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Original Research Paper

Characterization and evaluation of morphological and yield traits of tamarind genotypes

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ABSTRACT

The evaluation of morphological and yield traits of tamarind genotypes was carried out during 2017-18 at Forest Research Station, Govinkovi, Honnali taluk, Davangere district. The experiment was laid out in randomized complete block design with 16 genotypes and three replications. Trees were 14-years-old and of grafted origin. All the morphological and yield traits showed significant difference among the selected genotypes indicating the presence of adequate variations. The genotypes recorded morphological variation in terms of tree shape (semi-circle to irregular shape), foliage arrangement (dense to sparse), flowering time (early, mid and late), stem colour (dark brown, brown and light brown), bud colour (greenish white, pink, dark pink), petal colour (yellow and pale yellow), pod colour (greyish brown, brown, light brown and dark brown), pulp colour (light brown, brown and reddish brown), pod shape (straight, slightly curved, curved and deeply curved) and pod size (very big, big, medium and small). The analysis of variance revealed significant difference with respect to tree height, stem girth, pod traits, pod yield per tree (K-9 : 12.80 kg), number of pods per tree (NTI-52 : 989.07) and pulp per cent (K-9 : 48.87). Among the 16 genotypes, the genotype K-9 was found superior with respect to pod size, pod weight, pulp weight and pod yield per tree. Genotype K-9 was found promising and due to perennial in nature further evaluation is required for stability.

Keywords: Pod traits, tamarind and vegetative traits.

INTRODUCTION

Tamarind (*Tamarindus indica* L.) is a multipurpose tree belonging to the family Leguminosae (Fabaceae). It is a tropical fruit tree used primarily for its fruits, either eaten fresh or processed. In India, it is commonly grown in Karnataka, Madhya Pradesh, Bihar, Chattisgarh, Andhra Pradesh and Tamil Nadu. It is a robust tree which grows well even under different climatic conditions *viz*., tropical, subtropical and arid. In olden days it was grown from self sown seeds or by sowing seeds of unknown parentage. Hence, they exhibit a wide range of variation for morphological and yield traits. This variation may be due to effect of genetic or environmental or both. Therefore, it may be worthwhile focusing only on the very best trees in relation to neighboring ones and trees may be selected within the ecological zones. Before formulating any selection programme, it is necessary to understand the extent of variation among the genotypes and apply them for an increase in the pod and pulp production (Nicodemus *et al.*, 1997).

Many tamarind trees have been identified which were of seedling origin and they were multiplied vegetatively and maintained in the gene bank. Different genotypes which are propagated by vegetative means are being cultivated in different parts of the country. They have to be evaluated for morphological and yield attributing traits. Further, the elite lines may be useful in selection programme for the development of new cultivars.

MATERIALS AND METHODS

This study was carried out during 2017-18 at Forest Research Station, Govinkovi, Honnali taluk, Davangere district which is situated in the Southern

Transitional Zone of Karnataka at a latitude of 14.165367 and longitude of 75.6680832. The experiment was laid out in randomized complete block design with three replications and 16 genotypes *viz.,* K-9, NTI-52, K-11, S-7, S-8, S-14, S-3, N-6, D-2, C-4, D-9, NTI-89, D-19, S-6, K-10 and K-12. The morphological traits recorded were tree height, stem girth, tree shape, foliage arrangement, flowering time, stem colour, bud colour, petal colour, pod colour, pulp colour, pod shape, pod size and shell detachability along with that yield traits were also recorded. The height of the tree was measured from base to tip of the tree by using a pole and measuring tape, it was expressed in terms of meters. The girth of the tree trunk was measured by using a measuring tape and the reading was expressed in terms of meters. Tree shape, foliage arrangement, stem colour, bud colour, petal colour and pod shape were characterized based on visual observations. Tree shape was categorized as dome, cone, oval, round, semi-circle and irregular shapes. Foliage arrangement was categorized as dense and sparse arrangement. Based on the time of flower initiation, flowering time was categorized as early, mid and late flowering. Stem colour was categorized as light brown, brown and dark brown. Bud colour was categorized as greenish white, pink and dark pink. Petal colour was categorized as pale yellow and yellow. Pod and pulp colour was classified by using colour chart of Royal Horticultural Society (R.H.S), London. Pod shape was categorized as deeply curved, curved, slightly curved and straight. Based on the length, width and curvature of the pod, pod size was classified as very big, big, medium and small. Based on the ease of separation of shell from the pod, shell detachability was classified as easy, slightly hard and hard. Yield traits such as pod yield per tree was recorded at different intervals of harvest and expressed in kilograms. The number of pods per tree was recorded from each harvest and total yield was computed. Pulp per cent was calculated by dividing weight of pulp by weight of pod and multiplied by 100. Shell per cent was calculated by dividing weight of shell by weight of pod and multiplied by 100. Fibre per cent was calculated by dividing the weight of fibre over weight of pod and multiplied by 100. The number of fibres per pod was counted after separating fibres from the pulp and was expressed in numbers. The beak length of each pod was measured with the help of a thread and expressed in terms of centimetres. The experimental data recorded on various traits during the investigation were analyzed statistically using the method of analysis of variance (ANOVA) for randomized complete block design (RCBD) as given by Gomez and Gomez (1984). Whenever 'F' test was found significant for comparing the means of two treatments, the critical difference (C.D. at 5%) was worked out.

RESULTS AND DISCUSSION

In the present study the morphological traits showed significant variation (Table 1) among the selected genotypes indicating the presence of adequate variations. Two different shapes of tree were observed *viz.,* semicircle (K-9, S-7, N-6, D-2, D-19, K-10 and K-12) and irregular (NTI-52, K-11, S-8, S-14, S-3, C-4, D-9, NTI-89 and S-6). The foliage arrangements observed were dense (K-9, NTI-52, S-14, N-6, D-2, C-4, D-9, NTI-89, D-19, S-6, K-10 and K-12) to sparse(K-11, S-7, S-8 and S-3). Early (K-9, NTI-52, K-11, N-6, NTI-89, K-10 and K-12), mid (S-7, S-8, S-14, S-3, C-4 and S-6) and late flowering (D-2, D-9 and D-19) was recorded among the genotypes and pod beak was present in all the 16 genotypes. The variations with respect to the above characters are due to the effect of genotypic character and environmental conditions. Variation in tamarind genotypes were also earlier reported by Algabal *et al.* (2012) and Bhogave *et al.* (2018).

The colour traits among the genotypes showed wide variations (Table 2), in which the stem colour ranged from dark brown, brown and light brown. Bud colour ranged from greenish white, pink and dark pink. The different petal colours recorded were yellow and pale yellow. Variation with respect to petal and bud colour is due to genotypic effect. These wide range of colouration in reproductive organs that can serve as an immense breeding value and can be used not only as a morphological marker in progeny testing programme but can also enhance the fruit set by enhancing the pollinators. While, the different pod colour recorded were greyish brown, light brown, brown and dark brown. The colour of the pulp varied from light brown, brown to reddish brown. The variation with respect to the colour traits is due to the distinct feature of different tamarind genotypes and supported by Bhogave *et al.* (2018).

Table 1 : Variation in morphological traits and flowering time of tamarind genotypes

Trait	Category	Genotypes
Tree shape	Semi circle	K-9, S-7, N-6, D-2, D-19, K-10 and K-12
	Irregular	NTI-52, K-11, S-8, S-14, S-3, C-4, D-9, NTI-89 and S-6
Foliage arrangement	Dense	K-9, NTI-52, S-14, N-6, D-2, C-4, D-9, NTI-89, D-19, S-6, K-10 and K-12
	Sparse	K-11, S-7, S-8 and S-3
Flowering time	Early	K-9, NTI-52, K-11, N-6, NTI-89, K-10 and K-12
	Mid	S-7, S-8, S-14, S-3, C-4 and S-6
	Late	D-2, D-9 and D-19

Table 2 : Variation in colour of the selected tamarind genotypes

Genotype	Stem colour	Bud colour	Petal colour	Pod colour	Pulp colour
K-9	Dark brown	Dark pink	Yellow	Brown	Reddish brown
NTI-52	Brown	Dark pink	Pale yellow	Brown	Brown
K-11	Brown	Dark pink	Yellow	Grayish brown	Brown
S-7	Light brown	Pink	Pale yellow	Grayish brown	Light brown
S-8	Light brown	Pink	Yellow	Brown	Reddish brown
S-14	Brown	Dark pink	Pale yellow	Dark brown	Reddish brown
S-3	Brown	Dark pink	Yellow	Light brown	Brown
N-6	Brown	Dark pink	Yellow	Light brown	Light brown
D-2	Brown	Pink	Pale yellow	Brown	Brown
C-4	Brown	Greenish white	Pale yellow	Brown	Brown
D-9	Light brown	Pink	Pale yellow	Brown	Brown
NTI-89	Brown	Greenish white	Pale yellow	Brown	Reddish brown
D-19	Brown	Dark pink	Pale yellow	Grayish brown	Reddish brown
S-6	Brown	Greenish white	Pale yellow	Dark brown	Reddish brown
K-10	Light brown	Pink	Pale yellow	Grayish brown	Brown
K-12	Light brown	Pink	Pale yellow	Grayish brown	Brown

With respect to the shape of the pod *viz.,* straight, slightly curved, curved and deeply curved were recorded. Based on the length, breadth and curvature of the pod, pod size is classified as very big, big, medium and small sized pods. The variation with respect to the above traits (Table 3) is due to the effect of genotypic difference among the genotypes. Based on the ease of separation of shell from the pod, shell detachability was classified as easy, hard and very hard. This variation (Table 3) is due to the compactness or attachment of seeds to the pulp or shell to the pulp. Apart from this, it also depends on shell thickness. The results are also supported by Sharma *et al.* (2015).

Among 16 genotypes studied, the longest tree height was recorded in K-9 (5.08 m) while, the shortest was recorded in K-10 (3.00 m) and the maximum stem girth was recorded in K-9 (1.01 m) whereas, the minimum was recorded in S-7 (0.48 m). The variation with respect to tree height and stem girth (Table 4) is due to the effect of genotypic difference among the genotypes and also due to the differential utilization of resources from the soil. Such factors are known to cause morphological and genetic evolutionary

Table 3 : Variation in pod shape, pod size and shell detachability of tamarind genotypes.

Genotype	Pod shape	Pod size	Shell detachability
K-9	Deeply curved	Very big	Very hard
NTI-52	Slightly curved	Medium	Easy
K-11	Slightly curved	Small	Hard
S-7	Deeply curved	Big	Hard
S-8	Slightly curved	Medium	Easy
S-14	Slightly curved	Medium	Easy
S-3	Slightly curved	Medium	Easy
N-6	Curved	Big	Easy
D-2	Slightly curved	Medium	Easy
C-4	Slightly curved	Medium	Easy
D-9	Curved	Medium	Hard
NTI-89	Slightly curved	Big	Easy
D-19	Curved	Medium	Easy
S-6	Curved	Medium	Easy
K-10	Straight	Medium	Very hard
K-12	Slightly curved	Medium	Very hard

Table 4 : Variation in quantitative traits of tamarind genotypes

Genotype	Tree height (m)	Stem girth (m)	Pod yield per tree (kg)	Pulp per cent per pod	Shell per cent per pod	Fibre per cent per pod	Number of fibres per pod
K-9	5.08	1.01	12.80	48.87	21.47	6.17	4.03
NTI-52	4.13	0.85	10.79	40.78	27.06	2.84	4.27
K-11	3.17	0.58	4.77	41.18	23.83	2.16	3.07
S-7	3.67	0.48	5.97	42.10	22.39	3.17	5.00
S-8	3.67	0.53	5.03	46.38	22.07	5.13	3.97
S-14	3.33	0.58	4.55	44.45	15.78	3.24	3.80
S-3	4.23	0.62	3.96	52.03	28.13	3.45	2.90
N-6	4.00	0.77	9.07	42.03	22.21	6.94	7.33
D-2	4.50	0.93	6.88	38.45	25.97	2.96	5.37
C-4	4.17	0.65	4.53	44.50	27.60	3.10	2.97
D-9	4.00	0.60	5.33	38.07	26.15	3.16	4.93
NTI-89	4.13	0.57	8.72	42.13	26.03	3.51	4.03
D-19	3.87	0.60	6.84	44.52	17.18	3.94	4.93
S-6	4.10	0.49	4.44	42.15	16.53	4.13	4.37
K-10	3.00	0.60	8.21	40.52	27.53	4.92	7.23
K-12	3.20	0.70	7.38	35.09	28.87	5.48	5.87
S. Em ±	0.35	0.06	0.45	1.24	0.75	0.31	0.30
C. D @5%	1.01	0.17	1.30	3.58	2.17	0.90	0.86

divergences among the population. The supporting results have also been reported by Rao and Subramanyam (2010) and Divakara and Rathakrishnan (2011).

Significant difference in pod traits (Table 4) indicates the scope of genetic improvement. The genotype K-9 recorded significantly higher pod yield (12.80 kg/tree) and pulp per cent (48.87 %). The variation is attributed due to the difference in pod length, width, circumference, thickness and difference in the rate of development of vascular tissues (Pooja *et al.,* 2018). The highest number of pods per tree was recorded in NTI-52 (989.07) and the lowest number of pods per tree was recorded in S-8 (206.48) (Fig. 1). The minimum pod yield per tree was recorded in S-3 (3.96 kg/tree). The variation with respect to number of pods per tree is due to the higher number of primary and secondary branches and also inherent genetic makeup of each genotype. Apart from this, it also depends on environmental conditions. The highest beak length was recorded in D-19 (0.05 cm) and the lowest was observed in S-7, S-14, N-6, D-9, K-10 and K-12 (0.01 cm) (Fig. 2). The maximum number of fibres per pod was recorded in N-6 (7.33) and the minimum was recorded in S-3 (2.90). The difference in fibre number is attributed to the genetic makeup of each genotype. These findings are in line with the views reported by Fandohan *et al.* (2011) and Singh and Nandini (2014).

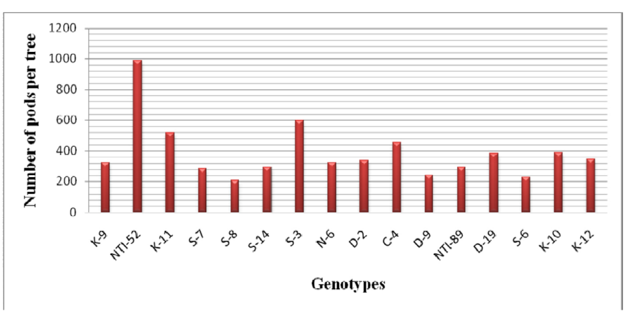

Fig. 1 : Variation in number of pods per tree of tamarind genotypes

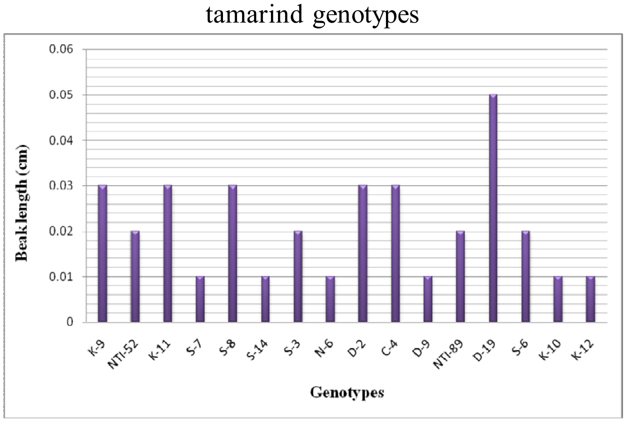

Fig. 2 : Variation in the beak length of tamarind genotypes

The highest pulp per cent was recorded in S-3 (52.03 %) which was on par with K-9 (48.87 %) and the lowest was observed in K-12 (35.09 %). The difference in pulp per cent per pod (Table 4) is clearly attributed due to the length, width, thickness and pulp content of the pod and also distinct feature of different genotypes. Similar results have also been reported by Prabhushankar *et al*. (2004) in tamarind and Usha *et al.* (2018) in macadamia nut. A significant difference was observed among the genotypes in respect of shell per cent per pod. The maximum shell per cent was recorded in K-12 (28.87 %) which was on par with S-3 (28.13 %) and C-4 (27.60 %) and the lowest was recorded in S-14 (15.78 %) which was significantly lower than all other genotypes. The variation in shell per cent is due to the difference in pod size, shell thickness and shell weight. Apart from this, it is inherent genetic makeup of each genotype. Similar variations with respect to shell per cent was also observed in tamarind by Sivakumar (2000) and Kotecha and Kadam (2002). The highest fibre per cent per pod was recorded in N-6 (6.94 %) which was on par with K-9 (6.17 %) and the lowest was observed in K-11 (2.16 %). The variation with respect to fibre per cent is due to the difference in the rate of development of vascular tissues in the pod, fibre weight per pod and also distinct feature of the different genotypes. Similar variations with respect to fibre per cent were also reported by Hanamashetti and Sulikeri (1997), Mastan *et al*. (1997) and Divakara (2008) in tamarind.

CONCLUSION

The study revealed existence of considerable variations among the genotypes for all the traits studied. The genotype K-9 was found superior compared to all other genotypes with respect to pod size, pod weight, pulp weight and pod yield per tree. Therefore, genotype K-9 found promising and subjected for further evaluation to ensure consistent results for utilization.

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