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Estimates of genetic variability, heritability and genetic advance for yield and yield component traits in ash gourd [*Benincasa hispida* (Cogn.)] genotypes

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ABSTRACT

Twenty-five diverse genotypes of ash gourd were evaluated to estimate variability, heritability and genetic advance over mean for fruit yield and yield component characters. Analysis of variance revealed significant differences for almost all the characters. High genotypic coefficient of variation was observed for fruits per plant, mean fruit weight, fruit yield per plant, fruit length, fruit girth and flesh thickness, which indicate that there exists high genetic variability and better scope for improvement of these characters through selection. The characters node to male flower, vine length, fruits per plant, mean fruit weight, fruit yield per plant, fruit length, fruit girth, flesh thickness, 100-seed weight, seeds per fruit and dry matter content had high heritability coupled with high genetic advance suggesting improvement of those characters through selection due to additive gene action. In the present study high heritability and low genetic advance was noted for days to first male and female flower indicating dominant gene action.

Key words: Ash gourd, Heritability, Genetic variability, Genetic advance.

INTRODUCTION

Ashgourd [*Benincasa hispida* (Cogn.)] is an important cucurbitaceous vegetable grown in China, India, Philippines and elsewhere in Asia. Immature ash gourd is coated in fine hairs which disappear and is replaced by a thick waxy cuticle as it ripens. The exterior colour can vary between dark green to a pale gray depending on the genotype. Ash gourd contains plenty of moisture and small amounts of fat, protein, carbohydrates and fibre, apart from calcium, phosphorous, iron, riboflavin, thiamine, niacin and Vitamin C. It is considered to be of medicinal value of particular importance to people suffering from nervousness and debility Resmi and Sreelathakumary (2012). The review of literature has indicated that only a meagre attempt has been made in crop improvement in ash gourd Manikandan *et al.* (2017). The effectiveness of selection in any crop improvement programme is primarily dependent on variation present in the population. Heritability and genetic advance are important selection parameters. The study of variability, heritability and genetic advance of different traits in the genetic stock will facilitate evaluation and identification of suitable genotypes. The estimates of heritability help in the selection of elite genotypes from diverse genetic population. Genetic advance measures the amount of progress that could be expected with selection in a character. High heritability coupled with high genetic advance indicates that the improvement could be made for a character by simple selection. In crop improvement only the genetic component is transmitted to the next generation. The extent of improvement further depends upon the intensity of selection and genetic advance obtained from the population. Hence the present study focuses on assessment of available genetic variability, heritability and genetic advance for yield and yield related characters in twenty five ash gourd genotypes.

MATERIALS AND METHODS

The basic material for the study included twenty-five collections of ash gourd from different ago climatic regions of South India including the released varieties of Kerala Agricultural University. The seeds of the twenty-five genotypes were laid out in randomised block design with three replications. In each replication four pits per genotype were taken and a single plant was maintained in each pit. Normal cultural methods as per the package of practices recommendations of the Kerala Agricultural University were adopted (KAU, 2007). Seeds were sown in pits of 60cm diameter and 35-45 cm depth taken at a spacing of 4.5 x 2.0 m. Fertilizers at the rate of 28:10:10 g NPK were given per pit. Weeding and raking of the soil were done at the time of fertilizer application.

Four plants per genotype were selected for recording the following biometric observations: days to first male flower, node to first male flower, days to first female flower, node to first female flower, vine length (m), branches per plant, fruits per plant, mean fruit weight (kg), fruit yield

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per plant (kg), fruit length (cm), fruit girth (cm), flesh thickness (cm), dry matter content (%), seeds per fruit and 100 seed weight (g). Data from mean of individual genotypes were subjected to method of analysis of variance and statistical analysis was performed to estimate genetic variability, phenotypic and genotypic coefficient of variation, heritability and genetic advance.

Variability that existed in the population for various characters were apportioned using the estimates of coefficient of variation.

For the character X_i,

Phenotype coefficient of variation, $PVC = \frac{\sigma_{pi}}{x_i} \times 100$

Genotypic coefficient of variation, $GCV = \frac{\sigma_{gi}}{x_i} \times 100$

Environmental coefficient of variation, $ECV = \frac{\sigma_{ei}}{x_i} \times 100$

Where σ_{pi}, σ_{gi} and σ_{ei} are the phenotypic, genotypic and environmental standard deviations respectively.

Jain (1982) proposed the mathematical relationship of variance estimates on computation of heritability, which is usually expressed as a percentage

Heritability (broad sense) $H^2 = \frac{\sigma_{gi}^2}{\sigma_{pi}^2} \times 100$

The heritability % were categorised as suggested by Robinson *et al*. (1949) as low (0-30), moderate (30-60) and high (above 60).

Genetic advance as percentage of mean was calculated as per the formula given by Lush (1949).

Genetic advance, $GA = \frac{kH^2 \sigma_{pi}}{\bar{x}_i} \times 100$

Where H^2 is heritability in broad sense, σ_{pi} is phenotypic standard deviation and k is the selection differential that is 2.06 in case of 5% selection in large samples (Miller *et al*. 1958). Genetic advance as percentage were categorised into low (<20%) and high (>20%) as suggested by Robinson *et al.* (1949).

RESULTS AND DISCUSSION

The mean performances of the twenty-five genotypes for all the characters are presented in Table 1. The analysis of variance with respect to the various characters revealed a wide range of variation for all the characters which suggests ample scope of improvement. Similar finding was reported by Farhana (2006). The range of variation was highest for seeds per fruit (93.3 – 1983.3) followed by fruit length (11.4 – 41.7 cm). Relatively low range of variability was recorded in respect to node to first female flower (17.7 – 28.3) and branches per plant (1 – 2.7).

The basic information which a breeder usually requires as a pre requisite to any breeding programme of a particular crop species is the extend of variability present in the available germplasm. Since the observed variability is the sum of variation arising due to genotypic and environmental effects, knowledge on the nature and magnitude of genetic variation contributing to gain under selection is essential. In the present study high phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for mean fruit weight, fruit yield per plant, flesh thickness and fruits per plant which indicates that there exists high genetic variability and better scope for improvement of these characters through selection (Table 2). High estimates of PCV and GCV were earlier reported for mean fruit weight (Singh *et al*. 2002), fruit yield per plant (Bairwa 2016), flesh thickness, fruit length and fruit diameter (Kanimozhi *et al*. 2015) and fruits per plant (Resmi and Sreelathakumary 2011) in ash gourd. Comparatively low GCV was observed for days to first male and female flower (Nagaraju *et al*. 2016) indicating presence of low variability and thus limiting the scope for further improvement through selection. Perusal of the data showed that fruit length, fruit girth and seeds per fruit had very less difference in PCV and GCV (32.8 and 32.2; 28.9 and 28.2; 70.8 and 70.4 respectively) indicating that variation in these traits are mainly due to genotype. Low level of difference between the magnitude of PCV and GCV for various traits in ash gourd was recorded by Gangopadhyay *et al.* (2008).

Information on heritability and estimates of genetic advance that could be obtained in the next cycle of selection are of vital importance to the breeder in deciding appropriate method of breeding. The estimates of heritability and genetic advance as percentage of mean of the various characters are expressed in the Table 2 and Fig 1. High heritability estimates were recorded for all the characters except node to first female flower and branches per plant, which had moderate heritability. High genetic advance was noted for node to first male flower, vine length, branches per plant, mean fruit weight, fruit yield per plant, fruits per plant, fruit length, fruit girth, seeds per fruit, flesh thickness, dry matter content and 100-seed weight. While days to first male flower, days to first female flower and number of nodes to first female flower recorded low genetic advance. Low estimates of genetic advance for various traits in ash gourd were recorded by Chandraprakash (2008).

High heritability and high genetic advance of characters is indicative of additive gene action suggesting the possibility of genetic improvement of those characters through selection. The characters node to male flower, vine length, fruits per plant, mean fruit weight, fruit yield per plant, fruit length, fruit girth, flesh thickness, 100-seed weight, seeds per fruit and dry matter content had high heritability coupled with high genetic advance. Similar results were also obtained by Latif *et al*. (2008) for node to

Table 1: Varietal differences with respect to various characters in ash gourd

Genotype	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
BH1	58.2	25.2	60.3	27.7	11.1	2.0	5.0	3.1	12.8	21.7	42.5	3.1	3.0	826.7	4.4
BH2	54.8	14.8	61.0	19.6	9.2	1.7	4.7	7.2	24.8	24.0	73.0	4.1	2.7	1910.0	4.3
BH3	61.7	12.0	67.7	17.7	12.9	1.7	2.7	6.3	14.9	38.4	63.5	4.0	3.5	1983.3	4.9
BH4	57.2	14.3	64.3	22.3	12.0	2.3	3.7	6.5	17.8	28.7	69.7	3.0	3.4	1543.3	6.4
BH5	57.2	13.2	68.3	20.0	12.0	2.0	2.3	6.4	13.1	41.7	50.3	3.5	4.1	933.3	4.7
BH6	63.3	26.3	67.3	19.7	15.1	1.3	5.0	2.3	11.2	20.7	45.6	2.0	3.5	340.0	3.9
BH7	57.0	13.7	60.4	20.2	10.3	2.3	3.3	6.3	19.8	23.4	74.3	3.2	3.1	1760.0.	5.0
BH8	65.6	19.9	65.7	28.3	8.4	2.7	4.7	2.6	13.9	19.7	35.1	1.9	3.5	258.3	2.2
BH9	57.0	15.4	59.9	21.2	12.3	1.0	4.0	6.7	21.6	23.0	52.3	2.2	3.0	1061.7	5.3
BH10	59.0	13.6	68.7	19.3	10.3	1.3	2.3	6.1	12.4	24.4	69.5	3.1	3.5	1386.7	6.8
BH11	59.7	12.7	61.3	21.0	9.2	1.7	3.3	3.2	8.4	26.0	72.2	4.5	2.5	386.7	6.2
BH12	57.2	16.7	66.3	21.0	8.3	1.3	3.3	4.8	13.3	16.3	49.1	3.1	3.2	603.3	6.1
BH13	59.3	18.1	64.3	19.0	10.7	2.0	4.3	5.2	19.2	35.5	62.7	5.0	3.6	693.3	4.6
BH14	58.3	15.6	64.7	20.0	14.8	1.0	4.0	7.6	24.4	28.3	70.8	3.6	3.0	590.0	6.4
BH15	55.5	15.3	66.4	24.1	7.1	1.3	5.0	1.0	5.4	16.9	30.8	2.2	3.9	493.3	3.9
BH16	57.4	17.0	70.7	21.7	8.0	2.0	6.3	0.8	3.8	12.2	30.3	1.2	4.5	176.7	3.5
BH17	62.7	16.0	64.7	20.2	11.7	1.3	4.0	3.7	15.1	24.4	44.0	2.8	3.1	666.7	5.9
BH18	63.0	15.3	67.0	21.7	11.2	2.0	7.3	0.8	6.2	13.2	34.0	1.1	4.3	93.3	5.1
BH19	58.7	12.3	60.7	18.7	11.1	2.3	6.3	1.4	8.1	20.0	36.4	2.4	3.8	416.7	3.6
BH20	60.3	14.7	59.5	19.8	9.5	2.3	5.3	7.3	30.8	36.9	67.7	5.2	2.9	623.3	4.8
BH21	62.3	11.3	76.0	18.0	8.1	2.0	7.3	0.9	5.6	11.4	29.3	0.9	4.3	103.3	3.3
BH22	62.7	19.7	71.3	23.7	10.4	2.3	5.0	6.2	30.2	33.3	57.2	3.8	3.0	480.0	5.0
BH23	57.0	14.8	71.7	18.7	10.7	1.0	4.0	6.2	17.3	24.6	52.2	3.0	3.4	580.0	4.7
BH24	49.0	15.5	58.0	18.5	10.8	1.3	3.7	5.2	14.2	29.3	51.7	3.2	3.3	716.7	4.4
BH25	53.0	8.7	63.7	17.7	11.5	1.7	3.3	5.9	14.9	31.0	48.0	4.2	3.1	676.7	6.0
Mean	58.7	15.7	65.2	20.8	10.7	1.8	4.4	4.6	15.2	25.0	52.5	3.0	3.4	772.1	4.9
F	10.2**	9.8**	9.9**	3.1**	37.8**	3.2**	6.5**	19.5**	28.6**	87.0**	60.2**	17.9**	37.0**	277.8**	46.5**
SE	1.03	1.25	1.42	1.55	0.32	0.27	0.59	0.53	1.36	0.87	1.92	0.27	0.08	32.7	0.16
CD	3.23	3.52	4.04	4.41	0.91	0.77	1.52	1.50	3.87	2.47	5.47	0.76	0.22	92.9	0.46

** Significant at 1%

X1- days to first male flower; X2- node to first male flower; X3- days to first female flower; X4- node to first female flower; X5- vine length (m); X6- branches per plant; X7- fruits per plant; X8- mean fruit weight (kg); X9- fruit yield per plant (kg); X10- fruit length (cm); X11- fruit girth (cm); X12- flesh thickness (cm); X13- dry matter content (%); X14- seeds per fruit and X15-100 seed weight (g)

Table 2: Estimates of genetic parameters with respect to yield and related characters in ash gourd.

Characters	Co-efficient of variation (%)		Heritability (H^2) %	Genetic advance as % of mean
	PCV	GCV		
Days to first male flower	6.75	5.86	75.30	10.48
Days to first female flower	7.52	6.51	74.84	11.60
Node to first male flower	27.39	23.66	74.61	42.09
Node to first female flower	16.89	10.86	41.36	14.39
Vine length	19.02	18.29	92.46	36.23
Branches per plant	35.18	22.92	42.46	30.77
Fruits per plant	35.44	28.54	64.83	47.33
Mean fruit weight	53.75	49.87	86.07	95.31
Fruit yield per plant	49.67	47.17	90.19	92.28
Fruit length	32.80	32.24	96.63	65.29
Fruit girth	28.91	28.21	95.18	56.69
Flesh thickness	39.39	36.30	84.89	68.89
Dry matter content	15.46	14.86	92.31	29.40
Seeds per fruit	70.82	70.44	98.93	144.32
100 seed weight	23.47	22.73	93.81	45.36

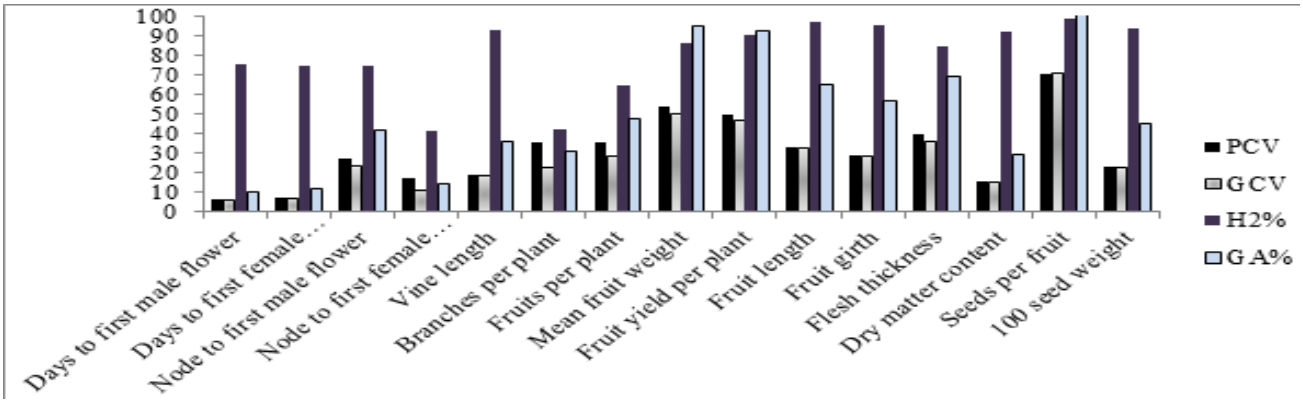


Fig 1: Variability parameters for various characters in ash gourd germplasm

male flower, Sureja *et al*. (2010) for fruits per plant and seeds per fruit and Sahu (2015) for average fruit weight and fruit yield per plant. The results are in conformity with indication that these characters are under additive gene effects and are more reliable for effective selection. High heritability and low genetic advance of characters indicate dominant gene action suggesting the possibility of genetic improvement through hybridisation. In the present study high heritability and low genetic advance was noted for days to first male and female flower.

CONCLUSION

The present study clearly indicates that greater variability exists in all the characters among the selected genotypes. The GCV estimates were high for mean fruit weight, fruit yield per plant and flesh thickness indicating higher magnitude of variability for these characters. The investigation suggests preponderance of additive gene effects for fruits per plant, mean fruit weight, fruit yield per plant and fruit length, while days to first male and female flower had non-additive gene action.

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