***Original Research Article***

**GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN IN RIDGE GOURD**

**Abstract**

To investigate the genetic variability, heritability in broad sense and genetic advance over mean in the Ridge gourd, the research experiment was conducted during the *kharif* season, 2021 with two replications in randomized block design. The six generations of three crosses are Cross-I P1 x P2 (Arka Sumeet x Konkan Harita), Cross-II P1 x P3 (Arka Sumeet x Jaipur Long), Cross III P4 x P5 (Saloni-5 x NRG-9) along with five parents *viz.,* Arka Sumeet, Konkan harita, Jaipur long, Saloni-5 and NRG-9 with the observation of eighteen attributes recorded. The results of phenotypic coefficient of variation, genotypic coefficient of variation, genetic advances over mean and broad sense in heritability reported that the higher PCV and GCV showed for the vine length, node number at which first male flower appeared, number of branches vine-1, sex ratio, fruit yield vine-1, number of fruits vine-1 these characters showed highest variability indicated characters for further development and the showed In addition to the highest genetic advance over mean along with the highest heritability (broad sense) included the vine length (97.10, 98.40, 80.90 & 55.17, 65.23, 40.27 percent), node number at which first male flower (96.70, 85.60, 96.80 & 48.31, 29.43, 58.67 percent) and female flowers appeared (82.80, 86.00, 98.10 & 20.04, 25.17, 40.41 percent), number of branches vine-1 (92.20, 96.30, 95.00 & 40.80, 56.32, 52.94 percent), number of pickings (86.20, 70.10, 95.60 & 29.60, 13.64, 31.48 percent), fruit length (87.10, 71.00, 96.60 & 18.24,10.36, 26.18 percent), sex ratio (95.20, 96.50, 92.50 & 48.85, 46.35, 36.39 percent), diameter of fruit (88.10, 95.40, 93.80 & 28.12, 28.77, 30.74 percent) and number of fruits per vine (98.70, 97.30, 98.90 & 41.15, 35.34, 45.09 percent), fruit yield per vine (98.30, 98.10, 99.30 & 70.00, 61.20, 78.03 percent), weight of fruit (97.00, 97.60, 98.90 & 29.02, 26.90, 34.92 percent), fruit yield per plot (98.40, 98.10, 99.30 & 70.05, 61.28, 78.01 percent) along with the yield per hectare (98.40, 98.10, 99.30 & 70.04, 61.27, 78.02 percent). In high variability and heritability accompanying genetic advance over mean to results mentioned the traits included increased possibility of improvement through direct selection, a lower dependence on environmental factors and more control over the additive nature of gene action.

**Key words:** Genetic advance, Heritability, Selection, Variability, Six generation

**INTRODUCTION**

A major cucurbitaceous crop ridge gourd (*Luffa acutangula* L. Ruxb.) Particularly warm season crop. It pertains to the Cucurbitaceae family and is widely grown in India during the summer as well as *kharif* season. Its chromosome number is 2n=26. India regards the sensitive fruits of the ridge gourd as a well-known and popular culinary vegetable due to its high yield potential and rich nutritional content (Seshadri, 1985). Recognising the convoluted quantitative inheritance process is essential for establishing effective methods of selection aimed at enhancing yield and associated attributes.

Ridge gourds come in a variety of genotypes and cultivars, each with unique traits, and are cultivated throughout the nation. Geographical variations or spontaneous cross-pollination may be the cause of this genetic variability. Prior to starting any breeding effort, it is essential to have a complete grasp of the genetic variability that currently exists in a crop Singh (1992).

Any trait's ability to be selected for effectively depends on the degree of heritability as well as the degree of phenotypic and genotypic variability. The degree of heritability reveals how well genotypes may be chosen depending on phenotypic performance Johnson *et al.* (1955).

Plant breeders can select crop types better suited to the demands of various populations by using genetic resources to produce innovative plant gene combinations. systems of agriculture (Glaszmann *et al.,* 2010). The degree of transmissibility of desired traits, the type and magnitude of genetic diversity, and the actual anticipated genetic gain for the character in a population all affect how effective selection is (Golani *et al.,* 2007).

Heritability, genetic advancements, and genotypical and phenotypic coefficient of variations permit breeders to research progenies' genetic diversity and potential. To ascertain whether selection is preferable, dividing the overall variability into its heritable and non-heritable components will be helpful because the environment has a significant influence on many economic attributes, which are quantitative in nature. Breeding evolution is controlled by the traits of both non-genetic and genetic changes.

**MATERIAL AND METHODS**

The experiment was studied that at Mahatma Phule Krishi Vidyapeeth, Rahuri, Dept. of Horticulture, AICRP on Vegetable Crops. with two replications and Randomized block design estimated that *kharif*-2021. The six generations in three crosses are Cross-I P1 x P2 (Arka Sumeet x Konkan Harita), Cross-II P1 x P3 (Arka Sumeet x Jaipur Long) Cross-III P4 x P5 (Saloni-5 x NRG-9) with five parents namely Arka Sumeet, Konkan harita, Jaipur long, Saloni-5, NRG-9 in ridge gourd. Parents as well as crosses are five plants selected randomly recorded that growth, flowering, yield and fruit attributes was indicated that six generations in three crosses and with five parents for eighteen traits *viz*., the vine length (m), days to appearances of first male flower and first female flower, number of branches/vine, number of nodes at which first male flower appear and first female flower appeared, sex ratio, days to 50 percent flowering, number of picking, days to last pickings, days to first pickings, fruit weight (g), fruit yield/vine (kg), fruit diameter (cm), number of fruits/vine, , length of fruit (cm), fruit yield/plot (kg) and fruit yield/hectare. To determine the significance of differences between generations, including parents, F1, F2, and back crosses, the first step in generation mean analysis to analysis of variance for Randomized Block Design (RBD) for statistical analysis. As recommended by Panse and Sukhatme (1967), the analysis of variance was performed for all metric qualities under investigation.

**Estimations of component of variations**

In phenotypical and genotypical variance was indicated by respectively mean squared values (Johnson *et al.,* 1955a).

1. Environmental variance (σ2e) = MSe
2. Genotypic variance (σ2g) = MSg-MSe/r
3. Phenotypic variance (σ2p) = (σ2g)+ (σ2e)

Where,

MSg is genotypic mean sum of square

MSe is an error mean sum of square

R is number of replications

**Estimations coefficient of variation**

The coefficient of variation was considered in both genotypical and phenotypical terms Burton and De Vane (1953).

1. Phenotypic coefficient of variation (PCV)

√σ2p

PCV (%) = ------ x 100

X̅

Where, σ2p = Phenotypic variance

X̅ = General mean of character

1. Genotypic coefficient of variation (GCV)

√σ2g

GCV (%) = ------ x 100

X̅

**Estimations of the heritability (percentage)**

The ratio of genotypic to phenotypic variance called as heritability. The general heritability percentages were computed for a range of attributes (Lush, 1949).

σ 2g

h2 (b.s.) = -------- x 100

σ 2p

Where, σ 2g = Genotypic variance

σ 2p = Phenotypic variance

Genetic advances expressed as over mean were evaluated by the following formula.

GA

Genetic advance as over mean (GAM) = -------- x 100

X̅

According to the formula, Johnson *et al.* (1955a) suggested the heritability and anticipated genetic advancements.

**RESULTS AND DISCUSSION**

Heritability Broad-sense, genetic advance as over mean and the phenotypic and genotype coefficient of variations all showed genetic variability in the six generations of ridge gourd showed table 1. For each cross trait, when phenotypical coefficient of variation (PCV) exceeded the matching genotypical coefficient of variation (GCV), it suggested that the attributes were less affected by environmental influences. Narrow variations between the PCV and GCV stated that affect little influenced by the environmental conditions, but wide differences between the GCV and PCV suggested that their environmental conditions play a significant accomplish. Similarly, was reported by the Gautham and Balamohan (2018), Kannan and Rajamanickam (2019) and Panda *et al.* (2022) of ridge gourd, Alekar (2019) of bitter gourd observed Maurya *et al.* (2018) along with Deepa *et al.* (2018) of cucumber crop.

high range of both PCV and GCV and was indicated that the vine length, number of branches vine-1, sex ratio, fruit yield vine-1, number of fruits vine-1, node number at which first male flower appeared, fruit yield plot-1, number of fruits vine-1 along with fruit yield ha-1 showed that the higher variability these attributes which is beneficial to the advances development, likewise observed that Gautham and Balamohan (2018) with Kannan and Rajamanickam (2019) in ridge gourd and Deepa *et al.* (2018) of Cucumber. In medium values of both the PCV along with GCV were showed that these characters number of pickings, node number at which first female flower appear, fruit diameter, fruit weight, fruit length, similarly, reported in ridge gourd that Singh *et al.* (2002), Kumar *et al.* (2017), Ananthan with Krishnamoorthy (2017). Yadagiri *et al.* (2017) in bitter gourd, these variations in the populations, some of which allowed additional selection. However, the lower both PCV and GCV indicated that days to 50 percent flowering, days to appearance of first male flower and days to appearance of first female flower, number of pickings, days to first picking, fruit length and days to last picking. These characters were lowest magnitudes variability's, there was a low chance for their traits to improve. Similarly, were indicated that Kanimozhi *et al.* (2014) in wax gourd.

In both high heritability and genetic advancement over the mean were showed vine length(98.40% & 65.23%), number of branches vine-1 (96.30&56.32), node number at which first male flower appeared (85.60%&29.43%) and first female flower appeared (86.00% & 25.17%), sex ratio (96.50%&46.35%), fruit weight (97.60% & 26.90%), fruit diameter (95.40%28.77%), number of fruits vine-1 (97.30%&35.34), fruit yield vine-1 (98.10%&61.20%) along with fruit yield plot-1 (98.10% &61.20%) and fruit yield ha-1 (98.10% &61.20%). showed these attributes was lesser affected by the environment factors and governed by the additive nature of gene action and greater better improvement for direct selection. Reported that the bottle gourd by the Doddamani *et al*. (2018) of Cucumber, Sharma and Sengupta (2012), Gautham and Balamohan (2018), Kannan and Rajamanickam (2019) in ridge gourd. High heritability along with moderate genetic advance over mean, these attributes are days to first male flower appeared (80.70%&04.82%), days at which first female flower appeared (88.20%&06.09%) and days to first picking (92.0% &05.94%) in cross-III, number of picking (70.10% &13.64%), days to 50 percent flowering (96.70% &13.03%) and fruit length71.00% &10.36%). The higher heritability coupled with lower genetic advance as over mean was noted for cross-I and cross-II of days to appearance of first male flower and first female flower, days to first pickings and days to last picking. The cross-III for days to last picking and days to 50 percent flowering these characters showed some degree of the non-additively nature of gene effect and inadequate the selection for crop improvement. Similarly reported that Pathak *et al.* (2014) of bitter gourd and Maurya *et al.* (2018) of bitter gourd

**CONCLUSION**

The highest values Both the genotypical and phenotypical coefficients of variation (GCV and PCV) and was reported in vine length, node number at which first male flower appeared, number of branches vine-1, sex ratio, number of fruits vine-1, fruit yield vine-1, fruit yield plot-1 besides fruit yield ha-1, greater selection scope is provided when widely ranges of variants appear and selection is based on these attributes. The traits are highly heritability and combined with the genetic advance as over mean were showed the vine length (97.10, 98.40, 80.90 & 55.17, 65.23, 40.27 percent), the node number at which the first male (96.70, 85.60, 96.80 & 48.31, 29.43, 58.67 percent) and female flowers appeared (82.80, 86.00, 98.10 & 20.04, 25.17, 40.41 percent), number of branches vine-1 (92.20, 96.30, 95.00 & 40.80, 56.32, 52.94 percent), number of pickings (86.20, 70.10, 95.60 & 29.60, 13.64, 31.48 percent), fruit length (87.10, 71.00, 96.60 & 18.24,10.36, 26.18 percent), sex ratio (95.20, 96.50, 92.50 & 48.85, 46.35, 36.39 percent), diameter of fruit (88.10, 95.40, 93.80 & 28.12, 28.77, 30.74 percent) and number of fruits per vine (98.70, 97.30, 98.90 & 41.15, 35.34, 45.09 percent), fruit yield per vine (98.30, 98.10, 99.30 & 70.00, 61.20, 78.03 percent), weight of fruit (97.00, 97.60, 98.90 & 29.02, 26.90, 34.92 percent), fruit yield per plot (98.40, 98.10, 99.30 & 70.05, 61.28, 78.01 percent) along with the yield per hectare (98.40, 98.10, 99.30 & 70.04, 61.27, 78.02 percent) these traits governed by the additive genes actions for greater chance of selection. In high variability, high heritability (broad sense) along with high genetic advance over mean for further hybridization for crop improvement.

*.*

**References**

Alekar, A. N., Shinde, K. G and Khamkar, M. B.: Studies on genetic variability, heritability, genetic advance and correlation in bitter gourd (*Momordica charantia.* L.) *Int. J. Chemical Studies.,***7**:1155-1159 (2019).

Ananthan, M. and Krishnamoorthy, V.: Genetic variability, correlation and path analysis in ridge gourd (*Luffa acutangula* (Roxb) L.). *Int. J. Current Microb. Appl. Sci.*, **6,** 3022-3026 (2017).

Burton, G. W. and De Vane, E. H.: Estimating heritability in tall fescus (*Festuce arundinaceae* L.) from replicated clonal material. *Agron. J.,* **45**, 478-481 (1953).

Deepa. S.K., Hadimani, H. P., Hanchinamani,C.N., Ratnakar Shet, Koulgi, S, and Ashok.: Estimation of genetic variability in cucumber (*Cucumis sativus* L). *Int. J. Chem.study*., **6**, 115-118 (2018).

Doddamani M, Satish SD, Nishani S, Dileepkumar A, Masuthi SGK and Tataga MH.: Assessment of genetic variability in local collections of cucumber (*Cucumis sativus* L.) genotypes for productivity traits. *Int, J. Genetics*., **8**, 01-05 (2018).

Gautham SP and Balamohan TN.: Genetic variability studies in F2 and F3 generations of ridge gourd for yield and yield components [(*Luffa acutangula* L.) Roxb]. *Ann. Plant Sci.,* **7**, 2385-2390 (2018).

Glaszmann, J.C., Kilian, B., Upadhyaya, H.D., Varshney, R.K., 2010. Accessing genetic diversity for crop improvement. *Curr. Opin. Plant Biol.* 13, 167–173

Golani, I.J., Mehta, D.R., Purohit, V.L., Pandya, H.M., Kanzariya, M.V., 2007. Genetic variability and path coefficient studies in tomato*. Ind J. Agril. Res.* 41(2), 146–149

Johnson H. W., Robinson, H. F. and Fatokun, C. A.: Genetic advance in pea (*Pisium sativum* L.). *Madras Agric*., **67**, 387-390 (1955).

Johnson, H. W., Robinson, H. F. and Comstock, R.W.: Estimation of genetic and environmental variability in soybeans. *Agron. J.,* **47**:314-318 (1955a).

Kanimozhi RG, Mohammed YS, Ramesh K, Kanthaswamy V, Thirumeni S.: Genetic analysis in segregating generation of wax gourd. *Int. J. Veg. Sci.* **21**, :281-296 (2015).

Kannan A and Rajamanickam C.: Genetic variability, correlation and path analysis of F5 generation of ridge gourd (*Luffa acutangula* (L.) Roxb.) for yield and quality. *Int. J. Current Microb. Appl. Sci.,* **8**, 1153-1164 (2019).

Lush, J.L. 1949. Heritability of quantitative characters in farm animals. Heritability of quantitative characters in farm animals

Maurya, S.K., Ram, H.H. and Singh, O.K.: Standard heterosis for fruit yield and its components in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). *Ann. Hort..,* **2**, 72- 76 (2009).

Panda M, Reddy Mohanty A, Sarkar S, Sahu GC, Tripathy P, Das S and Patnaik A.: Variability studies in ridge gourd (*Luffa acutangula (L.) Roxb.)*. *The Pharma Inn. J.*, **11**, 1716-1719 (2022)

Panse, V.G and Khargonkar, S.S.: Genetics of quantitative characters in relation to plant breeding. *Indian J. Genetics.,* 17: 318-327 (1957).

Pathak M., Manpreet and Kanchan P.: Genetic variability, correlation and path coefficient analysis in bitter gourd (*Momordica charantia* L.). *Int. J. Adv. Res.,* **2,** 179-184 (2014).

Seshadri, V. S.: Cucurbits Vegetable crops in India, Ed. Bose T. K. and Som, M. G. Noya Prakash, Calcutta, India pp. 91-164 (1986).

Sharma, A. and Sengupta, S. K.: Evaluation of genetic variability in bottle gourd (*Lagenaria siceraria* (Molina) Standl.) genotypes. *Veg. Sci*., **39,** 83-85 (2012).

Singh RP, Mohan J and Dharmendra S.: Studies on genetic variability and heritability in ridge gourd (*Luffa acutangula* L.). *Agri. Sci. Digest.*, **22**, 279-280 (2002).

Yadagiri J, Gupta NK, Tembhre D and Verma S.: Genetic variability, correlation studies and path coefficient analysis in bitter gourd (*Momordica charantia* L.). *J. Pharmacogn and Phytochem*., **6**, 63-66 (2017).

**Table.1 Genotypic coefficient of variation, Phenotypic coefficient of variation, heritability and per cent mean of genetic advance of six generations in three crosses**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Arka Sumeet x Konkan harita C1 : (P1 x P2)** | | | | | **Arka Sumeet x Jaipur long C2 : (P1 x P3)** | | | | **Saloni-5 x NRG-9 C3: (P4 x P5)** | | | |
| **Sr.**  **No.** | **Character** | **GCV (%)** | **PCV (%)** | **h2 bs (%)** | **GAM (%)** | **GCV (%)** | **PCV (%)** | **h2 bs (%)** | **GAM (%)** | **GCV (%)** | **PCV (%)** | **h2 bs (%)** | **GAM (%)** |
| 1. | Number of branches per  vine | 20.63 | 21.49 | 92.20 | 40.80 | 27.86 | 28.39 | 96.30 | 56.32 | 26.37 | 27.05 | 95.00 | 52.94 |
| 2. | Length of vine (m) | 27.17 | 27.57 | 97.10 | 55.17 | 31.92 | 32.19 | 98.40 | 65.23 | 21.74 | 24.17 | 80.90 | 40.27 |
| 3. | Days to appearance first  male flower | 04.02 | 04.17 | 92.90 | 07.98 | 02.60 | 02.90 | 80.70 | 04.82 | 05.70 | 05.83 | 95.50 | 11.47 |
| 4. | Days to appearance first  female flower | 04.77 | 04.91 | 94.40 | 09.56 | 03.15 | 03.35 | 88.20 | 06.09 | 06.37 | 06.39 | 99.40 | 13.09 |
| 5. | Node number at which first  male flower appeared | 23.84 | 24.24 | 96.70 | 48.31 | 15.44 | 16.70 | 85.60 | 29.43 | 28.94 | 29.41 | 96.80 | 58.67 |
| 6. | Node number at which first  female flower appeared | 10.69 | 11.75 | 82.80 | 20.04 | 13.80 | 14.21 | 86.00 | 25.17 | 19.80 | 20.00 | 98.10 | 40.41 |
| 7. | Days to 50% flowering | 07.12 | 07.25 | 96.50 | 14.42 | 06.43 | 06.54 | 96.70 | 13.03 | 03.38 | 03.50 | 93.40 | 06.74 |
| 8. | Sex ratio | 24.31 | 24.91 | 95.20 | 48.85 | 22.90 | 23.32 | 96.50 | 46.35 | 18.36 | 19.09 | 92.50 | 36.39 |
| 9. | Days to first picking | 04.05 | 04.26 | 90.60 | 07.95 | 03.01 | 03.14 | 92.0 | 05.94 | 06.01 | 06.18 | 94.40 | 12.03 |
| 10. | Number of pickings | 15.48 | 16.68 | 86.20 | 29.60 | 07.90 | 09.44 | 70.10 | 13.64 | 15.63 | 15.99 | 95.60 | 31.48 |
| 11. | Days to last picking | 04.78 | 04.83 | 97.90 | 09.75 | 04.49 | 04.53 | 97.90 | 09.15 | 04.04 | 04.06 | 98.60 | 08.26 |
| 12. | Length of fruit (cm) | 9.49 | 10.17 | 87.10 | 18.24 | 05.96 | 07.08 | 71.00 | 10.36 | 12.93 | 13.15 | 96.60 | 26.18 |
| 13. | Diameter of fruit (cm) | 14.54 | 15.48 | 88.10 | 28.12 | 14.30 | 14.63 | 95.40 | 28.77 | 15.40 | 15.90 | 93.80 | 30.74 |
| 14. | Weight of fruit (g) | 14.30 | 14.52 | 97.0 | 29.02 | 13.22 | 13.38 | 97.60 | 26.90 | 17.04 | 17.14 | 98.90 | 34.92 |
| 15. | Number of fruits per vine | 20.10 | 20.23 | 98.70 | 41.15 | 17.39 | 17.62 | 97.30 | 35.34 | 22.01 | 22.14 | 98.90 | 45.09 |
| 16. | Fruit yield per vine (kg) | 34.27 | 34.56 | 98.30 | 70.00 | 29.99 | 30.28 | 98.10 | 61.20 | 38.01 | 38.15 | 99.30 | 78.03 |
| 17. | Fruit yield /plot (kg) | 34.28 | 34.57 | 98.40 | 70.05 | 30.03 | 30.32 | 98.10 | 61.28 | 38.00 | 38.13 | 99.30 | 78.01 |
| 18. | Fruit yield (q/ha) | 34.28 | 34.56 | 98.40 | 70.04 | 30.03 | 30.32 | 98.10 | 61.27 | 38.00 | 38.13 | 99.30 | 78.02 |