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Influence of liquid organic manures on growth and yield of V^{-1} mulberry (*Morus alba*)

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Abstract
A field experiment was conducted to study the influence of liquid organic manures on growth and yield parameters of V^{-1} mulberry planted at 90 + 150 × 60 cm spacing at department of sericulture during 2020-21. The results revealed that soil application of bio digested liquid organic manure equivalent to 150% N ha^{-1} (T9) increased the mulberry yield attributing parameters *viz*., plant height (138.48 cm), number of shoots per plant (25.00), number of leaves per plant (330.53), leaf area (165.20 cm^2) and leaf yield (826.66 g/plant) compared to control. Non-significant difference was observed with respect to internodal length of mulberry and lower leaf dry matter content was also recorded in the mulberry plot applied with bio digested liquid organic manure equivalent to 150% N ha^{-1} (T9).

Keywords: Mulberry, jeevamrutha, amritpani, bio digested, growth and yield

Introduction
Sericulture is a low input, income generating occupation and highly suited to rural and semi urban areas. India's traditional and culture-bound internal market, as well as an amazing divergence of silk garments that reflect geographic specificity, have aided the country to reach the top of the seri-enterprise world, producing all the five types of commercial silks, *viz*., Mulberry, Tropical Tasar, Oak Tasar, Eri and Muga. Silkworm rearing can generate huge amount of waste in the form of silkworm faeces and left over leaves which is creating environmental issues. It was examined that by rearing 100 DFLs by consuming 1000 kg of mulberry leaves generates approximately 300 kg of litter and 500 kg of left over mulberry waste comprising of withered leaves, leaf veins, leaf stalks *etc*. It was suggested that it can be used for composting other plant leftovers in order to produce organic manures and vermicompost (Sakthivel *et al*., 2014) [12].

Apart from using conventional farm-based products, there is a growing demand for improvised materials such as jeevamrutha, panchagavya, amritpani, bio-digested liquid organic manures, sasyagavya, kunapajala, vermiwash, fish amino acids, fermented plant juices, and other improvised materials that primarily enrich the soil with indigenous microorganisms. Jeevamrutha is a low-cost improvised preparation that enriches the soil with indigenous microorganisms that are necessary for soil mineralization (Gore and Sreenivasa, 2011) [5].

It is estimated that various organic resources having the total nutrient potential of 32.41 million tonnes will be available for use in 2025. Out of these organic resources, considerable tappable potential of nutrients (N + P_2O_5 + K_2O) from human excreta, livestock dung and crop residue which accounts to be 7.75 million tonnes (Ravisankar *et al*., 2017) [11]. Though chemical farming has positive results at first, the sericulture farmers soon notice the negative effects on mulberry leaf yield as well as quality and cocoon productivity. Hence, practice of organic farming is need of the hour in sericulture to avoid indiscriminate use of chemicals in mulberry garden. In this context, this bulletin enumerates possible organic inputs and their utility in mulberry farming as well as recent advancements in eco-friendly agronomical package of practices developed for sustainable sericulture.

Material and Methods Treatment details

T_1: Jeevamrutha equivalent to 100% N ha^{-1}
T_2: Jeevamrutha equivalent to 125% N ha^{-1}
T_3: Jeevamrutha equivalent to 150% N ha^{-1}
T_4: Amritpani equivalent to 100% N ha^{-1}
T_5: Amritpani equivalent to 125% N ha^{-1}
T_6: Amritpani equivalent to 150% N ha^{-1}
T_7: Bio digested liquid organic manure equivalent to 100% N ha^{-1}
T_8: Bio digested liquid organic manure equivalent to 125% N ha^{-1}
T_9: Bio digested liquid organic manure equivalent to 150% N ha^{-1}
T_{10}: 100% RDF (as per POP) - control

Preparation of liquid organic manures Jeevamrutha

Jeevamrutha was prepared by mixing 10 kg cow dung, 10 litres cow urine, 2 kg local jaggery, 2 kg pulse grain flour and hand full of soil. All these were put in 200 litre capacity drum and mixed thoroughly and volume was made up to 200 litres. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. The solution was regularly stirred clockwise in the morning, afternoon and in the evening continuously for 7-8 days and it was then used for soil application (Palekar, 2006) [8].

Amritpani

Amritpani was prepared by thorough mixing of 10 kg cow dung with 500 grams honey to form a creamy paste, then 250 grams of cow ghee was added to the mixture and it was diluted with 200 litres of water. Then the final mixture was digested for 7 days (Pathak and Ram, 2018) [9].

Bio digested liquid organic manure

Enriched bio digested liquid organic manure was prepared by using 30 kg of green biomass of selected plant species (pongamia, glyricidia, neem, subabul and mulberry leaves), 15 kg cow dung and 20 litres of cow urine. 20 litres of cow urine was taken separately in 200 litres cylindrical cement tank. 100 litres of water was added to the tank. The contents were kept incubated for 45 days. During the period the contents were digested by the microorganisms present in cow dung (Shetty *et al.*, 2014) [13].

The nitrogen, phosphorous and potassium contents (1.86%, 0.21% and 0.12% per 100L (Jeevamrutha), 1.61%, 0.32% and 0.22% per 100 L (Amritpani) and 1.29%, 0.39% and 0.57% (Bio digested liquid organic manure) of liquid organic manures were analysed prior to the soil application. Soil application of liquid organic manures to the mulberry garden was done in two intervals. First application was at 10 days after pruning and second application was at 25-30 days after pruning. Fertilizer dose of 350:140:140 kg N: P2O5: K2O ha^{-1} $year^{-1}$ was applied for irrigated mulberry (control) in the form of urea, di ammonium phosphate and murate of potash as a source of nitrogen, phosphorous and potash, respectively. A basal dose of 60:60:60 kg N: P_2O_5: K_2O ha^{-1} was applied after pruning of mulberry during third week of December, 2020 by broadcasting method.

Growth parameters of mulberry Plant height (cm)

Plant height was recorded from the base of the main shoot to the top most fully opened leaf in five randomly selected plants under each treatment, in three replications. The mean of five plants was worked out to obtain the plant height.

Number of shoots $plant^{-1}$

The number of branches in five randomly selected plants was counted in each plant under each replication and the mean was worked out. Mean number of shoots were calculated.

Number of leaves $plant^{-1}$

Number of leaves $plant^{-1}$ was counted from five randomly labelled plants. Mean number of leaves were calculated and taken.

Internodal distance

Distance between two successive nodes was measured in centimeters of the main shoot and average intermodal distance was calculated.

Leaf area (cm^2)

Single leaf area was measured by taking length and breadth of individual leaves of different treatments in each replication. Leaf area was calculated by factor method.

$$LA=L \times B \times 0.69$$

Where, LA= Leaf area L = Length
B = Breadth
0.69 = Correction factor

Leaf dry matter $plant^{-1}$ (%)

Leaf dry matter was calculated at 30, 45 and 60 days after pruning by harvesting the leaves from plants in each treatment. After taking the fresh weight leaves were oven dried at 60- 65 °C to a constant weight. The final weight of the sample after drying was weighed and expressed as per cent dry matter content (Dolma *et al*., 2010) [4].

Yield parameters of V^{-1} mulberry Individual leaf weight (g)

Individual leaf weight was recorded by weighing the leaves from five randomly selected plants at 45 Days after Pruning and was recorded as individual leaf weight.

Yield $plant^{-1}$ (g)

The leaf yield was obtained by harvesting of mulberry leaves as grams $plant^{-1}$ from five randomly selected mulberry plants on 60 days after pruning.

Yield $hectare^{-1}$ (tonnes)

The leaf yield was obtained by harvesting of mulberry leaves as grams $plant^{-1}$ from five randomly selected mulberry plants and converted into leaf yield in tonnes ha^{-1} $year^{-1}$.

Results and Discussion

Influence of soil application liquid organic manures on growth parameters of V^{-1} mulberry

Soil application of different liquid organic manures recorded significant difference on plant height and number of shoots per plant at 30, 45 and 60 Days after Pruning (DAP) (Table 1). Higher plant height of 60.21, 107.65 and 138.48 cm was recorded in mulberry plot applied with bio digested liquid organic manure equivalent to 150% N ha^{-1} (T9) compared to control (50.71,103.49 and 131.41 cm at 30, 45 and 60 DAP, respectively). Significantly higher number of shoots $plant^{-1}$ of 18.27, 21.60 and 25.00 at 30, 45 and 60 DAP, respectively was recorded in mulberry plot applied with bio digested liquid organic manure equivalent to 150% N ha^{-1} (T9) compared to control (14.93, 20.13 and 22.93 at 30, 45 and 60 DAP, respectively). Similar results were observed by Devamani (2018) [3] who reported that higher plant height was observed in

mulberry plot treated with 3 MT vermicompost + 12 litres panchagavya at 3% level acre^{-1} year^{-1} after 18 months of application compared to control. The current study is in line with Sudhakar *et al*. (2018) [14] who reported that application of N175 P70 + 20 kg seri azo + 25 kg seriphos + 10/5 MT farm yard manure and vermicast spray has recorded higher plant height and number of shoots per plant over control. The results are also comparable with the findings of Narayanaswamy *et al*. (2006) [7], Rani and Evanjaline (2015) [10], Anil *et al*. (2017) [1], Anita *et al*. (2018) [2], Thangaroja *et al*. (2018) [15] and Mala and Chandrashekhar (2020) [6]. This may be due to addition of more nitrogen to the soil through bio-digested liquid organic manure which includes various nutrients, enzymes, and plant growth stimulating hormones, all of which could have helped the plant's vigorous growth, resulting in an increase in the plant height and number of shoots per plant.

Table 1: Plant height and number of shoots plant^{-1} of V^{-1} mulberry as influenced by soil applied liquid organic manures

Treatments	Plant height (cm)			Number of shoots plant^{-1}		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	42.60	101.18	129.90	13.93	17.93	21.07
T_2	49.29	102.43	130.87	14.33	20.00	22.53
T_3	51.34	106.39	134.29	15.80	20.73	24.53
T_4	40.52	96.56	127.86	11.93	17.07	19.40
T_5	41.85	96.95	128.57	13.60	17.67	19.67
T_6	51.21	105.85	132.25	15.07	20.20	23.20
T_7	46.79	101.19	130.53	14.00	18.67	22.13
T_8	56.69	106.84	136.81	15.73	20.93	24.80
T_9	60.21	107.65	138.48	18.27	21.60	25.00
T_{10}	50.71	103.49	131.41	14.93	20.13	22.93
F test	*	*	*	*	*	*
S. Em±	1.550	1.440	2.152	0.567	0.864	0.971
CD at 5%	4.604	4.290	6.394	1.685	2.567	2.885

The data on the number of leaves plant^{-1} recorded at different days after pruning revealed that the number of leaves plant^{-1} was found significant at 30 DAP (Table 2). The mulberry plot applied with bio digested liquid organic manure equivalent to 150% N ha^{-1} (T9) has recorded higher number of leaves plant^{-1} (142.07) at 30 DAP compared to control (127.80). Number of leaves plant^{-1} was found non-significant at 45 and 60 DAP. However, higher number of leaves plant^{-1} (262.87 and 330.53, respectively) was recorded in bio digested liquid organic manure equivalent to 150% N ha^{-1}. The internodal distance of V^{-1} mulberry variety was statistically non-significant for different days after pruning. Sudhakar *et al.* (2018) [14] who reported that higher number of leaves (274.60) in mulberry plot applied with N 175 P70 + 20 kg seri azo + 25 kg seriphos + 10/5 MT farm yard manure+ 5% vermicompost + panchagavya spray compared to control (271.80). This may be due to the fact that liquid organic manures might have helped in slow release of macro and micro-nutrients. Anil *et al.* (2017) [1] who reported that the internodal distance of S^{-1}635 mulberry variety was found to be non-significant when mulberry plot was sprayed with sea weed liquid fertilizer *Ascophyllum nodosum* extract at different concentrations of 0.5 ml/litre, 1.0 ml / litre at 21, 28 and 35 DAP, 0.5 ml/litre and 1.0 ml/litre at 21 and 28 DAP and 0.5 and 1 ml/litre at 21 DAP along with control (water spray).

Table 2: Number of leaves plant^{-1} and internodal length of V^{-1} mulberry as influenced by soil applied liquid organic manures

Treatments	Number of leaves plant^{-1}			Internodal distance (cm)		
30 DAP		45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	124.27	243.87	315.07	5.43	5.51	5.73
T_2	128.20	247.67	318.07	5.39	5.48	5.67
T_3	129.33	252.20	326.40	5.36	5.39	5.60
T_4	120.53	234.13	310.47	5.75	5.82	5.99
T_5	124.07	242.13	318.33	5.49	5.57	5.77
T_6	128.13	252.13	320.33	5.57	5.67	5.82
T_7	126.60	246.13	315.20	5.47	5.54	5.73
T_8	137.60	256.53	328.07	5.19	5.29	5.38
T_9	142.07	262.87	330.53	5.29	5.36	5.50
T_{10}	127.80	248.60	316.80	5.39	5.46	5.62
F test	*	NS	NS	NS	NS	NS
S. Em±	3.203	5.562	4.649	0.120	0.113	0.112
CD at 5%	9.515	-	-	-	-	-

The statistical data on the leaf area was recorded at different days after pruning revealed that leaf area of V^{-1} mulberry variety was found non-significant at 30 DAP. Significantly maximum leaf area of 122.91 cm^2 and 165.20 cm^2 was recorded in bio digested liquid organic manure equivalent to 150% N ha^{-1} compared to control (110.52 and 156.05 cm^2) at 45 and 60 DAP, respectively (Table 3). The maximum leaf dry matter of 26.77, 26.87 and 39.47 per cent was recorded in amritpani equivalent to 100% N ha^{-1} (T_4) compared to control (24.46, 26.12 and 32.55%) at 30, 45 and 60 DAP, respectively. Whereas, the lowest leaf dry matter of 21.56, 24.85 and 25.09 per cent was recorded in bio digested liquid organic manure equivalent to 150% N ha^{-1} at 30, 45 and 60 DAP, respectively. The results are comparable with Rani and Evanjaline (2015) [10] and Thangaroja *et al*. (2018) [15]. This may be due to the supply of adequate nutrients to the plants by liquid organic manures might have increased the area of photosynthesis and translocation of photosynthates in liquid organic manure treated plant which

subsequently accelerated the formation of leaves with more area.

Table 3: Leaf area and leaf dry matter per plant of V^{-1} mulberry as influenced by soil applied liquid organic manures

Treatments	Leaf area (cm^2)		Leaf dry matter (%)			
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
T_1	82.12	107.05	150.82	26.45	26.75	34.94
T_2	82.88	110.00	154.03	24.67	26.61	33.13
T_3	83.90	112.04	159.80	22.84	25.32	27.80
T_4	77.96	100.77	146.63	26.77	26.87	39.47
T_5	80.42	104.19	148.40	26.67	26.82	35.49
T_6	83.64	111.08	151.09	23.63	25.65	31.57
T_7	82.20	107.67	153.52	25.45	26.69	33.65
T_8	87.35	121.87	160.15	21.57	25.29	26.08
T_9	88.84	122.91	165.20	21.56	24.85	25.09
T_{10}	83.39	110.52	156.05	24.46	26.12	32.55
F test	NS	*	*	*	*	*
S. Em±	2.620	3.313	3.685	0.451	0.377	0.669
CD at 5%	-	9.843	10.949	1.340	1.121	1.987

The individual leaf weight at 45 DAP and yield of V^{-1} mulberry plant at 60 DAP were significantly superior in mulberry plot applied with bio digested liquid organic manure equivalent to 150% N ha^{-1} 2.39 g $leaf^{-1}$, 826.66 g $plant^{-1}$ and 57.40 tonnes ha^{-1} $year^{-1}$ compared to control (2.15 g $leaf^{-1}$, 706.99 g $plant^{-1}$ and 49.09 tonnes ha^{-1} $year^{-1}$), respectively (Table 4). Devamani (2018) [3] who reported that higher leaf yield was recorded in 3 MT vermicompost + 12 litres panchagavya at 3% level $acre^{-1}$ $year^{-1}$ over control and Sudhakar *et al*. (2018) [14] reported that higher leaf yield of 53.66 MT ha^{-1} $year^{-1}$ was recorded in mulberry plot treated with N 175 P70 + 20 kg seri azo + 25 kg seriphos + 10/5 MT farm yard manure + 5% vermicast spray + 7% panchagavya spray over control (53.28 MT ha^{-1} $year^{-1}$). This may be due to accumulation of large number of beneficial microbes in the liquid organic formulations at the site of application or rhizosphere correspondingly enhancing the absorption of nutrients at the soil that increases the growth and yield attributes of mulberry.

Table 4: Leaf yield and associated parameters of V^{-1} mulberry as influenced by soil applied liquid organic manures

Treatments	45 DAP	60 DAP	
	Individual leaf weight (g)	Yield $plant^{-1}$ (g)	Yield ha^{-1} $year^{-1}$ (tonnes)
T_1	2.06	684.85	47.55
T_2	2.13	703.85	48.87
T_3	2.21	791.09	54.93
T_4	2.06	651.15	45.22
T_5	2.07	666.19	46.27
T_6	2.20	758.34	52.65
T_7	2.09	686.46	47.66
T_8	2.24	813.15	56.46
T_9	2.39	826.66	57.40
T_{10}	2.15	706.99	49.09
F test	*	*	*
S. Em±	0.066	6.441	0.445
CD at 5%	0.195	19.138	1.323

Conclusion

The study concluded that the mulberry growth and yield parameters were improved due to soil application of liquid organic manures. Instead of using chemical fertilizers to the soil, we can use organic nutrients for the betterment of soil health which helps in producing good quality of mulberry leaf necessary for the silkworm's healthy growth that yields improved quality cocoons.

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