

PROFILING OF GUAVA GENOTYPES GROWN IN VIDARBHA CONDITIONS ON THE BASIS OF MORPHOLOGICAL TRAITS

*R.A. PATIL, S.G.BHARAD AND S.N. SAWANT

Department of Horticulture,
Dr. Panjabrao Deshmukh Agricultural University,
AKOLA, MAHARASHTRA (INDIA)

*Corresponding Author

Email: raghwendrapatil@gmail.com

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ABSTRACT

Assessment of genetic diversity in the available germplasm is the prerequisite for development of improved genotypes through planned breeding programmes. In the view of this Forty-eight genotypes of seedling origin guava along with 1 check (L-49/Sardar) collected and conserved at germplasm block, Main Garden, Department of Horticulture, Dr. P. D. A. University, Akola were evaluated for genetic variability and diversity based on the qualitative characteristics. The genotypes were evaluated for sixteen morphological traits viz. tree, leaf, floral and fruit traits. Results Show considerable extent of variability amongst the 49 genotypes in each traits. A sizeable amount of intrapopulation diversity recorded can be used to identify diverse parents which can be utilized in hybridization programmes.

Figure : 01

References : 16

Table : 01

KEY WORDS : Genotypes, Guava, Vidarbha

Introduction

Guava, *Psidium guajava*, fourth most important fruit in area and production after mango, banana and citrus, originated from Tropical America. Spanish and Portuguese spread it rapidly throughout the world in their various voyages, even introduced it in India from west in seventeenth century⁵. Shape, roughness or smoothness, seedlessness, colour of flesh or place of origin was the basis for naming the variety. In India, only a few like Allahabad Safeda and Sardar (L-49) occupy the major area under its cultivation. Efforts have been made over past few decades to widen genetic base through creating new variability using both indigenous and exotic/wild strains and utilizing it for selection of elite variety or hybrids for commercial cultivation. Besides, its importance, however, very meagre work has been done on genotypic and phenotypic variation studies on vegetative, reproductive and fruit traits, genetic systems controlling inheritance of these traits and genetic and environment factors that influence their expression.

Material and Methods

The experiment shows morphological characteristics of 48 seedling originated genotypes

of guava along with 1 check (L-49/ Sardar). The work was conducted at Analytical Laboratory, University Department of Horticulture, Dr. P.D.A. University, Akola. One plant of each treatment selected, marked, and kept under observations for recording. Since the study is based on single plant hence, the samples were collected from each direction i.e. East, West, South and North. Each of these directions were considered as one replication. For vegetative and floral characters 5 leaves/5 flower buds/ 5 flowers per plant were collected from all the four directions of plant and observations were recorded. For fruit characters, 10 fruits/plant were collected randomly and observations were recorded on each fruit separately. The observations recorded were as per keys explained.^{1,2,6,10,11}

Results

The results of variability for the sixteen qualitative characteristics amongst forty-nine genotypes of guava have been presented (Table-1 and Fig. 1). Genotypes expressed substantial amount of variability for all the traits.

Tree characters:

Nature of the genotypes were rated as evergreen and deciduous, and among 49

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genotypes 21 genotypes were deciduous and remaining 28 were evergreen including L-49 (Table-1). Nature of growth of the tree was rated as erect, semi spreading and spreading. Among 49 genotypes, ten genotypes were erect growing; 14 were semi spreading including L-49 and remaining 25 were spreading type. Ten genotypes possess obloid tree shape; fifteen were spheroid shape tree including L-49 and 24 genotypes were ellipsoid tree shape. Density of branches was rated as sparse, medium and dense, of 49 genotypes, the branch density of 15 genotypes was sparse; 24 genotypes having medium density of branches and 10 genotypes were densely branched.

Leaf characters:

Most of the genotypes possessed light green leaves (28 genotypes) and exhibited variation in leaf shape i.e. orbicular, ovate, obovate, lanceolate and elliptic (Table-1). On the basis of appearance of young leaves three types could be recognized viz. yellowish green with reddish margin, yellow and copper colour with yellowish green veins. In most of the genotypes, mature/old leaves were found to be pubescent especially on ventral surface of the leaves along with mid rib and veins. However, leaves of 24 genotypes were found to be highly pubescent (Table-1).

Flower characters:

Fruit bearing cycle rated as *Ambia*, *Mrig* and *Hastha*. Of 49 genotypes, 31 genotypes including check variety (L-49) bear fruit in only one season i.e. *Mrig bahar* whereas, 18 genotypes bear fruits in *Mrig* as well as *Hasthabahar*. Fruit bearing in all genotypes were axillary and opposite.

Fruit characters:

Texture rated as smooth, rough and bumpy. Twenty-seven genotypes were smooth textured, 16 were rough textured whereas, and 06 were bumpy (Table-1). Shape of the fruit was divided into spheroid, ellipsoid, oblique, obloid and pyriform. Most of the genotypes were spheroid shaped (33 genotypes), 09 genotypes were ellipsoid whereas, 03 genotypes were pyriform and each of two genotypes was oblique, and obloid (Table-1). Fruit was rated as large, medium and small, most of the genotypes were of medium size (forty) two genotypes were small in size and seven genotypes possessed large fruit (Table-1). Colour of fruit was rated as straw yellow, greenish yellow and green; 21 genotypes among 49 were of straw-yellow, 16

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genotypes bear greenish yellow fruits whereas, 12 genotypes bear green coloured fruits (Table-1). Colour of flesh was rated as cream, white and pink, most of the genotypes were of cream coloured flesh i.e. 31 followed by white coloured fruits i.e. 17 genotypes and only one genotype i.e. GG-6-1 was with pink fleshed fruits (Table-1). Regarding the hardness of fruits, fruits of 26 genotypes were soft seeded and remaining 23 genotypes were hard seeded (Table-1).

Forty-nine genotypes were evaluated for 16 morphological characters showing variation viz. tree characters (nature of tree, nature of spread, tree shape and density of branches), leaf characters (leaf shape, leaf colour, appearance of young leaves and presence of pubescence), floral characters (bearing cycle), fruit characters (fruit bearing habit, texture of fruit, shape of fruit, size of fruit, colour of fruit and colour of flesh) and seed characters (seed hardness).

Cluster analysis:

The observations for 16 morphological traits were then used to cluster the genotypes which grouped the genotypes into two main clusters. In the dendrogram (Fig.1) the genotypes clearly divide themselves into 2 major clusters A and B. Cluster A divided into 4 subclusters and cluster B divided into 3 subclusters comprising all the 49 genotypes. The genotype GG-11-1 was grouped with the check variety i.e. L-49 as it was having more number of morphological traits like L-49 viz. growth habit, density of branches, leaf shape, bearing cycle, fruit bearing habit, texture of fruit, size of fruit colour of fruit and colour of flesh (Table-1).

Discussion

This variability in respect to all the qualitative characteristics could be attributed to the genetic makeup of individual tree, variation in soil conditions, age and environmental condition³. Workers¹² reported that, in case of qualitative characteristics the gene action is primarily of non-additive type dominance and epistasis.

Morphological characterization is the first step in description and classification of crop germplasm because breeding programme mainly depends upon magnitude of genetic variability¹⁴. Qualitative characters are important for plant description and are influenced by consumers' preference, socio-economic scenario and natural selection⁷.

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TABLE- 1: Grouping of genotypes on the basis of morphological characters

Characters	Description	Genotypes
Nature of tree	Evergreen	GG-1-1, GG-1-2, GG-1-3, GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-3-2, GG-3-3, GG-3-4, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-4-5, GG-5-1, GG-5-2, GG-6-3, GG-6-5, GG-7-1, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-8-6 and L-49
	Deciduous	GG-6-1, GG-6-2, GG-7-2, GG-8-1, GG-9-1, GG-9-2, GG-9-3, GG-10-1, GG-10-2, GG-10-3, GG-10-6, GG-11-1, GG-11-3, GG-11-4, GG-11-5, GG-11-6, GG-12-1, GG-12-2, GG-13-3, GG-13-4 and GG-13-5
Growth habit	Upright	GG-1-1, GG-3-2, GG-5-1, GG-5-2, GG-6-1, GG-6-2, GG-6-5, GG-7-2, GG-13-4 and GG-13-5
	Semi-spreading	GG-1-2, GG-1-3, GG-4-1, GG-4-3, GG-6-3, GG-9-1, GG-9-2, GG-10-1, GG-10-3, GG-11-4, GG-11-5, GG-11-6 and GG-13-3
	Spreading	GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-3-3, GG-3-4, GG-4-2, GG-4-4, GG-4-5, GG-7-1, GG-8-1, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-8-6, GG-9-3, GG-10-2, GG-10-6, GG-11-1, GG-11-3, GG-12-1, GG-12-2 and L-49
Tree shape	Spheroid	GG-1-2, GG-1-3, GG-4-1, GG-4-3, GG-6-3, GG-7-1, GG-9-1, GG-9-2, GG-10-1, GG-10-3, GG-11-4, GG-11-5, GG-11-6, GG-13-3 and L-49
	Ellipsoid	GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-3-3, GG-3-4, GG-4-2, GG-4-4, GG-4-5, GG-8-1, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-8-6, GG-9-3, GG-10-2, GG-10-6, GG-11-1, GG-11-3, GG-12-1 and GG-12-2
	Obloid	GG-1-1, GG-3-2, GG-5-1, GG-5-2, GG-6-1, GG-6-2, GG-6-5, GG-7-2, GG-13-4 and GG-13-5
Density of branches	Sparse	GG-3-2, GG-4-3, GG-5-1, GG-5-2, GG-6-1, GG-6-2, GG-7-1, GG-7-2, GG-8-4, GG-8-5, GG-8-6, GG-9-1, GG-9-3, GG-12-1 and GG-12-2
	Medium	GG-1-1, GG-1-2, GG-2-1, GG-2-2, GG-2-4, GG-2-5, GG-3-1, GG-4-1, GG-4-5, GG-8-2, GG-9-2, GG-10-1, GG-10-2, GG-10-3, GG-10-6, GG-11-1, GG-11-3, GG-11-4, GG-11-5, GG-11-6, GG-13-3, GG-13-4, GG-13-5 and L-49
	Dense	GG-1-3, GG-2-3, GG-3-3, GG-3-4, GG-4-2, GG-4-4, GG-6-3, GG-6-5, GG-8-1 and GG-8-3,

Leaf shape	Elliptical	GG-3-2, GG-4-1, GG-4-2, GG-4-5, GG-7-1, GG-11-4 and GG-13-5
	Ovate	GG-1-2, GG-1-3, GG-2-1, GG-2-3, GG-2-4, GG-2-5, GG-3-3, GG-5-1, GG-6-2, GG-6-5, GG-7-2, GG-8-1, GG-8-3, GG-8-4, GG-9-2, GG-10-3, GG-11-5 and GG-13-3
	Lanceolate	GG-3-1, GG-4-3, GG-5-2, GG-8-2, GG-8-5, GG-9-3, GG-10-1, GG-10-2, GG-11-6, GG-12-1 and GG-13-4
	Obvate	GG-2-2, GG-3-4, GG-4-4, GG-6-1, GG-6-3, GG-8-6, GG-9-1, GG-10-6, GG-11-1, GG-11-3, GG-12-2 and L-49
Leaf colour	Orbicular	GG-1-1,
	Light green	GG-1-2, GG-1-3, GG-2-1, GG-3-2, GG-4-2, GG-4-4, GG-5-1, GG-5-2, GG-6-1, GG-6-2, GG-6-5, GG-7-2, GG-8-1, GG-8-2, GG-9-1, GG-9-2, GG-9-3, GG-10-2, GG-10-3, GG-11-1, GG-11-4, GG-11-5, GG-11-6, GG-12-2, GG-13-4 and L-49
	Dark green	GG-1-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-3-3, GG-3-4, GG-4-1, GG-4-3, GG-4-5, GG-6-3, GG-7-1, GG-8-3, GG-8-4, GG-8-5, GG-8-6, GG-10-1, GG-10-6, GG-11-3, GG-12-1, GG-13-3 and GG-13-5
Appearance of young leaves	Uniformly yellow	GG-1-3, GG-2-2, GG-2-3, GG-4-1, GG-4-5, GG-6-1, GG 6-2, GG-10-6 and GG-11-6,
Appearance of young leaves	Yellowish green with reddish margin	GG-1-1, GG-1-2, GG-2-1, GG-2-5, GG-3-1, GG-3-2, GG-3-3, GG-3-4, GG-4-2, GG-4-4, GG-5-1, GG-5-2, GG-6-3, GG-6-5, GG-7-1, GG-7-2, GG-8-2, GG-8-3, GG-8-4, GG-8-6, GG-9-1, GG-9-2, GG-10-1, GG-10-2, GG-10-3, GG-11-1, GG-11-3, GG-11-5, GG-12-2, GG-13-3, GG-13-4 and L-49
	Copper colour with yellowish green veins	GG-2-4, GG-4-3, GG-8-1, GG-8-5, GG-9-3, GG-11-4, GG-12-1 and GG-13-5
Appearance of dorsal and ventral surface of leaves	Pubescent	GG-1-1, GG-1-2, GG-1-3, GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-3-1, GG-4-2, GG-4-5, GG-6-2, GG-6-3, GG-8-5, GG-9-1, GG-9-3, GG-10-1, GG-10-3, GG-11-5, GG-11-6, GG-12-1, GG-12-2, GG-13-3, GG-13-4, GG-13-5 and L-49
	Highly pubescent	GG-2-5, GG-3-2, GG-3-3, GG-3-4, GG-4-1, GG-4-3, GG-4-4, GG-5-1, GG-5-2, GG-6-1, GG-6-5, GG-7-1, GG-7-2, GG-8-1, GG-8-2, GG-8-3, GG-8-4, GG-8-6, GG-9-2, GG-10-2, GG-10-6, GG-11-1, GG-11-3 and GG-11-4

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Bearing cycle	<i>Mrig</i>	GG-1-1, GG-1-2, GG-1-3, GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-4-5, GG-5-1, GG-5-2, GG-6-1, GG-6-2, GG-6-3, GG-6-5, GG-10-1, GG-10-2, GG-10-3, GG-10-6, GG-11-1, GG-11-3, GG-11-4, GG-11-5, GG-13-3, GG-13-4, GG-13-5 and L-49
	<i>Mrig and Hastha</i>	GG-3-1, GG-3-2, GG-3-3, GG-3-4, GG-7-1, GG-7-2, GG-8-1, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-8-6, GG-9-1, GG-9-2, GG-9-3, GG-11-6, GG-12-1 and GG-12-2,
Fruit bearing habit	Solitary	GG-1-1, GG-1-2, GG-1-3, GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-3-2, GG-3-3, GG-3-4, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-4-5, GG-5-1, GG-5-2, GG-6-1, GG-6-2, GG-6-3, GG-6-5, GG-7-1, GG-7-2, GG-8-1, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-8-6, GG-9-1, GG-9-2, GG-9-3, GG-10-1, GG-10-2, GG-10-3, GG-10-6, GG-11-1, GG-11-3, GG-11-4, GG-11-5, GG-11-6, GG-12-1, GG-12-2, GG-13-3, GG-13-4, GG-13-5 and L-49
Texture of fruit	Smooth	GG-1-3, GG-2-1, GG-2-5, GG-3-1, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-4-5, GG-5-2, GG-6-2, GG-6-5, GG-7-1, GG-7-2, GG-8-1, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-9-3, GG-10-1, GG-10-6, GG-11-3, GG-11-5, GG-12-1, GG-12-2, GG-13-3, GG-13-4 and GG-13-5
	Rough	GG-1-1, GG-1-2, GG-2-2, GG-2-3, GG-2-4, GG-5-1, GG-6-3, GG-8-4, GG-8-5, GG-8-6, GG-9-2, GG-10-2, GG-10-3, GG-11-1, GG-11-6 and L-49
	Bumpy	GG-3-2, GG-3-3, GG-3-4, GG-6-1, GG-9-1 and GG-11-4,
Shape of fruit	Spheroid	GG-1-1, GG-1-2, GG-1-3, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-4-1, GG-4-2, GG-4-3, GG-5-2, GG-6-2, GG-6-3, GG-7-1, GG-7-2, GG-8-1, GG-8-2, GG-8-3, GG-8-6, GG-9-1, GG-9-2, GG-9-3, GG-10-1, GG-10-2, GG-10-6, GG-11-3, GG-11-5, GG-11-6, GG-12-1, GG-13-4, GG-13-5 and L-49
	Ellipsoid	GG-2-1, GG-3-2, GG-3-3, GG-3-4, GG-5-1, GG-8-4, GG-8-5, GG-11-1 and GG-12-2
	Pyriform	GG-6-1, GG-6-5, GG-11-4,
	Oblique	GG-4-5 and GG-13-3
	Obloid	GG-4-4 and GG-10-3,

Size of fruit	Small	GG-6-1 and GG-8-5,
	Medium	GG-1-1, GG-1-3, GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-1, GG-3-2, GG-3-3, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-4-5, GG-5-1, GG-5-2, GG-6-2, GG-6-3, GG-6-5, GG-7-1, GG-7-2, GG-8-1, GG-8-3, GG-8-4, GG-8-6, GG-9-2, GG-9-3, GG-10-1, GG-10-6, GG-11-1, GG-11-3, GG-11-4, GG-11-5, GG-11-6, GG-12-1, GG-12-2, GG-13-4, GG-13-5 and L-49
	Large	GG-1-2, GG-3-4, GG-8-2, GG-9-1, GG-10-2, GG-10-3, and GG-13-3
Colour of fruit	Green	GG-2-4, GG-3-3, GG-3-4, GG-5-1, GG-7-1, GG-7-2, GG-8-4, GG-8-5, GG-8-6, GG-10-2, GG-11-6 and GG-12-2
	Straw yellow	GG-1-1, GG-1-3, GG-2-1, GG-2-2, GG-2-3, GG-4-1, GG-4-4, GG-4-5, GG-6-3, GG-6-5, GG-9-2, GG-10-1, GG-10-3, GG-10-6, GG-11-3, GG-11-4, GG-11-5, GG-12-1, GG-13-3, GG-13-4 and GG-13-5
	Greenish yellow	GG-1-2, GG-2-5, GG-3-1, GG-3-2, GG-4-2, GG-4-3, GG-5-2, GG-6-1, GG-6-2, GG-8-1, GG-8-2, GG-8-3, GG-9-1, GG-9-3, GG-11-1 and L-49
Colour of flesh	Cream	GG-1-1, GG-1-2, GG-2-1, GG-2-3, GG-2-5, GG-3-1, GG-3-2, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-4-5, GG-5-1, GG-6-3, GG-6-5, GG-7-2, GG-8-1, GG-8-2, GG-8-3, GG-8-6, GG-9-1, GG-9-2, GG-9-3, GG-10-1, GG-10-3, GG-10-6, GG-11-1, GG-11-3, GG-11-5, GG-13-5 and L-49
	White	GG-1-3, GG-2-2, GG-2-4, GG-3-3, GG-3-4, GG-5-2, GG-6-2, GG-7-1, GG-8-4, GG-8-5, GG-10-2, GG-11-4, GG-11-6, GG-12-1, GG-12-2, GG-13-3 and GG-13-4
	Pink	GG-6-1
Seed hardness	Soft	GG-1-1, GG-1-2, GG-1-3, GG-3-1, GG-3-2, GG-4-1, GG-4-2, GG-4-3, GG-4-4, GG-6-2, GG-6-3, GG-6-5, GG-8-2, GG-8-3, GG-8-4, GG-8-5, GG-8-6, GG-9-1, GG-10-2, GG-10-3, GG-10-6, GG-11-3, GG-11-4, GG-11-6, GG-12-2 and GG-13-5
	Hard	GG-2-1, GG-2-2, GG-2-3, GG-2-4, GG-2-5, GG-3-3, GG-3-4, GG-4-5, GG-5-1, GG-5-2, GG-6-1, GG-7-1, GG-7-2, GG-8-1, GG-9-2, GG-9-3, GG-10-1, GG-11-1, GG-11-5, GG-12-1, GG-13-3, GG-13-4 and L-49

The present findings are in confirmity^{4,9,10} in guava.

The results obtained for various characters from varying number of clones in each cluster gives an idea of diversity among the clusters compared.

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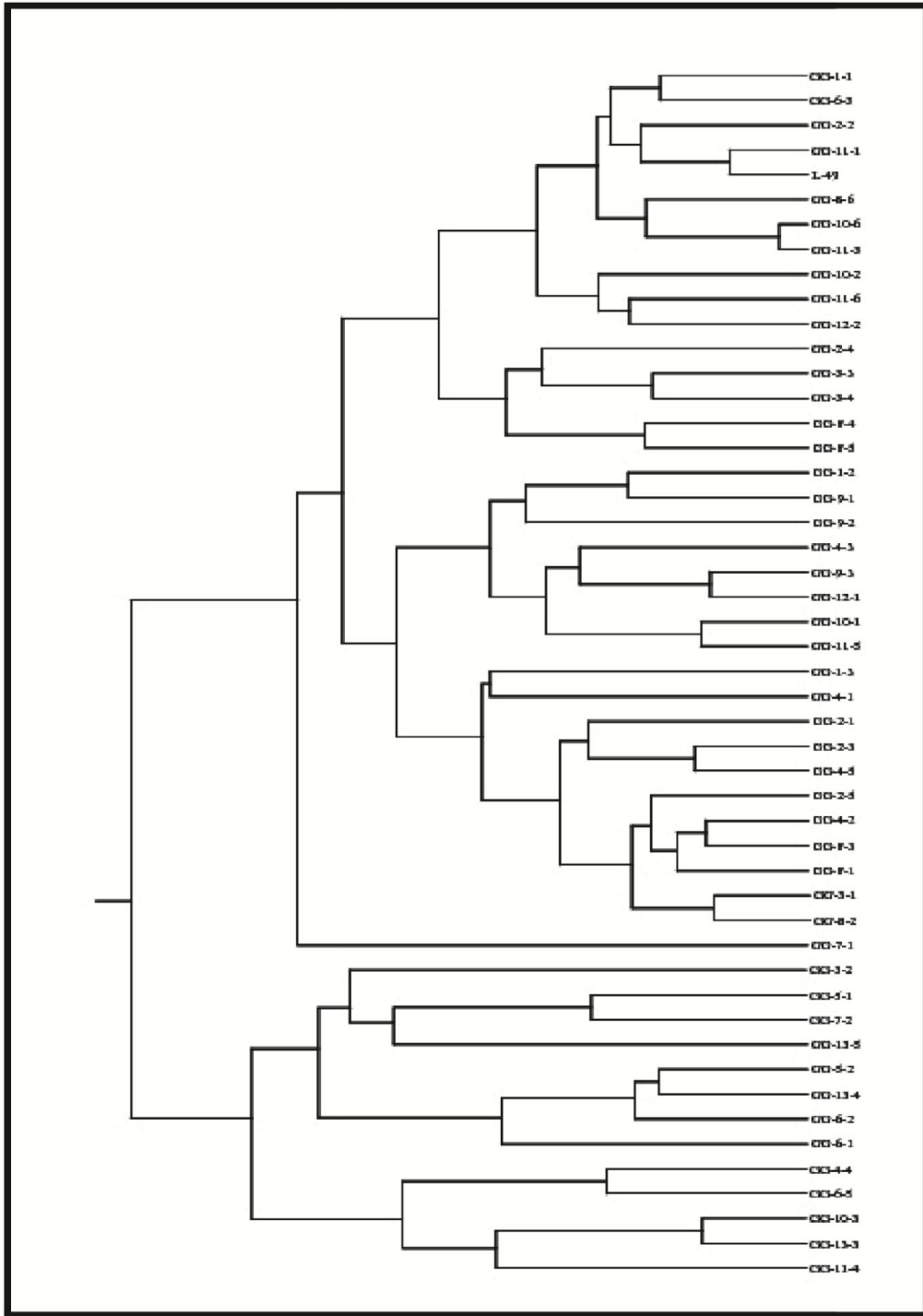


Fig.1 : Grouping of genotypes into different clusters based on morphological characters

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It also helps to group the clusters according to their average performance⁸.

Conclusion

It can be concluded that, the maximum

genetic divergence between the clusters indicates that, these diverse genotypes can be utilized in further crop improvement programme. Hence, the priority should be given to the genotypes those are genetically more diversified.

References

1. ANONYMOUS (1980) Tropical fruit descriptor. Int. Plant Genetic Res. Inst. (IPGRI), Rome.
2. ANONYMOUS (1999) Descriptor for *Citrus*. Int. Plant Genetic Res. Inst. (IPGRI), Rome.
3. BIHARI, M. AND SURYANARAYAN (2011) Genetic diversity, heritability, genetic advance and correlation coefficient in guava. *Ind. J. Agric. Sci.* **81** (2): 107-110.
4. CHEEMA, G. S. AND DESHMUKH, G. B. (1927) Culture of guava and its improvement by selection in western India. *Bombay Deptt. Agric. Bult.* **148** : 20-30.
5. DOIJODE, S. D. (2001) Seed storage of horticultural crops. pp. 65.
6. KAULGUD, S.N., SUPE, V.S., KARALE, A.R. AND KESKAR, B.G. (1997) Descriptor of pomegranate. Department of Horticulture, MPKV, Rahuri (M.S.) India.
7. KURLOVICH, B.S. (1998) Species and interspecific diversity of white, blue and yellow hupins. *Plant Genet. Resour. News.* **115** : 23-32.
8. MANCHEKAR, M.D., MOKASHI, A.N., HEGDE, R.V., VENUGOPAL, C.K. AND BYADGI, A.S. (2011) Clonal variability studies in alphanso mango (*Mangifera indica* L.) by genetic divergence (D^2) analysis. *Karnataka J. Agric. Sci.* **24** (4): 490-492.
9. MATHEW, I.P. AND SHANKER, G. (1964) Pomological description of important guava varieties of Uttar Pradesh. *The Allahabad Farmer.* **XXXVII** (6) : 27-32.
10. MRINALINI, RAGHAVA (2005) Estimation of genetic variability and characterization of guava (*Psidium* spp.). Ph.D. Thesis submitted to G.B. Pant University of Agriculture and Technology, Pantnagar.
11. RODRIGUEZ-MEDINA, N.N., FERMIN, G.A., VALDES-INFANTE, J., VELASQUEZ, B., RIVERO, D., MARTINEZ, F., RODRIGUEZ, J. AND RHODE, W. (2010) Illustrated descriptors for guava (*Psidium guajava*). *Acta Hort.* **849** : 103-109.
12. SINGH, P.K. AND CHOUDHARY, R.D. (1997) Biometrical methods in quantitative genetic analysis, Kalyani Publishers, New Delhi. pp. 178-185.
13. SINGH, U.R., PANDEY, I.C., UPADHAYAY, N. P. AND TRIPATHI, B.M. (1976) Description of some guava varieties (*Psidium guajava* L.) IV. *Plant J.* **16** : 121-124.
14. SMITH, S.E., AL-DOSE, A. AND WARBURTON, M. (1991) Morphological and agronomic variation in North African and Arabian alfalafas. *Crop Sci.* **31** : 1159-1161.
15. TEAOTIA, I.C., PANDEY, B.N., AGNIHOTRI AND KAPUR, K.L. (1962) Study of some guava varieties (*Psidium guajava* L.) of Uttar Pradesh. *Ind. Agriculturist.* **6** : 47-53.
16. VILORIA, Z., SANCHEZ-URDANETA, A.B., SUAREZ, E., GONZALEZ, M.R. AND AMAYA Y. (2010) Morphological characterization of elite genotypes of guava seedlings. *Acta Hort.* **849** : 375-380.