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Impact of agronomic practices on the productivity of mulberry (*Morus alba* L.) G4 variety

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Abstract

A field experiment was carried out in a newly established mulberry garden in Akuthotapalli, Anantapur district, Andhra Pradesh, from 2021 to 2023. The study used the G4 mulberry variety and employed a split-split plot design, incorporating four different spacing patterns: 5' x 5' (tree type), 2' x 2', 3' x 1', and 6' x 3' x 2', along with varying fertilizer doses. The findings revealed that the T3 spacing (3' x 1') combined with the F3 (NPK) fertilizer treatment had a positive effect on both leaf weight and plant height. The research indicated that although the wider 90 x 90 cm spacing resulted in a notably higher NPK content in the leaves compared to the 60 x 60 cm spacing, the closer spacing yielded a significantly greater leaf output. This implies that while wider spacing enhances the nutritional value of the leaves, it does not lead to an overall increase in yield per hectare, as the number of plants per unit area is reduced.

Keywords: Mulberry variety, spacing, nutrients, fertilizers, productivity

Introduction

Mulberry (*Morus alba* L.) is a fast-growing, deep-rooted crop of significant commercial value, continuously producing leaves throughout the year, which are essential for silkworm rearing (*Bombyx mori* L.). The yield and quality of mulberry leaves depend on factors such as soil type, plant variety, nutrient availability, and agro-ecological conditions, all of which influence the quality of silk production. The productivity of mulberry leaves is highly reliant on nutrients like nitrogen (N), phosphorus (P), and potassium (K), and it responds well to organic manure application (Jaiswal *et al.*, 2005) [9]. Long-term studies on nutrient management in different cropping systems have shown a decline in productivity and soil organic matter, along with the depletion of available N, P, and K in the soil. Additionally, significant damage to the soil's physio-biochemical properties has been observed. Currently, Indian soils are deficient in several key nutrients, including nitrogen (70%), phosphorus (50%), potassium (13%), zinc (4.7%), copper (4.8%), iron (11.5%), and manganese (4.0%) (Pal, 2007) [15].

The rising costs and limited availability of chemical fertilizers have made them increasingly expensive. Furthermore, intensive mulberry cropping depletes soil nutrients, and excessive use of inorganic fertilizers and pesticides has negatively impacted soil health. In this context, providing essential nutrients to mulberry through organic manures and biofertilizers is crucial. Organic manures, though bulky, supply the crop with small amounts of major nutrients like NPK, as well as trace elements, and also encourage the growth of beneficial soil microflora (Lakshmi *et al.*, 1977) [11]. The introduction of beneficial microbial inoculants into the soil plays a key role in mobilizing the nutrients required by the crop. The success of sericulture relies not only on high yield but also on the quality of mulberry leaves (Das *et al.*, 1983; Rangaswami *et al.*, 1976) [6, 17]. Increasing the yield of mulberry leaves per unit area leads to higher cocoon production per hectare at a lower cost. Therefore, scientific approaches to mulberry leaf production are essential for the economic viability of sericulture (Rangaswami *et al.*, 1976) [17]. Maximizing leaf yield is critical for improving cocoon production and its economic returns. Enhancing both the yield and quality of mulberry can be achieved through the application of fertilizers. Research from various countries indicates that mulberry plants respond

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positively to nitrogen fertilization, especially regarding leaf yield. Leaf quality can also be improved with the addition of phosphatic and potassic fertilizers along with nitrogen (Basavanna *et al.*, 1974; Kasiviswanathan *et al.*, 1979; Bongale, 1994) ^[1, 10, 2]. This study aimed to develop cultivation practices for elite mulberry cultivars.

Materials and Methods

The experiment took place in a mulberry garden at Akuthotapalli, Anantapur district, Andhra Pradesh from 2021 to 2023. The soil in the experimental area was black soil, known for its high water-holding capacity. Irrigation was provided with 4 to 5 cm of water every 10 days. The experiment was conducted during the late rainy season and the onset of winter. The half-acre plot was divided into five sections with varying planting densities: 5'x5', 2'x2', 3'x1', and 6'x3'x2', using the G4 variety for four plots, while one plot was left as a control.

The fertilizers were applied to the experimental plots as follows:

1. Foliar spray was applied to plots with 5'x5' spacing, designated as T1, with a corresponding control plot labelled TC1.
2. Plots spaced at 2'x2' received nitrogen (urea) treatment, designated as T2, with its control plot labelled TC2.
3. Mixed fertilizers were applied to plots spaced at 3'x1', designated as T3, with its control plot labelled TC3.
4. Plots with a 6'x3'x2' spacing received a combination of farmyard manure (FYM) and vermicompost, labelled as T4, with its control plot labelled TC4.

In this experiment, a foliar spray called Super Height was applied at a concentration of 5 to 10 ml per liter. Nitrogen was

supplied in the form of urea (46% N), and a mixed fertilizer ratio of 360:180:180 was used. Phosphorus was provided as single super phosphate (SSP) containing 16% P₂O₅, while potassium was supplied as muriate of potash (MOP) with 60% K₂O. Farmyard manure (FYM) was applied at a rate of 20 metric tons per hectare per year, and vermicompost was added to the designated plots. The control plot received no fertilizers, only water. Irrigation was scheduled every 12 days due to the black soil's high water-holding capacity. The results were measured by evaluating leaf weight and shoot height. Fertilizer treatments were applied after pruning and completion of intercultural practices. Sixty days after pruning, plant height and leaf weight were assessed by measuring 5 leaves from 3 plants in each plot (Tables 1, 2, and 3).

Results and Discussion

The study was conducted across three seasons: rainy, winter, and summer. During the rainy season, the weight of the 3rd leaf, the 6th leaf, and the average of five leaves was significantly higher in T3, with values of 0.684, 5.682, and 18.04, respectively (Table 1; Figs. 1, 2, and 3). In the winter season, the 3rd leaf weight was highest in T1 (0.782), while the 6th leaf and average five-leaf weights were highest in T3, with values of 5.132 and 18.20, respectively (Tables 2 and 3). Similarly, during the summer season, the 3rd leaf weight was again highest in T1 (0.78), while the 6th leaf and average five-leaf weights were highest in T3, with values of 5.13 and 16.6, respectively (Table 3). These observations clearly demonstrate that the T3 spacing (3' x 1') resulted in significantly higher leaf weights compared to other spacing types.

Table 1: Influence of T1 Variety, Spacing, and Fertilizer Treatments on the Weight of the 3rd and 6th Leaves, Average Leaf Weight, and Mulberry Plant Height During the Rainy

Spacing	TC1	T1	TC2	T2	TC3	T3	TC4	T4
Fertilizers	FC1	F1	FC2	F2	FC3	F3	FC4	F4
3 rd leaf wt(gms)	0.234	0.618	0.13	0.536	0.16	0.684	0.19	0.59
6 th leaf wt(gms)	3.626	4.32	1.78	4.23	2.16	5.682	2.74	4.524
Avg 5 leaves wt(gms)	11.32	16.69	9.13	17.36	13.29	18.04	12.17	18.02
Height of shoot(cms)	94.12	230	32.16	248	49.4	286	56.28	258

In this study, the effect of spacing on mulberry plant height was found to be highly significant across the rainy, winter, and summer seasons. The plant heights recorded were 286 cm in T4 during the rainy season, 183 cm in T3 during the winter, and 153 cm in T3 during the summer. These results clearly indicate that the T3 spacing type consistently had a more positive impact on plant height compared to the other spacing types.

The study revealed that different fertilizer doses had a significant impact on leaf yield, growth, and leaf quality. During the rainy season, the weight of the 3rd, 6th, and average five leaves was notably higher with F3 (0.684), F3 (5.68), and F2 (18.04) treatments, respectively. In the winter season, the results were higher in F1 (0.86), F3 (5.86), and F3 (18.20), while during

the summer season, F1 (0.78), F3 (5.132), and F3 (16.64) showed the highest values. The study clearly indicated that F3 (NPK) fertilizers led to significantly higher leaf weight compared to other treatments.

Additionally, the impact of spacing on mulberry plant height was observed to be greater during rainy, winter, and summer seasons with T4 (286.08 cm), T3 (183.8 cm), and T3 (153.2 cm), respectively. The study highlighted that T3 (NPK) fertilizer had a more substantial effect than other treatments. The investigation spanning 2009-10 showed that the V3 (3'x1') spacing combined with T3 (NPK) fertilizer had a positive influence on both leaf weight and plant height in the mulberry G4 variety.

Table 2: Influence of G4 Mulberry Variety, Spacing, and Fertilizer Treatments on the 3rd and 6th Leaf Weight, Average Leaf Weight, and Plant Height During the Winter Season of 2023.

Spacing	TC1	T1	TC2	T2	TC3	T3	TC4	T4
Fertilizers	FC1	F1	FC2	F2	FC3	F3	FC4	F4
3 rd leaf wt(gms)	0.4	0.78	0.21	0.334	0.3	0.722	0.32	0.62
6 th leaf wt(gms)	1.56	4.78	1.06	4.36	1.23	5.132	1.33	4.73
Avg 5 leaves wt(gms)	7.85	16.49	4.38	15.32	5.63	16.04	6.08	15.32
Height of shoot(cm)	83	112	27	116	36	153	40	130

Previous studies have also noted significant differences in leaf yield among various mulberry varieties, with varieties like S36 showing higher NPK content and superior performance in both yield and quality compared to other varieties (Kashiviswanathan *et al.*, 1979; Saratchandra *et al.*, 1992)^[17].

Table 3: Impact of G4 Mulberry Variety, Spacing, and Fertilizer Treatments on the 3rd and 6th Leaf Weight, Average Leaf Weight, and Plant Height During the Summer Season of 2023.

Spacing	TC1	T1	TC2	T2	TC3	T3	TC4	T4
Fertilizers	FC1	F1	FC2	F2	FC3	F3	FC4	F4
3 rd leaf wt(gms)	0.48	0.86	0.21	0.73	0.26	0.76	0.29	0.69
6 th leaf wt(gms)	2.03	3.56	1.07	4.52	1.96	5.86	1.99	4.80
Avg 5 leaves wt(gms)	10.80	16.30	6.96	17.34	9.16	18.02	9.38	17.68
Height of shoot(cm)	59	163	27	167	38	183	43	149

Conclusion

The study found that while wider spacing of 90 x 90 cm led to significantly higher NPK content in the leaves compared to 60 x 60 cm spacing, the closer spacing produced a significantly higher leaf yield. This suggests that although wider spacing improves the nutritional quality of the leaves, it does not increase overall yield per hectare due to the reduced number of plants per unit area. Similar findings were reported by Choudhury *et al.* (1979)^[10]; Lellapalli Rithesh (2020)^[7], who observed a notable decline in leaf yield as spacing increased from 60 x 60 cm to 90 x 90 cm and further to 120 x 90 cm under irrigated conditions. Several researchers, including Kashiviswanathan *et al.* (1976)^[17], Dahiphale *et al.* (1992)^[5], Das *et al.* (1993)^[8], Azra *et al.*, 2024^[26] Rajesh *et al.*, 2019^[3], and Tikader *et al.* (1993), have previously reported on the effect of plant density on leaf yield and quality. Additionally, the application of different fertilizer doses had a significant impact on the growth, yield, and NPK content in mulberry leaves. The fertilizer treatment F1 (300:180:120 kg NPK/ha/yr) resulted in the highest growth, yield, and leaf quality, likely due to the higher fertilizer dose used. This study confirms that varying fertilizer doses significantly affect mulberry growth, yield, and nutrient content.

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