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RESEARCH ARTICLE

Evaluation of Different Spacing For Growth and Yield Contributing Characters of Tree Type Mulberry

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ABSTRACT

The two tree type, mulberry V1 and G4, were examined in the investigations for the impact of various spacing on growth and yield metrics. The results show that spacing has an impact on how mulberries grow. Among the different spacings, 6 ft x 6 ft had the highest single shoot length (133.10 cm), minimum internodal length (3.95 cm), length of the longest shoot (128.47 cm), total shoot length (1267.18 cm), physiological attribute like leaf area (137.75 cm^2), and yield attributes like single leaf weight of 5.35 g, weight of 100 leaves (518.50 g), number of leaves per shoot (61.75), and leaf yield per plant (3.00 kg). The cultivation of tree-type mulberries is particularly adaptable to a 6' x 6' spacing.

Keywords: *Growth; Spacing; Tree mulberry; Yield*

INTRODUCTION

Mulberry is the only host plant for *Bombyx mori* L. and one of the most significant economic crops grown specifically for silkworm rearing. Mulberry is accountable for 38.20% of the cocoons that are successfully produced. Mulberry must be precisely maintained with the application of the necessary quantity of organic and inorganic fertilizers because it is a perennial crop and is pruned periodically (Rahman *et al.,* 2020). Mulberry (*Morus* spp.) is Fast-growing, woody, perennial plant that is typically pruned repeatedly to form bushes or dwarf trees. Because it is the main source of food for silkworms (*Bombyx mori* L.), the availability of high-quality leaves has a significant impact on the viability and profitability of the sericulture sector. The plantation system has an impact on mulberry leaf quality as well (Sekhar *et al.,* 2015). Leaf yield is significantly impacted by spacing. Plant growth, including plant height, number of branches per plant, shoot length, number of leaves per plant, and leaf yield per plant, is directly influenced by spacing. In sericulture, the production of mulberries accounts for more than 60% of the entire cost of cocoon production (Wani *et al.,* 2014). The yield of leaves and other criteria related to yield are also crucial for improving mulberry quality and yield. The numerous leaf yield contributing traits, genotype, and agronomic techniques play a significant role in mulberry leaf yield. Mulberry leaf yield is influenced by plant leaf yield, internodal distance, and the quantity and length of shoots (Pawan *et al.,* 2017). Competition for air, light, soil moisture, nutrients, and other resources is visible due to a shortage of space, which results in a poor yield (Setua *et al.,* 2011). The current study was undertaken to assess the different spacing on tree-type mulberry plantation for growth, leaf yield, and yield contributing characters.

MATERIAL AND METHODS

The experimental study was done in Agriculture Research Station, Bhavanisagar, Tamil Nadu. All materials and methods used in the field experiments are detailed below.

Design	: RBD
Treatments	: Three
Replication	: Six
Crop	: Mulberry
Variety	: V1 and G4
Plot size	: 10000 sq. ft
Spacing between blocks	: 10 ft

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Treatments

T1: Plot with 5'x 5' spacing

T2: Plot with 6'x 6' spacing

T3: Plot with 7'x 7' spacing

Mulberry growth attributes

From each replication, five mulberry plants randomly selected under main field conditions were labelled for recording growth parameters.

Plant height

Plant height is the measure of the total distance between the highest point on the plant and the lowest point on ground level. It is generally expressed in terms of cm.

Inter-nodal distance

Length between the nodes having a fourth leaf and fifth leaf from the highest tip of the plant was recorded. The mean value measured was generally expressed in cm.

Leaf area (LA)

Five plants were randomly selected, and fifth leaf from the tip of the plant was collected, and leaf area was measured by following the length and breath method recommended by Montgomery (1911). The mean value was expressed in cm^2/ plant.

$$LA\ (A) = l \times b \times c$$

Where, A- leaf area, l – leaf length, b – leaf breath, c – constant factor (0.676)

Yield attributes of mulberry

Five plants were randomly selected under main field conditions and labelled for recording yield parameters.

Fresh leaf weight (g)

The leaves from middle portion of five randomly selected plants in each replication was collected and weighed immediately after harvesting. The average was computed and expressed in grams/plant.

Number of leaves per plant

Five randomly selected plants in each replication, a total number of leaves per plant, were counted and recorded. It was generally expressed in numbers/plant.

RESULTS AND DISCUSSION

Effect of different spacing on growth attributes of tree type mulberry

The different spacing of tree-type mulberry elucidated a positive significant effect on the shoot length of mulberry (Table 1). Among the various spacing, significantly higher shoot length (133.10 cm) was recorded in 6ft x 6ft spacing, which was followed by 7ft x 7ft. Regarding different mulberry varieties, V1 recorded the longest shoot length of 134.20 cm followed by G4 (129.20 cm), which were found to differ significantly from each other. In interaction between different spacing and varieties, a significantly maximum shoot length (135.40 cm) was recorded in the V1 variety at 6ft x 6ft, which was statistically superior to all other treatments. At the same time, minimum shoot length of 127.50 cm was observed in G4 at 5ft x 5ft. Ramakant *et al.* (2001) confirmed the same results with highest shoot length of 132.00cm and lowest shoot length was 123.23 cm was recorded. In accordance to Rao *et al*. (2000), plants with a 6ft x 3ft spacing had number of shoots (7.58), total length (750.51 cm), and shoot weight (317.93 g) per plant.

As shown in table 1, the data indicated that different spacing and mulberry varieties impact on the internodal length. Among the spacing evaluated, a minimum internodal length of 3.95 cm was found in 6ftx 6ft spacing, followed by 7ft x 7ft (4.56 cm). The lowest internodal length of 4.28 cm was observed in the V1 variety while it was G4 at 4.85 cm. In the interaction between different spacing and varieties, a significant minimum internodal length (3.17 cm) was recorded in the V1 variety at 6ft x 6ft, statistically superior to all other treatments. At the same time, maximum internodal length of 5.00 cm was observed in G4 at 7ft x 7ft. Yogananda Murthy *et al*. (2013) also noted that the internodal distance was lower in the mulberry variety Vishwa when planted with a spacing of 4x4 feet.

Length of longest shoot significantly varied between spacing, with the longest shoot of 128.47 cm in 6ft x 6ft (Fig. 1). The subsequent better treatment was 7ft x 7ft (119.43 cm). The lowest shoot length of 111.90 cm was observed in 5ft x 5ft. Among different mulberry varieties, V1 registered a notably longest shoot length of 123.97 than G4. The interaction between different spacing and mulberry varieties infers that a significantly longest shoot length was found in the 6ft x 6ft of V1 (132.37). This was followed by 6ft x 6ft of G4 (124.57). The lowest shoot length was recorded in G4 at 5ft x 5ft (108.24). In mulberry plantations with broader spacing, Yogananda Murthy *et al.* (2013) found a

considerably increased number of branches per plant and longer shoot length. Additionally, Vanitha *et al.* (2019) found that tree mulberry had a higher number of shoots than bush mulberry. According to the data obtained by Santoshkumar *et al.* (2020) from three different plantation systems (3x3 feet, 8x8 feet, and 10x10 feet), the number of new shoots per plant (63.29), longest shoot length (104.74 cm), number of leaves per metre of shoot length (21.43), leaf:shoot ratio (1.21), and leaf yield per plant per crop (3.96 kg) were all higher in 10x10 feet plantation spacing system.

The different spacing of tree-type mulberry elucidated positive significant effect on total shoot length of mulberry (Fig 1). Among the various spacing, significantly higher total shoot length (1267.18 cm) was recorded in 6ft x 6ft spacing, which was followed by 7ft x 7ft. Regarding mulberry varieties, V1 recorded the longest shoot length of 1252.99 cm followed by G4 (1138.49 cm), which differed significantly from each other.

In interaction between different spacing and varieties, a significantly maximum shoot length (1300.25 cm) was recorded in the V1 variety at 6ft x 6ft, statistically superior to all other treatments. At the same time, a minimum shoot length of 1060.59 cm was observed in G4 at 5ft x 5ft. Ananya (2014) reported that increased plant height, more branches, and longer shoots are the primary causes of the increased number of leaves per plant.

Leaf area showed considerable variation among the different spacing on mulberry plants (Table 2). Among these spacing, a higher value of leaf area (137.75 cm^2) was noticed in 6 ft x 6 ft, which was found to be on par with 7ft x 7ft (135.75 cm^2). This was followed by 5ft x 5ft (129.00 cm^2). Regarding mulberry varieties, V1 had a significantly high leaf area of 139.06 cm^2 than G4 (129.26 cm^2). In the case of interaction, there was no significant difference in the leaf area in response to spacing and mulberry varieties. Effect of spacing on number of shoots per plant varies like 8.07 on 6ft x 6ft spacing and regarding the varieties 8.56 was observed. Roja Kaliappan *et al.* (2021) found that the influence of chitosan on the V1 variety of mulberry considerably increased shoot length (170.67 cm), number of shoots per plant (9.03), number of leaves per shoot (29.48), leaf area (130.26 cm^2), and leaf area index (2.72).

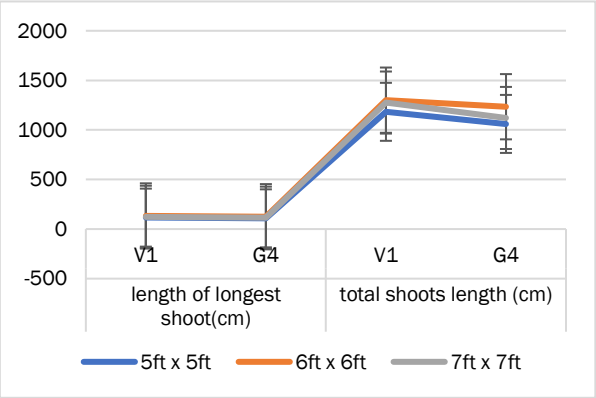

Figure 1. Impact of different spacing on length of longest shoot (cm) and total shoot length (cm) of tree type mulberry

Effect of different spacing on yield attributes of tree type mulberry

Single leaf weight significantly varied between spacing and varieties (Fig 2). The highest single leaf weight of 5.35 g was recorded in 6ft x 6ft spacing. The next better treatment was 7ft x 7ft (5.05 g), which was on par with 5ft x 5ft (4.75). Among mulberry varieties, V1 registered notably high single-leaf weight of 5.30 than G4. In the case of interaction, there was no significant difference in the single leaf weight in response to spacing and mulberry varieties. Similar findings were reported by Ghosh *et al.* (2009), who indicated that wider spacing plantation systems had considerably better contributing traits and leaf yield than narrow-spacing plantation systems.

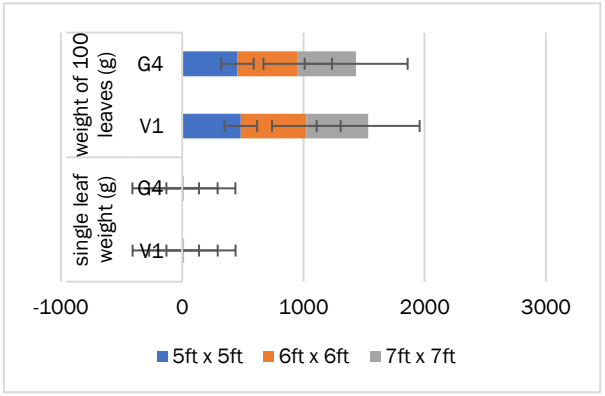

Figure 2. Impact of different spacing on single leaf weight (g) and weight of 100 leaves (g) of tree type mulberry

Weight of 100 leaves is significantly different between spacing and varieties (Fig 2). The highest weight of 100 leaves was recorded in 6ft x 6ft spacing with 518.50 g followed by 7ft x 7ft spacing with 496 g. Among mulberry varieties, V1 registered the highest weight of 100 leaves (511.33 g) than G4 (478.33g). In the case of interaction, there was no significant difference in the weight of 100 leaves in response to spacing and mulberry varieties.

According to Eltayb *et al.* (2013), *M. alba* and *M. mesozygia* recorded the maximum leaf weight and yield per unit area in plots measuring 1.00 x 1.00 m and 1.50 x 1.00 m, respectively.

Significantly higher number of leaves per shoot of 61.75 was observed 6ft x 6ft followed by 7ft x 7ft (55.30) (Table 2). With respect to mulberry varieties, more number of leaves per shoot of 59.26 was noticed in V1, followed by G4 (53.30). In the interaction of spacing and different mulberry varieties, a significantly higher number of leaves per shoot (65.30) was found in 6 ft x 6 ft spacing of V1. This was followed by 7ft x 7ft of V1 (58.30) and 6ft x 6ft of G4 (58.20), and all were statistically on par with each other. The lower number of leaves per shoot was observed in 5ftx 5ft (49.40) of G4. According to Ghosh *et al.* (2009), mulberry leaf yield and growth metrics were both higher with wider spacing than with close spacing. In accordance with Yadav *et al*. (2019) study, 270 cm x 60 cm spacing produced the highest plant height (194.56 cm), number of branches per plant (13.59), number of leaves per plant (286.27), and leaf yield per plant (1.35 kg), followed by 240 cm x 60 cm spacing. A significantly higher leaf yield per plant of 2.96 kg was observed 6ft x 6ft followed by 7ft x 7ft (2.90 kg) (Table 2). With respect to mulberry varieties, more leaf yield per plant of 3.00 kg was noticed in V1 followed by G4 (2.95). According to Santoshkumar *et al.* (2020), among different spacing evaluated, 8ft x 8ft was recorded highest leaf yield per plant (3.13 kg) and 3ft x 3ft was 0. 72 kg per plant.

Table 1. Effect of different spacing on single shoot length (cm) and Internodal length (cm) of tree type mulberry

Treatments		Shoot length (cm)			Internodal length (cm)			Number of shoots/plant		
		V1	G4	Mean	V1	G4	Mean	V1	G4	Mean
5 ft x 5 ft		133.00	127.50	**130.25**	5.14	4.82	**4.98**	**8.32**	**7.50**	**7.91**
6 ft x 6 ft		135.40	130.80	**133.10**	3.17	4.73	**3.95**	**8.56**	**7.59**	**8.07**
7 ft x 7 ft		134.20	129.20	**131.70**	4.54	5.00	**4.77**	**8.42**	**7.54**	**7.98**
Mean		**134.20**	**129.20**	**131.69**	**4.28**	**4.85**	**4.56**	**8.43**	**7.54**	**7.99**
CD (P=0.05)	T	4.39**			0.23**			0.56**		
	V	2.53**			0.19**			0.41**		
	T X V	7.33*			0.33**			0.45**		

Table 2. Impact of different spacing on number of leaves (nos.), leaf yield and leaf area (cm²) of tree type mulberry

Treatments		Number of leaves (nos.)/plant			Leaf area (cm²)			Leaf yield/ plant/ harvest (kg)		
		V1	G4	Mean	V1	G4	Mean	V1	G4	Mean
5ft x 5ft		54.20	49.40	**51.80**	137.50	120.50	**129.00**	2.70	2.65	**2.67**
6ft x 6ft		65.30	58.20	**61.75**	140.50	135.00	**137.75**	3.00	2.95	**2.96**
7ft x 7ft		58.30	52.30	**55.30**	139.20	132.30	**135.75**	2.93	2.85	**2.90**
Mean		**59.26**	**53.30**	**56.28**	**139.06**	**129.26**	**134.16**	**2.88**	**2.81**	**2.84**
CD (P=0.05)	T	4.55**			NS			0.11*		
	V	3.71**			8.41*			0.10*		
	T X V	8.01*			NS			NS		

*Significant, ** Highly Significant, NS – Non-Significant; Each value is mean of six replications and pooled mean of two crops

CONCLUSION

According to the findings of this study, among the various spacing, 6ft x 6ft was recorded higher in all the growth and yield contributing factors. This study reveals that numerous yield metrics were found to be better in 6ft x 6ft spacing plantation systems when compared to narrow spacing. This could be related to the spacing effect, in which broader spacing allows for more vigorous growth with less competition for nutrients and space. Leaf yield per plant was highest with 6ft x 6ft spacing, possibly due to adequate area for root spread and good fertilizer and moisture uptake.

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Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Consent for publication

All the authors agreed to publish the content.

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