In two segregating F₂ populations, PNB × CAZG-16-10-3 (9:6:1) showed polymeric gene action, F₅ × RGC-1066 (9:3:4) showed supplementary gene action, and IDB-29-2 × BSL (3:1) showed branching and bearing pattern controlled by one pair of genes with monogenic inheritance, according to the current study.

Key words:

Clusterbean, population segregation, Chi-square technique, monogenic inheritance, polymeric gene action, and supplementary gene action.

Introduction

Guar (*Cyamopsis tetragonoloba* L.), a warm-season legume crop with a deep, well-developed root system that can withstand drought, is mostly grown as a rain-fed crop in arid and semi-arid regions. Guar has historically been used in agriculture as a green manure crop, vegetable, and animal feed. It needs less agronomic input and may be grown on marginal and impoverished terrain. It can fix nitrogen symbiotically since it is a grain legume. As a result, it may naturally and economically enhance the quality of the soil, which will increase the production of succeeding crops. Despite being a small crop, cluster beans are regarded as a significant income crop for industrial gum production because of their superior and finer guar gum properties (Hymowitz & Motlock 1963; Sharma & Gummagolmath 2012; Pathak & Singh 2010). Guar gum is used in agriculture as an anticrusting agent, soil aggregate, and water retainer. Additionally, guar gum is more useful for controlling pollution and serves as an absorbent, flocculating, and exchanging agent in the textile industry's waste water treatment (Mahalonobis 1936). The germ (43–47%), endosperm (35–42%), and seed coat (14–17%) make up a mature clusterbean seed. Galactomannan, often known as gaur gum, is a very viscous, water-soluble hetero-ysaccharide with a 1:2 galactose to mannose ratio that makes about 80–90% of the endosperm. Protein, carbohydrates, vitamins A and C, and essential minerals like calcium and iron may all be found in young pods (Kumar & Singh 2002). Due to its cleistogamous character, the crop is thought to be exclusively self-pollinating;

yet, reports of outcrossing have ranged from 0.5 to 7.9% (Sainiet al. 1981). In order to improve certain qualities in plants, it is crucial to understand how traits are inherited. This enables the well-adapted varieties with increased production potential to effectively incorporate inherited favourable features. This research looks at how the two qualitative traits of branching and bearing behaviour are inherited in cluster beans.

Materials and Methods

The guar improvement project carried out at the ICAR-CAZRI, Jodhpur, supplied the F1 seeds of three distinct crossings and the parents of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub], namely F5 × RGC-1066, PNB × CAZG-16-10-3, and IDB-29-2 × BSL (11X15). In order to examine branching and bearing patterns, the segregating progenies were cultivated at 50 cm row to row and 20 cm plant to plant spacing. Every F2 segregating plant in a cross was tagged, and observations were made on a regular basis until the phenotype was confirmed.

Statistical analysis:

Chi-square method was used as per Singh and Chaudhary (1977) to test the goodness of fit for segregating ratios observed for branching and bearing pattern in Guar. The chi square statistic is defined

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where, O_i is the observed number of cases in category i , and E_i is the expected number of cases in category i .

Results and Discussion PNB × CAZG-16-10-3

In a hybrid between PNB and CAZG-16-10-3, the parent CAZG-16-10-3 is branching (bushy) in nature, while the parent PNB is single stem and regular in bearing. In the F2 segregating population, 58 plants were identified as single stem, 38 as branched, and 8 as basal, indicating a gene interaction ratio of 9:6:1 for single stem, branched, and basal plants. All F1 plants of the hybrid possessed single stem regular traits. The goodness-of-fit χ^2 test yielded a value of 0.36 with a probability of 0.8-0.9 (Table 1). This indicated that two gene pairs were segregating with polymeric gene effects, in which the production of a single stem (unbranched) characteristic requires both genes in dominant form.

1. Chi-square analysis of F₂ segregating population of a cross PNB × CAZG-16-10-3

PNB × CAZG-16-10-3		O_i	E_i	$O_i - E_i$	$(O_i - E_i)^2$	$(O_i - E_i)^2/E_i$
Basal	8	58	58.5	-0.5	2.25	0.34
	104				χ^2	0.369
Single stem		58	58.5	-0.5	P	0.25
Branched		38	39	-1	1	0.025

#Expected ratio 9:6:1, non allelic gene interaction, polymeric gene effect

IDB-29-2 × BSL

In the cross IDB-29-2 × BSL, parent IDB-29-2 has a single stem with regular bearing, whereas parent BSL only has branches on the basal nodes, leaving the upper portion branchless and exhibiting regular podding. This cross's F1 plants were all confirmed to be single stem regular. A single stem characteristic exhibited dominant behaviour over the basal trait in F1. Forty plants showed basal branching, whereas 130 plants in the F2 group were found to be single stem regular. Simple Mendelian monogenic inheritance seems to govern traits. A good match of ratios in the 3:1 segregation pattern for single stem regular and basal plants with a probability of 0.5-0.7 was found using a goodness-of-fit test (Table 2). It seems that a single stem was dominant and inherited in a monogenic manner.

Table 2. Chi-square analysis of F₂ segregating population of a cross IDB-29-2 × BSL

IDB-29-2 × BSL	O _i	E _i	O _i - E _i	(O _i -E _i) ²	(O _i -E _i) ² /E _i
Single stem	130	127.5	2.5	6.25	0.049
Basal	40	42.5	-2.5	6.25	0.147
Total	170			X ²	0.196
				P	0.5-0.7

#Expected ratio 3:1 Allelic gene interaction, monogenic

Cross F5 × RGC-1066

Parents F5 RGC-1066 were used to create an F2 population, with parent F5 having a branching characteristic and parent RGC-1066 having an intermittent single stem. A total of 85 plants were found to be branching, 32 to be single-stemmed, and 46 to be basal in a segregating population of this hybrid. The chi-square test found a ratio of 9:3:4 for branching, single stem, and basal (Table 3). This indicated that there is an additional gene impact when two gene pairs interact.

Table 3. Chi-square analysis of F₂ segregating population of a cross F5 × RGC-1066

F5 × RGC-1066	O _i	E _i	O _i - E _i	(O _i -E _i) ²	(O _i -E _i) ² /E _i
Branched	85	91.68	-6.68	44.62	0.48
Single stem	32	30.56	1.44	2.07	0.067
Basal	46	40.75	5.25	27.56	0.67
	163			X ²	1.217
				P	0.5-0.7

#Expected ratio 9:3:4, supplementary gene effect

Conclusion

For the F₂ population of clusterbeans, the inheritance of two characteristics—branching behaviour and bearing habit—was examined. In three segregating F₂ populations, PNB × CAZG-16-10-3 (9:6:1), F5 × RGC-1066 (9:3:4), and IDB-29-2 × BSL branching pattern, these features were governed by two pairs of genes that showed monogenic inheritance. These characteristics had a complicated inheritance pattern and were governed by a main gene. Additionally, additional crosses involving other parents and the following generation of segregation should be confirmed.

Reference

- Boghara MC, Patel NJ, Parekh MJ, Kumar S, Dhaduk HL, and Sharma R. 2016. Cluster bean (*Cyamopsis tetragonoloba* L. Taub.) genetic divergence, route analysis, and molecular diversity analysis. *Industrial crops and products*, 89: 468-477.
- Matlock RS & Hymowitz T. 1963. Oklahoma Agricultural Experiment Station Technical Bulletin, Guar in the United States. 611: 1-34.
- Mahalanobis PC. 1936. Regarding the statistical generalised distance. *National Institute of Science, India, Proceedings*. 2: 49-55.
- Singh M. & Pathak R. 2010. Genetic divergence in rainfed clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.) for gum content and seed productivity, *Indian J. Agricultural Science*, 79 (7):559-561.
- Saini ML, Paroda RS, and Arora RN. 1981. Three *Cyamopsis* species' morphologies. *Guar Newsl.* 2, 7-11.
- Gummagolmath and Sharma P. 2012. Guar sector reform in India: challenges and solutions. 25: 37-48; *Agric. Econ. Res. Rev.*