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STANDARDIZATION OF PROPAGATION METHODS AND TIME IN TAMARIND (*TAMARINDUS INDICA* L.) UNDER BUNDELKHAND REGION OF UTTAR PRADESH, INDIA

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ABSTRACT

The experiment was conducted during 2022-23 at Fruit Nursery, Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology to Standardize Propagation methods and time in tamarind under Bundelkhand region. Data were collected on per cent success, days taken to bud sprouting, sprouting percentage, length of sprouts, number of leaves per plants and leaf area. Softwood grafting, patch budding and chip budding were carried out at monthly intervals. Softwood grafted plants sprouted earliest during April (17.00 days) followed by March (19.82 days) and February (23.33 days). However maximum time was taken in the month of September (41.33 days). In Softwood grafting maximum bud sprouting (80.00 %) was observed in April, whereas minimum (33.33%) bud sprouting noted in the month of September. Maximum length of sprouts 17.47 cm and 27.58 cm were registered in the month of April with softwood grafting at 60 and 90 days, respectively. Whereas, the minimum length of sprouts 9.14 cm and 18.74 cm were proclaimed in the month of September with softwood grafting at 60 and 90 days, respectively. Softwood grafted plants had the maximum number of leaves and leaf area than patch budded plants. Softwood grafted plants was recorded maximum number of leaves (7.33 and 13.21) and leaf area (20.35 cm^2 and 28.49 cm^2) at 60 and 90 days, respectively. Chip-budded plants failed to sprout in all seasons and hence, they were excluded from further statistical analysis.
***Keywords*:** Tamarind, propagation methods, time.

Introduction

Tamarind *(Tamarindus indica* L.) belongs to the Fabaceae family and subfamily Caesalpinioideae. The tamarind tree is a leguminous plant that is also referred to as the "sweet angle" and the "plum tree" (Soares, *et al.,* 2017). Tamarind is a diploid species with chromosome number of 2n=24. It is commonly known as Imli in Hindi. It reached Persian and Arabs who termed ‘Tamar Hindi’, Indian date due to the date–like appearance of the dried pulp. It is also known as 'Amli' in Gujrati and 'Tetul' in Bengali. Tamarind is an underutilized crop noted for its resistance to climate change. Kerala is well known for its diverse range of native and wild tamarind trees. (Shankar Prashad, *et al.,* 2022). Tamarind (*Tamarindus indica* L.) is a resilient tree found in India's plains and sub-Himalayan regions, which is known for its wood and delicious fruits.

It is suitable for arid circumstances, especially those that are vulnerable to protracted drought. Since tamarinds can endure drought conditions for up to six months, it can be grown in any environment. Tamarind trees are resilient and can thrive well in various soil types, including black and sandy soils, which are common in Bundelkhand. Additionally, the region is warm climate would be conducive to tamarind tree

growth. The tamarind tree bears brown pod-like fruits with a fleshy, juicy, acidic pulp. When the flesh turns brown or reddish brown, it is prepared to consume. Asian tamarinds have longer pods (with 6 to 12 seeds), but African and West African variants have shorter pods (containing 1 to 6). Its crown can have a diameter of up to 12 meters, while its trunk has a circumference of about 8 meters. After planting, it starts to bear fruit 13–14 years later (Lewis and Neelakantan, 1964). Due to its great flexibility, avenue plantations, backyards, and agroforestry systems are excellent places for this tree to be planted. It produces fruit as pendulous pods ten months following fruit set and bears terminal and lateral drooping bisexual flowers in May and June (Coronel *et al*., 1991). There are specific conditions like diarrhoea and stomach problems that can be treated using parts of tamarind. Treatments for jaundice, colds, fever, and skin cleansing have all been linked to it. Most of the tropical regions use it as food (De Caluwé *et al*., 2010). It grows to be a huge tree and is used in all medical systems for a variety of ailments, including jaundice, liver complaints, as an acid refrigerant, as a gentle laxative and as a skin cleanser (Zohrameena *et al*., 2017). This woody perennial fruit tree is recognized for both producing fruit and surviving a variety of climatic and edaphic circumstances (El-Siddig *et al*., 1999). Ripe fruit pulp is edible and used as a flavoring in soups, sauces, chutneys, jams, juices, and other culinary preparations (Siddhuraju *et al*., 1995) This tropical fruit tree is mostly used for its fruits, which can be processed or consumed raw (Pooja *et al*., 2022).

Materials and Methods

The investigation was carried out at Fruit Nursery, Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology during 2022-23. The study area is located at 24º 53'-25º 55 N Latitude and 80º 07'-81º 34'E longitude and at an altitude of 214.96 meters from the sea of southern Uttar Pradesh of India. The average rainfall at the time of the experiment was 77.5 cm and most of it about 94 % received during only 4 months i.e. June to September. This area has a rather high average yearly temperature, which can reach up to 23- 42℃.

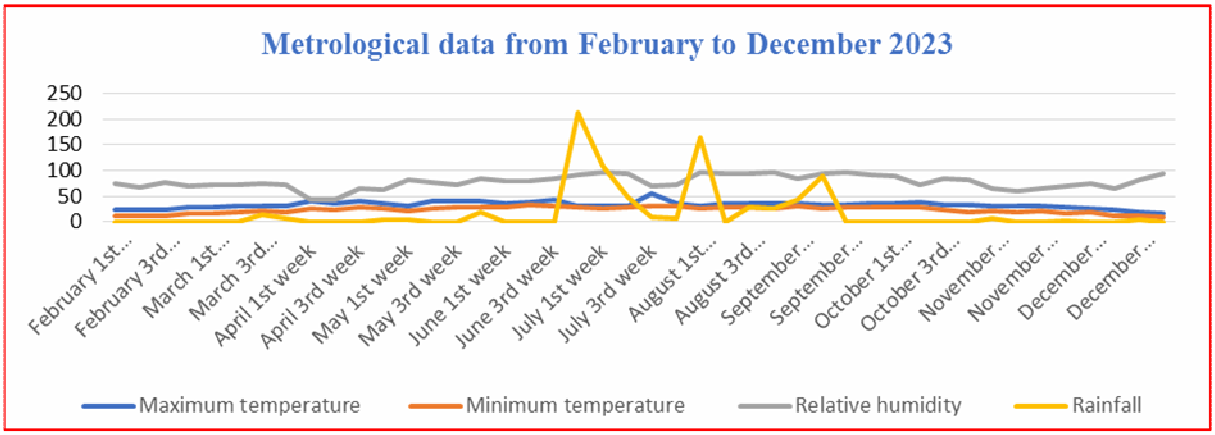

Fig. 1: Meteorological observations were recorded at weekly intervals during the experimental period from February to September 2023.

May month is the hottest month and December is the coolest month of this region. The average annual rainfall has 850 mm in this region. The relative humidity has highest in August and lowest in May and June month. The experiment was designed using Factorial CRD with three propagation methods (softwood grafting, patch budding, chip budding) and with seven seasons (February, March, April, June, July, August, and September). Each treatment was conducted with three replications with 60 plants per treatment per season.

For grafting and budding, one-year old local tamarind seedlings of uniform growth and pencil thickness were used as rootstocks. Scion sticks of 10-12 cm with 6-8 buds were used for softwood grafting whereas, a single bud taken from a scion stick was used for patch budding and chip budding. Scion shoots were collected from a selected tree present in the Instructional Farm, Department of Fruit Science, College of Horticulture, Banda University of Agriculture and Technology. Immediately after separation from the mother tree, they were wrapped in moist cloth and carried in polythene covers to the fruit nursery. Observations were recorded for the days taken to bud sprout, sprouting percentage, length of sprouts, number of leaves per plant and leaf area at 60 and 90 days respectively. All the data were analyzed using OPSTAT (Sheoran *et al*., 1998).

Results and Discussion

The perusal of the data presented in (Table 1.) revealed that days required for bud sprouting differed significantly due to method and time of propagation. It was recorded that softwood grafted plants sprouted earliest when propagation was done on 15th April (17.00 days), closely followed by March (19.82 days) and February (23.33 days), while the maximum time taken when it was performed on September. Similarly, patch budded plants took least time to sprout when propagation was done on August (22.40 days), closely followed by July (24.40 days) and June (25.11 days) propagated plants. However, it took the maximum time to sprout (41.33 days) on September propagated plants. Interaction effect of method and time on minimum days taken for bud sprouting showed when propagation was performed on 15th April with softwood grafting similarly minimum days taken for bud sprouting were recorded with patch budding (August). Whereas, the maximum days taken for bud sprouting showed on September with softwood grafting. No bud sprouting took place in February, March and April in patch budded plants. The minimum days required for early sprouting may be the result of more active buds and better physiological state at the ideal time of propagation, which allows for greater adjustment to the metrological environment. The speed of substrate supply and apical dominance govern the forming sprout. When phytohormones are found, cell division takes place and enzymatic pathways are utilized to release energy through the process of hydrolysis of carbohydrates and polysaccharides. Our findings are in conventionality with the results obtained by Moti *et al.* (1976) in bael and Rani *et al*. (2014) in guava.

One-year pooled data exhibited higher sprouting percentage which was observed on 15th April (80 %) with softwood grafting followed by 15th March (73.33 %), 15th February (60 %) propagated plants, whereas, higher sprouting percentage when patch budding was done on 15th August (70 %) which was *at par* with 15th July (56.66 %) and 15th September (50 %). The highest percent of sprouts is due to the most favorable temperature and humidity prevailing during this period resulting in early contact of cambium layers of stock and scion, early callus formation and initiation of subsequent growth. The lowest percentage of sprouting might be due to the immature bud wood and slow sap flow. The present results are also in conformity with the research findings of Singh and Singh (2006) in jamun and Prasanth *et al*. (2007) in mango. The interaction effect between method and time on highest sprouting percentage showed on 15th April (80 %) propagated plants with softwood grafting similarly, maximum sprouting percentage was recorded on 15th August propagated plants (70 %) with patch budding. Least sprouting percentage showed on 15th September (33.33 %) with softwood grafting and 15th June (36.67 %) with patch budding

The Data presented in table 2 indicated that length of sprouts increased with days after grafting and budding. At time of final observation (i.e. after 90 days), the data revealed significant variation in length of sprout that ranged between 18.74 cm to 27.58 cm and 18.84 cm to 25.50 cm in softwood grafting and patch budding, respectively. The maximum mean length of sprouts (27.58 cm) was recorded in softwood grafting when grafting was performed on April followed by March (25.34 cm) and February (23.91 cm). Whereas, it was notable highest when propagation was performed in the month of August (25.50 cm) with patch budding. The most probable reason for the increase in length of sprout might be as a result of the nutritional status of the plant, which is responsible for protein synthesis and cell division, which ultimately lead to vegetative growth. Parallel findings were reported by Anadi and Karadi (2012) in jamun and Singh and Singh (2015) in mahua.

The maximum number of leaves also increased with increasing days after grafting and budding. Generally, softwood grafted plants recorded higher number of leaves per plant when compared with patch budded plants. The maximum number of leaves per plant was recorded when propagation was done in the month of April (13.21) and August (12.50) in softwood grafted plants and patch budded plants after 90 days, respectively, followed by March (12.20) and July (10.71). The availability of ideal environmental conditions, which favors the creation of strong unions and improve root uptake of nutrients, may be the cause of the highest number of leaves per plant. The mentioned result is in accordance with Dhutraj *et al.* (2018a) in tamarind and Karna *et al*. (2018) in mango. The minimum number of leaves was observed in the plants propagated during the month of September (6.93) and June (7.20) with softwood grafted and patch budded plants, respectively (Table 3).

The maximum leaf area also increased with increasing days after grafting and budding. Softwood grafted plants recorded higher leaf area per plant when compared with patch budded plants. The maximum number of leaf area per plant was recorded when propagation was performed in the month of April (28.49 cm^2) followed by March (26.16 cm^2) and February (11.13 cm^2) with softwood grafting at final date of observation (i.e. after 90 days) (Table 4). Whereas, the maximum leaf area was observed in August propagated plants (12.50 cm^2) followed by July (10.71 cm^2) in case of patch budding after 90 days of

observation. The ideal temperature stimulates photosynthesis and supplies more food materials, which ultimately promotes the growth and development of the graft sprout. Temperature is an essential component in the photosynthetic activity of leaves. The results are reinforced by the finding of Raghavendra *et al*. (2009) in wood apple. Similar findings were also proclaimed by Sharma (2019) in Bael and recorded maximum leaf area (22.22 cm^2) on July with patch budding. The least leaf area was recorded in September propagated plants with softwood grafting (14.15 cm^2) and June (21.68 cm^2) propagated plants with patch budding at final date observation.

Table 1 : Effect of methods and time of propagation and their interaction, on days taken for bud sprouting and sprouting (%).

Treatment	Days taken for bud sprouting (Days)		Spouting (%)	
	Softwood grafting	Patch budding	Softwood Grafting	Patch budding
15th February	23.33	0.00	60.00	0.00
15th March	19.82	0.00	73.33	0.00
15th April	17.00	0.00	80.00	0.00
15th June	24.46	25.11	60.00	36.67
15th July	25.60	24.40	53.00	56.66
15th August	39.60	22.40	43.33	70.00
15th September	41.33	27.19	33.33	50.00
Sem±	Method = 0.217		Method = 1.429	
	Time = 0.406		Time = 2.673	
	M × T = 0.574		M × T = 3.780	
CD at (5%)	Method = 0.631		Method = 4.160	
	Time = 1.181		Time = 7.782	
	M × T = 1.670		M × T = 11.006	

Table 2 : Effect of methods and time of propagation and their interaction on length of budded and grafted sprouts.

Treatment	Length of budded and grafted sprouts at 60 days		Length of budded and grafted sprouts at 90 days	
	Softwood grafting	Patch budding	Softwood Grafting	Patch budding
15th February	13.55	0.00	23.91	0.00
15th March	15.61	0.00	25.34	0.00
15th April	17.47	0.00	27.58	0.00
15th June	11.96	13. 75	22.85	18.84
15th July	11.53	15.72	22.53	23.93
15th August	10.51	17.03	21.88	25.50
15th September	9.14	14.36	18.74	24.17
Sem±	Method = 0.153		Method = 0.181	
	Time = 0.287		Time = 0.339	
	M × T = 0.406		M × T = 0.480	
CD at (5%)	Method = 0.446		Method = 0.528	
	Time = 0.835		Time = 0.987	
	M × T = 1.181		M × T = 1.397	

Table 3 : Effect of methods and time of propagation and their interaction on number of leaves at 60 & 90 days.

Treatment	Number of leaves at 60 days		Number of leaves at 90 days	
	Softwood grafting	Patch budding	Softwood Grafting	Patch budding
15th February	4.47	0.00	11.13	0.00
15th March	6.51	0.00	12.20	0.00
15th April	7.33	0.00	13.21	0.00
15th June	3.64	2.42	9.48	7.200
15th July	3.27	4.91	7.41	10.71
15th August	3.26	5.60	7.62	12.50
15th September	2.29	3.42	6.93	8.47
Sem±	Method = 0.147		Method = 0.162	
	Time = 0.276		Time = 0.304	
	M × T = 0.390		M × T = 0.430	
CD at (5%)	Method = 0.429		Method = 0.473	
	Time = 0.802		Time = 0.885	
	M × T = 1.135		M × T = 1.252	

Table 4 : Effect of methods and time of propagation and their interaction on leaf area (cm^2) at 60 & 90 days.

Treatment	Leaf area at 60 days		Leaf area at 90 days	
	Softwood grafting	Patch budding	Softwood Grafting	Patch budding
15th February	18.51	0.00	23.15	0.00
15th March	19.50	0.00	26.16	0.00
15th April	20.35	0.00	28.49	0.00
15th June	15.49	14.13	21.25	21.68
15th July	15.27	18.29	18.16	25.92
15th August	14.07	19.37	16.06	26.63
15th September	13.60	15.78	14.15	23.92
Sem±	Method = 0.288		Method = 0.289	
	Time = 0.539		Time = 0.540	
	M × T = 0.762		M × T = 0.764	
CD at (5%)	Method = 0.839		Method = 0.841	
	Time = 1.569		Time = 1.573	
	M × T = 2.220		M × T = 2.224	

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