Original Research Article

Evaluation of Sponge gourd *(Luffa cylindrica* L.) hybrids for growth, yield and quality traits

Abstract

A set of ten hybrids of Sponge gourd were evaluated for studying of "Evaluation of Sponge gourd (*Luffa cylindrica* L.) Hybrids for growth, yield and quality traits". The experiment was conducted in a Randomized Block Design with three replications during the Kharif season, 2020- 2022 at Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini. The analysis of variance showed that considerable variability existed among the hybrids showing possibilities of further genetic improvement, in Sponge gourd, Hybrid AG-61 (153.30) is performed superior in Prayagraj, having highest fruit yield q/ha than other tested hybrids and showing superiority for yield and yield attributes. The high heritability was recorded for the characters node days to first picking. Genetic advance as percentage of mean was observed lowest for fruit days to first picking. Fruit yield (Kg/plant) showed a positive and significant correlation with Fruit yield (Kg/plot) at both genotypic and phenotypic level. Genotypic path coefficient analysis revealed that vine length (cm), total number of harvest and fruit yield (Kg/plot) showed the positive direct effect on fruit yield (kg/plant) at genotypic level. Phenotypic path coefficient analysis revealed that number of fruits per plant and fruit yield (Kg/plot) showed the positive direct effect on fruit yield (Kg/plant) at phenotypic level. Clustering pattern indicated that cluster I is largest cluster comprising 5 out of 10 hybrids. Cluster I, II and III was characterized by high mean value for fruit yield (kg/plant) and low mean values for fruit yield (kg/plot). The highest contribution in manifestation of genetic divergence was exhibited by fruit diameter (cm), fruit weight per plant (g). Thus, selections for these characters will be proved efficient for the improvement for Sponge gourd cultivation

Keywords: Sponge gourd, variability, correlation and path coefficient analysis, genetic diversity.

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More clearly the novelty of this research

1.INTRODUCTION

Sponge gourd [*Luffa cylindrica* (L.) Roem.] is an important vegetable crop having chromosome no (2n=26). It is an annual climbing plant with cross pollinated nature. It is difficult to assign with accuracy the indigenous area of Luffa species. They have a long history of cultivation in tropical countries of Asia and Africa. Indo-Burma is reported to be the centre of diversity for sponge gourd and is originated in subtropical Asian region particularly India. (**Kalloo, 1993**). Luffa commonly called Sponge gourd, loofah, vegetable sponge, bath sponge or dish cloth gourd, is a member of Cucurbitaceous family. The vernacular names of sponge gourd are kali tori, ghia tori, torianemia, nenuwa, chiori, dundul, ghosaligilka, bhol or tarada and ghiraula in different parts of the world.

The sponge gourd is now widely cultivated in Malaysia, Korea, Japan, Taiwan and China for medicinal purpose. In India the crop is widely grown in U.P., Bihar, W.B., Orrissa and Kerala (**Arya and Prakash, 2002**). In Chhattisgarh, sponge gourd is being grown on about 2597 ha

with an annual production of 23447 MT (**Anon 2017**) particularly in Mahasamund, Kanker, Raigarh, Korba and Koria district.

In India the crop is widely grown in Uttar Pradesh, Bihar, West Bengal, Orissa, Assam, Andhra Pradesh and Kerala. Sponge gourd is commonly grown for its immature tender fruits as well as for sponge which is used for scrubbing purpose. Tender fruits are rich in vitamin A, vitamin C and iron. The fibrous vascular system inside the fruit often separating from the skin, flash and seeds, can be used as a bathroom sponge, as a component of shock absorbers, as a sound proof linings, as a utensils cleaning sponge, as packing materials for making crafts as a eaters factories and as a part of sole of shoes. Sponge gourds are also used as absorbent (**Altinisik et al. 2010**). Sponge gourd struts are characterized by a micro cellular architecture with continuous hollow micro channels, which form vascular bundles and yield a multimodal hierarchical pore system. The cellulose content varies from 55 to 90%, the lignin content is within the range of 10 and 23%, and the hemicelluloses content is around 8 and 22% and ash 2.4%. The tender fruit used as vegetable which is easily digestible and increases appetite when consumed.

The edible fresh and tender fruit contains 94 percent moisture and large number of chemical components including 16Cal per 100g with 9.5g carbohydrates, 2g of protein, 0.25g of fat, 10ug of vitamin A, 12.5mg of vitamin C besides minerals like sodium, calcium, potassium and phosphorus (2.5g, 30g, 375g and 62.5mg respectively). Besides being a vegetable, the mature, dry fruit consist of a hard shell surrounding a stiff, dense network of cellulose fibre (sponge) which is a good source of fiber used in industries for filler and cleaning the motor car, glass wares. Sponge gourd is an annual climber and monoecious vegetable.

In India sponge gourd and ridge gourd are grown as mixed crops in river beds cultivation and sole crop in the arable land. The sponge gourd is now widely cultivated in Malaysia, Korea, Japan, India, Central America, Thailand, Philippines, Indonesia, Taiwan and China for medicinal purpose. Japan is main exporter while, the main importers of sponge gourd are Brazil and U.S.A. In India the crop is widely grown in Uttar Pradesh, Bihar, West Bengal, Orissa, Assam, Andhra Pradesh and Kerala (**Arya and Prakash, 2002**). In Chhattisgarh, sponge gourd is being grown on about 2597 ha. with an annual production of 23447 metric tones (**Anon 2017**) particularly in Mahasamund, Kanker, Janjgir-chapa, Raigarh, Korba, Raigarh, Koria district.

Sponge gourd is commonly grown for its immature tender fruits as well as for sponge which is used for scrubbing purpose. Tender fruits are rich in vitamin A, vitamin C and iron (**Yawalker, 2004**). When the fruits of sponge gourd are cooked, they are easily digestible and are very appetizing, so its use is recommended to the patients suffering from malaria or other seasonal fevers. The dried fruits are used as bathing sponge, increase blood circulation, and the credited as a relief for rheumatic and arthritic suffers. The sponge gourd oil is also extracted from seeds for industrial uses.

The fibrous vascular system inside the fruit often separating from the skin, flash and seeds, can be used as a bathroom sponge, as a component of shock absorbers, as a sound proof linings, as a utensils cleaning sponge, as packing materials for making crafts as a ieters factories and as a part of sole of shoes (**Bal et al. 2004**). Sponge gourds are also used as absorbent (**Altinisik et al.2010**). Flowers are yellow and showy having five petals. The inflorescence of staminate flower is emerged in racemes while the pistillate flowers are

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solitary with short and long pendunculate. Both types of flower may occur in the same leaf axial. Fruits are nearly cylindrical, 15 to 30 cm long straight or curved, normally light furrows or strips but not ribbed.

As it is cultivated since long years back, and having cross pollination nature has resulted in a large amount of variation in sponge gourd for many economically important traits. In our country, huge range of variability is available, in the landraces or cultivars, in terms of qualitative as well as quantitative characters. Germplasm is a prerequisite for any breeding programme, serve as variable source material as it provides scope for building the genetic variability.

Progress in any breeding programme depends upon the magnitude of useful variability present in the population and the extent to which the desirable characters are heritable. Study of variability, heritability and genetic advance in the germplasm will help to ascertain the real potential value of the genotypes. The greater genetic diversity in population, provide more genetic potentiality and thereby wider scope for the improvement of the crop. The main objective of high yielding varieties with greater fruit number and weight, uniform thick cylindrical fruits free from bitterness, high female: male sex ratio, earliness, and non-fibrous fruit at edible stage and resistance to powdery mildew and downy mildew. Depending on genetic variability present in base population viz., character association, cause and effect relationship, heritability and genetic advance, breeders can make an effective selection in a breeding programme. Genetic variability increases the genetic potentiality and wider scope for improvement in the genotypes. Genotypic and phenotypic coefficient of variation is useful in detecting the nature and magnitude of present in the available genotype. The efficiency of selection in any breeding programme mainly depends upon the knowledge of association of the characters. So, it is necessary to ascertain the inter relationship among different traits and with yield too.

Correlation and path coefficient analysis are the important biometrical tools, which are effective for determining the various yield components of different crops leading to selection of superior genotypes. Therefore, for a rational approach for the improvement of 4 yield, it is essential to have information on the association between different yield components and their relative contribution to yield. Knowledge of such relationship is essential in selection for the simultaneous improvement of yield components and which in turn affect the yield. Path coefficient analysis as suggested by (**Wright, 1921**) on the other hand gives a clear picture about cause and effect as it splits the correlation into the estimates of direct and indirect contribution of each character towards yield.

Sponge gourd is an annual climber and monoecious vegetable. There is wide variability in size of fruit; ranging from a few centimeters to one meter, fruit shape and colour as traits are complex and controlled by several genes (**Beyer et al., 2002**);(**Zalapa et al., 2006)** . Evaluation of genotypes to assess the exiting variability is considered as preliminary step in any crop improvement programme. In order to pursue an effective breeding programme, the present investigation was carried out to gather information on genetic variability, heritability, correlation and path analysis for different characteristics of sponge gourd. There is wide variability in size of fruit; ranging from a few centimeters to one meter, fruit shape and colour as traits are complex and controlled by several genes (**Zalapa et al., 2006**). It is a cross pollinated vegetable, thus, its natural population has tremendous variability for fruit shape,

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color, taste etc. Evaluation of genotypes to assess the exiting variability is considered as preliminary step in any crop improvement programme. In order to pursue an effective breeding programme, the present investigation was carried out to gather information on genetic variability, heritability, correlation and path analysis for different characteristics of sponge gourd.

2.MATERIAL AND METHODS

This chapter contains the details of the materials used and the methods adopted in the present study entitled "Evaluation of sponge gourd (*Luffa cylindrica* L.) hybrids for growth , yield and quality traits" under Prayagraj agro-climatic conditions, was carried out on genetic variability, heritability, correlation, path coefficient analysis and genetic divergence in sponge gourd during 2021-2022 at the Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Prayagraj is situated at an elevation of 78 meters above sea level at 25.870 North latitude and 81.150 E longitudes. This region has a sub-tropical climate prevailing in the South-East part of U.P. with both the extremes in temperature, i.e., the winter and the summer. In cold winters, the temperature sometimes is as low as 320 F in December – January and very hot summer with temperature reaching up to 1150 F in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4 (cm) with maximum concentration during July to September months with occasional showers in winters.The experiment was laid out in Randomized Block Design. The experimental area was divided into plots of 7.5m x 3.0 m size. Pits of 45 cm x 45 cm x 30 cm size were dug at a spacing of 3.0 m x 60 cm in each plot. Well decomposed farmyard manure @ 25 t ha-1 was incorporated into the pits by mixing with the soil uniformly as basal application and filled up to 3-5 cm above the ground level. Recommended dose of fertilizers 80 kg N, 60 kg P2O5 and 60 kg K2O was applied to the soil. The entire quantity of phosphorus and potassium and half of nitrogen were mixed thoroughly and placed ridges in each plot in equal amount as basal dose before sowing. Two top dressings with nitrogen at 45 DAS and 60 DAS was done.

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3.RESULT AND DISCUSSION

The present investigation entitled **"Evaluation of Sponge gourd (*Luffa cylindrica* L.) hybrids for growth , yield and quality traits."** was conducted during 2021-2022 at Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Science and Technology. The experiment was comprised of 10 hybrids of sponge gourd laid out in randomized block design (RBD) with three replications to estimate the parameters of variability, correlation coefficient and path analysis.

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The analysis of variance indicated that the mean sum of square due to hybrids were highly significant for all the characters. Significant mean sum of squares due to fruit yield and attributing characters revealed existence of considerable variability in material studied for improvement of various traits.

Table 1 Analysis of variance for fruit yield and its component characters in sponge gourd

Sl.No.	Source Degrees of freedom	Replication df=2	Treatment df=9	Error df=18
1	Days to first picking	0.1580	0.235**	0.059
2	Vine length (cm)	5.2220	20.25**	5.066
3	Total number of harvest	0.0640	0.179**	0.018
4	Number of fruits per plant	0.080	0.199**	0.04
5	Average fruit weight (g)	24.7420	32.264*	12.414
6	Fruit length (cm)	1.890	2.358*	0.943
7	Fruit diameter (cm)	0.9910	2.699**	0.54
8	Fruit yield (Kg/plant)	0.1570	0.854**	0.054
9	Fruit yield (Kg/plot)	0.5850	1.141**	0.293
10	Fruit yiel d (q/ha)	14.3440	24.666*	7.144

3.2 The maximum fruit yield(kg/plant) was recorded by AG-61(2.74kg/plant) which was followed by SHYAAM,FHS-5044,ZINNAT and STAR-509whereas,minimum fruit yield (kg/plant) was recorded from SERENA (0.81).

The maximum fruit yield (kg/plot) was recorded in AG-61(11.13) which was followed by SHYAAM,FHS-5044,ZINNAT and STAR-509 whereas, minimum fruit yield was recorded from SERENA (9.10).

The maximum fruit yield (q/ha) was recorded in AG-61 (153.30) which was followed by SHYAAM,FHS-5044,ZINNAT and STAR-509 whereas, minimum fruit yield (q/ha) was recorded from SERENA (145.33).

Table no 2 Mean performances of Sponge gourd hybrids for fruit yield and its component traits.

Sl. No.	Hybrids	Days to first picking	Vine length (cm)	Total number of harvest	Number of fruits per plant	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield (Kg/plant)	Fruit yield (Kg/plot)	Fruit yield (q/ha)
1.00	ZINNAT	48.22	183.03	2.22	4.56	109.89	23.33	13.89	2.36	9.89	150.97
2.00	STAR-509	48.44	178.60	2.56	4.11	113.56	21.28	14.45	2.31	9.73	150.93
3.00	FHS-5044	49.09	181.73	2.11	4.00	107.89	22.50	12.61	2.39	9.94	151.23
4.00	GR-376	48.89	183.20	2.11	4.11	110.56	22.67	13.28	2.26	9.67	150.68

5.00	KSGH-55	48.43	180.67	1.78	3.89	108.89	22.78	12.94	2.17	9.58	145.78
6.00	AG-61	48.33	180.80	2.22	4.22	115.67	23.11	13.67	2.74	11.13	153.30
7.00	SHYAAM	48.77	177.83	2.67	3.67	111.56	23.28	13.97	2.62	10.77	151.80
8.00	SERENA	48.53	177.16	2.33	3.89	105.56	23.89	14.27	0.81	9.10	145.33
9.00	JANAK	48.66	179.78	2.22	4.33	105.44	22.67	15.67	2.18	9.66	149.50
10.00	SARIKA	48.89	184.47	2.22	3.89	108.00	21.06	12.56	1.88	9.38	145.70
Mean		**48.62**	**181.03**	**2.24**	**4.07**	**109.70**	**22.66**	**13.73**	**2.17**	**9.89**	**149.52**
CV		**0.50**	**1.24**	**5.99**	**4.92**	**3.21**	**4.29**	**5.35**	**10.73**	**5.48**	**1.79**
SEm		**0.14**	**1.30**	**0.08**	**0.12**	**2.03**	**0.56**	**0.42**	**0.13**	**0.31**	**1.54**
CD at 5%		**0.42**	**3.86**	**0.23**	**0.34**	**6.04**	**1.67**	**1.26**	**0.40**	**0.93**	**4.59**
CD at 1%		**0.57**	**5.29**	**0.32**	**0.47**	**8.28**	**2.28**	**1.73**	**0.55**	**1.27**	**6.28**
Minimum		**48.22**	**177.16**	**1.78**	**3.67**	**105.44**	**21.06**	**12.56**	**0.81**	**9.10**	**145.33**
Maximum		**49.09**	**184.47**	**2.67**	**4.56**	**115.67**	**23.89**	**15.67**	**2.74**	**11.13**	**153.30**
Treatment		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

3.3 High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits Fruit yield (Kg/plant) (23.783 & 26.089).

The high heritability was recorded for the characters node days to first picking (50.009), total number of harvest (74.815), number of fruits per plant (56.985), fruit diameter (cm) (57.132) and fruit yield (kg/plant) (83.1).

Table no 3 Parameters of variability for fruit yield and its components in Sponge gourd

Genetic parameters	Days to first picking	Vine length (cm)	Total number of harvest	Number of fruits per plant	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield (Kg/plant)	Fruit yield (Kg/plot)	Fruit yield (q/ha)
Var Environmental	0.059	5.066	0.018	0.04	12.414	0.943	0.54	0.054	0.293	7.144
ECV	0.499	1.243	5.992	4.92	3.212	4.286	5.352	10.725	5.478	1.788
Var Genotypical	0.059	5.061	0.054	0.053	6.617	0.472	0.72	0.267	0.283	5.84
GCV	**0.499**	**1.243**	**10.327**	**5.662**	**2.345**	**3.031**	**6.179**	**23.783**	**5.378**	**1.616**
Var Phenotypical	0.118	10.127	0.072	0.093	19.031	1.414	1.26	0.321	0.576	12.985
PCV	**0.705**	**1.758**	**11.94**	**7.501**	**3.977**	**5.249**	**8.175**	**26.089**	**7.677**	**2.41**
h2 (Broad Sense)	**50.009**	**49.975**	**74.815**	**56.985**	**34.768**	**33.34**	**57.132**	**83.1**	**49.075**	**44.979**
Genetic Advancement 5%	**0.353**	**3.276**	**0.413**	**0.358**	**3.124**	**0.817**	**1.321**	**0.97**	**0.767**	**3.339**
Gen.Adv as % of Mean 5%	**0.727**	**1.81**	**18.401**	**8.805**	**2.848**	**3.605**	**9.621**	**44.661**	**7.761**	**2.233**

FIG 1 Genetic advance as percentage of mean was observed lowest for fruit days to first picking, vine length (cm), total number of harvest, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit diameter (cm), fruit yield (kg/plant), fruit yield (kg/plot) and fruit yield (q/ha).

Reveals that fruit yield (Kg/plant) showed a positive and significant correlation with Fruit yield (Kg/plot). It showed non-significant positive association with total number of harvest, average fruit weight (g), fruit length (cm) and fruit diameter (cm) at genotypic level. Reveals that fruit yield (Kg/plant) showed a positive and significant correlation with Fruit yield (Kg/plot). It showed non-significant positive association with ,Total number of harvest, Fruit length (cm) and Fruit diameter (cm) at phenotypic level.

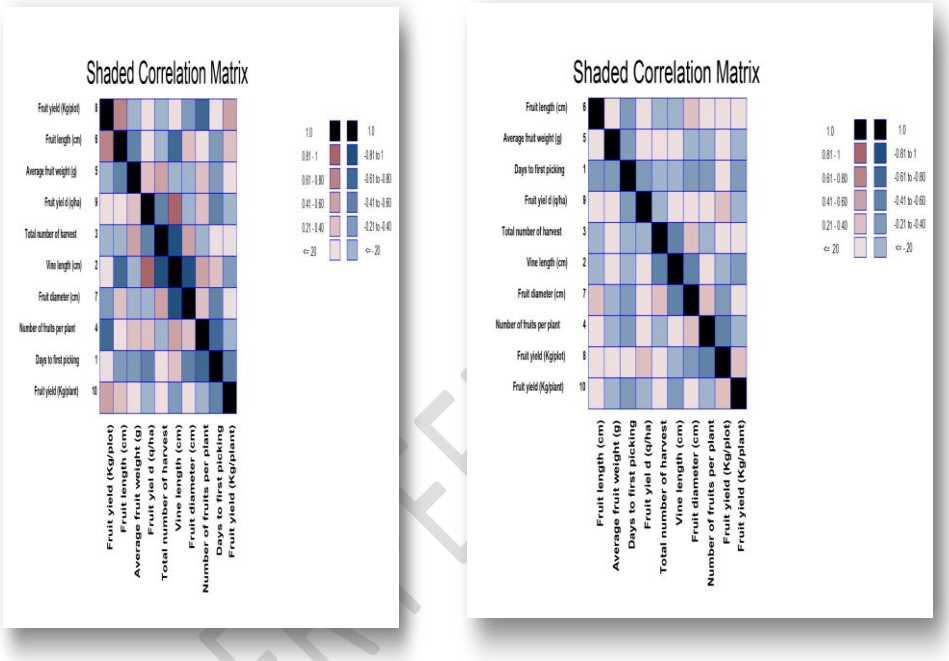

Fig 1 Genotypic and Phenotypic correlation coefficient between fruit yield and its component traits

in Sponge gourd

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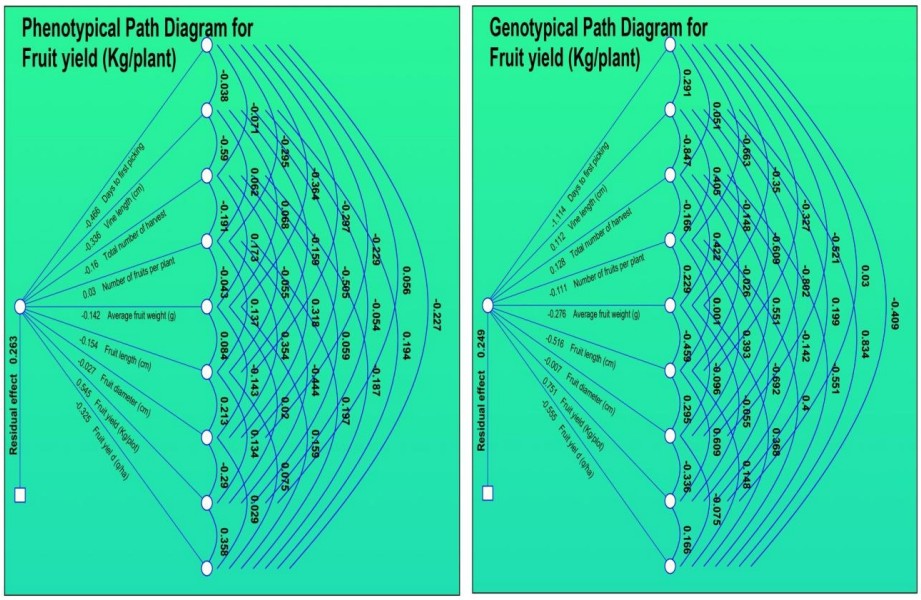

Fig 2 Genotypic and Phenotypic path co- efficient for fruit yield and its components in Sponge gourd

Genotypic path coefficient analysis revealed the vine length (cm), total number of harvest and fruit yield (Kg/plot) showed the positive direct effect on fruit yield (kg/plant) at genotypic level. Phenotypic path coefficient analysis revealed the number of fruits per plant and fruit yield (Kg/plot) showed the positive direct effect on fruit yield (Kg/plant) at phenotypic level.

Table 4 Clustering pattern indicated that cluster I is largest cluster comprising 5 out of 10 hybrids. On the other hand cluster II, comprised 4 hybrids and cluster III comprised hybrid1.

The inter cluster distance was maximum between III and I (54.52) followed by II and I (45.55) and II and III (37.57).

Cluster I, II and III was characterized by high mean value for fruit yield (kg/plant) and low mean values for fruit yield (kg/plot).

In the present investigation the highest contribution in manifestation of genetic divergence was exhibited by fruit diameter (cm), fruit weight per plant (g),number of fruits per plant and fruit length (cm).

Table no 4 Average of intra- and inter- clusters D^2 values for four clusters.

	Cluster 1	Cluster 2	Cluster 3
Cluster 1	20.48	45.55	54.52
Cluster 2	45.55	21.66	37.57
Cluster 3	54.52	37.57	0

4.CONCLUSION

The analysis of variance showed that considerable variability existed among the genotypes for most of the traits showing possibilities of further genetic improvement, in sponge gourd. Hybrid AG-61 (153.30) is performed superior in Prayagraj having highest fruit yield q/ha than other tested hybrids and showing superiority for yield and yield attributes. The high heritability was recorded for the characters node days to first picking , total number of harvest , number of fruits per plant , fruit diameter (cm) and fruit yield . Genetic advance as percentage of mean was observed lowest for fruit days to first picking, vine length (cm), total number of harvest, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit diameter (cm), fruit yield (kg/plant), fruit yield (kg/plot) and fruit yield (q/ha). Reveals that fruit yield (Kg/plant) showed a positive and significant correlation with Fruit yield (Kg/plot) at both genotypic and phenotypic level. Genotypic path coefficient analysis revealed that vine length (cm), total number of harvest and fruit yield (Kg/plot) showed the positive direct effect on fruit yield (kg/plant) at genotypic level. Phenotypic path coefficient analysis revealed that number of fruits per plant and fruit yield (Kg/plot) showed the positive direct effect on fruit yield (Kg/plant) at phenotypic level. Clustering pattern indicated that cluster I is largest cluster comprising 5 out of 10 hybrids. On the other hand cluster II, comprised 4 hybrids and cluster III comprised hybrids 1.

The inter cluster distance was maximum between III and I (54.52) followed by II and I (45.55) and II and III (37.57). Cluster I, II and III was characterized by high mean value for fruit yield (kg/plant) and low mean values for fruit yield (kg/plot). The highest contribution in manifestation of genetic divergence was exhibited by fruit diameter (cm), fruit weight per plant (g),number of fruits per plant and fruit length (cm).

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Figure 3 : Sample collection

Figure 4 : Agricultural field