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Efficacy of Organic Based Foliar Formulations on Growth and Yield of Tree Mulberry [*Morus alba* L.] under Southern Dry Zone of Karnataka

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Abstract

An investigation has been undertaken to assess the efficacy of organic based foliar formulations viz., Vermiwash, Panchagavya, and Jeevamrutha at three different concentrations (5, 7.5 and 10.0%) (Check: Seriboost @ 0.25%, Water control and Absolute control) through growth and yield parameters of tree mulberry. The organic based foliar formulations were sprayed on mulberry crop at 25 and 32 days after pruning (DAP). The current study revealed that, Vermiwash @ 10% concentration recorded significantly more plant height (112.9 ± 1.205 and 133.5 ± 1.220 cm), number of shoots per plant (23.80 ± 0.265 and 25.33 ± 0.120) and leaves per plant (389.2 ± 2.724 and 498.5 ± 4.989), leaf area (196.7 ± 4.437 and 221.2 ± 5.175 cm^2) and leaf area index (5.152 ± 0.132 and 7.421 ± 0.244) at 45 and 60 DAP, respectively when compared to other organic based formulations, Seriboost and controls (Water control and Absolute control). On the other hand, at 60 DAP, both Jeevamrutha and Vermiwash @ 10% recorded highest leaf-shoot ratio (53.40 ± 0.614: 46.40 ± 0.614 and 53.60 ± 0.278: 46.40 ± 0.278). However, Panchagavya sprayed @ 10% concentration registered more specific leaf weight (410.5 ± 3.788g/100 leaves). Whereas, Highest leaf yield (68,788 ± 235.8 kg/ha/year) was recorded due to foliar application of Vermiwash @ 10% concentration compared to Absolute control (52012 ± 333.8 kg/ha/year). Furthermore, Seriboost @ 0.25% displayed limited effectiveness surpassing only the Water control and Absolute control. Overall, the findings inferred that, organic foliar formulations especially Vermiwash and Panchagavya @ 10% concentration can be conveniently used for enhancing the productivity of mulberry.

***Key words*:** Jeevamrutha, Mulberry, Panchagavya, Seriboost, Vermiwash

Sericulture is an agro-based industry producing silk of commerce, prized for its economic and cultural significance. It plays a crucial role in rural economy, providing employment and curbing urban migration. Cultivation of mulberry, the primary source of food for the silkworm, *Bombyx mori* L. is paramount importance in production and productivity of cocoons. Mulberry leaves rich in nutrients are essential for growth and developments of silkworm in turn cocoon production. Nearly 70% of the silk proteins synthesized by silkworms are directly derived from the protein of mulberry leaves [1]. Therefore, cultivation of mulberry with appropriate package of practices is imperative for sustaining high-quality silk production.

In recent times, organic farming practices have garnered considerable attention for their ecological sustainability and potential to enhance crop productivity while mitigating environmental degradation. Organic sources such as manures, green manures and organic based foliar formulations, play a pivotal role in improving the fertility of soil, promoting nutrient retention and minimizing the adverse effects of chemical fertilizers on soil health. By prioritizing the use of organic resources, sericulture endeavours aim to optimize mulberry yield and quality thereby bolstering cocoon production and ultimately silk output. Organic foliar formulations, which are sprayed on to plants, have emerged as a promising approach to promote the growth and productivity of mulberry. Furthermore, these formulations, enriched with beneficial microorganisms and nutrients, not only rectify deficiencies but also promote biochemical composition, thereby fostering robust mulberry for healthy silkworm for production of superior quality of cocoons. Indiscriminate use of chemicals in agriculture has weakened the ecological base that lead to degradation of soil, water resources and quality of the food. At this juncture, a keen awareness has sprung on the adoption of "Organic Farming" as a remedy to cure the ills of modern chemical agriculture. Further, increased awareness on organic farming among the farming community is responsible to generate many organic formulations in crop production for increasing the yield of crops [2].

Over the last two decades, foliar nutrition has received significant attention in agriculture, horticulture and other foliage crops with studies confirming the advantageous effects of nutrient foliar sprays [3]. According to Subbarao *et al*. [4] and Fotedar and Chakraborty [5], foliar application of nitrogen significantly increased mulberry leaf yield ranging from 42 to 52% compared to soil-based application of nitrogen. Foliar fertilization has been found to enhance growth; increases yield and improve resistance against insect pests and drought [6]. The current investigation focuses on the influence of organic based foliar formulations on V-1 mulberry, aiming to promote sustainable sericulture and environmental protection. The

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current research underlines the importance of organic farming in achieving better crop productivity, preserving soil health, and reducing chemical pollution, thus ensuring the sustainability of sericultural crop production.

MATERIALS AND METHODS

The investigation was undertaken at Krishi Vigyan Kendra, V. C. Farm, Mandya (Agro-climatic Zone: Southern Dry Zone of Karnataka) which is geographically located at 12°34'6" North Latitude, 76°49'56" East Longitude with an altitude of 695 m above mean sea level and receiving an average rainfall of 716.3 mm/year. The established V-1 mulberry garden (5 year old) planted at a spacing of 4 × 4 feet (Small sized tree with three feet height). The experiment was laid out in Randomized Block Design consisting of 12 treatments with three replications with plot area of 96 square feet/replication. Before the initiation of the experiment, mulberry plants were pruned and cultivation practices like application of FYM (20 MT/ha/year: Two equal splits), chemical fertilizers (N:P:K @ 350:140:140 kg/ha/year: Five equal splits) and cultural practices were carried out as per the recommended package of practices developed for irrigated condition [7]. As mulberry is a perennial and nutrient demanding crop, along with the recommended package of practices, the organic formulations viz., Jeevamrutha, Panchagavya and Vermiwash were used as complementary component to enhance the nutritional value, production and productivity of mulberry leaf.

Three organic based formulations viz., Jeevamrutha [8], Panchagavya [9] and Vermiwash [10] were prepared by using standard procedure and diluted with water by volume/volume basis and sprayed @ 5, 7.5 and 10% at 25 and 32 days after pruning on mulberry leaves during dusk hours using Knapsack sprayer. Further, 'Seriboost' @ 0.25% was used as foliar spray for comparison as it has been commonly used by the sericulture farmers. In addition, water control and absolute control were maintained. The data on growth parameters of mulberry viz., plant height, number of shoots per plant, number of leaves per plant, internodal distance, leaf area, and leaf area index were recorded on 45 and 60 days after pruning (DAP). Whereas, yield parameters like leaf-shoot ratio, specific leaf weight and estimated leaf yield per hectare per year were recorded treatment-wise on 60 DAP from five randomly selected plants in each replication. The data emanated in the current investigation was subjected to ONE WAY analysis of variance ($P \leq 0.05$ and $P \leq 0.01$) [11] through SPSS for windows version 21.0.

RESULTS AND DISCUSSION

The growth parameters are crucial for enhancing crop productivity. Plant height and number of shoots per plant are important growth parameters contributing greatly for biomass production. While number of leaves per plant indicates plants health and facilitates to estimate growth rate. Further, leaf surface area is essential for light and nutrient absorption and leaf area index reflects expansion of leaf in relation to plant geometry. Maintaining an optimal leaf-shoot ratio ensures efficient resource allocation and specific leaf weight provides insights into leaf function. However, these parameters collectively leading to enhanced crop growth, productivity and yield potential. Mulberry leaf yield serves as a vital indicator, reflecting not just quantity but also serves as reliable measure of amplified productivity. Elevated leaf yield not only secures consistent food supply source for silkworms but also directly uplifts the economic prosperity of silkworm rearers.

Growth parameters of mulberry

Organic based foliar formulations exhibit significant variations with respect to plant height at 45 and 60 days after pruning of mulberry. At 45 DAP, plant height varied significantly ($p \leq 0.01$, F-value: 4.892**) among the organic based foliar formulations at varied concentrations with more height being recorded in T_9: Vermiwash @ 10% (112.9 ± 1.205cm) followed by T_8: Vermiwash @ 7.5% (112.2 ± 1.955cm), T_6: Panchagavya @ 10% (111.3 ± 1.330cm) and T_3: Jeevamrutha @ 10% (110.6 ± 0.405cm). However, plant height was less in T_{12}: Absolute control (104.4 ± 1.222cm) and closely aligning with T_{11}: Water control (104.6 ± 0.665cm). Similarly, at 60 days after planting (DAP) significantly ($p \leq 0.01$, F-value: 4.995**) more plant height being recorded in T_9: Vermiwash @ 10% (133.5 ± 1.220 cm), followed by T_8: Vermiwash @ 7.5% (132.3 ± 1.721 cm), T_6: Panchagavya @ 10% (131.8 ± 2.050 cm) and T_3: Jeevamrutha @ 10% (130.7 ± 0.581 cm). Considerably, plant height was lowest in T_{12}: Absolute control (121.8 ± 1.761 cm) and found on par with T_{11}: Water control (122.2 ± 0.825 cm) (Table 1).

Notable variations in number of shoots/plant on 45 and 60 days after pruning of mulberry were found among the organic based foliar formulations when applied on mulberry as foliar spray. At 45 days after planting (DAP), statistical ($p \leq 0.01$, F-value: 3.009**) variations were noticed in respect of number of shoots/plant among the organic based foliar formulations at varied concentrations with more number of shoots/plant being recorded in T_9: Vermiwash @ 10% (23.80 ± 0.265), followed by T_6: Panchagavya @ 10% (23.43 ± 0.546), T_3: Jeevamrutha @ 10% (23.10 ± 0.551) and T_8: Vermiwash @ 7.5% (23.03 ± 0.467). However, least number of shoots/ plant was noticed in T_{12}: Absolute control (20.33 ± 0.291) and was in parity with T_{11}: Water control (20.47 ± 0.384). Organic based foliar formulations at different concentrations could register statistical ($p \leq 0.01$, F-value: 20.94**) variations in number of shoots/plant at 60 days after planting (DAP). Number of shoot/ plant was considerably more with T_6: Panchagavya @ 10% (25.40 ± 0.115) and the treatments T_9: Vermiwash @ 10% (25.33 ± 0.120) and T_3: Jeevamrutha @ 10% (25.20 ± 0.173) were found next best with parity among them. However, less number of shoots/plant was noticed in T_{12}: Absolute control (22.73 ± 0.088 shoots/plant) and found parity with T_{11}: Water control (22.93 ± 0.033 shoots/plant) (Table 1).

Organic based foliar formulations when applied to mulberry on 25 and 32 DAP registered considerable variation in number of leaves per plant at both 45 and 60 days after planting (DAP). Jeevamrutha, Panchagavya and Vermiwash particularly at higher concentration (10%) significantly ($p \leq 0.01$, F-value: 4.889**) increased number of leaves/ plant at 45 DAP when compared to Seriboost and control groups (Water control and Absolute control). More number of leaves/ plant was noticed in T_9: Vermiwash @ 10%, (389.2 ± 2.724) and T_8: Vermiwash @ 7.5% (376.7 ± 10.41), followed by T_6: Panchagavya and T_3: Jeevamrutha @ 10% which registered 374.4 ± 6.991 and 368.7 ± 9.840 leaves/plant, respectively. However, less number of leaves/plant was observed in T_{12}: Absolute control (298.9 ± 7.788) and found on par with T_{11}: Water control (303.8 ± 8.325). Foliar application of organic based formulations on mulberry differs highly significant ($p \leq 0.01$, F-value: 3.997**). Similarly, at 60 days after planting (DAP), T_9: Vermiwash @ 10% concentration considerably recorded more number of leaves/plant (498.5 ± 4.989), followed by T_3: Jeevamrutha @ 10% (495.7 ± 11.41 leaves/ plant) and T_6: Panchagavya @ 10% (488.3 ± 12.84 leaves/ plant) compared to T_{12}: Absolute control (402.5 ± 3.910 leaves/ plant) and T_{11}: Water control (406.3 ± 8.875 leaves/ plant). The

organic based formulations like Jeevamrutha, Panchagavya and Vermiwash at different concentrations did not influence significantly on internodal distance both at 45 and 60 days after planting (Table 1).

Table 1 Efficacy of organic based foliar formulations on growth parameters of tree mulberry

Treatment	Plant height (cm)		No. of shoots/plant		No. of leaves/plant		Internodal distance (cm)	
	45 DAP	60 DAP	45 DAP	60 DAP	45 DAP	60 DAP	45 DAP	60 DAP
T_1: Jeevamrutha @ 5%	109.3 ± 0.486 (4.693)	127.5 ± 0.578 (4.680)	22.13 ± 0.219 (8.854)	24.50 ± 0.173 (7.787)	348.9 ± 7.520 (16.73)	465.2 ±10.78 (15.58)	5.833 ± 0.033 (-1.136)	5.800 ± 0.100 (-2.242)
T_2: Jeevamrutha @ 7.5%	110.2 ± 0.173 (5.556)	129.2 ± 0.876 (6.076)	22.50 ± 0.436 (10.67)	25.00 ± 0.153 (9.987)	350.7 ± 10.51 (17.33)	475.1 ± 32.39 (18.04)	5.933 ± 0.088 (0.559)	5.900 ± 0.252 (-0.556)
T_3: Jeevamrutha @ 10%	110.6 ± 0.405 (5.939)	130.7 ± 0.581 (7.307)	23.10 ± 0.551 (13.63)	25.20 ± 0.173 (10.87)	368.7 ± 9.840 (23.35)	495.7 ± 11.41 (23.16)	5.833 ± 0.033 (-1.136)	5.767 ± 0.088 (-2.798)
T_4: Panchagavya @ 5%	109.4 ± 0.781 (4.789)	127.8 ± 0.636 (4.926)	22.23 ± 0.418 (9.346)	24.77 ± 0.067 (8.975)	353.1 ± 13.90 (18.13)	471.5 ± 13.70 (17.14)	5.800 ± 0.100 (-1.695)	5.800 ± 0.058 (-2.242)
T_5: Panchagavya @ 7.5%	109.6 ± 0.426 (4.981)	129.5 ± 0.296 (6.322)	22.60 ± 1.150 (11.17)	25.03 ± 0.393 (10.12)	357.4 ± 20.67 (19.57)	477.7 ± 31.06 (18.68)	5.833 ± 0.145 (-1.136)	5.867 ± 0.120 (-1.112)
T_6: Panchagavya @ 10%	111.3 ± 1.330 (6.609)	131.8 ± 2.050 (8.210)	23.43 ± 0.546 (15.25)	25.40 ± 0.115 (11.75)	374.4 ± 6.991 (25.26)	488.3 ± 12.84 (21.32)	5.867 ± 0.088 (-0.559)	5.933 ± 0.088 (0.000)
T_7: Vermiwash @ 5%	109.7 ± 0.592 (5.077)	128.4 ± 3.797 (5.419)	22.63 ± 1.110 (11.31)	24.67 ± 0.167 (8.491)	358.6 ± 24.63 (19.97)	470.7 ± 11.98 (16.94)	5.833 ± 0.067 (-1.136)	5.800 ± 0.115 (-2.242)
T_8: Vermiwash @ 7.5%	112.2 ± 1.955 (7.471)	132.3 ± 1.721 (8.621)	23.03 ± 0.467 (13.28)	25.10 ± 0.252 (10.43)	376.7 ± 10.41 (26.03)	482.4 ± 5.745 (19.85)	5.800 ± 0.100 (-1.695)	5.933 ± 0.133 (0.000)
T_9: Vermiwash @ 10%	112.9 ± 1.205 (8.142)	133.5 ± 1.220 (9.606)	23.80 ± 0.265 (17.07)	25.33 ± 0.120 (11.44)	389.2 ± 2.724 (30.21)	498.5 ± 4.989 (23.85)	5.833 ± 0.088 (-1.136)	5.833 ± 0.088 (-1.685)
T_{10}: Seriboost @ 0.25%	109.2 ± 2.436 (4.598)	128.0 ± 1.651 (5.090)	22.03 ± 0.593 (8.362)	24.43 ± 0.267 (7.479)	348.3 ± 1.856 (16.53)	456.1 ± 1.890 (13.32)	5.800 ± 0.115 (-1.695)	5.900 ± 0.058 (-0.556)
T_{11}: Water Control	104.6 ± 0.665 (0.192)	122.2 ± 0.825 (0.328)	20.47 ± 0.384 (0.689)	22.93 ± 0.033 (0.880)	303.8 ± 8.325 (1.606)	406.3 ± 8.875 (0.944)	5.867 ± 0.088 (-0.576)	5.900 ± 0.058 (-0.556)
T_{12}: Absolute control	104.4 ± 1.222	121.8 ± 1.761	20.33 ± 0.291	22.73 ± 0.088	298.9 ± 7.788	402.5 ± 3.910	5.900 ± 0.058	5.933 ± 0.067
Mean	109.5 ± 0.504	128.6 ± 0.703	22.36 ± 0.224	24.59 ± 0.149	352.4 ± 5.25	465.8 ± 6.27	5.844 ± 0.022	5.864 ± 0.029
F-value	4.892**	4.995**	3.009**	20.94**	4.889**	3.997**	NS	NS

DAP: Days after pruning; **Highly significant ($p \leq 0.01$); (): % change over control; NS: Non-significant

Yield parameters of mulberry

Highly significant (p≤0.01, F-value: 6.088**) variations were evident due to foliar application of organic based formulations including Jeevamrutha, Panchagavya and Vermiwash with respect to leaf area at 45 DAP when compared to Seriboost and control groups (Water control and Absolute control). More leaf area (196.7 ± 4.437 cm^2) was noticed in T_9: Vermiwash @ 10%, followed by T_6: Panchagavya @ 10% and T_8: Vermiwash @ 7.5% which recorded 194.8 ± 6.127 and 194.8 ± 3.579 cm^2, respectively. On the other hand, less leaf area of 151.3 ± 7.557 cm^2 was observed in T_{12}: Absolute control and found closely aligning with T_{11}: Water control (152.0 ± 11.64). Similar trend was observed even at 60 DAP with respect to leaf area where higher concentration of organic based foliar formulations significantly (p≤0.01, F-value: 8.650**) increased the leaf area. Leaf area was considerably highest in T_9: Vermiwash @ 10% (221.2 ± 5.175 cm^2), followed by T_6: Panchagavya @ 10% (218.9 ± 6.104 cm^2), T_8: Vermiwash @ 7.5% (218.7 ± 1.572 cm^2) and T_3: Jeevamrutha @ 10% (217.3 ± 7.144cm^2) (Table 2).

Foliar application of organic based formulations viz., Jeevamrutha, Panchagavya and Vermiwash particularly @ higher concentrations significantly (p≤0.01, F-value: 11.19**) increased LAI at 45 DAP compared to Seriboost and control groups (Water control and Absolute control). Vermiwash @ 10% (T_9) (5.152 ± 0.132) significantly recorded more leaf area followed by T_8: Vermiwash @ 7.5% (4.939 ± 0.184) and T_6: Panchagavya @ 10% (4.912 ± 0.243). However, the less LAI was exhibited in Absolute control (3.049 ± 0.210) and aligning closely with the Water control (3.108 ± 0.266). On 60 DAP, T_9: Vermiwash @ 10% (7.421 ± 0.244) significantly (p≤0.01, F-value: 12.16**) recorded more LAI, followed by T_3: Jeevamrutha and T_6: Panchagavya @ 10% which registered 7.245 ± 0.282 and 7.200 ± 0.383, respectively. T_8: Vermiwash and T_5: Panchagavya @7.5% were found next best by recording LAI of 7.099 ± 0.058 and 6.840 ± 0.496. However, lower LAI was observed in absolute control (4.522 ± 0.177) and closely on par with the Water control (4.587 ± 0.178) (Table 2).

Foliar application of organic based formulations like Jeevamrutha, Panchagavya and Vermiwash on mulberry found

highly significant with respect to leaf-shoot ratio ($p \leq 0.01$, F-value: 3.016**). Among the different treatments higher leaf-shoot ratio was recorded due to foliar spray of T_3: Jeevamrutha @ 10% (53.60 ± 0.614: 46.40 ± 0.614), followed by T_9: Vermiwash @ 10% (53.60 ± 0.278: 46.40 ± 0.278) and T_6: Panchagavya and which recorded 53.40 ± 0.353: 46.60 ± 0.353 and respectively and were found in parity with each other. The lesser leaf-shoot ratio was recorded in Absolute control (50.80 ± 0.530: 49.20 ± 0.530) (Table 2).

The foliar application of organic based formulations like Jeevamrutha, Panchagavya and Vermiwash significantly ($p \leq 0.01$, F-value: 8.589**) increased the specific leaf weight (weight of 100 leaves) of mulberry. Among different treatments tested, maximum specific leaf weight (410.5 ± 3.788 g/100) was observed due to foliar spray of Panchagavya @ 10% (T_6), followed by T_9: Vermiwash @ 10% (410.3 ± 3.610 g/100 leaves). However, the minimum leaf weight was recorded in Absolute control (384.2 ± 1.906 g/100 leaves) and found parity with Water control (384.4 ± 4.067 g/100 leaves) (Table 2).

Foliar application of organic based formulations like Jeevamrutha, Panchagavya and Vermiwash significantly ($p \leq 0.01$, F-value: 7.605** and 7.591**) increased mulberry leaf yield at 60 DAP. Among the different treatments, T_9: Vermiwash @ 10% recorded highest leaf yield (68788 ± 235.8 kg/ha/year), closely followed by T_3: Jeevamrutha (67494 ± 2072.2 kg/ha/year) and T_6: Panchagavya @ 10% (67384 ± 1216.2 kg/ha/year). However, lowest leaf yield was recorded in T_{12}: Absolute control (52012 ± 333.8 kg/ha/year) and found parity with T_{11}: Water control (52502 ± 1282.8 kg/ha/year). However, Seriboost @ 0.25% displayed limited effectiveness with respect to growth and yield parameters surpassing only the water control and absolute control (Table 2).

Table 2 Efficacy of organic based foliar formulations on yield attributes of tree mulberry

Treatment	Leaf area (cm^2)		Leaf area index		Leaf : Shoot ratio		Specific leaf weight (g/100 leaves)	Leaf yield (kg/ha/year)
	45 DAP	60 DAP	45 DAP	60 DAP				
T_1: Jeevamrutha @ 5%	186.5 ± 3.667 (23.27)	205.0 ± 4.730 (22.75)	4.375 ± 0.046 (43.49)	6.419 ± 0.260 (41.95)	51.48 ± 0.824 : (1.339)	48.52 ± 0.824 (-1.382)	388.6 ± 5.168 (1.145)	60814 ± 1705.1 (16.92)
T_2: Jeevamrutha @ 7.5%	189.5 ± 6.472 (25.25)	208.7 ± 5.802 (24.97)	4.479 ± 0.289 (46.90)	6.654 ± 0.346 (47.15)	52.69 ± 0.580 : (3.720)	47.31 ± 0.580 (-3.841)	390.0 ± 1.450 (1.510)	62320 ± 4218.3 (19.82)
T_3: Jeevamrutha @ 10%	192.4 ± 8.487 (27.16)	217.3 ± 7.144 (30.12)	4.765 ± 0.133 (56.28)	7.245 ± 0.282 (60.22)	53.60 ± 0.614 : (5.512)	46.40 ± 0.614 (-5.691)	404.7 ± 3.215 (5.336)	67494 ± 2072.2 (29.77)
T_4: Panchagavya @ 5%	190.1 ± 5.678 (25.64)	209.4 ± 4.276 (25.39)	4.507 ± 0.076 (47.82)	6.635 ± 0.065 (46.73)	51.70 ± 0.520 : (1.772)	48.30 ± 0.520 (-1.829)	389.5 ± 1.617 (1.379)	61757 ± 1556.8 (18.74)
T_5: Panchagavya @ 7.5%	193.3 ± 4.967 (27.76)	213.0 ± 9.168 (27.54)	4.642 ± 0.229 (52.25)	6.840 ± 0.496 (51.26)	51.99 ± 0.419 : (2.343)	48.01 ± 0.419 (-2.419)	402.1 ± 3.996 (4.659)	64533 ± 3601.3 (24.07)
T_6: Panchagavya @ 10%	194.8 ± 6.127 (28.75)	218.9 ± 6.104 (31.08)	4.912 ± 0.243 (61.10)	7.200 ± 0.383 (59.22)	53.40 ± 0.353 : (5.118)	46.60 ± 0.353 (-5.285)	410.5 ± 3.788 (6.845)	67384 ± 1216.2 (29.55)
T_7: Vermiwash @ 5%	188.7 ± 5.317 (24.72)	210.8 ± 3.786 (26.23)	4.545 ± 0.283 (49.07)	6.676 ± 0.238 (47.63)	51.80 ± 0.411 : (1.969)	48.20 ± 0.411 (-2.033)	396.5 ± 4.028 (3.201)	62761 ± 1443.4 (20.67)
T_8: Vermiwash @ 7.5%	194.8 ± 3.579 (28.75)	218.7 ± 1.572 (30.96)	4.939 ± 0.184 (61.99)	7.099 ± 0.058 (56.99)	52.80 ± 0.471 : (3.937)	47.20 ± 0.471 (-4.065)	410.1 ± 3.568 (6.741)	66542 ± 761.9 (27.94)
T_9: Vermiwash @ 10%	196.7 ± 4.437 (30.01)	221.2 ± 5.175 (32.46)	5.152 ± 0.132 (68.97)	7.421 ± 0.244 (64.11)	53.60 ± 0.278 : (5.512)	46.40 ± 0.278 (-5.691)	410.3 ± 3.610 (6.793)	68788 ± 235.8 (32.25)
T_{10}: Seriboost @ 0.25%	187.4 ± 4.120 (23.86)	206.6 ± 6.949 (23.71)	4.390 ± 0.073 (43.98)	6.342 ± 0.231 (40.25)	52.60 ± 0.433 : (3.543)	47.40 ± 0.433 (-3.659)	393.8 ± 3.027 (2.499)	60419 ± 710.0 (16.16)
T_{11}: Water control	152.0 ± 11.64 (0.463)	168.2 ± 9.504 (0.719)	3.108 ± 0.266 (1.935)	4.587 ± 0.178 (1.437)	51.29 ± 0.785 : (0.965)	48.71 ± 0.785 (-0.996)	384.4 ± 4.067 (0.052)	52502 ± 1282.8 (0.942)
T_{12}: Absolute control	151.3 ± 7.557	167.0 ± 6.391	3.049 ± 0.210	4.522 ± 0.177	50.80 ± 0.530 :	49.20 ± 0.530	384.2 ± 1.906	52012 ± 333.8
Mean	184.8 ± 2.980	205.4 ± 3.332	4.405 ± 0.117	6.470 ± 0.168	52.31 ± 0.200	47.69 ± 0.200	397.0 ±1.836	62277 ± 999.6
F-value	6.088**	8.650**	11.19**	12.16**	3.016**	3.016**	8.589**	7.591**

DAP: Days after pruning; **Highly significant ($p \leq 0.01$); () % change over control

Improvement in mulberry growth and yield due to the foliar application of Vermiwash, Panchagavya, and Jeevamrutha can be attributed to several factors. These include nutrient enrichment, enhanced nutrient absorption efficiency, improved photosynthesis, regulation of hormonal balance. These organic foliar formulations might contribute to overall plant vigour, resulting in increased plant height, number of shoots, leaves per plant, leaf area, leaf weight and yield of mulberry. The findings in the current investigation are in corroboration with Ankalagi and Ansari [12] who delineated

that a tricontanol-based foliar spray on mulberry @ 1.0 ml/l recorded maximum shoot length (147cm), number of leaves/plant (35 leaves/plant) and fresh leaf weight (111.10g/plant). Moreover, Shanti *et al.* [13] highlighted the significance of micronutrient foliar sprays, particularly with iron at 0.50% concentration, applied on 20 and 40 days after pruning, resulting in heightened plant, leaf area and leaf yield of mulberry (Variety: MR-2). According to Somasundaram *et al*. [14], foliar spray of 'Ergostim' (bio-stimulant) on mulberry (variety: M-5) under irrigated condition has significantly increased the linear growth of plant, number of leaves/plant and leaf yield/plant. Rajegowda *et al*. [15] reported that spraying 'Seriboost' at 2.5 ml/l on mulberry (Variety: M-5) thrice at a week interval after 16 DAP significantly increased the number of shoots/plant, shoot length and total leaf yield.

As per Setua *et al*. [16], growth regulators including NAA, Kinetin and Tricontanol thrice at 15 days interval from the day of pruning enhanced growth parameters significantly. Notably, NAA increased growth rate by 5.52 g/m²/day compared to untreated control (3.15 g/m²/day). Similarly, Chikkaswamy *et al.* [17] found that foliar application of 'Green leaf' substantially improved shoot length, number of leaves and fresh leaf yield in mulberry. Furthermore, Jyothi *et al.* [18] observed notable enhancements in growth parameters and yield with the application of 'Daman Penshobao' on M-5 variety of mulberry. Narahari Rao *et al*. [19] inferred that Seriboost has significantly increased the number of leaves/plant (131) over control (126) and leaf yield. These findings are in corroborating with the present investigation. Foliar spray of micronutrients viz., zinc (0.5%), iron (1%), boron (0.5%), magnesium (0.5%) and manganese (0.5%) when sprayed on V-1 mulberry after 30 days of pruning significantly enhances the growth parameters [20]. Foliar application of 'Biofert' a plant growth promoter on M-5 mulberry variety twice at three different concentrations (1, 2 and 5%) increased number of shoots/plant, length of the branches, number of leaves/plant, weight of 100 leaves and leaf yield when compared to control [21]. Samuthiravelu *et al*. [22] explored the impact of foliar organic nutrients like Panchakavya (5 and 10%), vermiwash (5 and 15%) and Seriboost (0.2%) applied on V-1 mulberry at 15, 25 and 35 DAP. They found that Panchakavya (10%) and Vermiwash (15%) significantly boosted mulberry growth and yield. The findings drawn in this research are congruent with Karuppasamy and Isaiarasu [23] who revealed that when mulberry applied with concentrated samples of Vermiwash collected after a period of 30 days near the root and foliage registered improvement in growth parameters such as number of buds, number of leaves, weight of leaves and leaf yield when compared to control. Kumbar [24] evaluated organic foliar sprays like Panchgavya, Biodigester, and Vermiwash on mulberry (Variety: S-1635). Vermiwash @ 10% concentration notably boosted plant height, number of shoots and number of leaves per plant and leaf yield @ 45 and 60 DAP. Thangaroja *et al*. [25] compared foliar sprays of Panchagavya, Vermiwash, and Effective Microorganisms (EM) on mulberry growth. EM, @ 1% concentration, showed the highest efficacy in enhancing growth parameters and yield, followed by Panchagavya and Vermiwash compared to control.

The outcome of the current study is in accordance with Sudhakar *et al.* [26] who revealed that, the highest leaf yield obtained with 50% N and P plus 7% Vermicast wash, indicating its effectiveness in saving N and P while boosting yield with biofertilizer supplementation. Devamani [27] found that combining soil application of 3 MT Vermicompost with foliar spray of 12 liters of 3% Panchagavya per acre per year on V-1 mulberry enhanced plant growth parameters and yield. Further, Shafi [28] observed that foliar application of 15% Vermiwash + 1% nitrogen significantly increased shoot length, fresh weight of 100 leaves and leaf yield compared to the control. Moreover, Malthesh [29] reported that foliar application of 5% Vermiwash on the 25th and 45th days after pruning led to increased number of leaves per plant, average shoot length and leaf yield. Kannihalli *et al*. [30] found that foliar application of nano 19 all significantly enhanced mulberry leaf yield compared to the untreated control.

CONCLUSION

The use of organic foliar formulations resulted in significant improvements in various aspects of mulberry growth, including increased plant height, number of shoots / plant, number of leaves/plant, leaf area, leaf area index and leaf yield. This indicates that organic foliar formulations play a crucial role in enhancing the overall health and productivity of mulberry plants. These formulations not only enhance mulberry productivity but also contribute to environmental protection, making them a valuable asset in modern sericulture practices.

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