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Leaf characters of betelvine (*Piper betle* L.) as influenced nitrogen application

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ABSTRACT

A study was undertaken on physical and some qualitative characters of leaves in betelvine (cv. Simurali Deshi) after application of 200 kg N/ha through five organic manures, i.e., cowdung manure, neem cake, mustard oil cake, vermicompost and poultry manure alongwith inorganic sources of nitrogen (urea) in five different combinations (100:0, 60:40, 50:50, 40:60 and 0:100) for two consecutive seasons. The result showed that maximum leaf length (14.65 cm), leaf breadth (10.45 cm) and leaf area (129.00 sq.cm) were found at 50:50 combination of total N when mustard oil cake was used as an organic source alongwith inorganic N, whereas, those parameters were the lowest when betelvine was grown with organic manures only (100:0). Fresh weight of 100 leaves was recorded highest when the crop was grown with cowdung manure at 40:60 combination with inorganic N fertilizer (urea) . Chlorophyll b (0.57 mg/g tissue) content in leaf was found highest when the crop was grown with neem cake only (100:0), while chlorophyll a content did not vary significantly with source and combination. Maximum ascorbic acid content in leaves (2.75 mg/100 g) was found when only cowdung manure was used (100:0) as nitrogen source and lowest (2.02 mg/100 g leaves) with urea. β-carotene content was recorded highest (7.26 mg/100 g leaf) with mustard oil cake only as nitrogen source and lowest (6.82 mg/100 g leaves) with 100% inorganic nitrogen.

Key Words: Betel leaf, leaf characters, chlorophyll, ascorbic acid, β-carotene.

INTRODUCTION

Betelvine (*Piper betle* L.) is a perennial, dioecious, evergreen creeper and belongs to the family Piperaceae. Fresh, tender and green leaves of betelvine are used as a chewing stimulant in many parts of the world. It is an important cash crop in India. About 15-20 million people in the country consume betel leaves everyday. It is cultivated in an area of 55,000 ha in India with an annual turnover worth Rs. 9,000 million providing livelihood to millions of people (Guha, 7). Each part of this crop has some medicinal value, but the main economic part is the leaf. Hence, the requirement of the crop for nutrients, particularly nitrogen is quite high. Betelvine growers all over India follow different manurial practices with emphasis on applying large amount of various organic manures with or without inorganic fertilizers. Present experiment was undertaken to see the effect of application of commonly used organic manures in different combination with or without inorganic N source on physical and some qualitative characters of betel leaves.

MATERIALS AND METHODS

The investigation was carried out during 2006-08 at Horticultural Research Station, Mondouri, Nadia, West Bengal during two consecutive growing seasons. The experimental site was situated approximately at 23°N latitude and 80°E longitude with an altitude of 9.75 m above mean sea level**.** The experiment was carried out in an established *boroj* (an artificially constructed structure with bamboo, jute stick and *ulu* grass). The crop was fertilized with 200 kg N, 100 kg P_2O_5 and 100 kg K_2O/ha. Total amount of nitrogen was applied through five different combinations like 100:0, 60:40, 50:50, 40:60 and 0:100 of five organic manures like cowdung manure, neem cake, mustard cake, vermicompost and poultry manure and one inorganic source, *i.e.*, urea. The experiment was designed in factorial RBD with two factors (source and combination) and three replications phosphorus and potassium were applied through inorganic fertilizers namely single super phosphate and muriate of potash. Total amount of manures and fertilizers were applied in three split doses at four month interval. Irrigation and other cultural operations were done following the normal package of practices for its cultivation (Maiti *et al.*, 8; Dey *et al.*, 5). Bordeaux mixture was sprayed @ 1% at an interval of one month to control fungal diseases. Besides, neem oil was sprayed to protect the crop from insect attack as and when necessary. Data on physical parameters of betel leaf were measured and qualitative parameters were estimated from the leaf at the 8th node of vine in

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each replication. Leaf area was measured by using Licor electronic portal leaf area meter and expressed in sq. cm. Qualitative characters like chlorophyll (a, b and total) was estimated with the method suggested by Arnon (1) and β-carotene in leaf was estimated by the method of Broadman and Anderson (3). Data were analysed statistically by the method suggested by Gomez and Gomez (6).

RESULTS AND DISCUSSION

Data presented in Table 1 clearly indicate that sources and combination have significant influence on leaf length. Within the sources maximum leaf length (14.07 cm) was recorded with mustard oil cake and it was statistically *on par* with cowdung manure. The shortest leaf length (13.23 cm) was observed with poultry manure, which was found significantly inferior and non-significant with neem cake and vermicompost. Among the combination, 50:50 produced the longest leaves that was on par with 0:100 and 40:60 combination 100:0 produced the smallest. The interaction effect between sources and combination on leaf length was found significant. Maximum (14.65 cm) leaf length was obtained with mustard oil cake at 50:50 combination and minimum (12.83 cm) with poultry manure at 100:0 combination.

A significant variation in breadth of betel leaves was observed in all the sources of organic manures (Table 1). However, no significant difference was observed in the case of combinations. Application of mustard oil cake as a source of nitrogen produced highest leaf breadth (9.93 cm) and it was lowest (9.06 cm) with poultry manure. Interaction between nitrogen source and combination showed that widest leaf (10.45 cm) was obtained with mustard oil cake at 50:50 combination and the narrowest leaf (8.65 cm) was available with poultry manure at 100:0 combination.

Data presented in Table 2 clearly indicate a significant variation among different combinations of organic: inorganic and different sources of organic manures. Maximum leaf area (120.72 sq.cm) was recorded with organic and inorganic ratio of 50:50 closely followed by 40:60 ratio. Lowest leaf area (1151.52 sq.cm) was noticed when organic and inorganic nitrogen were applied in 100: 0 proportion. When total nitrogen was derived from organic sources, *i.e.*, 100:0 ratio, then it produced the shortest leaf area (111.52 sq.cm). Within the sources, mustard oil cake produced the maximum (122.67 sq.cm) leaf area and poultry manure produced the minimum (114.17 sq.cm). The results varied significantly in case of all other sources of organic manures. Regarding interaction, maximum leaf area (129.00 sq.cm) was obtained by application of mustard oil cake and inorganic nitrogen source (urea) at a combination of 50:50.

Similar observation was recorded by Saikia *et al.* (12) in a field experiment with cv. Local Bangla at Assam Agricultural University. They reported that 200 kg N/ha in the form of urea: mustard oil cake (1:1) had produced maximum leaf area (116.41 sq.cm). Dey *et al.* (3), and Sengupta *et al*. (13) also reported in the same way. Whereas, Mishra *et al.* (10) and Mandal *et al.* (9) recorded highest leaf area by using neem coated urea which is a slow releasing fertilizer. The better performance by mustard oil cake at 50:50

Table 1. Influence of organic and inorganic nitrogen sources and their combinations on length and breadth of betel leaves.

Source combination (ON:IN)	Leaf length (cm)						Leaf breadth (cm)					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	12.98	13.03	14.42	12.98	12.83	13.25	9.07	9.23	10.23	8.95	8.65	9.23
60 : 40	13.23	13.55	13.28	13.07	13.17	13.26	9.30	9.57	9.45	9.12	8.95	9.28
50 : 50	14.03	13.75	14.65	14.60	13.18	14.04	9.48	9.68	10.45	10.40	9.05	9.81
40 : 60	14.22	13.90	13.97	13.23	13.13	13.69	9.62	9.57	10.07	9.28	9.10	9.53
0 : 100	14.28	13.48	14.03	13.88	13.82	13.70	9.67	9.73	9.43	9.37	9.57	9.55
Mean	13.75	13.34	14.07	13.55	13.23		9.43	9.56	9.93	9.44	9.06	
	Source		Combination		Source × combination		Source		Combination		Source × combination	
CD (P = 0.05)	0.43		0.43		0.97		0.38		N.S		0.86	

ON = Organic nitrogen, IN = Inorganic nitrogen, CDM = Cowdung manure, NC = Neem cake, MOC = Mustard oil cake, VC = Vermicompost, PM = Poultry manure

Table 2. Influence of organic and inorganic nitrogen sources and their combinations on leaf area and leaf fresh weight of betelvine.

Source combination (ON:IN)	Leaf area (sq. cm)						Fresh weight of 100-betel leaves (g)					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	110.41	115.83	117.75	102.35	113.25	111.52	327.83	311.83	313.67	311.50	307.17	314.40
60 : 40	112.78	115.25	122.92	107.87	112.75	114.31	327.50	314.83	318.17	317.50	307.50	317.10
50 : 50	116.87	118.90	129.00	125.34	111.75	120.72	326.50	315.50	322.33	323.67	306.67	318.83
40 : 60	118.00	117.33	125.83	126.92	114.08	120.33	328.83	318.83	320.50	324.00	307.50	323.04
0 : 100	120.08	120.92	119.33	114.33	119.00	118.73	322.17	320.83	319.67	314.67	323.00	319.47
Mean	115.61	117.65	122.67	115.36	114.17		326.57	316.37	318.87	318.27	312.67	
	Source		Combination		Source × combination		Source		Combination		Source × combination	
CD (P = 0.05)	0.43		0.43		0.95		0.33		0.33		0.75	

ON = Organic nitrogen, IN = Inorganic nitrogen, CDM = Cowdung manure, NC = Neem cake, MOC = Mustard oil cake, VC = Vermicompost, PM = Poultry manure

combination in the present experiment may be due to proper supply of N to the root zone in available form or any other additional factor. Normally mustard oil cake contains 5% N, 1.5% P_2O_5 and 1% K_2O, which are higher than other organic manures applied. Hence, the plants treated with mustard oil cake got more amount of nutrients from organic source in comparison to others, which might play a positive role towards better results.

Fresh weight of 100 leaves was affected by different sources, combinations and interaction between them. Maximum fresh weight of leaves (326.57 g) was obtained with cowdung manure and minimum with poultry manure (312.67 g) (Table 2). Among the combinations, highest (323.04 g) and lowest (314.40 g) fresh weight of leaves were recorded at 40:60 and 100:0, respectively. Interaction effect exhibited highest fresh weight of leaves (328.83 g) at 40:60 combination with cowdung manure as a source of nitrogen. Lowest fresh weight of leaf (307.17 g) was recorded at 100:0 combination, which was statistically at par with 40:60 combination with poultry manure as source of N. Earlier, Saikia *et al*. (12), and Sengupta *et al.* (13) in their field experiment observed maximum fresh weight of 100 leaves, when it was cultivated with urea: mustard oil cake (1:1) with nitrogen at 200 kg/ha in cv. Deshi Bangla. Interestingly, Arulmozhiyan *et al.* (2) in cv. Vellaikodi, and Roy *et al.* (11) in cv. Simurali Bhabna recorded the highest 100-leaf weight with FYM. The specific reason behind variation of the result could not be sought out.

Data in Table 3 did not show any significant difference regarding chlorophyll a content in fresh leaves. Among the combinations, its range varied between 1.70 to 1.73 mg/g tissue. Within the sources its range was 1.70 to 1.72 mg/g tissue and in case of interaction between sources and combination its value was between 1.69 to 1.74 mg/g tissues. Source of organic manures had a significant effect on chlorophyll b content in leaves (Table 3). Maximum amount (0.57 mg/g tissue) of chlorophyll b was recorded by the source of nutrient with neem cake and minimum (0.49 mg/g tissue) was in poultry manure and both differed statistically from all other sources of organic manures. Chlorophyll b content was also affected by various combination of organic and inorganic nitrogen sources. Significantly highest (0.54 mg/g tissue) value was found in 0:100 combination, *i.e.*, when total nitrogen was applied through inorganic source, whereas, its amount was lowest in 50:50 combination of organic and inorganic sources. It was seen that nutrient supply through inorganic source or chemical fertilizer decreased chlorophyll b content in leaf. The reason behind it cannot be definitely mentioned. Considering the interaction effect neem cake as a source of N in any combination showed highest (0.57 mg/g tissue) value except 50:50 (0.56 mg/g tissue). Lowest amount of chlorophyll b (0.48 mg/g tissue) was found in case of poultry manure as a source and with a combination of 100:0 and it was statistically *at par* with same source in 60:40 and 50:50 combination of organic and inorganic sources.

A significant variation was observed in Table 4 in respect to ascorbic acid content in betel leaves among different sources and combinations. From the data it was revealed that maximum (2.75 mg) ascorbic acid content per 100 g fresh leaves was recorded in cowdung manure at 100:0 combination

and it was significantly different from all others. Minimum ascorbic acid (2.02 mg/100 g fresh leaves) was recorded from 0:100 combination of organic and inorganic nitrogen sources.

Among the sources, cowdung manure produced maximum (2.43 mg) ascorbic acid content per 100 g leaves and it was statistically *on par* with neem cake (2.40 mg), mustard oil cake (2.40 mg) and vermicompost (2.40 mg). Lowest ascorbic acid content (2.33 mg) per 100 g leaves was observed when poultry manure was supplied as a source of nutrient. The particular cause supporting this result could not be identified.

There was a significant variation in β-carotene content also found in leaves with a variation of different sources of nitrogen, combination of organic and inorganic sources of nitrogen and their interaction (Table 4).

Among the organic and inorganic nitrogen combinations 100:0 produced maximum β-carotene (7.20 mg/100 g) in betel leaves. On the other hand 0:100 combination produced minimum (6.83 mg/100 g) β-carotene in leaves. The result showed that β-carotene content decreased in leaves, with application of inorganic nitrogen at increasing rate. As a result β-carotene content was found minimum when total nitrogen was applied through inorganic fertilizers only. Within the sources, mustard oil cake proved its superiority in β-carotene synthesis and also statistically differed from all other sources.

Table 3. Influence of organic and inorganic nitrogen sources and their combinations on chlorophyll a and b content of betel leaves.

Source combination (ON:IN)	Chlorophyll a (mg/g tissue)						Chlorophyll b (mg/g tissue)					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	1.71	1.73	1.72	1.65	1.70	1.70	0.54	0.57	0.52	0.54	0.48	0.53
60 : 40	1.70	1.71	1.71	1.73	1.69	1.71	0.53	0.57	0.51	0.53	0.48	0.53
50 : 50	1.72	1.70	1.71	1.71	1.69	1.71	0.52	0.56	0.49	0.53	0.48	0.52
40 : 60	1.73	1.70	1.71	1.73	1.71	1.72	0.54	0.57	0.52	0.53	0.49	0.53
0 : 100	1.73	1.72	1.74	1.72	1.73	1.73	0.53	0.57	0.52	0.54	0.52	0.54
Mean	1.72	1.72	1.72	1.71	1.70		0.53	0.57	0.51	0.54	0.49	
	Source		Combination		Source × combination		Source		Combination		Source × combination	
CD (P = 0.05)	N.S		N.S		N.S		0.004		0.005		0.009	

ON = Organic nitrogen, IN = Inorganic nitrogen, CDM = Cowdung manure, NC = Neem cake, MOC = Mustard oil cake, VC = Vermicompost, PM = Poultry manure.

Table 4. Influence of organic and inorganic nitrogen sources and their combinations on ascorbic acid and β-carotene content content of betel leaves.

Source combination (ON:IN)	Ascorbic acid (mg/100 g fresh leaves)						β-carotene content (mg/100 g fresh leaves)					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	2.75	2.63	2.67	2.67	2.61	2.67	7.23	7.25	7.26	7.12	7.13	7.20
60 : 40	2.63	2.59	2.54	2.60	2.51	2.57	7.16	7.23	7.23	7.11	7.10	7.17
50 : 50	2.49	2.45	2.41	2.40	2.35	2.42	7.03	7.11	7.12	6.94	7.03	7.05
40 : 60	2.24	2.23	2.21	2.32	2.15	2.23	6.99	6.98	7.06	6.91	6.93	6.98
0 : 100	2.04	2.08	2.15	2.03	2.02	2.06	6.84	6.83	6.82	6.82	6.83	6.83
Mean	2.43	2.40	2.40	2.40	2.33		7.05	7.08	7.10	6.98	7.00	
	Source		Combination		Source × combination		Source		Combination		Source × combination	
CD (P = 0.05)	0.05		0.05		0.11		0.007		0.007		0.017	

ON = Organic nitrogen, IN = Inorganic nitrogen, CDM = Cowdung manure, NC = Neem cake, MOC = Mustard oil cake, VC = Vermicompost, PM = Poultry manure.

Vermicompost was proved to be most inferior in synthesis of β-carotene in the leaves of betelvine. In general β-carotene content in betel leaves was less when organic and inorganic nitrogen was applied in 0:100 proportion. Interaction effect between source and combination showed that highest (7.26 mg) value was recorded by mustard oil cake at 100:0 combination. Leaves produced with full inorganic nitrogen, i.e., urea at 0:100 combination, β-carotene content was recorded the lowest (6.82 mg). The specific reason behind this cannot be mentioned here as it is not identified. This result clearly indicated that application of N through organic source is best for improvement of quality of betel leaves.

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