

STUDY ON GENETIC PARAMETERS AND CHARACTERS ASSOCIATION IN BOTTLE GOURD (*Lagenaria siceraria*)

Abstract

The present investigation entitled, "Study on Genetic Parameters and Characters Association In Bottle Gourd (*Lagenaria Siceraria*)" was conducted in horticulture research farm, Department of Horticulture Naini Agriculture Institute, Sam Higginbottom University of agriculture, technology and Sciences (SHUATS), Prayagraj (U.P), during zaid season 2022-23. 10 genotypes of bottle gourd i.e., IET 2021 BOGHYB-1, IET 2021 BOGHYB-2, IET 2021 BOGHYB-3, IET 2021 BOGHYB-4, IET 2021 BOGHYB-5, IET 2021 BOGHYB-6, IET 2021 BOGHYB-6, IET 2021 BOGHYB-7, F1 SUYASH, PRATAP, VIJETA) are evaluated under prayagraj agro-climatic condition. The experiment was laid in randomized block design with three replications. From the present investigation it is concluded that among 10 genotypes of Bottle gourd, 3 genotypes namely; IET 2021/BOGHYB-1 (7.8 kg/plant), VIJETA (7.553 kg/plant) and PRATAP (7.083 kg/plant) exhibited substantially higher fruit yield per plant and performed better for other desirable traits.

Keywords: Bottle Gourd, Genetic Parameters, Agro-Climatic

Introduction

Cucurbits are vegetable crops from the cucurbitaceae family, which principally consist of species that are eaten as food all over the world. 825 species and 118 genera make up the family. Next to China, India is the world's greatest producer of vegetables, producing 162.187 million tonnes of vegetables annually from 92.05 million hectares of land. 2012–2013 Indian Horticulture Database This amount serves capita⁻¹ intake on only 135 g as opposed to the stated requirement of 285 g capita⁻¹ day⁻¹ for a balanced diet, which is far less than what we actually need. Bottle gourd [*Lagenaria siceraria* L.] (2n=2x=22) belongs to family Cucurbitaceae and is one of the most ancient crops cultivated during summer throughout the world. The genus *Lagenaria* is derived from the word *lagena*, meaning the bottle. It is also known as Calabash, Doodhi and Lauki in different parts of India (Deore et al., 2009). Its primary centre of origin is Africa (Singh, 1990). The fruit make delicious supplement to the human diet and 100 g of fruits contain nearly 96 g water, 0.2 g protein, 0.1 g fat, 2.5 g carbohydrate, 0.6 g fiber, 0.5 g minerals, 20 mg calcium, 10mg phosphorus, 0.7 mg iron, 0.3 mg thiamine, 0.01 mg riboflavin and 0.2 mg niacin and energy 1.2 cal. Their seeds are good sources of lipids and proteins and it contains 45 percent oil and 35 percent protein (Achu et al., 2005).

Materials And Method

Experimental site

The experiment was conducted during Zaid season of the year 2021 – 22 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The area is situated in the South of Prayagraj on the right bank of Yamuna at Rewa road at a distance of about 6 km from Prayagraj city. It is situated at 25.45 °N latitude and 81.84 °E longitude on elevation of 98 meter from the sea level, with annual rainfall range of 1013.4 mm.

The experiment was laid out in Randomized Block Design each genotype with three replications, thus making a total 30 plots. There would be Eight plants in each plot. The experimental field was prepared with the help of cultivator and harrowing followed by planking. Nutrients have to be applied based on soil tests. 20 to 25 t/ha well decomposed FYM is to be applied at 10 to 15 days before sowing. NPK are applied in the ratio of 100, 50 and 50 kg/ha.

Statistical analysis

The statistical analysis was done for the quantitative characters studied. The mean values of five randomly selected plants per treatment per replication were used for statistical analysis for all the fifteen characters under study. The data were analysed statistically for obtaining ANOVA and various genetic parameters such as variability, genotypic and phenotypic variances heritability, genetic advance and genetic advance as percent of mean.

Table 1: Details of genotypes

S. no	Genotypes	Notation	Source
1	IET 2021 BOGHYB-1	H1	IIVR
2	IET 2021 BOGHYB-2	H2	IIVR
3	IET 2021 BOGHYB-3	H3	IIVR
4	IET 2021 BOGHYB-4	H4	IIVR
5	IET 2021 BOGHYB-5	H5	IIVR
6	IET 2021 BOGHYB-6	H6	IIVR
7	IET 2021 BOGHYB-7	H7	IIVR
8	F1 SUYASH	H8	FNT Agro Pvt.Ltd.

9	PRATAP	H9	JM seedz Pvt.Ltd.
10	VIJETA	H10	Safal seeds and biotech Ltd.

Days to emergence of first female flowering

The maximum days to emergence of first female flowering of 30.367 was recorded at T1 IET 2021/BOGHYB-1 followed by T2 IET 2021/BOGHYB-2 of 29.2 whereas minimum days to emergence of first female flowering of 28.7 was recorded in T8 F1 SUYASH.

Result and discussion

Growth Parameters

Vine length at 30 days

The maximum vine length of 114.27 cm at 30 days after sowing was recorded at T1 IET 2021/BOGHYB-1 followed by T7 IET 2021/BOGHYB-7 of 113.70 cm whereas minimum plant height of 111.23 cm was recorded in T10 VIJETA.

Vine length at 60 days

The maximum vine length of 183.90 cm at 60 days after transplanting was recorded at T1 IET 2021/BOGHYB-1 followed by T7 IET 2021/BOGHYB-7 of 182.03 cm whereas minimum plant height of 170.43 cm was recorded in T3 IET 2021/BOGHYB-3.

Vine length at harvest

The maximum vine length of 404.667 cm at harvest was recorded at T3 IET 2021/BOGHYB-3 followed by T2 IET 2021/BOGHYB-2 of 382.933 cm whereas minimum Vine length at final harvest of 115.433 cm was recorded in T5 IET 2021/BOGHYB-5.

primary branches at 30 days

The maximum primary branches of 3.767 at 30 days after sowing was recorded at T8 F1 SUYASH followed by T1 IET 2021/BOGHYB-1 of 3.733 whereas minimum primary branches of 3.3 was recorded in T10 VIJETA.

primary branches at 60 days

The maximum primary branches of 4.02 at 60 days after sowing was recorded at T6 IET 2021/BOGHYB -6 followed by T1 IET 2021/BOGHYB -1 of 3.67 whereas minimum primary branches of 3.25 was recorded in T7 IET 2021/BOGHYB-7.

Earliness Parameter

Days To Germinate

The maximum days to germinate of 4.80 was recorded at T7 Jaipuri Long followed by T5 IET 2021/RIGVAR-5 of 4.67 whereas minimum days to germinate of 3.54 was recorded in T6 IET 2021/RIGVAR-6.

Days to emergence of first male flowering

The maximum days to emergence of first male flowering of 28.767 was recorded at T10 VIJETA followed by T8 F1 SUYASH of 28.4 whereas minimum days to emergence of first male flowering of 23.133 was recorded in T3 IET 2021/BOGHYB -3.

Number of fruits per plant

The maximum Number of fruits per plant of 14.467 was recorded at T1 IET 2021/BOGHYB-1 followed by T10

Number of male flowers

The maximum number of male flower of 6.89 was recorded at T6 IET 2021/RIGVAR- 6 followed by T4 IET 2021/RIGVAR-4 of 6.78 whereas minimum number of male flower of 5.44 was recorded in T5 IET 2021/RIGVAR-5 and T7 Jaipuri Long.

Number of female flowers

The maximum number of female flower of 1.53 was recorded at T6 IET 2021/RIGVAR-6 followed by T1 IET 2021/RIGVAR-1 of 1.45 whereas minimum number of female flower of 0.56 was recorded in T7 Jaipuri Long.

Sex ratio

The maximum sex ratio of 1.78 was recorded at T3 IET 2021/BOGHYB-3 followed by T8 F1 SUYASH of 1.63 whereas minimum sex ratio of 1.51 was recorded in T1 IET 2021/BOGHYB-1.

Nodes number at which first male flower appears

The maximum Nodes number at which first male flower appears of 4.033 was recorded at T1 IET 2021/BOGHYB-1 followed by T2 IET 2021/BOGHYB-2 of 3.867 whereas minimum Nodes number at which first male flower appears of 3.233 was recorded in T6 IET 2021/BOGHYB-6

Nodes number at which first female flower

The maximum Nodes number at which first female flower appears of 3.8 was recorded at T5 IET 2021/BOGHYB-5 & T10 VIJETA followed by T2 IET 2021/BOGHYB-2 of 3.667 whereas minimum Nodes number at which first female flower appears of 3.267 was recorded in T4 IET 2021/BOGHYB-4.

Days to first fruit setting

The maximum days to first fruit setting of 35.4 was recorded at T9 PRATAP followed by T6 IET 2021/BOGHYB-6 of 35.167 whereas minimum days to first fruit setting of 30.4 was recorded in T2 IET 2021/BOGHYB-2.

Days to first fruit picking

The maximum days to first fruit picking of 44.267 was recorded at T8 F1 SUYASH followed by T10 VIJETA of 44.233 whereas minimum days to first fruit picking of 40.767 recorded in T3 IET 2021/BOGHYB-3.

Yield Parameters

Average Fruit Weight

The maximum average fruit weight (Kg) of 0.68 kg was recorded at T10 VIJETA followed by T8 F1 SUYASH of 0.557 kg whereas minimum average fruit weight of 0.32 kg was recorded in T6 IET 2021/BOGHYB-6.

VIJETA of 11.333 whereas minimum Number of fruits per plant of 10 was recorded in T7 IET 2021/BOGHYB-7.

Average fruit yield per plant

The maximum Average fruit yield per plant (kg) of 7.8 was recorded at T1 IET 2021/BOGHYB-1 followed by T10 VIJETA of 7.553 whereas minimum Average fruit yield per plant (kg) of 4.647 was recorded in T5 IET 2021/BOGHYB-5

Fruit length (cm)

The maximum Fruit length (cm) of 37.567 cm was recorded at T10 VIJETA followed by T9 PRATAP of 34.4 cm whereas minimum Fruit length (cm) of 12.667 cm was recorded in T1 IET 2021/BOGHYB-1.

Fruit diameter (mm)

The maximum Fruit diameter (mm) of 125.367 mm was recorded at T1 IET 2021/BOGHYB-1 followed by T10 VIJETA of 66.333 mm whereas minimum Fruit girth (mm) of 48.433 mm was recorded in T2 IET 2021/BOGHYB-2.

Fruit yield (q)

The maximum Fruit yield (q) per hectare of 346.63 was recorded at T1 IET 2021/BOGHYB-1 followed by T10 VIJETA of 88.35 whereas minimum Fruit yield (q) per hectare of 206.49 was recorded in T7 IET 2021/BOGHYB-7.

Physiochemical Properties

TSS

The maximum TSS of 4.363 was recorded at T1 IET 2021/BOGHYB-1 followed by T7 IET 2021/BOGHYB-7 of 3.88 whereas minimum TSS of 2.623 was recorded in T9 PRATAP.

Vitamin C

The maximum Vitamin C (mg) of 19.8 was recorded at T1 IET 2021/BOGHYB-1 followed by T8 F1 SUYASH of 17.367 whereas minimum Vitamin C (mg) of 14.067 was recorded in T6 IET 2021/BOGHYB-6.

Days to emergence of female flower

Both low GCV% and PCV% were recorded at Days to emergence of female flower, Plant Height 60DAT, Primary Branches 30DAS, Days to First Female Flower, Sex ratio, Days to First Fruit picking, Node at which 1st female flower appear.

Genetic Parameters

Both High GCV% and PCV% are recorded highest at vine length of final harvest (GCV % 52.55) (PVC%52.59) followed by fruit diameter, Fruit weight, Fruit length, Number of fruits per plant, Days to first fruit picking, Number of fruits per Plant, Average

Fruit Yield Per Plant and Fruit Length. Moderate GCV% and PCV% are recorded at Plant Spread, Days to First Flowering and Nodes number at which first Female flower appears. This also suggests that improvement in these characters might be gained to a reasonable extent therefore, selection for these characters would be effective because the response to selection is directly proportional to the variability present in the experimental material.

The heritability estimate was found to be high (>60%) for almost all the characters viz., Plant Height 30DAT, fruit weight, No. of fruits per Plant, Days to 1st fruit setting, Height 60DAT, Plant Spread, Days to First Flowering, Days to First Fruit picking, Fruit length, Yield per hectare, TSS, Vitamin C.

High genetic advance was observed for Fruit weight, No. of fruits/plant, Days to first fruit picking, Fruit Length, Fruit Girth, Yield per Hectare and Vine Length at Harvest, TSS, Ascorbic Acid. While other characters had low estimates of genetic advance. The high or moderate value of genetic advance indicates additive gene action whereas low genetic advance value indicates non-additive gene action. The high or moderate value of genetic advance indicates additive gene action whereas low genetic advance value indicates non-additive gene action.

The estimation of genetic advance for all the characters are presented in Genetic advance as percent mean was categorized as low (0-10%), moderate (10-20% and $\geq 20\%$) as given by Johnson et al., (1955) and Falconer and Mackay (1996). The genetic advance as percent mean was highest in all characters and have moderate estimates for Sex Ratio character only.

Genotypic correlation

Genotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Primary Branches 30 DAS, Days to First Flowering, Nodes at which first male flower appears, Nodes at which first female flower appears, Number of fruits per plant, TSS and Vitamin C. While negative significant association was observed with Plant Height 30DAS, Plant Height 60DAS, Plant Spread, Days to first male flowering, Sex ratio, Days to first fruit setting, Days to first fruit picking, Fruit weight, Fruit Girth, Yield per hectare, Vine Length per hectare.

Table 2. List of genotypes and their variability in different parameters for vine

Genotype	Vine length 30 Days	Vine length 60 Days	Vine length At Harvest	Primary branches at 30 days	Days to 1 st male flower emergence	Days to 1 st female flower emergence	Node at 1 st female flower emergence	Node to 1 st male emergence
IET 2021 BOGHYB-1	114.7	183.90	360.5	3.733	25.167	30.367	3.333	4.033
IET 2021 BOGHYB-2	112.3	173.37	382.933	3.367	23.167	29.2	3.667	3.867
IET 2021 BOGHYB -3	112.57	170.43	404.667	3.6	23.133	28.833	3.433	3.733
IET 2021 BOGHYB -4	112.37	173.90	118.867	3.3	23.433	29.367	3.267	3.4
IET 2021 BOGHYB -5	112.40	175.83	115.433	3.433	23.867	29.367	3.8	3.333
IET 2021 BOGHYB -6	112.67	178.30	179.7	3.633	24.333	29.733	3.367	3.233
IET 2021 BOGHYB-7	113.70	182.03	133.5	3.4	25.867	29.067	3.467	3.667
F1 SUYASH	113.10	173.20	160.6	3.767	28.4	28.7	3.633	3.533
PRATAP	112.73	173.27	140.6	3.367	23.833	29.133	3.567	3.5
VIJETA	111.23	174.23	206.3	3.3	28.767	30.2	3.8	3.633
F-Test	S	S	S	S	S	S	N/A	N/A
SE.d(±)	0.35	1.69	3.76	0.26	1.14	0.49	0.138	0.172
C.D at 5%	0.74	13.54	7.90	0.54	2.40	1.04	0.195	0.243
C.V	0.39	1.17	2.09	8.97	5.59	2.06	6.772	8.299

Table 3. List of genotypes and their variability in fruit yield

Genotype	Days to first fruit setting	Days to first fruit picking	Number of fruits per plant	Fruit Yield per plant (kg/ha)	Fruit Yield per (q/ha)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)
IET 2021 BOGHYB-1	33.433	42.9	14.467	7.8	346.63	0.507	12.667	125.367
IET 2021 BOGHYB-2	30.4	43.267	12.1	5.43	233.3	0.35	25.133	48.433
IET 2021 BOGHYB -3	32.967	40.767	11.133	4.963	220.57	0.347	25.667	54.667
IET 2021 BOGHYB -4	32.733	41.8	10.667	4.66	207.12	0.337	24.833	64.367
IET 2021 BOGHYB -5	34.6	43.433	11.3	4.647	206.5	0.343	26.7	57.467
IET 2021 BOGHYB -6	35.167	42.867	11.467	4.817	214.05	0.32	22.9	55.6
IET 2021 BOGHYB-7	34.667	43.633	10	4.647	206.49	0.33	26.233	61.867
F1 SUYASH	34.767	44.267	10.9	5.687	252.58	0.557	31.833	56.867
PRATAP	35.4	42.8	11.1	7.083	314.78	0.64	34.4	68.133
VIJETA	34.3	44.233	11.333	7.553	335.67	0.68	37.567	66.333
F-Test	S	S	S	S	S	S	S	S
SE.d(±)	0.463	0.68	0.639	0.395	25.37	0.08	2.50	4.32
C.D at 5%	0.655	0.962	0.903	0.558	53.31	0.16	5.26	9.08
C.V	2.371	2.741	9.664	11.936	12.25	21.22	11.44	8.03

Table 4. List of genotypes showing variability in chlorophyll content, ascorbic acid and TSS

Genotype	Chlorophyll content	Ascorbic acid	TSS	Sex ratio
IET 2021 BOGHYB-1	43.633	19.8	4.363	1.51
IET 2021 BOGHYB-2	39.733	14.333	2.673	1.59
IET 2021 BOGHYB -3	39.633	14.333	2.677	1.78
IET 2021 BOGHYB -4	40.3	14.233	2.667	1.53
IET 2021 BOGHYB -5	41.333	15.667	3.65	1.53
IET 2021 BOGHYB -6	40.833	14.067	3.07	1.62
IET 2021 BOGHYB-7	40.6	16.833	3.88	1.55
F1 SUYASH	40.667	17.367	3.457	1.63

PRATAP	40.9	16.067	2.623	1.64
VIJETA	40.7	17.2	3.757	1.54
F-Test	S	S	S	S
SE.d(±)	0.94	0.44	0.20	0.07
C.D at 5%	1.97	0.93	0.42	0.14
C.V	2.81	3.37	7.38	5.02

Table 5. Genetic parameters for different characters in Bottle gourd

Characters	GCV(%)	PCV(%)	HBS(%)	GAM(%)	GA(5% LOS)
Days to 1st picking	1.92	3.35	32.84	0.97	2.26
No. of Fruits/Plant	8.8	13.07	65.95	0.22	49.41
Fruit Wt	29.54	36.37	82.32	12.37	46.16
Fruit Length	24.7	27.22	94.29	43.04	65.3
Fruit Diameter	32.64	33.62	75.61	2.16	37.64
Yield/Plant	21.02	24.17	74.88	95.62	37.68
Yield/ha	21.14	24.43	99.84	238.29	108.16
Vine length	52.55	52.59	32.87	0.5	1.7
Days to emergence of 1st Female Flower	1.44	2.52	65.28	3.19	12.76
Days to emergence 1st Male Flower	7.67	9.49	22.85	0.13	3.63

Table 6. Genetic parameters for different characters in Bottle gourd

Characters	GCV(%)	PCV(%)	HBS(%)	GAM(%)	GA(5% LOS)
Node at which 1st Female Flower appear	3.69	7.71	22.85	0.13	3.63
Node at which 1st Male Flower appear	4.86	9.62	25.57	0.18	5.07
Days to 1st Fruit Setting	4.25	4.86	76.22	2.58	7.64
No. of Primary Branches	7	8.91	-1.38	-0.01	-0.25
Chlorophyll Content	2.19	3.56	37.84	1.13	2.77
TSS	18.55	19.97	86.36	1.17	35.52
Ascorbic acid	11.44	11.92	92.00	22.60	3.61
Plant height(30DAT)	3.42	16.88	4.11	1.43	1.56
Plant height(60DAT)	2.34	2.61	79.84	4.30	7.56
sex ratio	4.15	6.52	40.59	5.45	0.09

2. Both High GCV% and PCV% are recorded highest at vine length at final harvest (GCV % 52.55) (PVC%52.59) followed by Fruit Diameter , Fruit weight, Fruit length , Number of Fruits per Plant, Fruit Yield Per Hectare and Fruit Yield Per Plant . Moderate GCV% and PCV% are TSS, Ascorbic acid, Days to First Fruit Setting and Number of Primary Branches. This also suggests that improvement in these characters might be gained to a reasonable extent therefore, selection for these characters would be effective because the response to selection is directly proportional to the variability present in the experimental material. High genetic advance was observed for Plant Height 30DAS, Plant Height 60DAS, Plant Spread, Days to First Male Flowering, Days to first fruit setting, Days to first fruit picking, Fruit Length, Fruit Girth, Yield per Hectare and Vine Length.

3. Genotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Primary Branches 30 DAS, Primary Branches 60 DAS, Days to First Flowering, Nodes at which first male flower appears, Nodes at which first female flower appears, Number of fruit per plant, TSS and Vitamin C. Phenotypic correlation coefficient analysis revealed that fruit yield plant-1 (kg) showed positive significant association with Plant Height 30DAS, Plant Height 60DAS, Primary Branches 30DAS, Days to First Flowering, Days to first female flowering, Sex Ratio, Nodes at which first female flower appears, Days to first fruit setting, Fruit weight, Fruit Girth, Yield per Hectare, Vine Length at Harvest, TSS and Vitamin C. This indicated that priority should be given to these characters during selection for improvement in Bottle gourd.

Table 7. Genotypic correlation for different characters in Bottle Gourd

Genotypic coorelation for different characters in bottle gourd										
-	plant height	fruit length	days to first fruit picking	fruit weight	fruit diameter	yield per plant	yield per hectare	vine length	days first fruit picking	days to first fruit setting
var 1	1	0.954	0.942	0.934	0.927	0.985	0.952	0.95	0.893	0.947
var 2		1	0.998	0.81	0.805	0.922	0.846	0.852	0.753	0.847
var 3			1	0.78	0.774	0.901	0.818	0.823	0.717	0.817
var 4				1	0.999	0.973	0.998	0.994	0.99	0.991
var 5					1	0.972	0.997	0.995	0.993	0.993
var 6						1	0.986	0.987	0.946	0.983
var 7							1	0.997	0.982	0.994
var 8								1	0.985	0.999
var 9									1	0.987
var 10										1

Table 8. Phenotypic correlation for different characters in Bottle Gourd

phenotypic correlation for different characters in bottle gourd										
-	plant height	fruit length	days to first fruit picking	fruit weight	fruit diameter	yield per plant	yield per hectare	vine length	days first fruit picking	days to first fruit setting
var 1	1									
var 2	0.954	1								
var 3	0.942	0.998	1							
var 4	0.934	0.81	0.78	1						
var 5	0.927	0.805	0.774	0.999	1					
var 6	0.985	0.922	0.901	0.973	0.972	1				
var 7	0.952	0.846	0.818	0.998	0.997	0.986	1			
var 8	0.95	0.852	0.823	0.994	0.995	0.987	0.997	1		
var 9	0.893	0.753	0.717	0.99	0.993	0.946	0.982	0.985	1	
var 10	0.947	0.847	0.817	0.991	0.993	0.983	0.994	0.999	0.987	1

Conclusion:

From the present investigation it is concluded that among 10 genotypes of Bottle gourd, 3 genotype namely; IET 2021/BOGHYB-1 (7.8 kg/plant), VIJETA (7.53 kg/plant) and PRATAP (7.08 kg/plant) ; kg/plant) exhibited substantially higher fruit yield per plant and performed better for other desirable traits. The analysis of variance for all characters of bottle gourd genotypes revealed presence of good extant of significant differences among the genotypes for all traits. Henceforth, the data for all characters that showed sufficient amount of significant differences were subjected to further

statistical analysis.

Reference:

1. Arora, S.K., Pandit, M.L., Pratap, P.S. and Sindhu, A.S. 1983. Variability and correlation studies in sponge gourd (*Luffacylindrica* Rome).
2. Janaranjani, K.G and Kanthaswamy, V. 2015. Correlation Studies and path analysis in Bottle gourd. *J. Hort.* 2 (1): 1-4.
3. Badade, D.S., Warade, S.D. and Gaikawad, S.K. 2001. Genetic divergence in bottle gourd of maharashtra, *Agri. Uni.*, 26: 137-139.

4. Bhave, S.G., Bendale, V.W., Pethe, V.B., Bede, Singh, A.K., Pan, R.S. and Bhavana, P. 2012. S.A. and Mehta, J.L. 2003. Correlation and path analysis in segregating generation of bitter gourd. J. Soil and Crop, 13(1): 33-40.
5. Bouyoucos, D.G.J. 1952. Hydrometer Method for making partical size analysis of soli. J. Agronomy, 54: 464-465.
6. Kumar, P. and Syamal, M.M. 2009. Genetic variability, heritability and genetic advance in bottle gourd [*Lagenaria seceraria* (Molina) Standl.]. Indian J. Arid Hort. 4 (2): 95 -67
7. Choudhary, R., Suresh Kumar. 2011. Genetic analysis in ridge gourd [*Luffa acutangula* (Roxb.) L.] under hot arid conditions. Indian J. Arid Horticulture, vol.6 (1-2): 55-58.
8. Singh, A.K., Pan, R.S. and Bhavana, P. 2012. Correlation and path coefficient analysis for quantitative traits in early season bottle gourd [*Lagenaria seceraria* (Molina) Standl.]. Veg. Sci. 39 (2): 198-200.
9. Ara Z, Zakaria M, Uddin MZ, Rahman MM, Rasul MG, Kabir AFMR. 2014. Correlation matrix among different parameters of bottle gourd genotypes. International Journal of Natural and Social Sciences. 1:48-51
10. Pandit, M.K., Mahato, B. and Sarkar, A. 2009. Genetic variability, heritability and genetic advance for some fruit characters and yield in bottle gourd (*Lagenaria siceraria* Molina. Standl.) Genotypes. Acta Hort. 809: 221

