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Evaluation of seedling and clonal progenies of Tamarind *(Tamarindus indica)*

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ABSTRACT

In tamarind wide variation in yield and other characters is observed in different genotypes and naturally existing trees. Therefore to know the extent of variability in tamarind of both clonal and seedling progenies,were evaluated during 2002 and 2003 at Kittur Rani Channamma College of Horticulture at Arabhavi of University of Agricultural Sciences, Dharwad. Among the twenty clonal and sixteen seedling progenies significant variation existed for growth of tree, crown size, tree height, tree girth with orthotropic and plageotropic nature of growth habit. Clonal progenies expressed significant variability for pod characters such as pod length, width thickness, pod weight, pulp weight, etc., where as, there was not much variability in pod characters of seedling progenies. Among sixteen genotypes only six and 12 out of 20 clonal genotypes flowered and fruited at 6^{th} year of planting. The pulp characters in clonal progenies found to be higher than that of seedling progenies in the content of tartaric and ascoarbic acids. Clonal progenies were higher than seedling progenies in better qualities of pods. The genotype NTI-19 resulted in higher pod yield and pulp yield in both seedling and clonal progenies.

Key words : Clonal Progenies, Seedling Progenies, Tamarind.

In India most of the area under Tamarind *(Tamarindus indica* L.) cultivation is planted with unselected inferior cultivars. Genetic erosion is occurring in most of the growing areas due to deforestation, selective felling of individual trees for timber and fuel wood. A Systematic Germplasm Collection Maintenance and conservation programme for tamarind is desired. Plant genetic resources are the basic raw materials for improvement of any crop plant. Diversity in only form and races, local selections, elite trees, cultivars and relatives of crop plants, are a genetic resource which have to be collected evaluated conserved and utilized for the benefit of mankind. There exists a wealth of tamarind germplasm across the regions with appreciable range of variability. Therefore, systematic germplasm collection maintenance and conservation programme for tamarind will be beneficial both in short and long term for the tamarind growing countries. Hence, collection, conservation and it's vegetative propagation needs to be standardized for clonal orchards to exploit the genetic variation in tamarind (Singha, 1995).

The existence of variability is common in highly cross pollinated species and this is true for tamarind also. A wide variability in germplasm exists in tamarind in terms of acidity of the pulp, pod bearing ability and pod size. Realising the importance of this variability the Department of forest Government of Karnataka and University of Agricultural Sciences, Dharwad made the collection of clonal and seedling progenies of diverse tamarind genotypes at K.R.C.C.H, Arabhavi, which were considered for evaluation of the present study.

MATERIAL AND METHODS

The clonal and seedling progenies of tamarind planted during 1996 were considered for the evaluation during 2002 and 2003. The genotypes were planted at a spacing of 6 x 6m, in a black soil of Spices and Plantation crops department of KRCCH, Arabhavi. The genotypes were exposed to same set of conditions. Twelve out of twenty genotypes in clonal and six out of sixteen in seedling progenies flowered and fruited. The genotypes were evaluated for growth, yield, pod characters which exhibited wide range of variability. The data were subjected to special package for Agricultural Research (SPAR) for statistical analysis which was suggested by Doshi and Gupta (1991).

RESULTS AND DISCUSSION

Growth parameters of clonal progenies:

Clonal progenies of tamarind exhibited wide range of tree height from 0.78 to 3.42m in NTI-70 and NTI-19 respectively at the age of 6^{th} year, which were significantly differed. The tree girth ranged between 18.16cm in NTI-7 to 46.88cm in PKM-I with the mean of 33.68cm. The genotype NTI-14 had maximum East-West canopy spread of 4.53m, the lowest was in NTI-70 (1.21m). North-South spread ranged 1.22 to 3.73m in NIT-71 and NIT-14 respectively, which were found to have higher canopy in EW and NS directions (Table 1). As a result of maximum canopy spread NTI -14 expressed higher crown size of 3.53m, Where as lower was found in NTI-79 with 1.39m indicating the significant variation of crown size among the genotypes. Two types of growth habits were noticed viz., orthotropic and plageotropic. Genotypes NTI-2,5,7,15,62,71,77,79, SMG-4 and PKM-1, exhibited the orthotropic nature of growth habit indicating their suitability for high density planting, where as the genotypes NTI-14,19,32,57,70,75, Urigam Red tamarind and Sweet tamarind exhibited plageotropic nature (Table 1).

Growth parameters of seedling progenies:

Seedling progenies of tamarind exhibited the significant variation in growth parameters. NTI-70, expressed maximum tree height (4.00m) and that of minimum was noticed in NTI-32 (1.5m). The average height 3.03m at the age of 6th year. The tree girth was maximum in NTI-5 (49.75cm) and minimum in NTI-32 (12.27cm). Similar variations were observed by Debroy (1989) for the tree girth at 9th year of age in *Albizzia lebbeck.*

The maximum canopy spread was noticed in NTI-14 with 4.40m. The genotype NTI -32 had minimum spread (EW) of 1.35m, where as NS spread of canopy was more in NTI-14 (4.26m). It was less in NTI-32. The crown size was minimum in NTI-14 followed by NTI-19. Similar studies of crown spread in trifoliate orange during pre-bearing period were carried out by Agarwal (2000) who observed the growth performance of trifoliate orange considering it's stem diameter, tree height, canopy height, EW and NS spread, tree volume and canopy volume. The genotypes of seedling origin also exhibited two types of growth habits viz., orthotropic and plageotropic. The genotypes NTI-2,5,7,15,62,71,77,79,83 and SMG-4 were of orthotropic growth habit but, the genotypes NTI-14, 19,32,57,70, 75, were of plageotropic growth habit. Hence, the seedling and clonal progenies exhibited wide variation in growth parameters. The variation in growth parameters observed by Govind and Singh (2002) also exhibited wide range in plant height, stem girth and plant spread in EW and NS similar study it tamarind canopy spread was carried out by Devaranavadgi etal. (2003). The studies of Kahlon and Bains (1993), Solanki (1996), Ram *et al* (1997) Gabhane et al (1999) are in accordance with present investigations. Therefore, the genotypes of clonal and seedling origin differ in their growth and nature.

Pod characteristics :

The clonal and seedling progenies at KRCCH Arabhavi which fruited at 6th year were NTI-2,5,7,14,15,19,57, SMG-4 PKM-1, Red tamarind and Sweet tamarind in clonal and NTI-5, 14,15,19,57, and 70 in seedling progenies respectively. The observations on pod characters were made only on these respective genotypes there was not much variation in average pod length (11.92cm) in clonal and 11.48cm in seedling progenies . However, the clonal progenies exhibited the significant variation in pod length. The average pod width in clonal and seedling progenies was 2.56 and 2.33 cm, respectively. Overall average pod thickness was higher in clonal (1.69cm) than seedling progenies (1.48cm). Hence, clonal progenies possess pods with good length, width and thickness than seedling progenies (Table 3 & 4). The average pod weight of clonal and seedling progenies were noticed to be 15.27g and 10.21g respectively. Genotypes NTI-19 (23.40g) and NTI-15 (12.28g) were having higher pod weight in clonal and seedling respectively. However, seedling progenies did not exhibit the significant variation.

Clonal progenies only possessed the significant and higher values of pulp weight per pod (6.59g) than the seedling progenies (3.21g pod). The maximum pulp weight per pod was noticed in NTI-19 (11.45g) in clonal progenies where as the same was low in seedling progenies (3.94g) in same genotype. But the higher pulp weight per pod was noticed in NTI-15 (4.35g) in seedling the same in clonal type had higher pulp weight (5.23g) indicating the variation in same genotype with reference to it's clonal and seedling origin (Table 3 & 4). Likewise both type of genotypes exhibited variation in seed, shell, average pod weight. The clonal progenies were accompanied by the higher magnitude of values as compared to seedling progenies in respect of these parameters.

Commercially, the genotypes (either seedling or clonal origin) which exhibit lower seed, shell and vein weight per pod resulting in the higher pulp proportion are preferred, such genotypes were PKM-1 and NTI-5 (clonal) for low seed weight NTI-5 and 57 (clonal and seedling respectively) for low shell weight (Table 3 & 4). Hanamashetti (1997) made the similar observations with reference to pod characters of clonal progenies and Chellapilli (1995) and Mastan *et at* (1997) in seedling origin trees of chittore and Anantapur Districts of Andhrapradesh.

Table 1. Growth parameters of clonal progenies of tamarind at age of 6th year at KRCCH, Arabhavi.

SI. No.	Genotypes	Tree ht (m)	Girth of tree (m)	Tree spread (m)		Crown size (m)	Growth habit
				EW	NS		
1	NTI-2	2.53	26.67	2.36	2.80	2.57	Orthotropic
2	NTI-5	2.05	32.66	2.63	3.10	2.86	Orthotropic
3	NTI-7	2.03	18.16	2.62	1.90	1.92	Orthotropic
4	NTI-14	2.76	39.50	4.53	3.73	3.53	Plageotropic
5	NTI-15	2.37	21.83	2.53	3.10	2.60	Orthotropic
6	NTI-19	3.42	35.36	3.62	3.31	2.92	Plageotropic
7	NTI-32	2.67	30.00	3.18	3.16	3.17	Plageotropic
8	NTI-57	2.28	28.33	3.25	3.15	2.58	Plageotropic
9	NTI-62	2.03	20.16	2.98	3.13	1.84	Orthotropic
10	NTI-70	0.78	36.55	1.21	1.28	1.80	Plageotropic
11	NTI-7 1	1.66	37.08	1.70	1.22	2.66	Orthotropic
12	NTI-75	2.50	37.40	1.66	2.20	2.19	Plageotropic
13	NTI-77	3.20	26.65	2.86	2.70	2.78	Orthotropic
14	NTI-79	2.06	31.98	1.92	2.15	1.38	Orthotropic
15	NTI-83	2.71	41.00	2.96	3.12	2.51	Orthotropic
16	SMG-4	3.03	42.51	1.53	1.67	2.77	Orthotropic
17	PKM-1	2.85	46.88	3.08	2.17	3.04	Orthotropic
18	Urigaum	2.41	37.88	3.33	3.33	2.87	Plageotropic
19	Red tamarind	3.07	46.46	2.95	2.99	2.67	Plageotropic
20	Sweet tamarind	3.58	37.66	2.58	2.81	3.42	Plageotropic
	Mean	2.51	33.68	2.90	2.68	2.62	
	SEm±	0.26	2.16	0.45	0.31	0.40	
	CD (0.05%)	0.98	6.20	1.29	0.98	1.16	

Per Cent of Pulp, Seed, Shell and Vein:

Clonal and seedling progenies differed for above characters. The average pulp per cent was high (43.65%) in clonal than seedling progenies (31.05%), (Table 5&6) indicates the superiority of clonal over seedling types. On the contrary to this per cent of seed shell and vien were observed to be high in seedling progenies. However, another pulp estimate (Real Value) of pulp was also found to be high (2.92%) in clonal than seed ling (1.03%). The highest pulp per cent of clonal NTI-19 (49.06%) was found to be low in seedling type of same genotype (34.70%). The other genotypes also behaved similarly. Therefore over all pod characters of clonal progenies were superior than seedling progenies. Similarly Singh (1995) reported higher pulp per cent (55 per cent). Tripathi and Bora (1994) and Ram *et al.* (1997) in Guava studied the selection criterias, Mastanreddy *et al,* (1997), Ravinder kumar *et al.* (2003), Govind and Singh (2002) reported higher pulp pre cent in tamarind and other crops.

Tartaric and ascorbic acid content of clonal and seedling progenies:

The content of Tartaric and ascorbic acids in clonal and seedling progenies varied with a significance. The clonal progenies observed to be superior over seedling progenies. The average tartaric acid per cent of clonal was 12.84 and of seedling progenies was 10.52 per cent. The maximum tartaric acid in clonal progenies was found in NTI-19 (17.44%) the same genotype of seedling origin exhibited 7.97 per cent, indicating the superiority of clonal over seedling types. Rest of genotypes also exhibited other similar behavior, Seshagiri and Shastri, (1952) observed that there is a diurnal and seasonal fluctuation in titrable acid number (TAN) of tamarind since it is a crassulacean acid metabolism tree it retains more of acidity. The titrable acid number (TAN) also increased with the in crease in age of the tree. Kennedy *et al* (1998) reported a tartaric acid range of 14.91 to 17.4 per cent and he observed that sweet types recorded lower acidity. Similar observations were made in sweet tamarind which

Table 2. Growth parameters of seedling progenies of tamarind at age of 6th year at KRCCH, Arabhavi

SI. No.	Genotypes	Tree height (m)	Tree girth (cm)	Canopy spread (m)		Crown size (m)	Growth habit
				EW	NS		
1	NT1-2	1.87	14.92	1.77	1.61	1.69	Orthotrooic
2	NT1-5	3.51	49.75	3.37	3.3	3.35	Orthotronic
3	NTI-7	2.06	21.0	2.31	1.81	2.28	Orthotropic
4	NTI-14	3.75	43.56	4.40	4.26	4.34	Plaeeotrooic
5	NT1-15	3.43	30.60	3.85	3.41	3.65	Orthotrooic
6	NTI-19	3.60	44.13	4.20	3.95	3.98	Plaeeotrooic
7	NT1-32	1.50	12.27	1.35	1.35	1.33	Plaeeotrooic
8	NT1-57	3.78	41 .50	3.43	3.26	3.29	Plaeeotronic
9	NTI-62	3.83	43.42	3.45	3.56	3.52	Orthotrooic
10	NTI-70	4.00	46.50	3.98	3.97	3.44	Plaeeotrooic
11	NTI-71	3.40	36.33	3.85	3.62	3.52	Orthotrooic
12	NT1-75	3.08	34.17	3.68	3.12	3.25	Plaeeotrooic
13	NT1-77	2.40	39.33	2.92	2.88	2.73	Orthotrooic
14	NTI-79	2.93	44.83	3.65	3.74	3.68	Orthotrooic
15	NTI-83	2.03	49.00	3.20	3.66	3.42	Orthotrooic
16	SMG-4	2.96	35.17	3.53	3.42	3.43	Orthotrooic
	Mean	3.026	36.65	3.31	3.18	3.14	
	S.Em±	0.354	7.73	0.695	0.454	0.534	
	CIX0.05)	1.02	23.32	1.95	1.31	1.54	

Table 3. Pod characters of clonal progenies of tamarind at 6th year at KRCCH, Arabhavi

SI. No.	Genotypes	Pod length (cm)	Pod width (cm)	Pod thickness (cm)	Av. Pod wt. (g)	Pulp wt. pod^{-1} (g)	Seed wt. pod^{-1}	Shell $wt.pod^{-1}$ (g)	Vein $wt.pod^{-1}$ (g)	No.of Pods $tree^{-1}$	Yield $Tree^{-1}$ (kg)
1	NTI-2	9.28	2.06	1.61	8.51	3.54	2.25	2.53	0.36	12.00	0.102
2	NTI-5	12.94	2.16	1.40	12.21	4.63	3.63	3.35	0.60	40.50	0.282
3	NTI-7	11.94	1.99	1.42	11.23	4.23	3.29	3.14	0.57	7.00	1.203
4	NTI-14	9.90	2.44	1.78	14.94	6.53	4.00	3.84	0.57	63.50	0.560
5	NTI-15	10.83	2.67	1.58	15.47	5.23	4.88	5.00	0.56	16.00	0.248
6	NTI-19	14.43	3.49	2.03	23.40	11.45	5.01	5.99	0.95	213.00	5.790
7	NTI-57	12.00	2.40	1.76	14.46	6.40	4.54	3.17	0.35	89.00	1.290
8	NTI-75	11.00	2.70	2.00	18.79	7.28	5.76	4.94	0.81	21.00	0.395
9	SMG-4	15.11	2.86	1.86	25.06	10.73	6.41	6.87	0.05	139.50	3.610
10	PKM-1	11.08	2.68	1.73	11.38	6.13	1.99	2.89	0.37	29.00	0.181
11	Red tamarind	13.16	3.05	1.54	15.02	7.10	2.50	5.02	0.40	48.00	0.419
12	Sweet tamarind	11.34	2.19	1.55	12.81	5.82	3.28	3.41	0.30	16.00	0.106
	Mean	11.92	2.56	1.69	15.27	6.59	3.96	4.16	0.56	63.70	1.14
	SEm±	0.218	0.065	0.031	0.863	0.938	0.147	0.222	0.038	3.66	0.06
	CD (0.05%)	0.64	0.019	0.009	2.53	2.75	0.43	0.65	0.11	10.74	0.19

Table 4. Pod characters and yield of seedling progenies at 6th year of planting at KRCCH, Arabhavi.

Sl. No.	Genotypes	Pod length (cm)	Pod width (cm)	Pod thickness (cm)	Av. Pod wt. (g)	Pulp wt. pod^{-1} (g)	Seed wt. pod^{-1}	Shell $wt.pod^{-1}$ (g)	Vein $wt.pod^{-1}$ (g)	No.of Pods $tree^{-1}$	Yield $Tree^{-1}$ (kg)
	NT1-5	9.77	2.45	1.66	9.17	2.33	1.36	5.30	0.18	15.00	0.128
1	NTI-14	11.45	2.15	1.59	11.95	4.07	3.97	3.40	0.51	16.50	0.223
2	NT1-15	14.39	2.38	1.39	12.28	4.35	3.17	4.06	0.70	49.00	0.601
3	NTI-19	12.93	2.35	1.38	11.93	3.94	2.69	4.95	0.35	100.00	1.962
4	NT1-57	10.19	2.06	1.37	7.18	2.47	1.84	2.58	0.29	11 .25	0. 179
5	NTI-70	10.14	1.96	1.48	8.72	2.10	2.51	3.86	0.25	32.00	0.384
6	Mean	11.48	2.23	1.48	10.21	3.21	2.59	4.03	0.38	37.29	0.58

Table 5. Percent of pulp, seed, shell, vein, real value of pulp,tartaric acid and ascorbic acid content of clonal progenies of tamarind at 6th year of planting at KRCCH Arabhavi

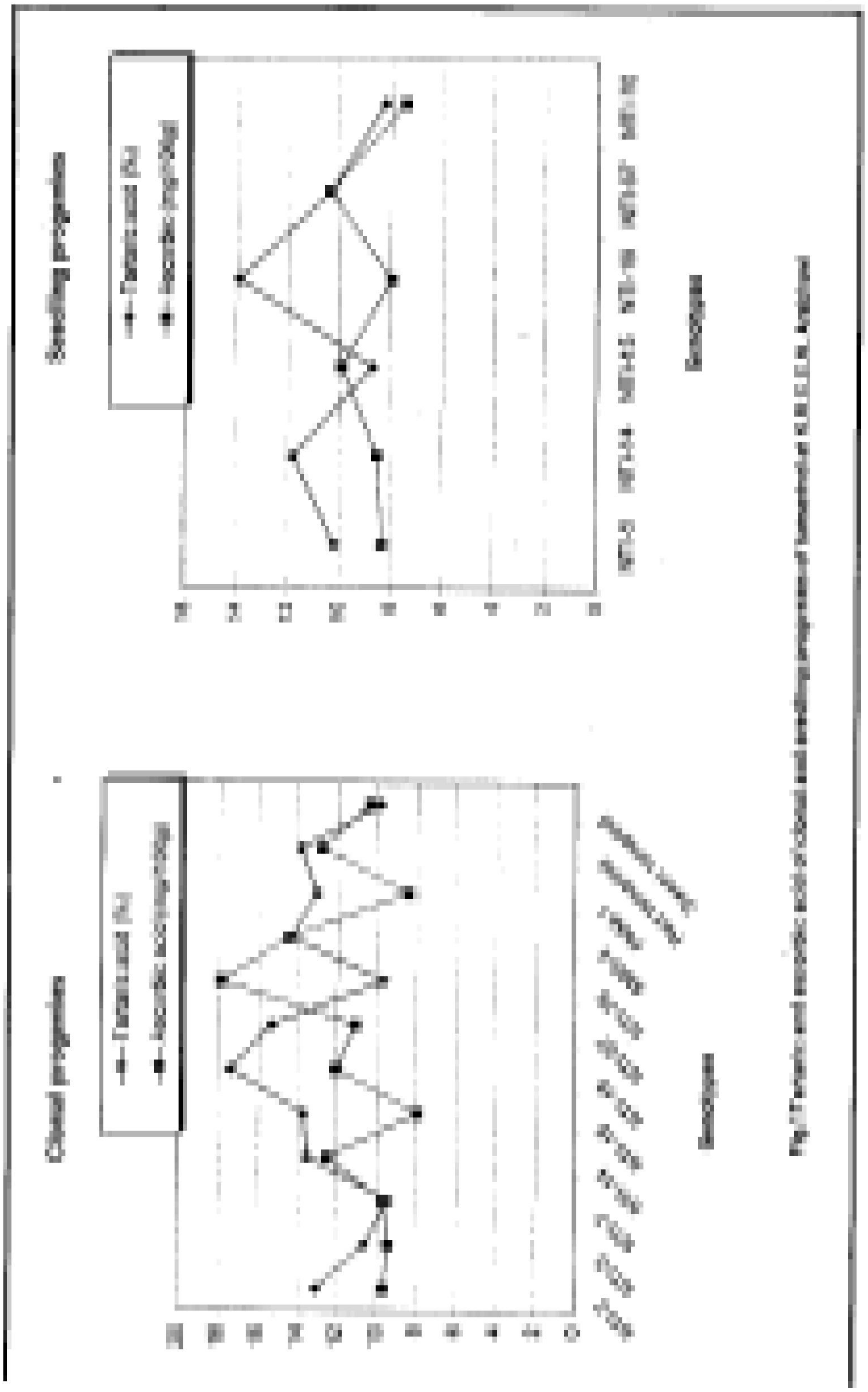
Sl. No.	Genotypes	Pulp (%)	Seed (%)	Shell (%)	Vein (%)	RVof pulp (%)	Tartaric acid (%)	Ascorbic acid (mg/lOOg)
1	NTI-2	41.62	26.4	27.65	4.33	1.47	13.08	9.66
2	NTI-5	36.86	30.41	27.84	4.89	1.71	10.66	9.42
3	NTI-7	37.7	29.32	27.9	5.08	1.6	9.43	9.66
4	NTI-14	45.48	24.04	26.78	3.7	2.97	13.56	1256
5	NTI-15	40.44	24.89	32.32	2.35	2.12	13.73	7.97
6	NTI-19	49.06	19.66	27.19	4.09	5.62	17.44	12.08
7	NTI-57	44.24	31.42	21.91	2.39	2.83	15.34	11.11
8	NTI-75	38.76	30.65	26.3	4.29	2.82	9.69	17.88
9	SMG-4	43.04	25.69	27.08	4.19	4.62	14.37	14.49
10	PKM-1	53.92	17.50	25.37	3.21	3.31	13.08	8.45
11	Red tamarind	47.26	23.14	26.93	2.67	3.36	13.89	12.18
12	Sweet tamarind	45.41	23.03	29.24	2.32	2.64	9.85	10.39
	Mean	43.65	25.51	27.21	3.63	2.92	12.84	11.37
	SEm±	2.213	1.858	0.948	0.065		0.246	0.692
	CD (0.05%)	6.49	5.45	2.78	0.19		0.72	2.03

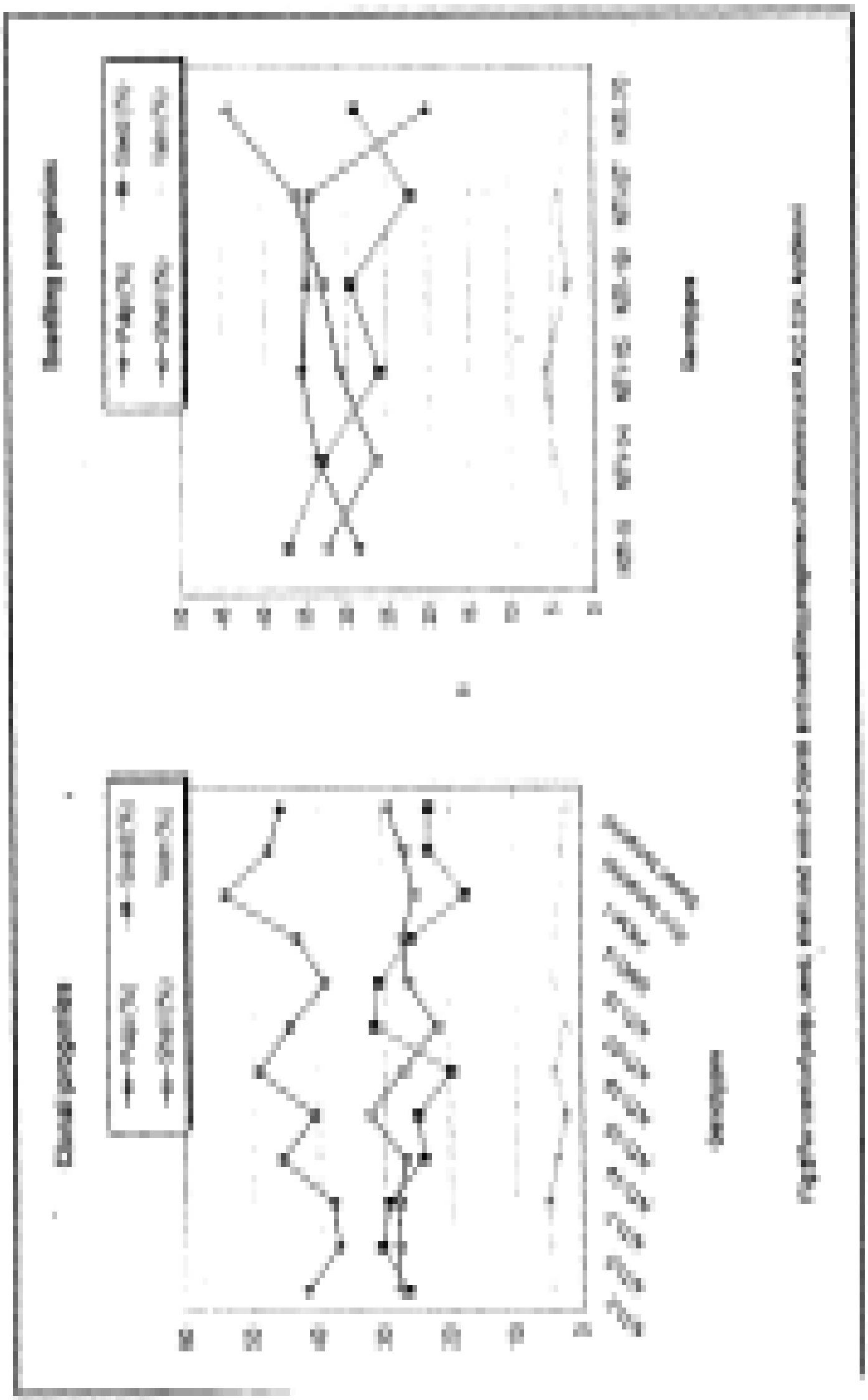
recorded 9.85 per cent in clonal type (Table 5, 6). He also reported a wide range of physico-chemical characters in various types of tamarind.

Shankaracharya (1998) reported 8-18 per cent of tartaric acid in tamarind. Similarly ascorbic acid content was also high in colnal than seeding progenies. The higher (17.88mg $100g^{-1}$) in NTI-75 of clonal type and 10.39mg $100g^{-1}$ in NTI-57 of seedling type. However, Eromosele *et al*. (1991) observed the range of 1.28 to 403.3g per lOOg in fruits, Kennedy *et al,* (1998) observed 2.72 to 3.34mg per lOOg of ascarbic acid, shankaracharya (1998) also observed 3-9mg $lOOg^{-1}$ range of ascorbic acid in tamarind. Therefore the clonal progenies might opened to be as superior in respect of quality than the seedling progenies.

Pod Yield Per Tree:

Numberof pods and pod yield varied significantly among the genotypes of both clonal and seedling origin (Tables 3 & 4). The clonal progenies registered the higher yield over seedling progenies. The average yield of clonal progenies was 1.14kg $tree^{-1}$ where as that of seedling progenies 0.58kg $tree^{-1}$. The higher yield per tree was noticed in NTI-19 in both clonal and seedling origin (5.79





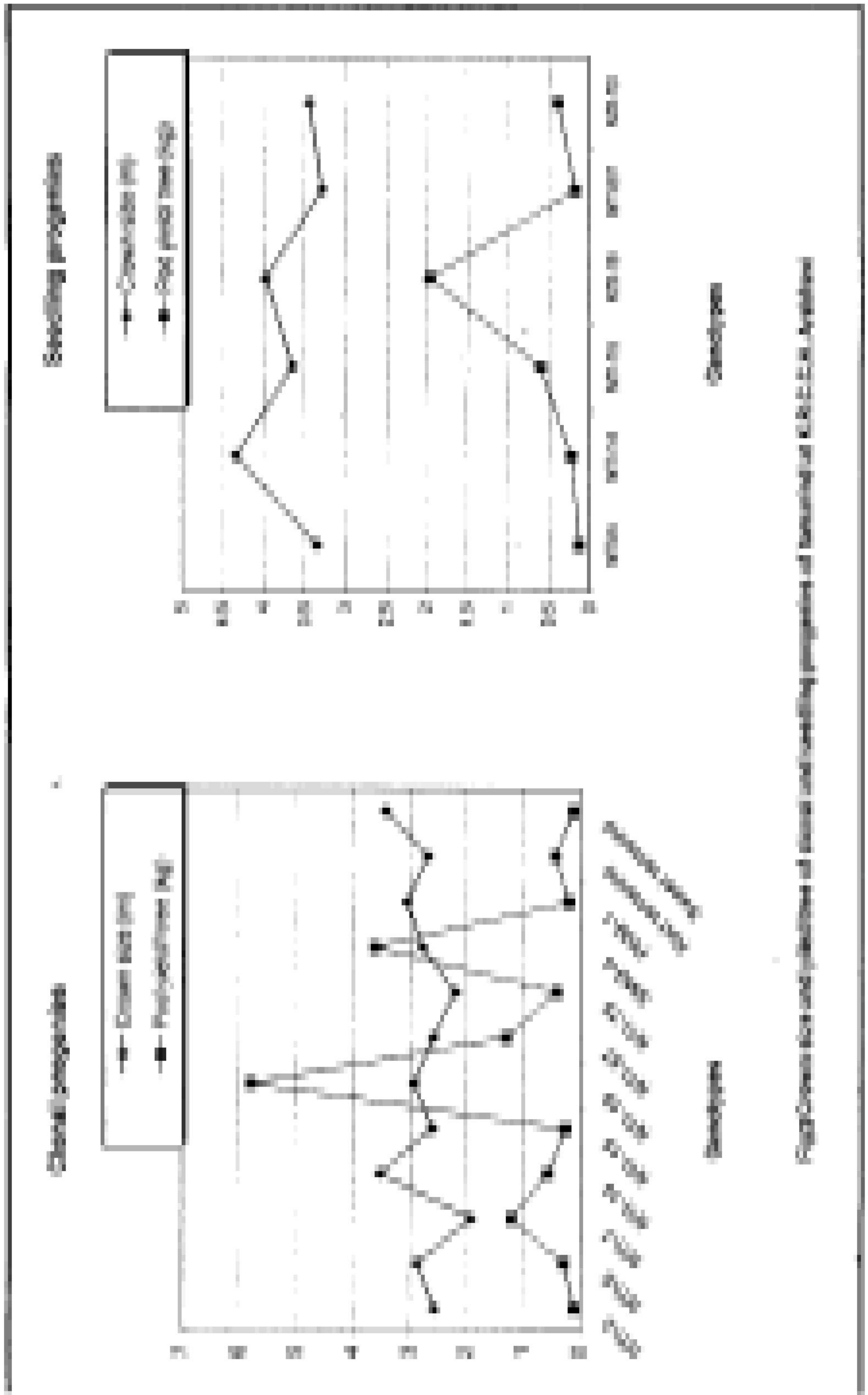


Table 6. Per cent of pulp, seed,shell,vein,real value of pulp,tartaric acid and ascorbic acid of seedling progenies at 6th year of planting at KRCCH, Arabhavi.

Sl. No.	Genotypes	Pulp (%)	Seed (%)	Shell (%)	Vein (%)	RVof pulp (%)	Tartaric acid (%)	Ascorbic acid (mg/lOOg)
1	NTI-5	28.44	37.00	32.41	2.15	0.66	10.17	8.33
2	NTI-14	33.35	32.71	26.39	4.64	1.36	11.79	8.51
3	NTI-15	35.39	25.85	30.70	5.70	1.54	8.72	9.91
4	NTI-19	34.70	29.39	32.83	3.08	1.37	13.89	7.97
5	NTI-57	34.28	22.05	36.10	4.18	0.85	10.33	10.39
6	NTI-70	20.11	28.77	44.38	2.91	0.42	8.23	7.42
	Mean	31.05	29.30	33.80	3.78	1.03	10.52	9.09

and 1.962kg) tree^{-1} respectively). Other genotypes also behaved similarly except NTI-15 which gave higher yield in seedling progeny than clonal which might be attributed to higher crown size in NTI-15 of seedling than clonal. The higher yield of NTI-19 might be ascribed to be due to high pod weight, pulp weight per pod, more number of pods per tree its higher growth parameters. Seedling progenies did not differ significantly as that of clonal progenies.

The average number of pods, per tree in clonal was 63.71 where as in seedling in was 37.29. The difference in higher number of pods in NTI-19 (213.00 and 100.00 pod per tree in clonal and seedling types respectively) might be due to clonal and seedling origin of the genotype. The lowest number of pods per tree was noticed in NTI-2 of clonal type. This variation in clonal progenies might be due to genotypes. Overall, most of the clonal progenies have recorded more number of pods than seedling progenies. Similar variation in yield of clonal and seedling progenies were noticed by Saideshwar Rao (1995) and Nageshwar Rao (1997).

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