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Variability and Heritability Studies for Horticultural Traits in Ridge Gourd [*Luffa acutangula* (L.) Roxb.]

Harshitha S., Meenakshi Sood* and Indiresh K. M.

Dept. of Vegetable Science, University of Horticultural Sciences, Bagalkot, Karnataka (587 104), India

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Corresponding Author

Meenakshi Sood

e-mail: meenakshi.sood@uhsbagalkot.edu.in

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Abstract

Ridge gourd is an important cucurbit cultivated in the tropical and sub-tropical regions of India as well as other parts of the world, especially for its green long fruits, consumed as vegetable. Genetic variability and penetrance of favourable characters to the progenies are two important factors in the success of any crop improvement programme. Therefore the present study was conducted with 25 genotypes of ridge gourd collected from different sources and their evaluation for growth parameters, fruit yield and yield contributing traits using Randomized Block Design at College of Horticulture, Mysuru, Karnataka during *Kharif*, 2015. The results indicated significant variability among the genotypes studied for all traits observed except for seed test weight. Considerable variability was found for fruit yield per plant (0.297 kg -1.83 Kg), with IC-92638 and ArkaSujath being the highest yielders. Number of fruits per plant varied from 1.60 (Ghataprabha Local) to 8.0 (IC-92638). High values of Phenotypic co-efficient (PCV) and genotypic co-efficient (GCV) of variation were observed for fruit yield per plant, number of fruits per plant, vine length and for seed yield per plant. These traits also exhibited high heritability coupled with high values of genetic advance expressed over per cent of mean, suggesting the possibility of improvement in these traits through simple selections. However, the earliness traits viz., days to 50% female flowering, days to first harvest, and fruit size in terms of length and fruit diameter exhibited moderate values of GCV and PCV along with moderate levels of heritability and genetics advance.

Keywords: Ridge gourd, variability, heritability, genetic advance

1. Introduction

Ridge gourd [*Luffa acutangula* (L.) Roxb.], commonly called as angled gourd, angled loofah, or ribbed gourd, belongs to family Cucurbitaceae with a diploid chromosome number of 26. It is cultivated in the tropical and sub-tropical regions for its tender fruits which are used in curries or as cooked vegetable. Fruit contains moisture (92.5 g), protein (0.5 g), fat (0.5 g), carbohydrate (3.4 g), energy (17 k calories), calcium (18 mg), vitamin C (5 mg), riboflavin (0.01 mg), phosphorous (26 mg), iron (0.5 mg) and carotene (33 µg) per 100 g of edible portion (Sheshadri and Parthasarthy, 1980). Being a low calorie vegetable, it is considered good for diabetic patients (Pullaiah, 2006). In Ayurveda, it is also reported to have many properties like immune system booster, antioxidant, hypoglycemic, diuretic, blood purifier and a remedy in jaundice (Manikandaselvi et

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al., 2016). The crop is believed to have originated in India, where wild types still occur and later spread to all the areas with high rainfall (Grubben and Denton, 2004). It is emetic and traditionally used for the treatment of stomach ailment and fever (Chakravarthy, 1959). Seeds are also reported to be possessing purgative, emetic and antihelmintic properties due to the secondary metabolite cucurbitacin (Robinson and Decker-Walters, 1997). Isolation of Ribosome Inactivating Proteins (RIPs) and luffaculin from ridge gourd seeds have received wide attention for their potential applications in medicine as they possess various pharmacological activities including abortifacient, antifungal, antitumor, antivirus and HIV-1 integrase inhibitory properties (Hou et al., 2006). It is a cross pollinated crop, predominantly monoecious in nature. It is cultivated in the tropics and sub-tropics for its tender edible fruits both on commercial scale and kitchen gardens throughout India and some parts of Indonesia, Myanmar, Malasia, Phillipines, Srilanka and Taiwan. It can be grown as spring or summer crop as well as rainy season crop. Broad genetic variation for various growth, morphology and fruit characteristics is observed in different parts of India viz., fruit shape, size and colour, and staminate and pistillate flower sex ratio. The fruit shape may be categorized as very long, long, oblong or short. The choice and success of any breeding program depends on the germplasm used. Genetic resources enable plant breeders to create novel plant gene combinations and select crop varieties more suited to the needs of diverse agricultural systems (Glaszmann et al., 2010). The efficiency of selection depends on the nature and extent of genetic variability, degree of transmissibility of desirable characters (Golani et al., 2007) and on the actual expected genetic gain for the character in a population. Therefore, it is very important to know the magnitude of variability and the level of heritability important traits within the germplasmavailable. The present investigation, hence, aimed at studying the nature and extent of genetic variability and heritability in a set of genotypes collected from different sources, and to use the information for planning further breeding programs.

2. Materials and Methods

The present investigation was carried out at the Experimental farm of College of Horticulture, Mysuru, Karnataka, Indialocated at latitude of 120 22'45"N and longitude of 760 31'28" E, 807 m above mean sea level. The area receives an average annual rainfall of 767 mm. This college forms a sub-campus of University of Horticultural Sciences,Bagalkot. The trial was taken up during *kharif*, 2015 with twenty five diverse genotypes of ridge gourd which were evaluated using Randomized Block Design with two replications. The package of practices recommended by University of Horticultural Sciences, Bagalkot were followed for raising the crop. The seedlings were raised from seeds in portrays and were transplanted to the field when they were 14 days old at a spacing of 1.2 m between the rows and 0.9 m between the plants. Ten plants were maintained in treatment per replication. Observations were recorded on five competitive randomly selected plants from each treatment and replication for growth parameters (Number of branches per plant, vine length, number of nodes per vines and internodal length), flowering traits (Days to anthesis for first male flower, days to anthesis for first female flower, node number at which first male flower appeared, node number at which first female flower appeared, days to 50% flowering, sex ratio and yield parameters. The values observed in five selected plants were averaged and subjected to statistical analysis as per Panse and Sukhatme (1967) for analysis of variance.Amount of Vitamin C (ascorbic acid) present in the fruit sample was analyzed by using DCIP titration (Sadasivam and Manickam, 1997), protein by using Microkjeldahl methodandthe chlorophyll content in leaves was assessed by using DMSO (Dimethyl Sulphoxide) procedure (Hiscox and Israelstam, 1979). Phenotypic and genotypic components of variance were estimated by applying the formula as suggested by Cochran and Cox (1959). Phenotypic and genotypic co-efficients of variation were calculated by using the following formulae suggested by Cockerham (1963) and genetic advance estimation was done as per Johnson et al. (1955).

3. Results and Discussion

In the present investigation, variance due to treatments was significant for all the characters studied except for 100 seed weight (Table 1), indicating the presence of sufficient amount of variability between the genotypes studied for all the traits except one.

3.1. Morphological and growth parameters

The results pertaining to the genetic variability observed in 25 ridge gourd genotypes for growth and morphological parameters are presented in Table 2. Low genotypic and phenotypic co-efficients of variation were recorded for days to first harvest which indicated the variability of lower magnitude and suggests the need for generation of variability either by introduction, exploration or by hybridization for improvement in this trait.High PCV and GCV were recorded for parameters like number of primary branches, vine length, number of nodes per plant, internodal length, number of nodes to first male and female flower, number of fruits per plant, fruit yield per plant, vitamin C, crude protein, total chlorophyll content, seed yield per plant and number of seeds per fruit, indicating that high magnitude of variability was present in the germplasm for these characters, thus indicating scope for improvement of these characters through simple selection. High estimates of heritability were noticed for number of primary branches per vine, vine length, number of nodes per vine, internodal length, days to anthesis of first male flower, number of nodesto first male and female flower indicating that characters are less influenced by environmental factors and are under the control of additive gene effect. Therefore selection for improvement of such characters would be rewarding. Similar results were reported by Dubey et al.

Table 1: Analysis of variance (mean sum of squares) for morphological, growth, yield, fruit quality and seed parameters in Ridge gourd [*Luffa acutangula* (L.) Roxb] genotypes

Sl. No.	Character	Replication	Genotypes	Error	CD (*p*=0.0 5)
df		1	24	24	
A. Morphological and growth parameter					
1.	Number of branches	1.62	2.05**	0.13	0.74
2.	Vine length	86.75	57149.64**	390.71	40.8
3.	Number of nodes vine^{-1}	139.68	140.90**	4.34	4.3
4.	Internodal length	47.02	12.34**	2.59	3.32
5.	Days to anthesis for first male flower	0.01	51.27**	5.73	4.94
6.	Days to anthesis for first male flower	7.26	40.02**	14.44	7.84
7.	Number of nodes to first male flower	0.42	4.28**	0.48	1.43
8.	Number of nodes to female flower	0.15	23.43**	2.54	3.29
9.	Days to 50% flowering	54.79	64.70**	21.92	9.66
10.	Days to first harvest	2.1	30.72**	10.41	6.66
11.	Days to last harvest	564.48	149.21*	62.11	16.26
12.	Sex ratio	18.54	11.63*	5.28	4.74
B. Yield and quality components					
1.	Per cent fruit set (%)	174.32	132.44**	46.01	14
2.	Number of fruits plant^{-1}	0.42	5.41**	0.51	1.47
3.	Fruit yield plant^{-1} (g)	108220.97	321245.43**	31638.89	367.11
4.	Average fruit weight (g)	860.3	2722.30**	456.97	44.12
5.	Fruit length (cm)	16.92	55.95**	14.73	7.92
6.	Fruit diameter (mm)	20.67	39.96**	16.63	8.42
7.	Vitamin C (mg)	0.09	73.12**	6.11	5.1
8.	Crude protein (%)	0.04	39.68**	0.72	1.75
9.	Chlorophyll (m)	0.04	0.49**	0.03	0.36
C. Seed parameters					
1.	Seed yield per fruit (g)	0.88	91.13**	13.42	7.556
2.	100 seed weight (g)	1.7	15.04NS	8.9	6.16
3.	Number of seeds fruit^{-1}	121.9	3268.49**	675.95	53.66

(2013), Koppad et al. (2015), Radha Rani (2012), Singh et al. (2002) and Khatoon et al. (2016) in ridge gourd.

Heritability estimates along with genetic gain (GAM) is more useful than heritability alone in predicting the resultant effect for selecting the best individuals (Johnson et al., 1955). High GAM was observed for number of primary branches per vine, vine length, number of nodes per vine, days to anthesis of first male flower, number of nodes to first male and female flower suggesting that the characters were governed by additive genes and selection will be rewarding for improvement of such traits. These results are in conformity with Singh et al. (2002) and Khatoon et al. (2016).

3.2. Yield and yield parameters

The results pertaining to the genetic variability observed in 25 ridge gourd genotypes for yield, quality and seed parameters are presented in Table 3.

High values of PCV as well as GCV was recorded for number of fruits per plant and fruit yield per plant. The high magnitude of GCV further revealed the greater extent of variability present in the characters, suggesting good scope for improvement through selection of this crop. High heritability estimates with high GAM for number of fruits plant^{-1}, fruit yield plant^{-1} and average fruit weight indicated the predominant role of additive genetic. Therefore, there is scope for improvement

Table 2: Estimates of mean, range, components of variance, heritability and genetic advance for morphological and growth parameters in ridge gourd [*Luffa acutangula* (L.) Roxb] genotypes

Sl. No.	Character	Range	Mean	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
A. Morphological and growth parameter										
1.	Number of branches	3.00-7.40	4.09	0.96	1.09	23.96	25.50	88.23	1.89	46.89
2.	Vine length	219.96-818.84	438.68	28379.47	28770.17	38.40	38.67	98.64	344.67	78.57
3.	Number of nodes $vine^{-1}$	17.40-49.57	29.79	68.28	72.62	27.74	28.61	94.03	16.51	55.41
4.	Internodal length	8.92-19.45	14.56	4.88	7.47	15.16	18.77	65.28	3.67	25.24
5.	Days to anthesis for first male flower	21-42.78	25.85	22.77	28.5	18.4	20.65	79.90	8.7	33.99
6.	Days to anthesis for first male flower	23.8-47.34	34.59	12.79	27.23	10.34	15.09	46.98	5.05	14.60
7.	Number of nodes to first male flower	2.05-6.40	4.01	0.79	1.27	22.16	28.11	62.11	1.44	35.97
8.	Number of nodes to female flower	4.40-21.54	9.18	10.45	12.99	35.19	39.25	80.42	5.97	65.01
9.	Days to 50% flowering	36.12-56.42	44.50	21.39	43.31	10.39	14.79	49.38	6.69	15.04
10.	Days to first harvest	39.55-58.58	47.98	10.15	20.57	6.64	9.45	49.37	4.61	9.61
11.	Days to last harvest	84.5-114	98.2	43.55	105.66	6.72	10.47	41.22	8.73	8.89
12.	Sex ratio	18.28-28.36	24.19	3.17	8.46	7.36	12.02	37.52	2.25	9.29

GCV: Genotypic coefficient of variation; GA: Expected genetic advance; h^2 (%): Heritability (broad sense); PCV: Phenotypic coefficient of variation; PV: Phenotypic variance; GV: Genotypic variance; GAM: Genetic advance over per cent of mean

Table 3: Estimates of mean, range, components of variance, heritability and genetic advance for yield and yield parameters, quality and seed parameters in ridge gourd [*Luffa acutangula* (L.) Roxb] genotypes

Sl. No.	Character	Range	Mean	GV	PV	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
1.	Per cent fruit set (%)	51.41-78.16	65.94	43.22	89.22	9.97	14.32	48.44	9.42	14.29
2.	Number of fruits $plant^{-1}$	1.60-8.00	4.47	2.45	2.96	35.02	38.50	82.78	2.93	65.64
3.	Fruit yield $plant^{-1}$ (g)	297.04-1825.20	948.49	144803.2	176442.1	40.12	44.29	82.07	710.14	74.87
4.	Average fruit weight (g)	141.40-267.90	208.75	1132.67	1589.63	16.12	19.10	71.25	58.52	28.03
5.	Fruit length(cm)	18.1-39.80	27.07	20.61	35.34	16.77	21.96	58.33	7.14	26.39
6.	Fruit diameter (mm)	37.72-56.10	46.26	11.67	28.29	7.38	11.50	41.23	4.52	9.76
7.	Vitamin C (mg)	4.95-39.15	16.42	33.50	39.62	35.25	38.33	84.57	10.97	66.78
8.	Crude protein (%)	4.06-22.09	12.58	19.48	20.20	35.08	35.72	96.44	8.93	70.97
9.	Chlorophyll (mg)	0.91-3.03	1.92	0.23	0.26	24.95	26.56	88.24	0.93	48.27
10.	Seed yield $fruit^{-1}$ (g)	8.42-32.67	18.13	38.85	52.28	34.38	39.88	74.33	11.07	61.06
11.	100 seed weight (g)	10.48-24.21	15.12	3.07	11.97	11.59	22.88	25.63	1.83	12.08
12.	Number of seeds $fruit^{-1}$	55.09-198.32	121.37	1296.27	1972.22	29.66	36.59	65.73	60.13	49.54

GCV: Genotypic coefficient of variation; GA: Expected genetic advance; h^2 (%): Heritability (broad sense); PCV: Phenotypic coefficient of variation; PV: Phenotypic variance; GV: Genotypic variance; GAM: Genetic advance over per cent of mean

of these traits through phenotypic selection as its estimates of GCV and PCV are closer as well as parallel and phenotypic variability is a good measure of genotypic variability. These results corroborate the findings of Radha Rani (2012), Samadia (2007), Basavarajeshwari et al. (2014), Choudhary and Kumar (2011), and Khatoon et al. (2016).

Fruit length exhibited high GAM indicating that this character was controlled by additive gene actions and can be used as an important component trait while selecting for higher yield.

3.3. Quality and seed parameters

High heritability along with high genetic advance over per cent of mean was observed for vitamin C, total chlorophyll, crude protein content, indicated that the improved genotypes can be successfully selected for these characters. Higher estimates of GCV and PCV and broad sense heritability associated with high genetic advance over per cent mean was recorded for seed yield per fruit and number of seeds per fruit. These results are accordance with Ram et al. (2006), Samadia (2007), Kumar et al. (2013). High GCV and heritability values suggest that the characters are controlled by additive gene action, indicating ample scope of improvement through simple selection.

4. Conclusion

High values of GCV (>30%) coupled with high heritability (>80%) were observed for vine length, nodes per vine, the node number at which first female flower appeared, number of fruits per plant and fruit yield per plant among growth and yield parameters and,vitamin C and crude protein content among quality parameters. Hence, it may be concluded that selections can play an important role in development of new improved breeding line and genotypes of ridge gourd with desirable horticultural traits.

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