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Effect of organic manures and nutrients on growth and yield of betelvine (*Piper betle* L.)

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Abstract

The field experiment was conducted at Horticultural College and Research Institute, Periyakulam to study the effect of organic manures and nutrients on growth and yield of Betelvine variety SGM1 and Vellaikodi during 2018 – 2019. The experimental design was FRBD (Factorial Randomized Block Design) consisting of eight treatments replicated thrice. In this study, different percentage of organic manures viz., FYM (50 and 25%), Vermicompost (75% and 50%), Neem cake (50 and 25%) along with Recommended dose of fertilizers (150:100:30 kg/ha NPK). Among the various treatments, soil application of 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅) recorded the highest growth and yield parameters in terms of vine length, number of nodes per vine, number of laterals per vine, leaf length, breadth, leaf area, number of leaves per vine, fresh weight of 100 leaves, single leaf fresh and dry weight and leaf yield.

Keywords: *Piper betle*, Betelvine, organic manure, vermicompost, Neem cake, FYM, leaf yield

Introduction

Betelvine (*Piper betle* L.) belongs to the family Piperaceae originated from Eastern Malaysia, Sumatra and possibly Java (Chattopadhyay and Maiti, 1967) [3]. It is also grown in other countries like Philippines, Indonesia, Myanmar, Nepal, Bangladesh, Bhutan, Srilanka and India. It is called as 'The Neglected Green Gold of India'. This is historic cash crop which has been under cultivation since ancient times in India. The vine is dioecious shade loving perennial root climber having the heart shaped deep green leaves. In India locally called as "Paan" in Hindi. Betel leaves regarded as an excellent mouth freshener and mild vitalizer, routinely served on the social, cultural and religious occasions like marriage, Puja (religious festivals), Sraddha ceremony (religious function performed, after cremation) etc. It is also used as a special item offered to the guests in order to show respect and for such traditional use of betel leaf in the Indian society; the leaf really stands alone without any parallel even today Betelvine leaves are considered as auspicious in almost all the socio-religious functions and celebrations.

There are about 100 varieties of betel leaf (Paan) across the world of which 40 varieties are encountered in India and 30 varieties in West Bengal and Bangladesh (Guha 1997) [5]. In Betelvine cultivation, nutrition plays an important role. Among the various essential nutrients, nitrogen plays a pivotal role in improving the productivity and quality of leaves. It is usually cultivated in small holdings and once the crop is established it becomes a continuous source of income for the farmers. Since the green leaves constitute the economically relevant part of the plant, the nitrogen requirement of the crop is quite high (Saikia *et al.*, 1995) [10].

Yield and quality of betel leaf can be increased by proper nutrient management. Moreover, nutrient availability throughout the crop growth period from the applied sources has considerable importance. The crop is usually manured with heavy doses of organic manures. The farmers are reluctant to use commercial fertilizers as they fear that the quality of the leaves may be affected by the use of fertilizers. The organic manures can be partly replaced by chemical fertilizers without affecting the chewing quality of leaves. In view of the above, the trial has been taken to study the effect of organic manures and nutrients on growth and yield of betel vine.

Materials and Methods

This experiment was carried out in farmer's field at Banglamedu, Periyakulam, and Tamil Nadu during 2018 – 2019.

The experimental plot having clay soil with pH of 8, EC of 0.35 ds/m and initial soil NPK values were 420 kg/ha, 31.2 kg/ha, 180 kg/ha. The experimental design was FRBD (Factorial randomized block design) with three replications. The age of the crop was one year old. Plot size of 5 m² in a paired row system accommodated 50 plants per plot. The trial consisted of eight treatments. The treatment details are as follows,

Factor I

Variety V₁ – SGM 1

V₂ - Vellaikodi

Factor II

Organic manures

T₁: Control (without organic manures)

T₂: RDF (150:100:30 NPK kg / ha)

T₃: 50% N as FYM + 50% N as Vermicompost

T₄: 50% N as Vermicompost + 50% as Neem cake

T₅: 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake

T₆: 50% N as FYM + 50% N as Neem cake

T₇: 75% N as Vermicompost + 25% N as FYM

T₈: 75% N as Vermicompost + 25% N as Neem cake.

The nitrogen sources were applied in the form of FYM, Vermicompost, and Neem cake. Phosphorous and potassium were applied as basal dose in the form of rock phosphate and press mud respectively. Recommended dose of fertilizers were applied as urea, SSP and MOP. The treatments are imposed by two split application with three months intervals single dose at the month. The observations were taken on growth and yield parameters of the Betelvine viz., vine length, number of laterals per vine, number of leaves per vine, are recorded in 30 days intervals and the leaf length, breadth, petiole length, single leaf fresh weight are recorded after the harvesting of leaves. Leaf area was calculated by the formula ($A = 0.6695 \times LB - 0.7608$) and expressed as cm² (Ancy and Jayachandran 1994) [2]. The field observations are taken by tagging five randomly selected plants in each plots and the mean were used for statistical analysis (Panse and Sukhatme, 1985) [8].

Result and Discussion

The important growth parameters like vine length, petiole length, number of nodes per vine, number of laterals per vine, leaf length, leaf breadth, leaf area (Table 1) and yield parameter like number of leaves per vine, fresh weight of 100 leaves, single leaf fresh and dry weight (Table 2) influence of the crop which was efficiently influenced by the soil application of organic manures. The highest vine length of variety was recorded in V₂ (201.22 cm) compared to V₁ (139.12 cm). Among the organic manures, soil application of 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅) recorded the highest vine length in the variety V₂ (226.55 cm) and V₁ (152.04 cm) followed by T₈ (75% N as Vermicompost + 25% N as FYM). Similar result was found in cucumber by Huang and Zhao (1987) [6] that the combined application of vermicompost, FYM and Neem cake influenced the physical, chemical and biological properties of the soil through supplying macro and micro nutrients leading to better plant growth and development and also the same character was noticed by Adriana *et al.* (2010) [1] in lettuce, this effect could be due to the presence of phytohormones in organic fertilizers that stimulate the plant growth. The leaf

petiole length was significantly maximum in the variety V₂ (4.44 cm) and minimum in V₁ (1.27 cm). The highest petiole length in V₂ (5.23 cm) and V₁ (1.22 cm) was recorded by the soil application of 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅). According to the number of laterals per vine was significantly higher in the variety V₁ (11.83) than the V₂ (2.72). The more number of laterals per vine of 13.69 and 3.38 are recorded in the variety V₁ and V₂ respectively in the plants which received 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅). Smitha *et al.*, (2010) [12] reported that higher doses of FYM, vermicompost and Neem cake favoured initial plant growth by providing all the necessary nutrients in balanced proportion causing significant difference in plant growth of long pepper. The growth character of number of nodes per vine is significantly maximum in the variety V₁ (32.57) and minimum in V₂ (17.22). More number of nodes per vine *i.e.* 60.26 and 20.25 are recorded the variety V₁ and V₂ respectively in the plants given with 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅) followed by T₇ (75% N as Vermicompost + 25% N as FYM). The growth parameter of length and breadth of the leaves is statistically maximum in V₁ (14.83 cm, 8.73 cm) compared to the variety V₂ (12.05 cm, 8.18 cm) which was observed after the harvest. Application of 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅) produced the larger size of leaves in V₁ (15.65 cm length, 9.08 cm breadth) than the V₂ (12.84 cm length, 8.72 cm breadth). According to the same result which was examined by Umsha *et al.* (2011) [13] in *Solanum nigrum* and the result revealed that FYM being bulky organic manure, reduces the soil compaction and improves the aeration, in addition it supplies the essential plant nutrients, there by increases the soil biological activities (Hayworth *et al.*, 1996). Along with FYM, application of vermicompost resulted in addition of some growth parameters (Senapathi *et al.*, 1984) [11]. Significantly highest leaf area was recorded with the application of FYM, vermicompost and Neem cake in the production of more photosynthates and their accumulation. The maximum leaf area was significantly observed in V₁ (88.79 cm²) compared to V₂ (65.57 cm²). In this study, the leaf area was more in V₁ (96.46 cm²) than V₂ (76.11 cm²) in the treatment T₅ followed by T₈. The yield parameter of number of leaves per vine was significantly higher in V₁ (72.72) than V₂ (34.72). Among the various treatments, T₅ significantly gives the more number of leaves in V₁ (84.36) than V₂ (42.75). The result was concluded by Peyvast *et al.* (2008) [9] in spinach. The yield parameter of fresh weight of 100 leaves was significantly higher in V₁ (248.83 g) and lower in V₂ (212.13 g). Significantly the treatment T₅ (50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake) showed the higher leaf weight in V₁ (280.00 g) than the variety V₂ (267.33 g) because the applied combination of three nutrients was rich in nitrogen. Nitrogen is an important component of many essential structural, genetic and metabolic compounds in plant cells. It is also an elementary constituent of numerous important organic compounds including amino acids, proteins, nucleic acids, enzymes, and the chlorophyll molecule. Nitrogen is the nutrient which normally produces the greatest yield response in crop plants, promoting rapid vegetative growth. The similar result was noticed by Dwivedi and Singh (2007) [4] in betelvine. The leaf biomass of fresh and dry weight was similarly highest in V₁ (3.12 g and 0.68 g respectively) lowest in V₂ (2.33 g and 0.50 g respectively). Application of organic manure consisting of 50% N as Vermicompost + 25% N as

FYM + 25% N as Neem cake (T₅) produced the maximum fresh and dry leaf weight in the variety V₁ (3.64 g and 0.72 g respectively) and minimum in V₂ (2.63 g and 0.55 g respectively) followed by T₈ (75% N as Vermicompost + 25% N as FYM). Individual fresh and dry weight of leaf was higher in the treatment T₅ compared to other treatments, because the treatments consists of higher amount of nitrogen, it enriches the biomass of the leaf and the similar result was found by Vedpathak and Chavan (2016) [14] in fenugreek. The highest leaf yield of V₁ (3636.35 Nos.) and lowest in V₂ (1795 Nos.) per plot are recorded in the plants grown in the soil supplemented with 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅). T₅ produced maximum number of leaves in the variety V₁ (4218.33 Nos.), and minimum in V₂ (2200.00 Nos.) respectively. Highest

estimated leaf yield noticed in V₁ (374107.2) and the lowest in V₂ (253560) per hectare are recorded in the plants raised in the soil supplemented with 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake (T₅). The T₅ significantly produced maximum leaf yield per hectare the in the variety V₁ (485221.6) and V₂ (347709.6) respectively.

In this study, application 50% N as Vermicompost + 25% N as FYM + 25% N as Neem cake gave the best results compared to other treatments because it contains highest sources of nitrogen and also the percentage of nutrient application was high. In vermicompost the available nitrogen is 2%, FYM contain 0.5% of nitrogen and Neem cake contains 2 to 5% of nitrogen. Hence, the treatment T₅ improved the growth and yield of betel vine.

Table 1: Effect of organic manures on growth parameters of betelvine

Varieties	Treatment	Vine length(cm)	Number of nodes per vine (Nos.)	Number of laterals per vine(Nos.)	Petiole length(cm)
SGM 1	T ₁	122.28	21.43	9.76	1.00
	T ₂	124.58	22.43	10.98	1.05
	T ₃	135.66	28.10	11.51	1.08
	T ₄	141.91	33.65	11.88	1.33
	T ₅	152.04	44.23	13.69	1.72
	T ₆	136.89	30.26	11.61	1.20
	T ₇	147.68	39.10	12.33	1.38
	T ₈	151.93	41.36	12.91	1.40
Mean		139.12	32.57	11.83	1.27
Vellaikodi	T ₁	175.91	15.00	1.76	3.70
	T ₂	184.63	15.81	2.23	4.16
	T ₃	196.76	16.40	2.61	4.16
	T ₄	199.96	17.30	2.99	4.50
	T ₅	226.55	20.25	3.38	5.23
	T ₆	198.45	16.88	2.66	4.26
	T ₇	208.74	17.86	3.06	4.63
	T ₈	218.79	18.25	3.08	4.86
Mean		201.22	17.22	2.72	4.44
SED	V	0.62597	0.111	0.032	0.019
	T	1.25194	0.222	0.060	0.039
	VT	2.50388	0.444	0.129	0.056
CD (0.05)	V	1.23878	0.219	0.063	0.040
	T	2.47756	0.439	0.127	0.080
	VT	4.95512	0.879	0.255	0.110
CV (%)	-	2.55	3.09	3.08	2.46

Table 2: Effect of organic manures on yield parameters of betelvine

Varieties	Treatment	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm)	Single Leaf fresh weight (g)	Single leaf dry weight (g)	Fresh weigh of 100 leaves (g)	Leaf yield / plant (Nos.)	Leaf yield / plot (Nos.)	Estimated leaf yield / ha (in lakhs)
SGM 1	T ₁	14.07	8.33	77.31	2.65	0.62	228.66	58.69	2934.99	2,57,486.00
	T ₂	14.49	8.43	83.78	2.92	0.66	232.00	62.60	3129.99	2,99,398.00
	T ₃	14.54	8.66	84.98	2.98	0.66	247.33	69.64	3482.50	3,44,072.40
	T ₄	14.83	8.76	90.74	3.12	0.69	248.66	75.46	3773.33	3,86,131.60
	T ₅	15.65	9.08	96.46	3.64	0.72	280.00	84.36	4218.33	4,85,221.60
	T ₆	14.72	8.73	88.79	3.07	0.68	248.52	72.08	3604.16	3,61,416.00
	T ₇	14.84	8.94	91.10	3.24	0.70	252.00	72.72	3636.35	3,74,107.20
	T ₈	15.39	8.96	94.57	3.37	0.71	252.66	81.98	3848.33	4,08,687.20
Mean		14.83	8.73	88.79	3.12	0.68	248.83	72.72	3636.35	3,74,107.20
Vellaikodi	T ₁	11.04	7.73	55.71	2.04	0.45	185.33	28.33	1445.83	1,78,309.80
	T ₂	11.60	7.74	58.74	2.11	0.47	191.33	31.78	1612.50	2,02,884.60
	T ₃	11.63	7.96	61.24	2.16	0.48	200.67	33.59	1716.66	2,23,140.00
	T ₄	12.14	8.27	69.27	2.33	0.52	210.00	34.96	1784.16	2,47,499.40
	T ₅	12.84	8.72	74.11	2.63	0.55	267.33	42.75	2200.00	3,47,709.60
	T ₆	11.85	7.94	62.76	2.29	0.49	208.00	34.26	1750.00	2,40,399.60
	T ₇	12.44	8.46	69.37	2.48	0.53	219.33	34.40	1932.49	3,00,594.60
	T ₈	12.84	8.64	73.40	2.61	0.55	223.00	37.68	1925.00	2,87,940.00
Mean		12.05	8.18	65.57	2.33	0.50	213.12	34.72	1795.83	2,53,560.00
SED	V	0.010	0.032	0.47	0.022	0.004	1.989	0.222	10.361	-

	T	0.021	0.065	0.95	0.044	0.008	3.978	0.444	20.722	-
	VT	0.030	0.092	0.35	0.062	0.012	5.626	0.889	29.305	-
CD (0.05)	V	0.022	0.066	0.97	0.045	0.009	4.062	0.440	20.504	-
	T	0.044	0.133	1.95	0.090	0.018	8.124	0.880	41.008	-
	VT	0.063	0.188	2.76	0.012	0.025	11.490	1.761	57.994	-
CV (%)	-	0.29	1.36	2.10	2.71	2.59	3.06	2.87	2.64	-

Conclusion

Based on the results, it could be concluded that soil application of 50% N as vermicompost +25% N as FYM + 25% N as Neem cake significantly enhanced the crop growth parameters and yield attributes compared to control. Organic nutrition not only produced larger leaves but also recorded the highest leaf yield indicating the scope for sustainable farming in betelvine.

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