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# Studies on Evaluation of Sponge Gourd (*Luffa cylindrica* L.) Hybrids for Growth, Yield and Quality Traits

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## 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. Analysis of variance showed significant differences among hybrids for all 10 characters. Out of Sponge gourd hybrids evaluated for various characters, 5 hybrids were found superior for different characters. These 5 hybrids were found better for more than one character. High genetic advance as % mean (>20%) was recorded for fruit yield per plot(kg) and fruit yield (kg/plant) along with high heritability . These traits are governed by additive gene effects and therefore, may be improved through direct selection.High value of genetic advance are governed by additive genes resulting in improvement of traits. 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. Fruit yield (kg/plant) showed a positive and significant correlation with Fruit yield (Kg/plot) at both genotypic and phenotypic level.The pattern of group constellation proves the existence of significant amount of variability. The genetic divergence in selecting result in superior hybrids and desirable recombinations for the yield and quality traits.Thus, selections for these characters will be proved efficient for better yield and improvement of sponge gourd.

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

## 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" [1]. 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" [2]. "In Chhattisgarh, sponge gourd is being grown on about 2597 ha with an annual production of 23447 MT [3] particularly in Mahasamund, Kanker, Raigarh, Korba and 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). "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" [4] Sponge gourds are also used as absorbent [5]. Sponge gourds are also used as absorbent [5]. 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 sponge gourd oil is also extracted from seeds for industrial uses.

The edible fresh and tender fruit contains 94 % 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. In India the crop is widely grown in Uttar Pradesh, Bihar, West Bengal, Orissa, Assam, Andhra Pradesh and Kerala" [2]. "In Chhattisgarh, sponge gourd is being grown on about 2597 ha. with an annual production of 23447 metric tones [3] particularly in Mahasamund, Kanker, Janjgir-chapa, Raigarh, Korba, Raigarh, Koria district".

Flowers are yellow and showy having five petals. The inflorescence of staminate flower is emerged in racemes while the pistillate flowers are 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.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 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, [6] 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) [7] . "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" [7]. It is a cross pollinated vegetable, thus, its natural population has tremendous variability for fruit shape, color, taste etc. Evaluation of hybrids 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. MATERIALS 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 $25.87^0$ North latitude and $81.15^0$ 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 32°F in December – January and very hot summer with temperature reaching up to 115°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.

## 3. RESULT AND DISCUSSION

The present investigation 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.

- **Analysis of Variance**

The analysis of variance indicated that the mean sum of square due to hybrids were highly

significant for all the characters. Which revealed existence of considerable variability in material studied for improvement of various traits.

- **Mean Performance**

The observation of five plants from each hybrid in all three replications for fruit yield and its components characters were used for calculating the mean performance.

**Days to 1st picking**

Days to fruit first picking ranged from 48.22days to 49.09 days with a mean of 48.62 days. Early harvest was recorded in the Zinnat (48.22 days) which was followed by AG-61,KSGH-55 and Serena whereas, maximum days of fruit picking was recorded in Sarika (49.09 days).

**Vine length (cm)**

Vine length range from 184.47 to 177.16 cm with the mean of 181.03. Longest length was recorded in Sarika (184.47cm) whereas minimum was recorded in shyaam (177.16 cm).

**Total number of harvest**

Total number of harvest range from 1.78 to 2.67 with a mean of 2.24. Maximum number of harvesting fruit was recorded in Shyaam (2.67) whereas, minimum number of harvest was recorded in Serena (1.78).

**Number of fruits per plant**

Number of fruits per plant range from 3.67 to 4.56 with a mean of 4.07. Maximum number of fruits per plant was recorded in Zinnat (4.56) whereas, minimum number of fruits per plant was recorded from Shyaam (3.67).

**Average fruit weight (g)**

Average fruit weight (g) range from 115.67 to 105.44 with a mean of 109.70.Maximum average fruit weight was recorded in AG-61(115.67) whereas, minimum average fruit weight (g) was recorded from Sarika (21.06).

**Fruit length(cm)**

Fruit length (cm) range from 21.06 to 23.89 with mean 22.66. Longest length of fruit(cm) was recorded in Serena (23.89) whereas, minimum average fruit length(cm) was recorded in Sarika (21.06).

**Fruit diameter (cm)**

Fruit diameter (cm) range from 12.56 to 15.67 with a mean of 13.73. Maximum fruit diameter(cm) was recorded in GR-376(15.67) whereas, minimum fruit diameter was recorded in Sarika (12.56).

**Fruit yield (kg/plant)**

Fruit yield (kg/plant) range from 0.810 to 2.74. Maximum fruit yield (kg/plant) was recorded in AG-61(2.74)whereas, minimum fruit yield (kg/plant) was recorded in Serena (0.810).

**Fruit yield (kg/plot)**

Fruit yield (kg/plot) range from 9.10 to 11.13 with a mean of 9.89. Maximum fruit yield (kg/plot) was recorded in AG-61 (11.13) whereas, minimum fruit diameter was recorded in Serena (9.10).

**Fruit yield (q/ha)**

Fruit yield(q/ha) range from 145.33 to 153.30 with a mean of 149.52. Maximum fruit yield(q/ha) was recorded in AG-61 (153.30) whereas, minimum fruit yield (q/ha) was recorded from Serena (145.33).

- **Genetic Variability**

Variability is the base for any breeding programme.It is a complex phenomenon which is measured by the estimation of range, mean, genotypic and phenotypic coefficient of variation.

**Genotypic and phenotypic coefficient of variation**

“Genotypic and phenotypic coefficient of variation are simple measure of variability, these measures are commonly used for the assessment of variability.The relative value of these types of coefficient gives an idea about the magnitude of variability present in the genetic population.Thus, such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was computed.The phenotypic coefficient of variation was marginally higher than the corresponding genotypic coefficient of variation indicated influence of environment in the expression of the character under the study.Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV)are categorized as low (less than 10%), moderate (10-20%) and high (more than 20%)” as suggested by Sivasubramanian and Madhava Menon [8].

**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 yield (q/ha) | 14.3440 | 24.666* | 7.144 |

**Table 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 |

**Table 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 |

High magnitude of genotypic as well as phenotypic coefficient of variation were recorded for traits Fruit yield (kg/plant) (23.783 and 26.083).Moderate GCV and PCV were recorded for Total number of harvest (10.327 and 11.94). Whereas, lowest GCV and PCV was recorded for Days to first picking, vine length (cm), fruit diameter (cm), Fruit yield (kg/plot) and Fruit yield(q/ha).These findings were reported by Panday et al. [9], Kumar et al. [10] and Singh et al. [11] in Sponge gourd. Phenotypic Coefficient of Variation (PCV) was higher than the Genotypic Coefficient of Variation (GCV) for all the traits indicating that environmental factors influencing the expression of traits. Wide difference between phenotypic and genotypic coefficient of variations indicated their sensitiveness to environmental fluctuations whereas narrow difference showed less environmental interference on the expression of these traits.

**Heritability and genetic advance as a percent of mean**

Heritabilty is the resemblance between parents and their progeny whereas, genetic advance provide the knowledge about expected gain for a particular character after selection. Heritability suggests the relative role of genetic factors in expression of phenotypes and also act as an index of transmissibility of a particular trait to its offspring.Heritability and genetic advance are the important parameters for selecting a hybrid that permit a greater effectiveness of selection by separating out environmental influence from total variability.Heritability estimate along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone.It is not necessary that a character showing high heritability will also exhibit high genetic advance [12]. An attempt has been made in the present investigation to estimate heritability in broad sense and categorized as low (<40%), moderate (40%-50%)and high (>50%) as suggested by Robinson (1966). 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).Medium heritability was recorded for the characters Vine length(cm), fruit yield(kg/plot) and fruit yield (q/ha).

Low heritability was recorded for the charcters, Average fruit weight (g) and fruit length(cm). Similar results were reported by Panday et al. [9] and Samadia et al. (2010) in Sponge gourd [13-15].

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). “The high value of genetic advance for these traits showed that these characters are governed by additive genes and selection will be rewarding for further improvement of these traits.Moderate genetic advance for these traits suggest that both the additive and non-additive variance are operating in these traits and traits exhibiting low genetic advance indicates significance in non-additive gene effects”.Similar results reported by Panday et al. [9], Samadia et al. (2010) in Sponge gourd.

- **Correlation Analysis**

The analysis is important approach for crop improvement programme .It gives an idea about the relationship among the various characters and determines the component characters, on which selection can be used for genetic improvement in the fruit yield. The major causes underlying association are either due to pleiotropic gene action or linkage or both. The genotypic correlation includes a genotypic and environmental effect whereas, genotypic correlation provided a measure of genetic association between the characters normally used in selection. Genetic advance as percentage of mean was observed lowest for days to picking , vine length (cm), total number of harvest, number of fruits per plant, average fruit weight(g), fruit length (cm), fruit diamter(cm), fruit yield (kg/plant), fruit yield (kg/plot)and fruit yield (q/ha). The fruit yeild (kg/plant) showed 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 positive and significant correlation with fruit yield (kg/plot).It showed non –significant positive correlation with, total number of harvest, fruit length(cm) and fruit diameter(cm)at phenotypic level [16-18].

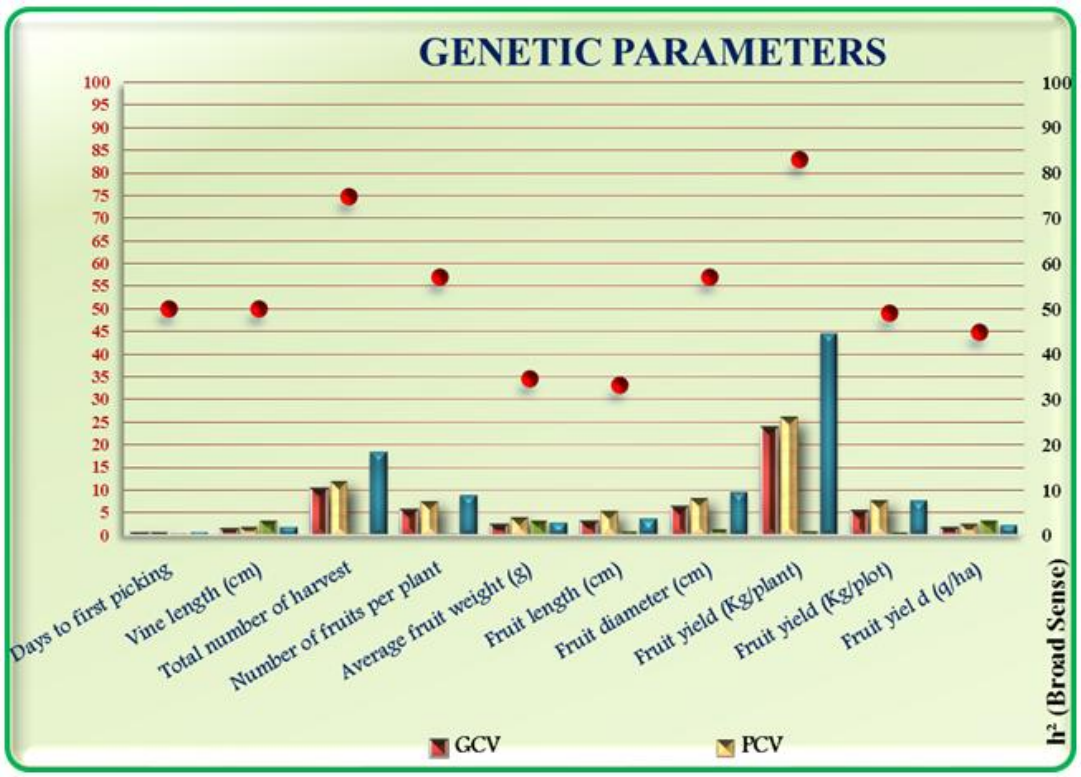


**Fig. 1. Parameters of variability for fruit yield and its components in sponge gourd**

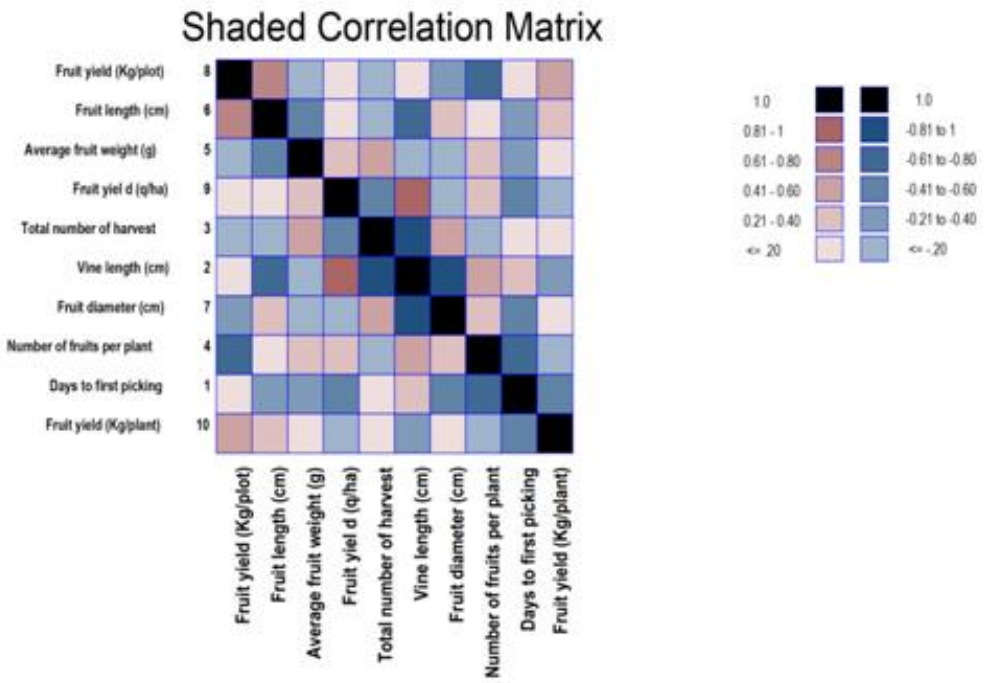


**Fig. 2. Genotypic coorelation coefficient between fruit yield and its component traits in sponge gourd**

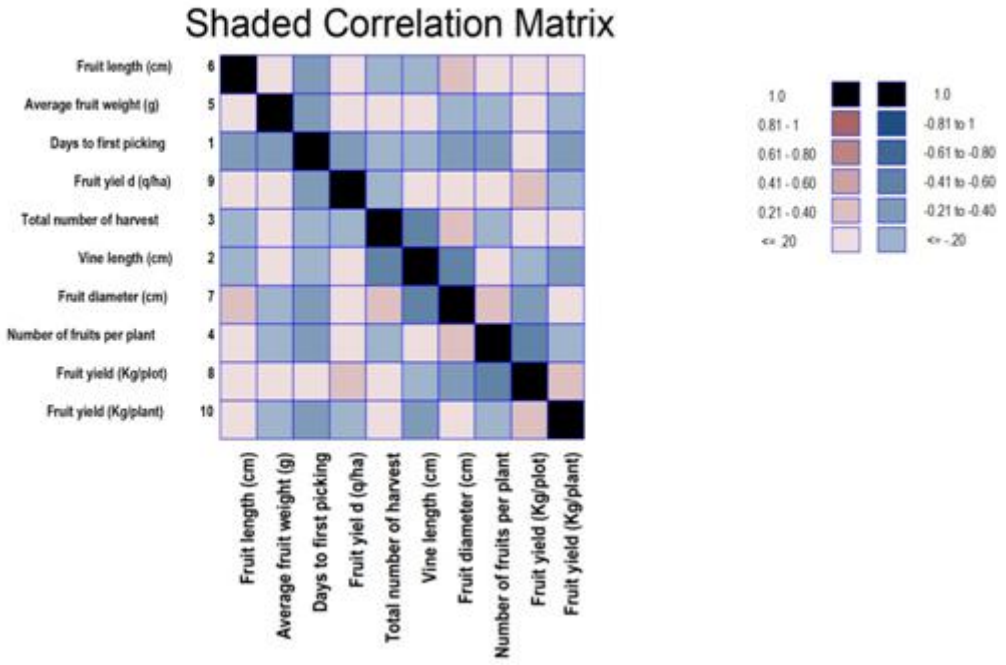


**Fig. 3. Phenotypic correlation coefficient between fruit yield and its component traits in Sponge gourd**

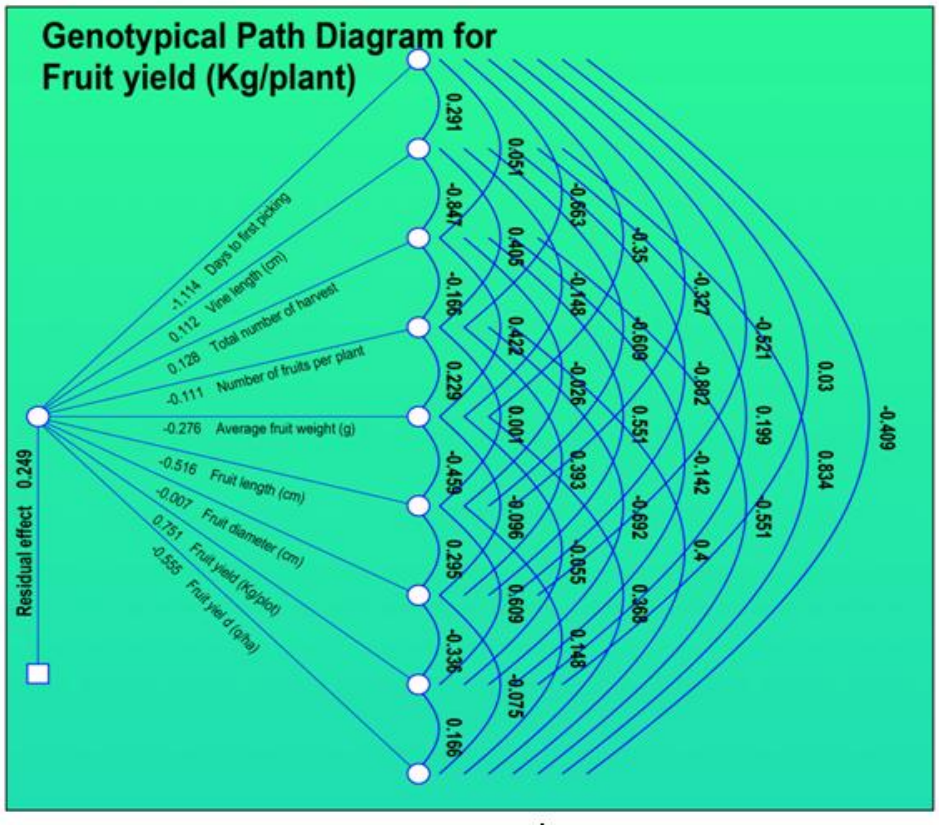


**Fig. 4. Genotypic path co-efficient for fruit yield and its components in Sponge gourd**

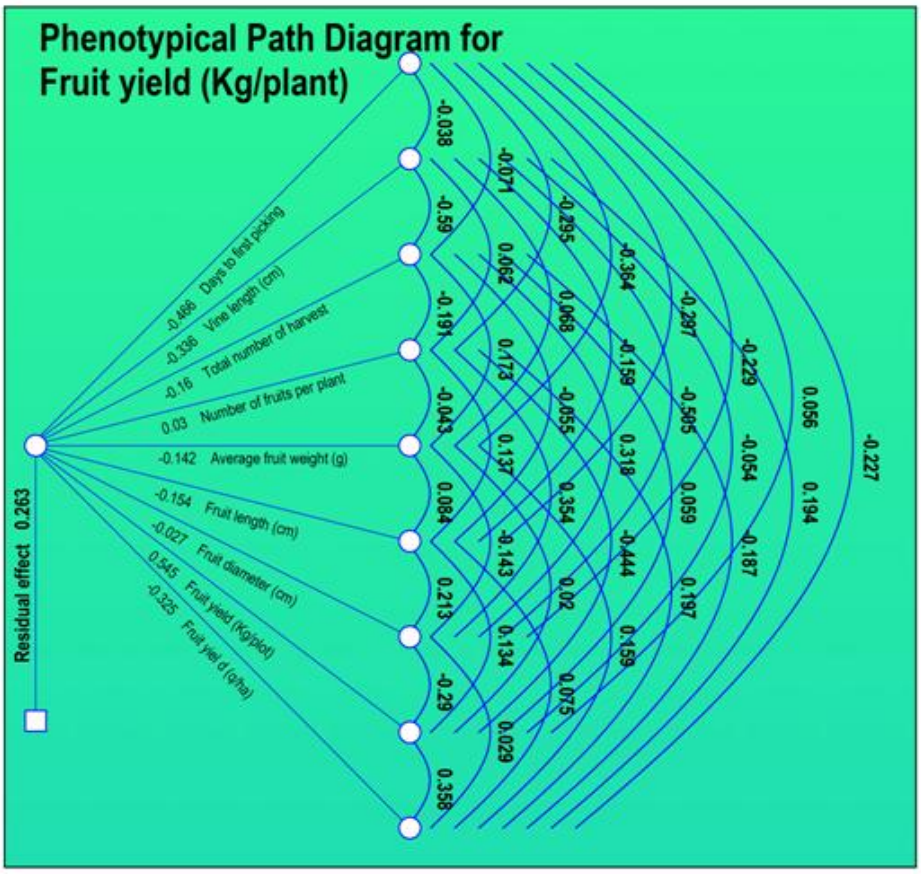


**Fig 5. Phenotypic path co-efficient for fruit yield and its components in Sponge gourd**

- **Path Coefficient Analysis**

Path coefficient analysis is an important tool for correlation coefficients into the direct and indirect effects of independent variables on a dependent variables.Two characters may show correlation, just because they are correlated with the common third one.In such circumstances path coefficient analysis provide an effective means of examination of correlation and measure the relative importance of each factor .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.

- **Genetic Divergence**

Mahalanobis $D^2$ statistics was used as quantitative assessment of genetic divergence for all the 10 characters.It is essential for increasing crop productivity through breeding.Selection of diverse parents in breeding programme helps in isolation of superior hybrids.

**Cluster pattern**

Clustering pattern of 10 hybrids of sponge gourd were grouped into clusters following Mahalanobis $D^2$ statistics. 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 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 |

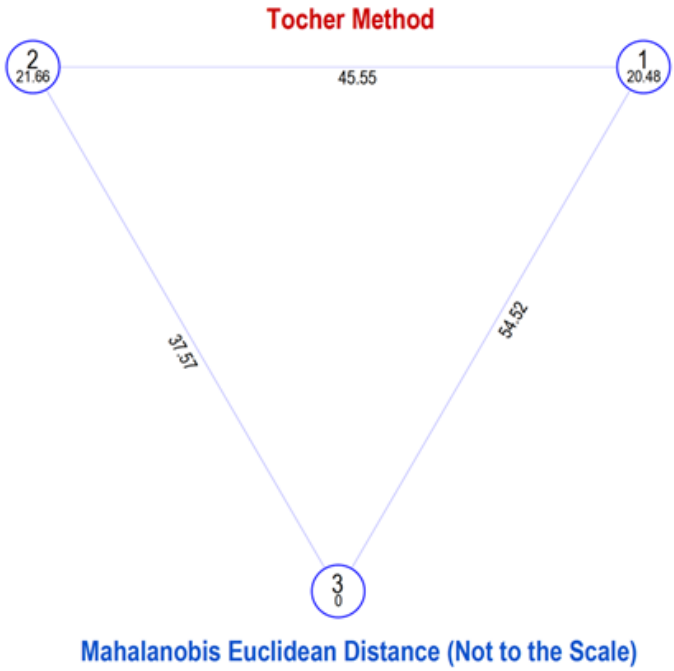


**Fig. 6. Average of intra- and inter- clusters $D^2$ values for four clusters**

**Fig. 7. Sample collection**

**Fig. 8. Horticultural department field**

## 4. CONCLUSION

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. Analysis of variance showed significant differences among hybrids for all 10 characters. Out of Sponge gourd hybrids evaluated for various characters, 5 hybrids were found superior for different characters. These 5 hybrids were found better for more than one character. High genetic advance as % mean (>20%) was recorded for fruit yield per plot(kg) and fruit yield (kg/plant) along with high heritability . These traits are governed by additive gene effects and therefore, may be improved through direct selection.High value of genetic advance are governed by additive genes resulting in improvement of traits. 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. Fruit yield (kg/plant) showed a positive and significant correlation with Fruit yield (Kg/plot) at both genotypic and phenotypic level.The pattern of group constellation proves the existence of significant amount of variability. The genetic divergence in selecting result in superior hybrids and desirable recombinations for the yield and quality traits. Thus, selections for these characters will be proved efficient for better yield and improvement of sponge gourd.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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