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ASSESSMENT OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN RIDGE GOURD (*LUFFA ACUTANGULA* L. ROXB.) GENOTYPES

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ABSTRACT

Genetic variability and heritability of different characters were studied in ridge gourd (*Luffa acutangula* L.) with 38 genotypes. High degree of variation was observed with respect to all the characters studied. The estimates of genotypic coefficient of variation were low as compared to phenotypic coefficient of variation for all the characters under study. The highest GCV and PCV was observed for number of fruits per vine, average fruit weight, fruit length and fruit yield per vine. High heritability coupled with high genetic advance as percent over mean was observed for sex ratio, number of fruits per vine, average fruit weight, fruit length, fruit diameter and fruit yield per vine, indicating greater scope of improvement through selection.

***Keywords* :** Ridge gourd, variability, heritability, fruits, vine

Introduction

Cucurbits constitute a significant and extensive category of vegetable crops, among which Ridge gourd [*Luffa acutangula* (Roxb.) L.], 2n=2x=26, emerges as a crucial vegetable originating from the old world in the subtropical Asian region, specifically India (Kalloo, 1993). India is renowned for producing 340 million tons of vegetables across 28.3 million hectares, making it the second-largest vegetable producer globally. Ridge gourd cultivation in India spans 9,920 hectares, yielding approximately 317,000 tons with an average productivity of 31.95 tons per hectare (Anon., 2022a). In Karnataka, ridge gourd cultivation covers 4,200 hectares, yielding approximately 38,882 tons with a productivity rate of 9.26 tons per hectare in the state (Anon., 2022b). The term "Luff" or "Loofah" has its roots in Arabic and is used to describe the sponge-like texture of the mature fruit. In India, there are seven out of the nine known species of Luffa, namely *Luffa acutangula* (L.) Roxb, *L. cylindrica* M. Roem, *L. echinta* Roxb., *L. graveolens*, *L. tuberose* Roxb., and *L.umbellata.* As a warm-season crop, it can withstand higher temperatures, making it ideal for extensive cultivation across tropical regions. Ridge gourd fruit is rich in essential nutrients and is an excellent source of calcium, phosphorus, vitamin C, iron and fiber (Aykroyd, 1963). As a low-calorie vegetable, it is considered beneficial for individuals with diabetes (Pullaiah, 2006) . Ayurveda also highlights numerous properties associated with it, such as enhancing the immune system, acting as an antioxidant, regulating blood sugar levels, promoting diuresis, purifying the blood and serving as a remedy for jaundice (Manikandaselvi *et al*., 2016) . This versatile vegetable is commonly called as kalitori and is also known by various other names such as angled gourd, angled loofah, chinese okra, silky gourd and ribbed gourd (Chakravarthy, 1959) .

The cultivation of these versatile and nutritious food crops is crucial in addressing issues related to malnutrition and food insecurity. This objective can be accomplished through intensive breeding programmes. Breeding programmes rely on understanding key traits, the genetic systems governing their inheritance and the genetic and environmental factors that affect their expression (Dubey *et al*., 2013a). The crop improvement programmes success and the effectiveness of selection rely highly on the level of genetic variability within the population, the extent to which desirable traits can be passed on (Golani *et al*., 2007) and the anticipated genetic gain for a specific trait within the population. Hence, understanding the extent of variability and the degree of heritability of key traits present in the available germplasm is crucial. The extensive genetic variability among existing ridge gourd accessions provides plant breeders with valuable genetic resources. This diversity enables the development of new gene combinations and the selection of cultivars that are better suited to different agricultural environments (Glaszmann *et al*., 2010).

Materials and Methods

The experiment was carried out at the field of Vegetable Farm, College of Horticulture, Bagalkot, during the rabi-summer season of the year 2023-24. The experiment was laid out in Randomized Block Design, with 38 genotypes in two replications. Ten plants per replication were raised. Two-week-old seedlings were planted at 2m x 1m spacing. Recommended agronomic practices were applied to the crop. Observations were recorded on five randomly-selected plants in each replication on 13 quantitative traits (vine length at final harvest (cm), number of primary branches per plant at final harvest, days to appearance of first male flower, days to appearance of first female flower, node to first male flower, node to first female flower, days taken to first harvest, sex ratio, number of fruits per vine, average fruit weight (g), fruit length (cm), fruit diameter (cm) and fruit yield per vine (kg/ vine).

Biometrical analysis

- ANOVA was performed following the guidelines established by Panse and Sukhatme (1967), using the average values of different characteristics in every replication within all treatments to assess the importance of treatment effects.
- The genotypic and phenotypic coefficient of variations was determined in accordance with the method established by Burton and Devane in 1953.
- The calculation of broad-sense heritability, extent of genetic advance and genetic advance as percent over mean for each character was determined by using the formula as proposed by Johnson *et al.* (1955).

Results and Discussion

The examination of variance demonstrated the existence of highly significant variations among the genotypes for all the characters, pointing to a substantial degree of variation within these genotypes. In this study, the Phenotypic Coefficient of Variation (PCV) was higher than Genotypic Coefficient of Variation (GCV) for all the examined traits indicating that the variation in the genotypes is not only due to the genetic makeup of the plant but also due to the influence of environment.

Growth parameters taken in this study includes vine length and primary branches at final harvest. Both the parameters showed moderate GCV and PCV with high heritability (Table 1). Whereas genetic advance as per cent of mean was high for both vine length and number of primary branches among the ridge gourd genotypes. These results are in line with the findings of Koppad *et al.* (2015) , Methela *et al.* (2019) , Madhuri *et al*. (2022) , Panda *et al*. (2022) and Yadav and Singh (2022) in ridge gourd. Moderate GCV and PCV with high heritability and GAM reported in these traits indicates that, it is controlled by both additive and non-additive gene actions for which the recurrent selection for improvement of these characters would be rewarding.

Low GCV and PCV was observed for the characters days to appearance of first male flower and days to appearance of first female flower. The obtained results are in line with the findings of Koppad *et al.* (2015), Methela *et al.* (2019), Akhila and Devi singh (2020), Sravani *et al.* (2021), Durga *et al.* (2021) and Thulasiram *et al.* (2022). Lower GCV and PCV values indicated the narrow genetic base among the traits. The characters like node at first male flower, node at first female flower and days taken to first harvest exhibited low GCV and PCV (Table 1). These results are in line with Ram *et al.* (2006), Koppad *et al.* (2015), Akhila and Devi Singh (2020), Thulasiram *et al.* (2022) and Panda *et al*. (2022).

Table 1: Estimation of mean, range and genetic parameters for growth and earliness parameters in ridge gourd genotypes

Sl. No.	Character	Range		Mean	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
		Min.	Max.								
1.	Vine length at final harvest (cm)	320.39	501.25	397.51	1927.03	2031.18	11.04	11.34	94.87	88.08	22.16
2.	Number of primary branches per vine at final harvest	2.17	4.08	3.02	0.16	0.22	13.11	15.62	70.47	0.68	22.67
3.	Days to appearance of first male flower	38.60	49.38	42.75	3.24	4.00	4.21	4.68	80.94	3.34	7.80
4.	Days to appearance of first female flower	46.46	57.26	49.87	3.97	4.55	4.00	4.28	87.27	3.84	7.69
5.	Node at first male flower	4.60	6.38	5.40	0.15	0.16	7.06	7.43	90.28	0.75	13.83
6.	Node at first female flower	7.17	10.51	8.26	0.52	0.60	8.72	9.36	86.77	1.38	16.74
7.	Days taken to first harvest	55.18	67.98	59.07	4.56	5.53	3.62	3.98	82.60	4.00	6.77
8.	Sex ratio (M: F)	18.54	32.45	25.24	14.26	15.22	14.96	15.46	93.68	7.53	29.83
9.	Number of fruits per vine	8.34	26.93	16.06	15.15	16.13	24.24	25.01	93.92	7.77	48.39
10.	Average fruit weight (g)	48.43	261.79	164.76	2345.60	2495.85	29.40	30.32	93.98	96.72	58.70
11.	Fruit length (cm)	12.92	50.75	23.03	63.84	66.78	34.70	35.49	95.60	16.09	69.89
12.	Fruit diameter (cm)	3.19	6.54	4.98	0.37	0.39	12.25	12.55	95.26	1.23	24.62
13.	Fruit yield per vine (kg)	0.59	3.86	2.62	0.69	0.76	31.73	33.33	90.63	1.63	62.24

Low GCV and PCV indicates the variability of lower magnitude and suggests the need for generation of variability either by introduction, exploration or by hybridization to get substantial gain in their improvement. The trait sex ratio showed moderate GCV and PCV indicating moderate genetic variation among the genotypes for this character, similar results were obtained by Koppad *et al.* (2015), Thulasiram *et al.* (2022) and Bhatt *et al.* (2022) in bottle gourd.

Yield is a complex character, yield attributing traits like number of fruits per vine, average fruit weight, fruit length and fruit yield per vine showed higher GCV and PCV. High values of GCV are an indication of high genetic variability among the genotypes. Thus, the scope for improvement of these characters through simple selection would be better. These results are in accordance with Varalakshmi *et al.* (2015) , Koppad *et al.* (2015) , Methela *et al.* (2019) , Akhila and Devi Singh (2020) , Durga *et al.* (2021) , Panda *et al.* (2022) and Som *et al.* (2020a) in sponge gourd. Moderate GCV and PCV was observed in fruit diameter, indicating moderate genetic variation among the genotypes for these traits, similar results were obtained by Koppad *et al.* (2015) , Methela *et al.* (2019) , Kannan *et al.* (2019) , Akhila and Devi Singh (2020) in sponge gourd.

Heritability estimates, in combination with genetic gain (expressed as genetic advance as a percentage of the mean), are more informative than heritability alone in anticipating the outcome of selecting the most favorable individuals (Johnson *et al.*, 1955) . Genetic advance serves as a metric of the potential enhancement achievable through selective breeding in a population. A scenario of high heritability coupled with low genetic advance suggests the significance of non-additive gene action, whereas high heritability accompanied by high genetic advance indicates the pre-dominance of additive gene effects.

High broad sense heritability and low genetic advance over per cent of mean was observed in the ridge gourd genotypes for the traits like days to appearance of first male flower, days to appearance of first female flower and days taken to first harvest (Table 1). These results indicate the effect of non-additive gene action and high heritability is due to the favorable climate, in such cases selection might be misleading. Therefore, we can go for heterosis breeding. These results are in line with the results of Kannan *et al.* (2019) , Akhila and Devi Singh (2020) and Thulasiram *et al.* (2022) . The traits node at first female flower and node at first male flower showed high broad sense heritability and moderate genetic advance as per cent mean indicating the predominance of the additive gene action for these traits and showing the effectiveness of direct selection in improving this trait. The results obtained are in confirmation with Manoj *et al.* (2018) in ridge gourd, Kumar *et al.* (2013) and Annigeri (2020) in sponge gourd. High heritability and high genetic advance as per cent over mean was reported for sex ratio, number of fruits per vine, average fruit weight, fruit length, fruit diameter and fruit yield per vine. These results are similar as that of Varalakshmi *et al.* (2015) , Koppad *et al.* (2015) , Methela *et al.* (2019) , Akhila and Devi Singh (2020) , Durga *et al.* (2021) , Sravani *et al.* (2021) , Panda *et al.* (2022) and Yadav and Singh (2022) in ridge gourd, indicating heritability was mainly due to additive gene effect and hence selection was highly effective for this character.

Conclusion

The PCV for all the traits were seen to be slightly higher than their corresponding GCV suggesting that environment interactions played important role in the expression of these characters. Yield attributing traits like number of fruits per vine, average fruit weight, fruit length and fruit yield per vine showed higher GCV and PCV coupled with high heritability and high genetic advance as per cent over mean. This indicates the presence of high genetic variability among the genotypes and predominance of additive components for these traits.Therefore, the scope for improvement of these characters through simple selection would be better and hence direct selection would be more effective in improving these traits for further development.

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