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RESEARCH ARTICLE

Genetic variation and correlations among the physiological growth attributing characters in ridge gourd (*Luffa acutangula* Roxb.) with reference to yield.

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Abstract

Evaluated eighteen genotypes of ridge gourd for physiological, yield, quality and fruit characters under the field condition revealed that PCV was higher than the GCV for most of traits. High heritability with moderate to high GCV and genetic gain was recorded for leaf area, leaf area index, specific leaf weight at 45 days after sowing (DAS), absolute growth rate, crop growth rate, relative growth rate of leaf, tendril and vine at 45-90 DAS, number of fruits per vine and yield per vine indicated that these characters could be improved by simple selection. Correlation coefficient analysis revealed that leaf area during 45 and 90 DAS (0.5350 and 0.4689 respectively), leaf area index during 45 DAS (0.5714), AGR of leaf at the period of 45 to 90 DAS (0.7765), CGR of leaf at the period of 45 to 90 DAS (0.6095) had positive significant correlation with the total fruit yield per vine but NAR of vine at the period of 45 to 90 DAS (-0.4796) had negative significant correlation

INTRODUCTION

Ridge gourd is one of the important vegetable crops grown for its tender green fruits throughout the India. It has a high nutritive value and export potential. To improve the yield and other characters, information on genetic variability and inter-relationship among different traits is necessary. Genetic variability is a perquisite for the meaningful selection the heritability in conjunction with expected genetic advance determines its success. Crop improvement is largely depends on existence of genetic variability. To know the extent of variability present in a population, evaluation of large number of germplasm lines is the first line of work. This improvement in any crop is based on the extent of genetic variation and magnitude of available beneficial genetic variability. Some of these parameters include genotypic (GCV) and phenotypic (PCV) coefficients of variation. High value of these coefficients indicates wider diversity. Similarly, narrow difference between GCV and PCV reveals low sensitivity to the environmental effects. Another indicator of variability is heritability, which is the ratio of genetic variance to total variance. This is broad sense heritability and gives an idea about that portion of observed variability which is attributable to genetic differences. Heritability estimates supplemented by genetic variance are more meaningful. Heritability is a component in the computation of expected progress which is most meaningful when accompanied by genetic advance. Genetic advance would be more in cases where the additive genetic variance is more than non-additive genetic variance (Lush, 1949). Further, correlated response to selection depends primarily on the nature and strength of relationship between characters. Keeping in view the above points, the present investigation was aimed to asses with 18 ridge gourd cultivars received from local places with the objective of obtaining information genetic variability, heritability, genetic advance and pattern of correlations of fruit yield with other physiological characters.

MATERIALS AND METHOD

The experiment was conducted at Dept. of Crop Improvement and Biotechnology, KRC College of Horticulture, Arabhavi during the summer season of 2012-14 using completely randomized block design with three replications. Treatment was in a plot of single row in each replication. Recommended cultural practices were followed as per the package of practices of horticultural crops of University of Agricultural Sciences, Dharawad (Anon**.,** 2010). Five randomly selected plants from each genotype were subjected for observations on dry matter production and its partitioning. Three plants of each genotype in each replication were uprooted and partitioned in to their component parts *viz.*, vine, leaves and tendrils. These were air dried and then transferred to hot air oven at 80^0C for 72 hours (until constant weight obtained) and their dry weight was recorded. The sum of the mean dry weight of all the plant parts was taken separately at 45 and 90 DAS and the mean was expressed as g. plant^{-1}. The RGR (Blackman, 1919), CGR (Watson**,** 1952), NAR (Gregory, 1926), AGR was calculated. Leaf area was estimated using the formula by Vivekanandan *et al*., (1972), leaf area index, specific leaf weight (Radford, 1967) and specific leaf area. On number of fruits per vine, average fruit weight, fruit length, fruit diameter, flesh thickness, rind thickness and total frit yield per vine. Variability for different qualitative characters and expected genetic advance at 5 per cent intensity were calculated as per Burton and Devan (1952) and Johnson *et al* (1955), respectively.

RESULT AND DISCUSSION

Analysis of variance in these 18 genotypes of ridge gourd showed that highly significant differences for all the quantitative and qualitative traits studied and data indicated adequate genetic variability among the genotypes (Table-1). Genetic variability estimates, including mean, range, genotypic and phenotypic variances, genotypic and phenotypic coefficient of variances, broad sense heritability, genetic advance and genetic advance over mean for different characters (Table-2).

In this study, for all the characters genotypic coefficient of variability is lower than phenotypic coefficient of variability. The difference between genotypic coefficient of variability and phenotypic coefficient of variability was very less; it indicates lesser environmental influence in the expression of a particular character. The coefficient of variation indicates only an extent of variability present for different characters and do not take into account for the heritable portion. To obtain the knowledge about heritable portion of variability, it is essential to know the heritability estimates for different quantitative characters. The heritability estimates devoid environmental influence from the total variability, indicates the accuracy with which a superior segregants in a population can be selected by its phenotypic performance, thus making the selection more effective. However, heritability estimates itself is not an indication of the amount of genotypic progress that would result from selecting the superior segregants (Johnson *et al.*, 1955).

Phenotypic variability

Physiological parameters have been extensively employed in crop sciences for better understanding of physiological basis of yield variation in crop plants. Biomass is one of the important characters which influence growth and development of the plants. The analyses made at individual plant level are LA, LAI, RGR, AGR, NAR, CGR, SLA and SLW. The technique of growth analysis is advantageous to crop scientist as it helps to find out the relationship between photosynthetic production and rate of increase in dry matter. Methods of growth studies provide better understanding of growth processes and limitations of the crop yield.

The data on leaf area was found to be significant among the different lines of ridge gourd at all the growth stages. Significantly higher total leaf area was recorded in Arabhavi Local (330.58 cm^2 and 177.52 cm^2) at 45 and 90 DAS. Whereas lowest was recorded in the line Gadag Local (86.87cm^2 and 77.92cm^2) at 45 and 90 DAS respectively. Leaf area being the photosynthetic surface area, which plays an important role in determining total biomass accumulation and quality of photosynthates available for yield production and it is well known fact that the persistence of assimilatory surface is a prerequisite for prolonged photosynthetic activity and ultimate crop productivity. The highest leaf area was observed in Arabhavi Local that might have lead to more assimilation of photosynthates and contributed to highest fruit yield. This data is conformity with the study of Reddy *et al*., (2014) on ridge gourd and Meena *et al*., (2013) in mustard.

Leaf area index was found to be significant during 45 and 90 DAS. Arabhavi Local and Kolar Local (0.0619) and (0.0349) was recorded the higher leaf area index during 45 and 90 DAS respectively. Whereas, Ghataprabha local (0.0216) and Deepthi (0.0112) was the lowest during 45 and 90 DAS respectively. Leaf area index is most important variable and it can be widely changed by manipulation. Leaf area index which is the ratio of the leaf area of a plant to the ground area occupied by the plant. Higher the leaf area and leaf area index might have contributed to highest yield per vine. The results were accordance with Meena *et al*., (2013) in mustard and Reddy *et al*., (2013) in ridge gourd.

Higher specific leaf area was recorded during 45 DAS in Jaipur Long 43.42 cm^2/g and lowest was recorded in the line Khanapur Local 10.78 $cm^2.g^{-1}$. While, at 90 DAS, Arka Sujata 12.21 cm^2/g was high and Arka Sumeet 5.05 cm^2/g was lowest. Specific leaf area is the ratio of assimilating area to its dry weight. The second highest leaf area was observed in Khanapur Local that might have lead to more assimilation of photosynthates and contributed to highest specific leaf area. SLA is maximum in open area crops because of high photosynthetic surface area (Radford, 1962). This was akin with the results of Reddy *et al*., (2013) in ridge gourd.

The Specific leaf weight was found to be significant among the different lines of ridge gourd at all the growth stages and Khanapur Local (0.02 g/cm^{-2} at 45 DAS). Whereas, highest was recorded in Jaipur Long (0.09 g/cm^2) at 90 DAS. Specific leaf weight is the reverse condition of the specific leaf area which indicates the leaf thickness. Hence, it is found less in Khanapur Local. The present findings also followed the earlier findings of Ahmad *et al.*, (2004) in sunflower and Reddy *et al*., (2013) in ridge gourd.

The AGR was estimated at period of 45-90 DAS with respect to vine, tendril and leaf. Arabhavi Local revealed the high AGR (18.03, 3.07 and 37.85 g day^{-1} for vine, tendril and leaf respectively). Similarly with respect to vine, tendril and leaf, Arka Sujata, Ghataprabha Local and AHRG-1 (9.08, 1.04 and 20.93 g day^{-1} revealed lower results respectively). Higher the leaf area in the Arabhavi Local may lead to the higher accumulation of biomass and more photosynthetic activity. These results were conformity with the results of Sharma *et al*., (1996) in cauliflower.

CGR is a simple and important aid of agriculture productivity and it is the rate of increase of dry weight per unit land area per unit time. Significantly higher CGR at period of 45-90 DAS with respect to vine, tendril and leaf was recorded in Arabhavi Local (33.39, 5.69 and 28.70 $g.m^{-2}day^{-1}$ respectively) and lowest was recorded in the line Dalasanur Local, Green long and Pusa Nasadar (16.81, 1.92 and 15.86 $g.m^{-2}day^{-1}$) with respect to vine tendril and leaf. Highest leaf area index is found in the genotype Arabhavi Local. CGR increases as LAI increases to an optimum because of greater light interception the variation in the biomass is further supported by growth analysis studies. These results were conformity with the results of Sharma *et al*., (1996) in cauliflower and Chavan *et al*., (2010) in tomato.

Among the different lines significantly higher RGR at period of 45-90 DAS with respect to vine, tendril and leaf was recorded in the lines Chintamani Local, Deepthi and Mandya Local (0.92, 0.88 and 0.74 $mg.m^2.day^{-1}$) and lowest was recorded in Kolar Local, Green long and AHRG-1 (0.41, 0.37 and 0.30 $mg.m^2.day^{-1}$). RGR is the rate of increase of dry weight per unit weight already present per unit time. These results were conformity with the results of Sharma *et al*., (1996) in cauliflower, Chavan *et al*., (2010) in tomato and Ninganur (2002) in cotton.

Among the different lines significantly higher NAR at period of 45-90 DAS with respect to tendril was recorded in the genotype Selection 4-12 (1.09 $g.cm^{-2}.day^{-1}$) and lowest was recorded in the line Green long 0.37 $g.m^{-2}.day^{-1}$ and higher NAR at 45-90 DAS with respect to leaf was recorded in Deepthi (5.26 $g.m^{-2}.day^{-1}$) and lowest was recorded in Jaipur Long 2.28 $g.m^{-2}.day^{-1}$. NAR is the rate of increase of dry weight per unit area of leaf per unit time. Higher AGR, CGR, RGR and NAR indicate better growth and development which in turn depends on the leaf area. Ningnur, (2002) in cotton and Chavan *et al*., (2010) in tomato.

Number of fruits per vine is one of the yield contributing trait, the genotype Arabhavi Local (9.66) bred more number of fruits whereas lowest was recorded in the line Pusa Nasadar (5.50) with range (5.50 - 9.66). The number of fruits directly proportional to the total fruit yields per vine hence the Arabhavi Local heavy yielder. The same results were with Anand (2012), Reddy *et al*., (2013) in ridge gourd and Rathod (2007) in bitter gourd.

The genotype Arabhavi Local having long fruits (33.03 cm), whereas the line Deepthi having shorter fruits (19.70 cm) among all genotypes with range (19.7-33.03). Fruit diameter was significantly higher in the genotype Arka Sujata (31.92 mm) which was on par with Arabhavi Local (30.49). Whereas, lowest was recorded in the line Chintamani Local (22.30 mm) with range (22.30 - 30.69 mm). The rind thickness was maximum in Arabhavi Local and Arka Summet (2.29 mm) and minimum was recorded in Srinivasapur Local (1.38 mm). Mean flesh thickness was maximum in Arabhavi Local (2.69 cm) and minimum flesh thickness was recorded in Jaipur Long (1.87 cm). Mean fruit yield was maximum in Arabhavi Local (1760.53 g) and minimum was recorded in Deepthi (695.98 g). The final yield and yield attributing characters are basically governed by vegetative growth as dry matter production and its distribution. Yield is the function of many yield contributing characters like number of fruits and average fruit weight. These results are in accordance with Narayanankutty *et al.* (2006) in snake gourd, Bharathi *et al.* (2006) Gayen and Hossain (2006) and Kumar *et al.* (2007) in bottle gourd. Rathod (2007), Anand (2012) in ridge gourd and Islam *et al*. (2009) in bitter gourd.

Genetic variability

Highly significant genotypic effects indicated that the present set of genotypes differed appreciably for leaf area (45 and 90 DAS), leaf area index (45 and 90 DAS), specific leaf area (45 and 90 DAS), specific leaf weight (45

and 90 DAS), AGR, CGR, RGR and NAR of tendril during 45-90 DAS, RGR and NAR of vine, leaf during 45-90 DAS respectively. Further, the components like number of fruits per vine, average fruit weight, fruit length, fruit diameter, flesh thickness rind thickness and fruit yield per vine were indicated the moderate phenotypic and genotypic coefficient of variation. The range of phenotypic coefficient of variation was 10.53 per cent - 56.63 per cent for flesh thickness and genotypic coefficient of variation was 7.31 per cent - 49.69 per cent for specific leaf weight at 45 DAS respectively (Table 2). The PCV and GCV >20 per cent, 10-20 per cent and >10per cent were classified as high, moderate and low (Johnson *et al*., 1955). The LA, LAI, AGR, CGR, RGR and NAR determined the growth and development of the crop, had high to moderate genetic variability (Table 2). The PCV invariably increased for all the traits and the genetic variability did not show any consistent pattern of change suggesting that non heritable factors contributed to the increased phenotypic variability and large genotypes x environment interactions play an important role in the expression of these characters. Flesh thickness, fruit diameter and average fruit weight had low genotypic variation. RGR of tendril at 45-90 DAS had high PCV and moderate GCV. High variability availability for the physiological characters and fruit yield per vine in the present materials could be quite useful for selection.

Heritability and genetic advance

The estimates of heritability varied substantially from 16.00 per cent for fruit diameter to 99.00 per cent for the AGR, CGR and RGR of vine at period of 45-90 DAS. The genetic advance (GA) was the highest (515.39 per cent) for fruit yield per vine and the lowest (0.23 per cent) for flesh thickness (Table 3).

The heritability estimates >70, 50-70 and <50 per cent were classified as high, moderate and low respectively. The genetic advance was categorized as high (>50per cent), moderate (25-50%) and low (<25%). High differences in the large environmental influence and consequently the lower estimates of heritability. The heritability was low for specific leaf area at 45 DAS (46 per cent), fruit diameter (16 %) and flesh thickness (48 %). The yield components had moderate heritability and the physiological traits had the high heritability. The yield components like number of fruits per vine, average fruit weight, fruit diameter, flesh thickness, rind thickness and fruit length had moderate heritability and low genetic advance indicating the characters were under the control of non additive gene action. The physiological traits were had the high heritability and genetic advance expressing the characters are under the control of additive gene action. Moderate heritability with moderate genetic advance for specific leaf weight and specific leaf area indicated the involvement of both additive and non additive effects in the genetic control of these characters. Although, heritability estimates of physiological characters did not show consistent pattern of change.

Variability studies provide information on the extent of improvement in different characters, but they do not throw light on the extent and nature of relationship existing between various characters. Therefore, for rational approach towards the improvement of yield, selection has to be made for the components of yield, since there may not be genes for yield *per se*, but only for various yield components (Grafius, 1959). Genetic correlations between two characters arise because of linkage, pleiotrophy or development induced functional relationship (Harland, 1939).Fruit yield per vine had positive and significant correlation with the AGR of leaf at 45-90 DAS (0.7765), number of fruits (0.9650), average fruit weight (0.9298), fruit length (0.7422), fruit diameter (0.6288), flesh thickness (0.7656), rind thickness (0.6700), CGR of leaf (0.6095), LA during 45 (0.5350), LAI during 45 DAS (0.5714) and LA during 90 DAS (0.4689). Negatively correlated with NAR of vine (-0.4796). Results of this study indicated that for increasing fruit yield, selection might be directed towards plants having higher number of fruits with large fruit size (Table 4). These results agree with the findings of Choudhary *et al.* (2008) and Hanumegowda *et al.* (2012) in ridge gourd. Hence, correlation study has greater significance and could be effectively utilized in formulating an effective selection scheme. Many of these yield contributing characters are interact in desirable and undesirable direction. Therefore, knowledge of association between the traits can greatly help in avoiding inversely related compensation effects during selection.

It can be concluded that, those genotypes which has ability to maintain better NAR, RGR, CGR, SLA and LAI under the stress conditions can be used for breeding programme for development of high yielding genotypes under the stress conditions.

Table.1: Analysis of variance (mean sum of squares) for physiological, yield and fruit quality parameters in Ridge gourd.

Sl. No	Character		Replication	Genotypes	Error	S. Em±	C.D. @ 5per cent
A.	**Physiological parameters**						
	AGR 45 – 90 DAS (g/day x 10^2)	**Vine**	0.19	11.63*	0.05	0.13	0.39
		Tendril	0.01	0.85*	0.01	0.05	0.15
		Leaf	2.80	49.47*	0.58	0.44	1.26
	CGR 45 – 90 DAS (g/m^2/day x 10^2)	**Vine**	0.67	39.89*	0.18	0.25	0.756
		Tendril	0.02	2.92*	0.03	0.09	0.28
		Leaf	1.46	32.20*	1.69	0.75	2.16
	RGR 45 – 90 DAS (mg/cm^2 /day x 10^2)	**Vine**	0.01	0.08*	0.01	0.01	0.03
		Tendril	0.02	0.05*	0.01	0.02	0.06
		Leaf	0.02	0.03*	0.01	0.01	0.04
	NAR 45 – 90 DAS (mg/m^2 /day x 10^2)	**Vine**	0.40	4.18*	0.26	0.29	0.84
		Tendril	0.01	0.18*	0.01	0.05	0.15
		Leaf	0.19	2.13*	0.16	0.23	0.69
	LA (cm^2)	**45 DAS**	1433.66	17477.02*	1098.45	19.13	57.44
		90 DAS	146.33	2752.52*	266.58	9.01	27.09
	LAI	**45 DAS**	0.0005	0.001*	0.0001	11.23	33.69
		90 DAS	0.0005	0.01*	0.0001	0.01	0.05
	SLA (cm^2/g)	**45 DAS**	9.64	244.66*	13.13	2.09	6.01
		90 DAS	0.59	12.07*	1.37	0.67	1.94
	SLW (g/cm^2)	**45 DAS**	0.0001	0.013*	0.0008	0.005	0.015
		90 DAS	0.0004	0.035*	0.0005	0.012	0.036
B.	**Yield parameters**						
	Number of fruits per plant		0.73	3.17*	0.33	0.33	0.99
	Fruit yield per plant (g)		21208.75	242637.36*	15747.00	72.45	208.20
	Average fruit weight (g)		2836.98	1059.29*	204.75	9.68	28.42
	Fruit length (cm)		29.91	54.22*	7.52	1.20	3.44
	Fruit diameter (mm)		86.88	22.08*	8.93	1.70	5.12
D.	**Fruit quality parameters**						
	Rind thickness (mm)		0.16	0.28*	0.04	0.17	0.53
	Flesh thickness (cm)		0.04	0.11*	0.03	0.13	0.39

Df : Degrees of freedom **DAS**: Days after sowing,
LA : Leaf area **LAI :** Leaf area index
SLA : Specific leaf area **SLW:** Specific leaf weight
AGR: Absolute growth rate **CGR:** Crop growth rate
RGR Relative growth rat **NAR:** Net assimilation rate

Table 2: Phenotypic and genetic variability for physiological parameters among the different ridge gourd genotypes

Sl. No.	Genotypes	Leaf area (cm^2)		Leaf area index		Specific leaf area (cm^2/g)		Specific leaf weight (g/cm^2)		AGR 45 -90 DAS (g/ day x 10^2)		
		45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS	Vine	Tendril	Leaf
1	Deepthi	122.72	96.24	0.0241	0.0112	19.34	7.85	0.05	0.13	14.54	2.57	26.18
2	Pusa Nasadar	219.71	109.28	0.0432	0.0223	28.04	9.35	0.04	0.11	14.32	2.42	21.71
3	Mudigere Local	330.49	165.53	0.0615	0.0215	27.29	9.17	0.04	0.11	15.27	2.84	30.82
4	Jaipur Long	298.22	134.13	0.0613	0.0318	43.42	11.46	0.09	0.09	11.99	2.17	27.03
5	Khanapur Local	329.54	101.86	0.0214	0.0349	10.78	8.45	0.02	0.12	12.88	2.23	22.16
6	Mandya Local	185.88	91.00	0.0326	0.0216	37.95	8.62	0.03	0.12	13.54	2.76	25.37
7	Selection 4-12	143.17	114.32	0.0315	0.0256	15.35	8.45	0.07	0.12	13.28	2.65	24.61
8	Gadag Local	86.87	77.92	0.0336	0.0232	15.15	5.75	0.07	0.18	14.30	2.57	23.78
9	Chintamani Local	132.60	98.86	0.0334	0.0119	13.74	6.83	0.07	0.15	13.73	2.47	23.05
10	Srinivasapur Local	239.56	90.84	0.0424	0.0226	24.08	5.96	0.04	0.17	12.25	2.24	23.06
11	Ghataprabha Local	112.38	96.37	0.0216	0.0229	12.63	6.90	0.08	0.15	13.33	1.04	21.10
12	Green Long	168.73	87.40	0.0385	0.0234	16.30	5.82	0.06	0.17	11.36	1.71	24.38
13	Arka Sujata	251.06	161.70	0.0513	0.0226	30.39	12.21	0.03	0.08	9.08	1.64	24.29
14	Dalasanur Local	228.07	85.91	0.0415	0.0329	21.42	5.39	0.05	0.19	12.07	2.11	22.35
15	AHRG-1	161.03	121.11	0.0313	0.0254	13.52	7.44	0.07	0.14	11.20	1.42	20.93
16	Arabhavi Local	330.58	177.52	0.0619	0.0219	25.36	8.86	0.04	0.11	18.03	3.07	37.85
17	Kolar Local	288.73	99.50	0.0524	0.0316	28.46	6.41	0.04	0.16	12.50	2.47	27.10
18	Arka Sumeet	250.06	77.82	0.0519	0.0218	23.56	5.05	0.04	0.20	10.84	2.72	26.41
	S.Em±	**19.14**	**9.43**	**0.0001**	**0.0003**	**2.09**	**0.68**	**0.01**	**0.01**	**0.13**	**0.05**	**0.44**
	C.D. @ 5per cent	**51.22**	**27.09**	**0.0011**	**0.0161**	**6.01**	**1.94**	**0.02**	**0.04**	**0.39**	**0.15**	**1.26**
	Mean	205.20	110.40	0.0313	0.0216	22.59	7.75	0.05	0.14	13.03	2.28	25.12
	Range	86.87-330.58	77.82 - 177.52	0.0216-0.0619	0.0112 - 0.0329	10.78 - 43.42	5.05 - 12.21	0.02 - 0.09	0.08 - 0.20	9.08 - 18.03	1.04 - 3.07	20.93 - 37.85
	GV	5561.9	828.65	2.88	2.37	1.35	1.64	10.23	0.02	3.86	2.80	1.61
	PV	6514.79	1095.23	3.75	3.24	2.93	2.47	13.29	0.02	3.91	2.89	1.67
	PCV	39.29	29.98	29.98	37.48	44.27	53.99	56.63	49.97	15.19	23.58	16.30
	GCV	36.31	26.07	26.07	32.03	29.99	44.03	49.69	40.73	15.08	23.24	16.02
	h2	85.00	76.00	76.00	73.00	46.00	67.00	77.00	66.00	99.00	97.00	97.00
	GA	141.95	51.58	3.03	27.00	2.77	68.00	21.08	21.00	4.01	16.50	8.14
	GAM	69.11	46.72	46.72	56.39	41.86	73.97	89.8	68.37	30.85	47.17	32.43

GCV = Genotypic coefficient of variation, GA = Expected genetic advance, h2 = Heritability (broad sense), PCV = Phenotypic coefficient of variation, PV= Phenotypic variance, GV= Genotypic variance, GAM = Genetic advance (per cent mean), DAS = Days after sowing, AGR= Absolute growth rate, CGR= Crop growth rate, RGR= Relative growth rate, NAR= Net assimilation Rate.

Table 2. Continued…

Sl. No.	Particulars	CGR 45 -90 DAS ($g.m^{-2}.day^{-1} \times 10^2$)			RGR 45 -90 DAS ($mg.m^{-2}.day^{-1} \times 10^2$)			NAR 45 -90 DAS ($g.m^{-2}day^{-1} \times 10^2$)		
		Vine	Tendril	Leaf	Vine	Tendril	Leaf	Vine	Tendril	Leaf
1	Deepthi	26.92	4.76	24.32	0.84	0.88	0.64	5.83	1.03	5.26
2	Pusa Nasadar	26.51	4.47	15.86	0.47	0.69	0.39	4.08	0.69	2.44
3	Mudigere Local	28.27	5.25	24.49	0.42	0.68	0.39	2.80	0.52	2.43
4	Jaipur Long	22.21	4.01	19.94	0.57	0.73	0.52	2.55	0.46	2.28
5	Khanapur Local	23.86	4.14	16.40	0.61	0.62	0.39	5.99	1.04	4.12
6	Mandya Local	25.07	5.11	23.25	0.87	0.86	0.74	4.47	0.91	4.14
7	Gadag Local	24.59	4.90	16.90	0.64	0.78	0.35	5.42	0.98	4.06
8	Chintamani Local	26.48	4.77	19.83	0.92	0.73	0.39	3.97	0.71	3.38
9	Srinivasapur Local	25.43	4.58	21.69	0.74	0.80	0.41	5.27	0.96	4.77
10	Ghataprabha Local	22.68	4.15	20.81	0.75	0.70	0.43	4.69	0.37	3.65
11	Green Long	24.68	1.92	19.20	0.91	0.37	0.36	2.44	0.37	2.39
12	Arka Sujata	21.04	3.16	20.59	0.65	0.57	0.46	2.72	0.49	3.57
13	Dalasanur Local	16.81	3.04	22.00	0.43	0.48	0.39	4.10	0.72	3.16
14	Selection 4-12	22.35	3.91	17.25	0.73	0.61	0.36	5.45	1.09	3.76
15	AHRG-1	20.73	2.62	18.05	0.70	0.49	0.30	3.49	0.44	3.05
16	Arabhavi Local	33.39	5.69	28.70	0.60	0.65	0.41	3.23	0.55	2.78
17	Kolar Local	23.14	4.58	22.13	0.41	0.76	0.41	3.07	0.61	2.94
18	Arka Sumeet	20.07	5.04	19.76	0.63	0.76	0.36	3.21	0.81	3.17
	S.Em±	**0.24**	**0.10**	**0.75**	**0.01**	**0.02**	**0.01**	**0.3**	**0.05**	**0.2**
	C. D. @ 5per cent	**0.71**	**0.30**	**2.16**	**0.03**	**0.05**	**0.04**	**0.9**	**0.16**	**0.7**
	Mean	24.12	4.23	20.62	0.66	0.68	0.43	4.04	0.71	3.41
	Range	16.81-33.39	1.92 - 5.69	15.83 - 28.70	0.41-0.92	0.37-0.88	0.30-0.74	2.44-5.99	0.37-1.09	2.28-5.26
	GV	1.32	9.65	5.55	2.61	1.78	1.12	1.30	5.74	6.52
	PV	1.34	9.93	5.75	2.63	1.87	1.17	1.56	6.65	8.19
	PCV	15.19	23.58	16.3	24.56	20.29	25.37	30.96	36.47	26.57
	GCV	15.08	23.24	16.02	24.47	19.76	24.87	28.30	33.88	23.72
	h^2	99.00	97.00	97.00	99.00	95.00	96.00	84.00	86.00	80.00
	GA	2.36	6.30	2.32	3.13	2.67	2.14	2.15	4.58	1.49
	GAM	30.85	47.17	32.43	50.22	39.63	50.20	53.27	64.82	43.61

GCV = Genotypic coefficient of variation, GA = Expected genetic advance, h2 = Heritability (broad sense), PCV = Phenotypic coefficient of variation, PV= Phenotypic variance, GV= Genotypic variance, GAM = Genetic advance (per cent mean), DAS = Days after sowing, AGR= Absolute growth rate, CGR= Crop growth rate, RGR= Relative growth rate, NAR= Net assimilation Rate.

Table 3. Phenotypic and genetic variability for yield and yield attributing characters among the different ridge gourd genotypes.

Sl. No	Particulars	Number of fruits per vine	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (mm)	Flesh thickness (cm)	Rind thickness (mm)	Fruit yield per vine (g)
1	**Deepthi**	5.50	126.54	19.70	26.55	2.12	1.86	695.98
2	**Pusa Nasadar**	5.50	132.35	21.40	25.92	2.19	1.82	727.93
3	**Mudigere Local**	7.83	179.83	25.48	31.70	2.54	2.23	1408.06
4	**Jaipur Long**	6.50	144.43	29.38	25.73	1.87	1.45	938.41
5	**Khanapur Local**	6.16	130.28	21.68	25.65	2.18	1.58	802.28
6	**Mandya Local**	6.50	139.79	22.27	27.73	2.30	1.59	908.57
7	**Gadag Local**	6.16	144.87	19.92	27.80	2.11	1.59	892.45
8	**Chintamani Local**	6.33	150.67	23.77	22.30	2.34	1.39	953.83
9	**Srinivasapur Local**	7.00	158.08	23.40	24.76	2.11	1.38	1106.92
10	**GPB Local**	6.50	131.08	22.62	29.03	2.31	1.60	852.68
11	**Green Long**	6.50	125.03	27.27	24.68	2.13	1.75	812.72
12	**Arka Sujata**	7.50	163.80	32.27	31.92	2.39	1.93	1228.67
13	**Dalasanur Local**	6.83	133.68	26.07	28.41	2.33	2.02	913.02
14	**Selection 4-12**	6.00	125.70	22.07	27.30	2.24	1.46	754.20
15	**AHRG-1**	6.16	156.48	26.35	24.92	2.25	1.47	963.48
16	**Arabhavi Local**	9.66	182.25	33.03	30.50	2.69	2.29	1760.53
17	**Kolar Local**	6.00	151.27	27.02	25.36	2.12	1.49	907.62
18	**Arka Sumeet**	8.16	175.54	32.53	31.05	2.53	2.29	1432.40
	S.Em±	**0.35**	**9.89**	**1.20**	**1.70**	**0.13**	**0.18**	**70.45**
	C.D. @ 5per cent	**0.99**	**28.42**	**3.44**	**4.88**	**0.37**	**0.53**	**208.22**
Mean		6.71	147.31	25.34	27.29	2.26	1.73	1004.48
Range		5.50 - 9.66	125.03 - 182.25	19.70 - 33.03	22.30 - 31.92	1.87 - 2.69	1.38 - 2.29	695.98 - 1760.53
GV		0.94	284.84	15.56	4.38	0.03	0.08	75630.00
PV		1.28	489.60	23.09	26.46	0.06	0.12	91377.28
PCV (per cent)		16.86	15.02	18.95	18.85	10.53	20.17	30.09
GCV (per cent)		14.49	11.45	15.56	7.66	7.31	16.47	27.37
h^2 (per cent)		73.00	58.00	67.00	16.00	48.00	66.00	62.00
GA		1.72	0.26	6.67	1.75	0.23	0.48	515.39
GAM		25.66	18.00	26.33	6.42	10.46	27.72	51.30

GCV = Genotypic coefficient of variation
GA = Expected genetic advance
h2 = Heritability (broad sense)
PCV = Phenotypic coefficient of variation
PV= Phenotypic variance
GV= Genotypic variance
GAM = Genetic advance (per cent mean)
DAS = Days after sowing

Table 4.: Correlation coefficient analysis for the physiological and yield attributing characters in ridge gourd.

	Fruit yield per vine (g)	Significance level
Fruit yield per vine (g)	1.0000	NS
AGR of Vine (g/ day x 10^2)	0.3555	NS
AGR of tendril (g/ day x 10^2)	0.4109	NS
AGR of Leaf (g/ day x 10^2)	0.7765	***
CGR of Vine ($g.m^{-2}.day^{-1}$ x 10^2)	0.3557	NS
CGR of tendril ($g.m^{-2}.day^{-1}$ x 10^2)	0.4105	NS
CGR of Leaf ($g.m^{-2}.day^{-1}$ x 10^2)	0.6095	**
RGR of Vine ($mg.m^{-2}.day^{-1}$ x 10^2)	-0.2582	NS
RGR of tendril ($mg.m^{-2}.day^{-1}$ x 10^2)	0.0073	NS
RGR of Leaf ($mg.m^{-2}.day^{-1}$ x 10^2)	-0.1645	NS
NAR of Vine ($g.m^{-2}day^{-1}$ x 10^2)	-0.4796	*
NAR of tendril ($g.m^{-2}day^{-1}$ x 10^2)	-0.2788	NS
NAR of Leaf ($g.m^{-2}day^{-1}$ x 10^2)	-0.2860	NS
LA 45 (cm^{-2})	0.5350	**
LA 90 (cm^{-2})	0.4689	*
LAI 45	0.5714	**
LAI 90	-0.1451	NS
SLA 45 (cm^{-2}/ g)	0.0778	NS
SLA 90 (cm^{-2}/ g)	-0.0445	NS
SLW 45 (g /cm^{-2})	-0.1972	NS
SLW 90 (g /cm^{-2})	0.0244	NS
Number of fruits per vine	0.9658	***
Average fruit weight (g)	0.9298	***
Fruit length (cm)	0.7422	***
Fruit diameter (mm)	0.6288	***
Flesh thickness (cm)	0.7656	***
Rind thickness (mm)	0.6700	***

LA: Leaf area
LAI: Leaf area index
SLA: Specific leaf area
SLW: Specific leaf weight
AGR: Absolute growth rate
CGR: Crop growth rate
RGR: Relative growth rate
NAR: Net assimilation rate

* Significance at 5per cent
** Significance at 1per cent
*** Significance at 0.1per cent
NS: Non significant

REFERENCES

Ahmad, S.I., Muhammad, S. K., Muhammad S. S., Gul S. S. and Iftikhar H. K., (2005). A study on heterosis and inbreeding depression in sunflower (*Helianthus annuus* L.). Songklanakarin J. Sci. Technol., 2005, **27**(1): 1-8.

Anand, N., (2012). Heterosis and combining ability in ridge gourd. M.Sc (Hort.) Thesis, Univ. Hortil. Sci., Bagalkot.

Anonymous, (2010). Package of practices for agricultural crops (Kannada), Univ. Agril. Sci., Dharwad, pp. 273-276.

Bharathi, L. K., Naik, G. and Dora, D. K., (2006). Correlation and path analysis in spine gourd (*Momordica dioca* Roxb.**).** The Orissa J. Hort., **33**(2): 105-108.

Blackman, V. H., (1919). The compound interest law and plant growth. Ann. Bot., **33**: 353 360.

Burton, G. W. and Devane, R. W., (1953). Estimating heritability in tall foscue (*Festuca arubdinaces*) from replicated clonal material. Agron. J., **45**: 478-481.

Chavan, M. L., Janagoudar, B. S., Dharmatti, P. R. and Koti, R. V**. (**2010). Effect of drought attributes of tomato (*Lycopersicon esculentum* Mill.,) genotypes. Indian J. Plant Physiol., **15(1)**: 11-18.

Choudhary B R, Pandey S, Singh P K and Singh R. (2011). Genetic divergence in hermaphrodite ridge gourd (*Luffa acutangula*). Vegetable Science **38**(1): 68–72.

Gayen, N. and Hossain, M., (2006). Study of heritability and genetic advance in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. J. Inter. Academicia, **10**(4): 463-466.

Grafiaus, J. E**.** 1959. A geometry of plant breeding. *Crop Sci*. **4**: 241-246.

Gregory, F. G., (1926) The effect of climatic conditions on growth of barley. Ann. Bot., **40**: 1-26.

Hanumegowda, K, Shirol A M, Mulge R, Shantappa T and Prasadkumar. (2012). Correlation co-efficient studies in ridge gourd [*Luffa acutangula* (L.) Roxb.]. Karnataka J. Agril. Sci. **25**(1): 160–2.

Islam, M. R., Hossain, M. S., Bhuiyan, M. S. R., Husna A. and Syed, M. A., (2009). Genetic variability and Path-coefficient analysis of bitter gourd (*Momordica charantia* L.). Int. J. Sustainable Agric., **1**(3): 53-57.

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

Kumar, S., Singh, R. and Pal, A. K. (2007). Genetic variability, heritability, genetic advance, correlation coefficient and path analysis in bottle gourd. Indian J. Hort., **64**(2): 163-168.

Lush, J. L., (1949). Heritability of quantitative characters in farm animals. Proc. of 85th Congress Genetics Heredities, Supplement, pp. 356-375.

Meena, D. R., Chauhan, J. S., Singh, M., Singh, R. H. and Meena, M. L., (2013). Genetic variation and correlation among physiological characters in Indian mustard (Brassica juncea L.) under high temperature stress. Indian J. Genet., 73(1): 101-104.

Narayanankutty, C., Sunanda, C. K. and Jaikumaran, U., (2006). Genetic variability and character association analysis in snake gourd. Indian J. Hort., **63**(4): 402-406.

Ninganur, B. T., (2002). Screening cotton genotypes for tolerance to drought using line source sprinkler irrigation technique. *Ph. D. Thesis*, Univ. Agril. Sci., Dharawad.

Prakash, M., (2012). Heterosis and combining ability in ridge gourd. M.Sc (Hort.) Thesis, Univ. Hortil. Sci., Bagalkot.

Radford, D. J., (1967). Growth analysis formulae; their use and abuse. Crop Sci., **7:** 171-175.

Rathod, V., (2007). Studies on genetic variability and molecular characterization of bitter gourd (*Momordica charantia* L) genotypes. *M.Sc (Hort.) Thesis*, Univ. Agril. Sci., Bangalore.

Reddy, K. P., Reddy, V. S. K. and Padma, S. S. V. **(**2013). Performance of parents and hybrids for yield and yield attributing characters in Ridge Gourd (*Luffa acutangula* (Roxb.) L.). *The Bioscan*, **8(4)**: 1373-1377.

Sharma, S.R., Mohan, J. and Gill, H. S., (1996). Genetic analysis of growth, photosynthesis and yield attributes in late cauliflower (*Brassica olarecea*). Indian J. Hort., **53**(3): 213-216.

Vivekandanan, A. S., Gunasena, H. P. M. and Shiavnygam, T., (1972). Statistical evaluation of the techniques used in the estimation of leaf area of crop plants. Indian J. Agril. Sci., **42:** 857-860.

Watson, D. J., (1952). The physiological basis of variation in yield. Advances in Agron., **4**: 101-104.