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RESEARCH ARTICLE

Evaluating the performance of *Tamarindus indica* L. grafted on flowering in experimental research plot

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Abstract

A field study on performance of propagules of grafted *Tamarindus indica* L. on blooming in a research plot was undertaken. Flowering pattern of grafted clones was recorded within the research plot on clone wise during June 2012 and June 2015 separately. Performance of clone was assessed based on the blooming ability of the propagules of each clone during the two survey was analyzed and results have been discussed in the light of variation in blooming and performance of flowering of each superior clones were compared and presented in detail.

INTRODUCTION

In recent years, *Tamarindus indica* L. a non timber fruit species has attained the status of commercial crop (Raghuveer, 1977). Owing to several industrial usages such as kernel powder, the pectin present in the seed helps in the production of Jam, Jelly and other commercial products leads to mushrooming the Tamarind plantation in different states of India. However earlier workers have documented Tamarind as a light demanding tree that grows very slowly. Flowering and fruiting times vary from country to country and region to region depending on the latitude and altitude. In India early, mid and late flowering types of Tamarind have been reported (Usha and Singh, 1994).

Phenology showed relationship with climatic factor such as temperature, rainfall and irradiance were documented in earlier reports. In Tamarind the timing of flowering is governed by variation in rainfall, photoperiodism and temperature (Morellato *et al.*, 2000 and Marques *et al.*, 2004). (Marques *et al.*, 2004) reported that variation in flowering among superior clones is associated with day length or temperature with a log of 4 -5 months. Little study was observed on the flowering of Tamarindus clones assembled which were not bloomed for a long period, even after completing sixteen years. The present study has been taken up to understand the performance of blooming of superior clones assembled in the research plot and to compare and document its variation in blooming of the clones naturally.

MATERIALS AND METHODS

Study area

The study was carried out in experimental Field Zone – 1 of State Forest Research Institute, Kolapakkam, Chennai, Tamil Nadu, India. The description of experimental plot no. was 10,003-7-10-72 as in plot file notification. Experimental plot file form no. /D. Mount Stuart, Madras East Region. Experiment was started during November 1998 covering an area of 2.75 Ha. with an objective to evaluate the performance of progeny of Tamarindus grafted on flowering in the experimental research plot. It was the Dry Evergreen Forest of Southernly Aspect, Plain slope with a mean annual rainfall of 750 mm. The area was characterized by red loamy soil with sand, well drained, Cashew CRA, under wood – miscellaneous thorny bushes with grass and miscellaneous weed growth were recorded in initial condition of the planting operation. Hare, Fox, Peacock, etc were found to be the biological interactions. The Geographic coordinates of the research plot was recorded using GPS device and tabulated (Table – 1).

Table 1. Geographic coordinates of the research plot.

Station	Latitude				Longitude			
	Degree		Minutes	Seconds	Degree		Minutes	Seconds
1	N	12	52	260	E	80	6	145
2	N	12	52	238	E	80	6	261
3	N	12	52	212	E	80	6	258
4	N	12	52	213	E	80	6	246
5	N	12	52	200	E	80	6	244
6	N	12	52	218	E	80	6	138

Preliminary operation of the study site

Initially the area was cleared and uprooted of stumps, ploughed (Disc plough) and planted clonal plants according to determined approved design in 45 cm^3 pits dusting and applied farmyard manure in pits, the clonal plants were prepared by vegetative propagation method by approach grafting and raised by seeds.

Collection of clones

Various clones of *Tamarindus indica* L. were collected from Virinjipuram, Melchengam and Ramanahalli and assembled in the plot. The name of the clones and their source with number of propagules planted were recorded in Tables – 2 .

Tables – 2. Sources of *T. indica* clones planted in the Experimental Plot

S. No.	Name of the clone	Source of clones	No. of propagules planted
1	**CPT**	CPT	12
2	**V/1**	Vellore/Virinjipuram	12
3	**H/2**	Hasanur/Virinjipuram	12
4	**H/7**	Virinjipuram	12
5	**T/142**	Thirupathur	12
6	**D/112**	Denkenikottai	12
7	**P**	Plus tree	12
8	**H/1**	Hasanur	12

9	**V/412**	V. Patti	12
10	**V/57**	Melchangam/Vellore	12
11	**HCT/164**	Ramanahalli	12
12	**H/8**	Virinjipuram	12
13	**KK/102**	Kondukapalli	12
14	**N/10**	Neyveli	12
15	**V/4**	Vellore	12
16	**PKM/418**	Periyakulam	12
17	**PKM/1**	Periyakulam	12
18	**A**	Average tree	12
19	**V/40**	Melchangam/Vellore	12
20	**V/13**	Melchangam/Vellore	12
21	**HCT/165**	Ramanahalli	12
22	**H/3**	Hasanur/Virinjipuram	12
23	**SEEDLINGS**	Virinjipuram	12
24	**S/226**	Sadivayal	12
25	**405**	Motathu	12
26	**A/PP**	Palakupalli	12
27	**T/50**	Thirupathur	12
28	**N/49**	Neyveli	12
29	**V/67**	Vellore	12
30	**V/14**	Vellore	12
31	**V/58**	Vellore	12
32	**V/59**	Vellore	12
33	**V/58**	Vellore/Virinjipuram	12
34	**H/10**	Hasanur	12
35	**R/141**	Reddiyur	12
36	**V/10**	Vellore	12
37	**V/66**	Vellore	12
38	**D/106**	Denkenikottai	12
39	**HCT/166**	Harur	12
40	**HCT/162**	Harur	12
41	**HCT/163**	Harur	12
42	**HCT/161**	Harur	12
43	**C/143**	Ramanahalli	12
44	**D/121**	Denkenikottai	12
45	**H/4**	Hasanur	12
46	**CT/161**	Chengam	12
47	**V/64**	Vellore/Virinjipuram	12
48	**V/2**	Vellore/Virinjipuram	12

49	**V/3**	Vellore/Virinjipuram	12
50	**V/29**	Vellore/Virinjipuram	12
51	**T/145**	Thailand	12
52	**PKM/11**	Periyakulam	12

T.indica propagules of the above mentioned clones were planted during November 1998 and propagules were systematically labeled according to the clones. After completing fourteen years and seven months, a first survey was made on the occurrence of flowering during June 2012 followed by second survey during 2015 June instant. With an objective to know the performance of flowering and were recorded during June – 2012 and 2015.

As it was a prolonged experiment about 16 years, the casualty parameter was also taken into account for ranking the blooming trees of each clones. At the time of second survey, pollarding management was also carried out covering 9 trees of five clones on the western side of the research plot in order to make a practice to know the performance of blooming. Pollarding was carried out on 24/03/2015.

The performance of clones on flowering was calculated and ranked based on the number of trees bloomed within a clone. Observation was made by monitoring blooming trees of each tree in every clone excluding casualty. The results were tabulated and interpreted based on the clonal performance.

RESULTS AND DISCUSSION

The results of the present study showed that out of 52 clones consisting of 572 trees under observation in the research plot, 34 clones consisting of 117 trees were bloomed during 2015 whereas 2012 survey revealed that out of 52 clones, 23 clones covering 119 trees were bloomed. Flowering was observed and recorded, within the trees. The clones were ranked on the basis of maximum number of trees flowered within the trees.

A comparative analysis was made on performance of clones on blooming was recorded, as a result, it was found that during 2012 survey trees planted on the western side (Fig. 1) of the research plot were bloomed whereas during 2015 survey blooming of trees planted on the eastern side (Fig. 2) of the research plot was observed. Both surveys were critically analyzed to assess the best performing clones of *T.indica* in the research plot.

The best performing clones were chosen and analyzed on the basis of clones bloomed recorded twice time i.e. 2012 and 2015 surveys. Interestingly, it revealed that 16 clones were recorded as best performing clones and was tabulated and indicated as stars (*).

Flowering observation in *T. indica* propagules in Experimental Plot

Fig. 1 - Flowering of Tamarindus propagules during 2012 - 13

Area : 2.75 Ha. **Total plants planted : 624**

Ep. No. 3/1998 - 1999

N

A/PP	V/67	V/57	HCT/164	C/143	V/59	H/8	SEEDLINGS	PKM/418	PKM/1	CPT
V/40	D/106	V/14	HCT/166	D/121	V/4	H/7	V/1	D/112	V/412	A
T/50	V/66	V/58	HCT/162	H/4	V/2	H/3	H/2	S/226	PKM/11	P
N/49	V/10	V/13	HCT/163	CT/161	V/3	V/58	T/145	H/1	KK/102	
R/141	N/10	HCT/165	HCT/161	V/64	V/29	H/10	T/142	405		

C

Total no. of plants planted : 624
Casualities : 2
Total no. of plants under observation : 572

- Flowering trees recorded on 09/06/2015

C - Casuality

Fig. 2 - Flowering of Tamarindus propagules as on June - 2015

Area : 2.75 Ha. **Total plants planted : 624** **Ep. No. 3/1998 - 1999**

A/PP	V/67	V/57	HCT/164	C/143	V/59	H/8	SEEDLINGS	PKM/418	PKM/1	CPT
					C		C	C C	C C C	C
							C	C C	C C C	
			C	C			C	C C	C C	

V/40	D/106	V/14	HCT/166	D/121	V/4	H/7	V/1	D/112	V/412	A
		C				C C				
	C C				C	C				

T/50	V/66	V/58	HCT/162	H/4	V/2	H/3	H/2	S/226	PKM/11	P
				C				C		
		C								

N/49	V/10	V/13	HCT/163	CT/161	V/3	V/58	T/145	H/1	KK/102
				C		C	C	C	C
	C						C		
	C		C		C		C		C C

R/141	N/10	HCT/165	HCT/161	V/64	V/29	H/10	T/142	405
		C					C	
							C	

Total no. of plants planted : 624
Casualities : 52
Total no. of plants under observation : 572

- Pollarding (24/03/2015)
- Flowering trees recorded on 09/06/2015
- C - Casuality

Tables – 3. A comparative analysis of best performing clones in flowering

Name of the clone	No. of clones planted	2012			2015			Best performing clones
		No.of trees under observation	No. of trees flowering	Rank	No.of trees under observation	No. of trees flowering	Rank	
T/50	12	12	11	**I**	12	1	**VIII**	*
V/57	12	12	10	**II**	12	4	**V**	*
N/49	12	12	9	**III**	12	1	**VIII**	*
HCT/164	12	12	8	**IV**	11	4	**V**	*
V/14	12	11	8	**IV**	11	1	**VIII**	*
V/58	12	12	8	**IV**	11	1	**VIII**	*
D/106	12	11	8	**IV**	10	0	-	-
A	12	12	0	**V**	12	3	**VI**	*
V/40	12	12	7	**V**	12	2	**VII**	*
HCT/165	12	12	7	**V**	11	2	**VII**	*

A/PP	12	12	7	**V**	12	1	**VIII**	*
R/141	12	12	7	**V**	12	0	-	-
N/10	12	12	6	**VI**	12	3	**VI**	*
CT/161	12	12	4	**VII**	11	0	-	-
CPT	12	12	3	**VIII**	11	9	**I**	*
V/67	12	12	3	**VIII**	12	1	**VIII**	*
V/3	12	12	3	**VIII**	11	0	-	-
PKM/11	12	12	3	**VIII**	12	0	-	
V/13	12	12	2	**IX**	12	2	**VII**	*
V/10	12	12	2	**IX**	10	0	-	-
V/58	12	12	1	**X**	11	1	**VIII**	*
V/59	12	12	1	**X**	11	1	**VIII**	*
HCT/166	12	12	1	**X**	12	0	-	-
V/1	12	12	0	-	12	8	**II**	-
H/2	12	12	0	-	12	8	**II**	-
H/7	12	12	0	-	9	7	**III**	-
T/142	12	12	0	-	10	7	**III**	-
D/112	12	12	0	-	12	7	**III**	-
P	12	12	0	-	12	7	**III**	-
H/1	12	12	0	-	11	5	**IV**	-
V/412	12	12	0	-	12	5	**IV**	-

H/8	12	12	0	-	11	4	**V**	-
KK/102	12	12	0	-	9	4	**V**	-
V/4	12	12	0	-	11	3	**VI**	-
PKM/418	12	12	0	-	3	3	**VI**	-
PKM/1	12	12	0	-	3	3	**VI**	-
H/3	12	12	0	-	12	2	**VII**	-
SEEDLINGS	12	12	0	-	9	2	**VII**	-
S/226	12	12	0	-	10	2	**VII**	-
405	12	12	0	-	12	2	**VII**	-
H/10	12	12	0	-	12	1	**VIII**	-
V/66	12	12	0	-	12	0	-	-
HCT/162	12	12	0	-	12	0	-	-
HCT/163	12	12	0	-	11	0	-	-
HCT/161	12	12	0	-	12	0	-	-
C/143	12	12	0	-	11	0	-	-
D/121	12	12	0	-	12	0	-	-
H/4	12	12	0	-	11	0	-	-
V/64	12	12	0	-	12	0	-	-
V/2	12	12	0	-	12	0	-	-
V/29	12	12	0	-	12	0	-	-
T/145	12	12	0	-	12	0	-	-
A	12	12	0	-	12	3	**VI**	-

Note - * indicates best performing clone

In the present study, clones of Tamarindus showed variation in characters of flower production. A narrow variation has been observed for floral trait i.e. blooming pattern (Fig. 1 & 2). In the present study it was revealed that majority of the trees planted on the eastern region of the research plot clones were recorded to be blooming during 2015, whereas during 2012 majority of the trees planted on the western side of the research plot were bloomed. The flowering time observed in the present investigation was correlated with Thimmaraju *et al.*, (1977); Radhamani *et al.*, (1993); Chaoudhary and Chaoudhary (1997) findings. This wide difference for flowering between eastern and western region could be mainly due to influence of variation in day and night duration and crown density.

It is reported that production of flowers varies considerably with the clones in India was reported. Clones with longer vegetative terminal shoots produce more flowers. In general, flowering and fruiting takes place in the dry season. Similar studies revealed that the variations in flowering are due to genotype environmental interactions (Coronel, 1991; Jayaweera, 1981; Nagarajan *et al.*, 1997). Flowering and fruiting varies from country to country and region to region depending on the latitude and altitude (El-Siddig *el al*, 2006).

Several studies revealed that tartaric acid is synthesized in the leaves in the light and translocated to the flowers and fruits (Patnaik, 1974). Dry weather is important for flower initiation and if heavy rain occur during flowering tamarind does not bear fruit (Morton, 1987). In the present study blooming performance of each clones varies from tree to tree within a clone and also from clone to clone were observed. This observation recorded was agreed in accordance with the results of (Mahadevan, 1991), which may reflect either genetic variation or genotype x environmental interactions or both. Similarly, little study reportred that the perdiction of photoperiod sensitivity would play a role in phonological development in particular flowering. To make rapid progress in second-generation breeding, early flowering in superior clones are needed in order to shorten the generation time (e.g. Longman *et al*., 1990).

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