RESEARCH ARTICLE Legume Research- An International Journal, Volume 46 Issue 9: 1179-1183 (September 2023)

Performance of Tamarind (*Tamarindus indica* L.) Accessions under Dryland Conditions

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10.18805/LR-4810

ABSTRACT

Background: The research was conducted at the ICAR-CRIDA Hayatnagar Research Farm in Hyderabad, India. The plant material consisting of tamarind trees that were planted in 1998 with a 5 m spacing to improve the morphological and reproductive characteristics of elite genotypes as well as quality among the forty tamarind accessions maintained at the research farm. The experiment was started in 1998 and observations were taken over the fruiting season of 2020-2021 with forty tamarind accessions, the experiments were established in a randomized block design. The trees were identified for their consistent health and development.

Methods: Biometric observations mainly average number of flowers per inflorescence, average number of inflorescence per Branch, average number of branches per tree, average fruit weight (g), average yield per plant (kg), fruit, pulp, seed weights as well as shell, fibre, fruit, number of normal seeds per pod as well as damaged number of seeds per pod were recorded and analyzed statistically.

Result: Significant differences among the tamarind accessions evaluated, NZB(S), Hasanur #5, Salem 132, NTI-14 and SMG-3 recorded the highest values in all the growth, pod and yield characters. NZB(S) recorded the highest number of flowers per inflorescence (14.62) while Hasanur # 5 recorded the highest number of inflorescence per branch (13.87). In yield attributes, NZB(S) recorded the highest average yield per plant (kg) (15.72) followed by Hasanur #5 (15.09), Salem 132 (14.81) and NTI-14 (14.65). The results revealed that NZB(S) showed the highest mean performance in terms of growth, yield and quality characters. The best performing accessions are being multiplied through vegetative propagation methods for planting on large scale in different locations.

Key words: Accessions, Flowering, Growth, Pod characters, Tamarind, Yield.

INTRODUCTION

The purpose of this research was to "Performance of Tamarind (*Tamarindus indica* L.) Accessions under Dryland Conditions". In many regions around the world, the exploration for novel high-quality and low-cost food sources is a key concern of governments and organizations concerned for food and nutrition (Balogun and Fetuga 1986).

Based on existing developments, projections indicate a gap between human population and food supply (Vijayakumari *et al*., 1997). As a consequence, research efforts are being focused on finding and analysing underutilised crops that have been neglected to the disadvantage of human development as future food crops (Egbe and Akinyele, 1990; Adekunle and Ojerinde, 2004).

Tamarind is a member of the dicotyledonous Leguminosae family, which is the third biggest flowering plant family with 727 genera and 19,327 species (Lewis *et al*., 2005). The term tamarind comes from the the Arabic word "Tamar-E Hind" meaning "Date of India". It is almost found throughout the tropics and sub-tropics of the world and has naturalized at many places particularly in India, South East Asia, Tropical America, the Pacific Islands and the Caribbean. The Asian countries, such as India and Thailand, are the primary producers. Tamarind popularly known as Imli is one of the auspicious, versatile tree in the Indian subcontinent and particularly abundant in the States of Madhya Pradesh, Bihar, Andhra Pradesh, Telangana, Chhattisgarh, Karnataka, Tamil Nadu and West Bengal (Singh *et al*., 2007). It is a diploid species with 2n=26 chromosomes (Purseglove, 1987). India is the world's largest producer of tamarind and it is estimated that 300,000 tons are produced annually. Tamarind is an important cash crop of India and enjoys sixth position in terms of export earnings. Tamarind tolerates high pH and is well suited to wastelands, drylands, saline and sodic soils. The trees act as windbreak in many areas and also suitable for drought prone areas. Tamarind thrives in a tropical climate with hot, dry summers and moderate winters. It can withstand drought but is prone to frost. Tamarind can be grown in almost all types of soil even on poor and margin soils, since; its life-span is long, deep loamy soils with adequate soil moisture holding capacity is ideal. A typical fruit contains about 55% pulp, 34% seeds and 11% shell and fibre on weight basis

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How to cite this article: Reddy, A.G.K., Osman, M., Yadav, S.K., Prasad, T.V., Shankar, K.S., Pushpanjali, Jyothilakshmi, N., Salini, K., Singh, V.K. and Yadagiri, J. (2023). Performance of Tamarind (*Tamarindus indica* L.) Accessions under Dryland Conditions. Legume Research. 46(9): 1179-1183. doi: 10.18805/LR-4810.

Submitted: 08-10-2020 **Accepted:** 04-02-2022 **Online:** 04-03-2022

(Rao *et al*., 2001; De Caluwe *et al*., 2010). Due to the obvious large amount of fruit produced, processing firms now have a plenty of raw material to work with. Fruit's excellent flavour, nutritional content and therapeutic properties indicate that it has a high potential for processing into value-added goods with a long shelf life. Processing into value-added products is one means of preserving this commodity and improving its use for human health. Soups, jams, chutneys, sauces and juices all use the edible pulp of ripe fruit as a flavouring component (Isholoa *et al*., 1990). The tamarind fruit pulp has the most tartaric acid (8-18%) of any natural source. Moreover, pulp is the only material used for culinary purposes (Balan *et al*., 2017). Hence the present investigation on performance of tamarind (*Tamarindus indica* L.) accessions under dryland conditions was carried out at Hayatnagar Research Farm, ICAR-CRIDA.

MATERIALS AND METHODS

The study was conducted at Hayatnagar Research Farm, ICAR-CRIDA Hyderabad, India, from 2020 to 2021 with the objective of recording the flowering and fruiting characteristics of elite genotypes as well as quality among the forty tamarind accessions kept at the research farm (Fig 1). The field trail was established in 1998 and evaluated during fruiting season of 2020-2021 (22 years aged plants). Three replications and 40 genotypes were used for the experiment, which has been arranged in a randomised block design viz., Hasanur #3, Hasanur #5, Vellore #2, Vellore #29, Salem 132, Urigam CT 164, Urigam CT 112, PKM-1, Urigam, Vantoor, Sweet, Red, NZB (S), KRMR, PKM (Red), Prathistan, HYD (Local), Salem Red, Salem Blue, NTI-14, NTI-32, NTI-39, NTI-42, NTI-56, NTI-60, NTI-73, NTI-75, NTI-76, NTI-82, NTI-84, NTI-85, NTI-86, CMK-5, CMK-6, CMK-7, SMG-3, SMG-4, SMG-7, SMG-13 and BDM-3. The findings of eleven quantitative characters' observations *viz.,* number of flowers per inflorescence, number of inflorescence per branch, number of fruits per branch, fruit weight (g), pulp weight per fruit (g), seed weight per fruit (g), shell weight per fruit (g), fibre weight per fruit (g), total number of seeds per pod (normal and damaged) were taken account of for all of the genotypes selection of study. For recording horticultural traits, five observations of each genotype were chosen at random from each replication. At a 5% level of probability, the significance of the mean was assessed using the Critical Differences (CD) test (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

Development of high yielding varieties of crop/ trees requires information about the nature and magnitude of variability present in the available accessions in phenotypic characters that are connected with yield. The morphological parameters of forty tamarind accessions are described in Table 1 and 2. Significant differences among forty tamarind accessions were observed. The findings revealed that among forty tamarind accessions, NZB (S) recorded the highest values in case of pod and yield characters. NZB (S) accession recorded the highest average number of flowers per inflorescence (14.62) which was the highest among the forty tamarind accessions followed by Salem 132 (13.61), Hasanur #5 (13.25) and NTI-75 (12.91) while it was the lowest in SMG-7 (8.18) followed by Urigam CT 164 (8.47), NTI-82 (8.63) and NTI-42 (9.12).

In case of average number of inflorescence per branch Hasanur #5 accession recorded the highest value of 13.87 followed by NZB (S) (12.94), NTI-14 (12.72) and PKM (Red) (12.61) and the lowest was noticed in SMG-7(7.4) followed by Urigam CT 164 (7.62), NTI - 82 (7.91) and NTI - 42 (8.27). Average number of branches per tree Hasanur #5 accession recorded the highest value of 6.11 followed by NZB (S) (5.94), Salem 132 (5.92) and NTI - 14 (5.91) and the lowest was noticed in SMG-7(3.21) followed by Urigam CT 164 (3.57), NTI - 82 (3.64) and NTI - 42 (3.68). In the case of average fruit weight (g), NZB (S) accession recorded the highest value of 19.24 followed by Salem 132 (19.08), Hasanur #5 (18.59) and PKM (Red) (16.34) and the lowest was noticed in CMK-6 (8.82)followed by KRMR (9.05), Urigam CT 164 (9.37) and Red (9.42). Average yield per plant (kg) NZB (S) accession recorded the highest value of 15.72 followed by Hasanur #5 (15.09), Salem 132 (14.81) and NTI-14 (14.65) and the lowest was noticed in SMG-7



Fig 1: General view of the experimental field.

Table 1: Evaluation of 40 tamarind accessions for flowering, fruiting and yield characters.

Variety	Ave. no. of flowers/ inflorescence	Ave. no. of inflorescence/branch	Ave. no. of branches/tree	Ave. fruit weight (g)	Ave. Yield/ plant (kg)
Hasanur #3	11.49	9.73	5.14	9.42	12.27
Hasanur #5	13.25	13.87	6.11	18.59	15.09
Vellore#2	10.17	11.41	5.13	10.64	12.36
Vellore#29	0	0	0	0	0
Salem 132	13.61	10.96	5.92	19.08	14.81
Urigam CT 164	8.47	7.62	3.57	9.37	4.83
Urigam CT 112	10.46	8.74	3.76	10.13	7.92
PKM-1	11.81	12.35	5.66	12.79	13.54
Urigam	12.17	11.41	4.65	11.26	10.54
Vantoor	10.92	9.28	3.84	13.92	8.79
Sweet	12.67	10.81	4.73	12.89	11.17
Red	12.15	11.36	4.82	9.45	11.51
NZB (S)	14.62	12.94	5.94	19.24	15.72
KRMR	12.34	11.77	5.81	9.05	13.94
PKM (Red)	11.21	12.61	4.92	16.34	12.13
Prathistan	12.87	10.48	4.79	14.50	11.38
HYD (Local)	10.93	9.69	3.95	12.82	8.84
Salem Red	0	0	0	0	0
Salem Blue	0	0	0	0	0
NTI-14	11.51	12.72	5.91	14.26	14.65
NTI-32	10.34	9.15	3.82	13.01	8.26
NTI-39	11.67	10.86	4.53	9.74	9.41
NTI-42	9.12	8.27	3.68	12.52	6.26
NTI-56	10.36	8.92	3.81	14.69	8.47
NTI-60	11.38	12.54	5.17	15.47	12.64
NTI-73	0	0	0	0	0
NTI-75	12.91	10.63	4.86	12.47	11.86
NTI-76	0	0	0	0	0
NTI-82	8.63	7.91	3.64	12.47	5.74
NTI-84	11.92	10.64	4.62	10.54	10.23
NTI-85	12.74	11.46	5.21	13.86	13.17
NTI-86	12.41	10.81	4.67	15.31	10.72
CMK-5	11.36	10.18	4.52	12.49	9.33
CMK-6	12.28	11.37	4.78	8.82	11.29
CMK-7	11.64	12.46	5.68	14.13	13.62
SMG-3	12.56	11.94	5.86	12.79	14.23
SMG-4	12.71	11.29	5.64	11.31	13.38
SMG-7	8.18	7.45	3.21	9.82	2.47
SMG-13	11.46	12.16	4.93	11.53	11.92
BDM-3	12.31	11.52	5.21	10.08	12.83
S.E.	1.30	1.11	0.47	0.92	0.79
CD (0.05%)	2.59	2.22	0.93	1.84	1.58

(2.47) followed by NTI-82 (5.74) and NTI-42 (6.26) and Urigam CT 112 (7.92).

The fruit characters such as pulp weight per fruit, seed weight per fruit, shell weight per fruit, fibre weight, total number of seeds per pod and normal number of seeds per pod number are presented in Table 2. Significant differences were observed among the forty tamarind accessions evaluated. The findings revealed that pulp weight per fruit ranged from 9.27 to 3.46 g. The highest pulp weight per fruit recorded in NZB (S) accessions (9.27 g) followed by Hasanur #5 (9.24 g), Vantoor (8.93) and Salem-132 (8.72). The lowest shell weight was found in CMK-6 of 3.46g followed by Urigam CT 164 (3.53), NTI-39 (3.76) and Hasanur #3 (3.83). Seed weight per fruit ranged from 6.52

Table 2: Evaluation of 40 tamarind accessions for pod characters.

Variety	Pulp wt / fruit (g)	Seed wt/ fruit (g)	Shell wt / fruit (g)	Fibre wt / fruit (g)	Total seed / pod (no's)	Normal seed / pod (no's)	Damaged seed/pod (no's)
Hasanur #3	3.83	3.15	2.12	0.32	7.23	6.61	1.23
Hasanur #5	9.24	6.52	2.32	0.51	9.27	8.45	0.82
Vellore #2	4.81	3.22	2.36	0.25	8.72	7.83	0.89
Vellore #29	0	0	0	0	0	0	0
Salem 132	8.72	6.42	3.86	0.24	8.54	7.48	1.06
Urigam CT 164	3.53	3.22	2.15	0.47	7.41	7.34	1.51
Urigam CT 112	4.63	2.61	2.36	0.53	6.83	5.71	1.12
PKM- 1	5.74	4.64	1.93	0.48	7.34	6.37	0.97
Urigam	4.38	3.73	2.72	0.43	8.93	7.68	1.25
Vantoor	8.93	5.76	3.67	0.70	8.38	7.45	0.93
Sweet	5.85	3.82	2.84	0.38	8.56	7.31	1.25
Red	4.26	2.59	2.38	0.47	6.97	5.81	1.16
NZB (S)	9.27	5.32	2.21	0.22	10.78	9.38	0.62
KRMR	4.41	2.63	1.63	0.38	6.28	5.38	0.9
PKM (Red)	5.92	4.21	2.32	0.54	8.37	7.21	1.16
Prathistan	6.27	4.26	3.25	0.72	10.54	6.18	1.16
HYD (Local)	5.87	4.13	2.37	0.45	9.78	8.24	1.54
Salem Red	0	0	0	0	0	0	0
Salem Blue	0	0	0	0	0	0	0
NTI-14	5.96	5.21	2.51	0.58	8.87	7.51	1.36
NTI-32	5.72	4.68	2.18	0.43	8.14	6.93	1.21
NTI-39	3.76	3.03	2.57	0.38	9.47	7.93	1.53
NTI-42	4.83	4.39	2.49	0.81	7.65	6.37	1.28
NTI-56	7.25	4.74	2.13	0.57	7.48	6.35	1.13
NTI-60	6.13	5.58	3.27	0.49	7.63	6.74	0.89
NTI-73	0	0	0	0	0	0	0
NTI-75	5.24	4.72	1.98	0.53	5.89	4.93	0.96
NTI-76	0	0	0	0	0	0	0
NTI-82	5.83	4.23	1.84	0.57	6.94	5.64	1.3
NTI-84	4.79	4.26	1.17	0.32	7.48	6.25	1.23
NTI-85	6.42	4.23	2.83	0.38	7.57	6.26	1.31
NTI-86	7.37	4.77	2.63	0.54	5.83	4.75	1.08
CMK-5	5.83	4.13	1.88	0.65	8.49	7.14	1.35
CMK-6	3.46	3.22	1.76	0.38	7.63	6.78	0.85
CMK-7	6.48	4.32	2.79	0.54	7.34	6.26	1.08
SMG-3	5.79	4.24	2.37	0.39	8.67	7.43	1.24
SMG-4	5.86	3.21	1.81	0.43	5.49	4.27	1.22
SMG-7	3.83	3.51	2.11	0.37	7.58	6.46	1.12
SMG-13	4.68	4.07	2.14	0.64	6.87	5.84	1.03
BDM-3	4.43	2.96	1.98	0.71	8.74	7.49	1.25
S.E.	0.94	0.64	0.35	0.06	0.76	0.91	0.18
CD (0.05%)	1.88	1.28	0.70	0.1327	1.52	1.82	0.37

to 2.59 g and the highest was recorded in Hasanur #5 (6.52 g) followed by Salem 132 (6.42), Vantoor (5.76) and NTI-60 (5.58) and the lowest in Red (2.59 g) followed by Urigam CT 112 (2.61), KRMR (2.63) and BDM-3 (2.96), Shell weight per fruit ranged from 3.86 to 1.17 g and the highest was recorded in Salem 132 (3.86 g) followed by and Vantoor (3.67 g), NTI -60 (3.27 g) and Prathistan (3.25). The lowest pulp weight was observed in NTI-84 (1.17 g) followed by KRMR (1.63 g), CMK-6 (1.70 g) and SMG-4 (1.81). Similarly, fibre weight per fruit ranged from 0.81 to 0.22 g and the highest was recorded in NTI-42 (0.81) followed by Vantoor (0.73), Prathistan (0.72) and BDM-3 (0.71) the lowest was noticed in NZB (S) (0.22) followed by Salem 132 (0.24), Vellore#2 (0.25) and NTI-84 (0.32). Similar, such variations in fruit characteristics were observed in tamarind by Divakara (2008a) and Nandini *et al*. (2011).

Regarding seed characters, accession NZB (S) recorded the highest total number of seeds per pod (10.78) which was the highest among forty tamarind accessions followed by Prathistan (10.54), Hyd (local) (9.73) and NTI-39 (9.47). The lowest total number of seeds per pod was noticed in SMG-4 accession (5.49) followed by NTI-86 (5.83), NTI-75 (5.89) and SMG-13 accession (6.87). The highest normal number of seeds per pod was recorded in NZB (S) (9.38) followed by Hasanur #5 (10.54), Hyd (local) (8.24) and NTI-39 (7.93) and the lowest was noticed in SMG-4 (4.27) followed by NTI -86 (4.75), NTI-75 (4.93) and SMG-13 accession (5.84). The highest number of seeds damaged per pod was recorded in Hyd (local) (1.54) followed by NTI-39 (1.53), Urigam CT 164 (1.51) and NTI-14 (1.36) and the lowest in NZB (S) (0.62) followed by Hasanur #5 (0.82), CMK-6 (0.85) and NTI-60 (0.89). Wide variations were noticed among the different accessions with respect to yield contributing traits and this may be due to their genotypic differences. In addition, age of the tree is also an important factor which influences the yield.

CONCLUSION

Among the forty tamarind accessions evaluated, NZB (S), Hasanur #5, Salem 132, NTI-14 and SMG-3 recorded the highest values in all the growth, pod and yield characters. NZB (S) recorded the highest number of flowers per inflorescence (14.62), Hasanur #5 recorded the highest number of inflorescence per branch (13.87). NZB(S) recorded the highest average fruit weight (g) (19.24), pulp weight per fruit (g) (9.27), total seed per pod (no's) (10.78), normal seed/pod (no's) (9.38) compare to remaining all tamarind accessions and also NZB(S) recorded the lowest Fibre weight per fruit (g) (0.22), Damaged seed per pod (no's) (0.62). In case of yield characters, NZB(S) recorded the highest average yield per plant (kg) (15.72) followed by Hasanur #5 (15.09), Salem 132 (14.81) and NTI-14 (14.65). Based on performance, yield and quality parameters, NZB (S), Hasanur #5, Salem 132, NTI-14 and SMG-3 accessions have been identified as the most promising in dryland situation representing semi-arid tropics and their further evaluation on large scale is recommended.

Conflict of interest: None.

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