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Effect of integrated nitrogen application on growth and yield of betelvine [*Piper betle* L.]

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Betelvine [*Piper betle* L.] is a perennial, dioecious, evergreen creeper and belongs to the family Piperaceae. It is well known to be intimately connected with the Indian history, religion and culture evidenced by the references as early as 3000 B.C. in Sanskrit literature. Marco polo noticed betelleaf-chewing habit in 1295A.D. among South Indian people. Though the crop is believed to be originated from the Central and Eastern Malaysia, but cultivated throughout the world mainly in tropical and subtropical countries like Malaysia, Singapore, Thailand, Philippines, Sri Lanka, India and Bangladesh. In India it is grown as an important cash crop in West Bengal, Orissa, Assam, Andhra Pradesh, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu, Tripura and Uttar Pradesh. About 15 – 20 million people in the country used to consume betel leaves every day. It is cultivated in an area of 55000 ha in India and plays a vital role in the economy of the country. The economic part of betelvine is green, tender and fresh leaf. So, the nutrient, particularly nitrogen requirement of the crop is quite high. But in West Bengal, as well as in India most of the betelvine growers apply large amounts of organic manures mainly in the form of mustard oil cake (Sarkar *et al.*, 1986). In most of the cases mustard oil cake is sold at higher price and contains low plant nutrients than inorganic fertilizers. To meet up the nutrient demand of the crop, an integrated nitrogen management involving balanced use of organic manures and inorganic fertilizers may prove beneficial for achieving a cost effective and eco-friendly nutrient management schedule. Considering different aspects of betelvine cultivation, present experiment was undertaken to find out the most suitable combination of organic and inorganic nitrogenous sources for optimum growth and leaf yield of betelvine.

Present investigation was carried out during 2005 – 06 and 2006 – 07 at Horticultural Research Station, Mondouri, Nadia, West Bengal. The experimental site was situated approximately at 23°N Latitude and 80° E Longitude with an altitude of 9.75m above mean sea level. The crop was fertilized with 200 kg N, 100 kg P_2O_5 and 100kg K_2O ha^{-1}. Total amount of nitrogen *i.e.* 200 kg ha^{-1} was applied through different combinations of organic (cowdung manure, neem cake, mustard cake, vermicompost and poultry manure) and inorganic (urea) sources. The organic manures were applied as sources of nitrogen. Rest of the required amount of phosphorus and potassium was applied through inorganic fertilizers namely single super phosphate and muriate of potash. Total amount of manure and fertilizers were applied in three splits at four month interval. Irrigation and other cultural operations were done following the normal package of practices for its cultivation. Vines were lowered down for two times in a year and covered by soil and manures (as per schedule) at the base of the vine. Bordeaux mixture (5: 5: 50) and neem oil were sprayed @ 1% regularly to protect the crop from fungal diseases and insect attack as and when necessary.

Increment in vine length

Data presented in table- 1 and 2 clearly indicate that sources of organic manure, combination and their interaction had a significant influence on increment of vine length in betelvine. Among the sources of nitrogen, vermicompost produced the longest vine (117.43cm), whereas the shortest (94.70cm) vine was found with neem cake as evidenced from the pooled data of September-November and the difference is significant. In case of combination, highest (119.30cm) and lowest (97.37cm) vine growth were found with the organic : inorganic combination of 40:60 and 0:100 respectively. Considering the interaction effect it was observed that maximum vine growth (131.83cm) was found in case of 50:50 combination (organic: inorganic) and vermicompost as a source of nutrition.

In the next three months i.e., December-February, maximum (68.00cm) vine increment was found with 50:50 combination and mustard oil cake as a source which was much lower than increment found during September-November probably due to low temperature. Minimum (42.00cm) was recorded in 100:0 combination with cowdung manure (full dose). Among the sources, the highest vine elongation (60.23cm) was recorded with mustard oil cake and lowest (46.60cm) in neemcake. The vine produced with the combination of organic: inorganic N 40:60 (58.87cm) and with 50:50 combination (58.67cm)

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were statistically *at par*. When the vines were fed with 100 percent organic manure the increment was found to be lowest (47.40cm). Very slow vine elongation in this period in comparison to others is mainly due to low temperature during this period.

The observation during March-May (Table2) showed that the combinations of organic and inorganic N at 40:60 produced the longest (104.10cm) vine, whereas, 0:100 produced the shortest (83.77cm). Within the sources mustard oil cake proved effective in producing better vine growth (103.23cm) compared to vermicompost and cowdung manure. Minimum vine length (82.33cm) was produced by Neem cake. In case of interaction effect, the best growth (116.00cm) was observed with the application of organic: inorganic N @ 50:50 combination and vermicompost as a source of nitrogen. When cowdung manure was used as a sole source of nitrogen, it failed to produce sufficient growth of vine (75.17cm).

During June-August, maximum (167.00cm) vine increment was recorded in 50:50 combination, when mustard oil cake was used as a source of nitrogen, but it was statistically *at par* with 40:60 combination with same source and 50:50 combination with vermicompost. Minimum vine elongation (109.67cm) was recorded in 100:0 combination with cowdung manure and it was also statistically non significant with poultry manure (118.93cm) as a source in the same ratio i.e. 100:0 combination. Among the sources, mustard oil cake produced the longest (147.63cm) vine and neem cake produced the shortest (118.47cm).

During June-August, betelvine grew vigorously, so increment of vine of all the sources, combination and their interactions were recorded maximum in comparison to other three seasons of observation. Betelvine is a crop of humid tropics and maximum vegetative growth of this crop is generally observed in this period. During June-August the agroclimatic condition i.e. humidity and temperature remained very congenial which favoured the crop for a luxurious vegetative growth. On the other hand, there is an optimum chance for attack of various diseases, especially the fungal diseases. Hence, a prophylactic measure was undertaken with regular spray of plant protecting organics and chemicals to avoid crop loss.

The positive effect of mustard oil cake on vegetative growth has also been reported by many workers in different varieties of betelvine. Highest vine length with application of 200 kg nitrogen hectare^{-1} in the form of mustard oil cake and urea (1:1) was reported by Saikia *et al.,* (1995) and Maiti *et al.*,(1995).In a similar type of experiment, Dey *et al.* (2003) found that highest increment of vine month^{-1} (24.80cm) in cv. Aima was recorded with mustard oil cake+ urea at 1:1 ratio. In another experiment, Sengupta *et al.*, (2004) recorded much lower vine increment per month (14.08cm) in cv.Deshi Bangla with mustard oil cake + urea at 1:1 ratio.

Internodal length

In the present experiment a significant variation in internodal length was observed among different combinations of organic: inorganic N sources and among different organic manures (Table 3). The maximum internodal length (6.83cm) was obtained with application of poultry manure with 40:60 combination and minimum internodal length (5.43cm) was obtained with application of cowdung manure and urea at 50:50 combination. Comparing the mean data it was observed that internodal length of 6.20 cm was found with poultry manure irrespective of any combination. Among the combinations, 40:60 ratio was proved best with mean internodal length of 6.42cm closely followed by 6.15 cm at 50:50 combination. It may be mentioned here that Sengupta *et al.,* (2004) recorded maximum (5.54cm) internodal length with the application of mustard oil cake + urea at 1:1 ratio.

Leaf petiole length

The length of leaf petiole showed a significant variation among sources, combination and their interaction. The data of the experiment showed that among the combinations, petiole length was highest (7.65cm) with sole application of inorganic nitrogen (0:100 combination) and it was lowest (6.43cm) with 100:0 combination. Among the sources, maximum petiole length (7.39cm) was obtained by application of mustard oil cake, which differed statistically from all other sources. The lowest petiole length (6.73cm) was obtained with neem cake (Table 3).

Leaf yield vine^{-1}

General emphasis is always given on more leaf production per vine per year as the economic part of betel vine is leaf. Data presented in Table 4 clearly indicates that sources, combination and their interaction had a significant influence on leaf yield vine^{-1}.

When organic and inorganic combination was 50:50, maximum number (65.34) of leaves were produced per vine and when total nitrogen was from organic sources (100:0) the vine showed lowest number (55.12) of leaf.

Maximum leaf production was recorded when organic and inorganic nitrogen was applied in equal proportion. This might be due to maximum utilization of nitrogen from inorganic and organic sources. Urea is a water soluble fertilizer, and prone to high leachability in the soil. Therefore, if nitrogen was applied fully through urea, then leaching loss was more and plants could not utilize nitrogen totally. On the other hand, the utilization of nitrogen was found better when it was applied with a combination from both the sources. Among the sources, mustard oil cake proved to be the best, producing highest number (67.30) of leaf and it significantly differed from all other sources. On the other hand, lowest number (51.93) of leaves was produced by neem cake which was statistically significant with all other sources.

Table 1: Influence of organic and inorganic nitrogen on vine length of betelvine

Treatment combinations (ON:IN)	Vine length of betelvine (cm)											
	September –November						December-February					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	85.7	100.5	109.0	107.2	99.5	**100.4**	42.0	48.5	56.2	45.7	44.7	**47.4**
60 : 40	102.5	82.2	87.3	120.0	100.2	**98.4**	51.7	40.5	61.8	54.8	49.5	**51.7**
50 : 50	105.2	96.0	126.8	131.8	121.3	**116.2**	55.2	47.3	68.0	66.5	56.3	**58.7**
40 : 60	119.0	99.0	125.2	128.3	125.0	**119.3**	60.2	49.3	64.7	61.2	59.0	**58.9**
0 : 100	95.7	95.8	97.5	99.8	98.0	**97.4**	48.2	47.3	50.5	52.0	51.3	**49.9**
Mean	**101.6**	**94.7**	**109.2**	**117.4**	**108.8**		**51.4**	**46.6**	**60.2**	**56.0**	**52.2**	

	September –November			December-February		
	Source	Combination	Source × Combination	Source	Combination	Source × Combination
SEm (±)	**1.52**	**1.52**	**3.39**	**0.18**	**0.18**	**0.40**
LSD (0.05)	**4.32**	**4.32**	**9.67**	**0.51**	**0.51**	**1.14**

Table 2: Influence of organic and inorganic nitrogen on vine length of betelvine

Treatment combinations (ON:IN)	Vine length of betelvine (cm)											
	March – May(cm)						June-August(cm)					
100 : 0	75.2	87.8	98.7	92.7	85.3	**87.9**	109.7	127.7	138.3	135.7	118.9	**126.1**
60 : 40	88.5	70.0	109.5	106.3	87.3	**92.3**	127.2	99.8	149.2	121.5	125.3	**124.6**
50 : 50	94.0	83.3	114.7	116.0	105.0	**102.6**	136.7	121.7	167.0	164.5	137.1	**145.4**
40 : 60	106.2	89.0	109.0	105.3	111.0	**104.1**	145.7	127.7	162.2	141.0	142.9	**143.9**
0 : 100	81.7	81.5	84.3	86.8	84.5	**83.8**	118.7	115.5	121.5	123.8	121.3	**120.2**
Mean	**89.1**	**82.3**	**103.2**	**101.4**	**94.6**		**127.6**	**118.5**	**147.6**	**137.3**	**129.1**	

	March – May			June-August		
	Source	Combination	Source × Combination	Source	Combination	Source × Combination
SEm (±)	0.13	0.13	0.29	2.18	2.18	13.91
LSD (0.05)	0.36	0.36	0.81	6.22	6.22	13.90

Table 3: Influence of different nitrogen sources and their combinations on intermodal length and leaf petiole length of betelvine

Treatment combinations (ON:IN)	Internodal length(cm)						Leaf petiole length (cm)					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	5.6	6.1	5.6	6.6	60	**6.0**	6.2	6.2	7.1	6.4	6.3	**6.4**
60 : 40	6.0	5.5	6.2	5.5	5.9	**5.8**	6.8	6.4	7.2	6.5	6.7	**6.7**
50 : 50	5.4	6.3	6.3	6.4	6.3	**6.2**	6.8	6.6	7.6	7.5	6.8	**7.1**
40 : 60	6.3	6.6	6.2	6.1	6.8	**6.4**	6.7	6.9	7.3	7.4	7.2	**7.1**
0 : 100	5.6	5.9	5.7	5.7	6.0	**5.8**	7.7	7.6	7. 8	7.5	7.7	**7.7**
Mean	**5.8**	**6.1**	**6.0**	**6.1**	**6.20**		**6.8**	**6.7**	**7.4**	**7.1**	**6.9**	

	Internodal length			Leaf petiole length		
	Source	Combination	Source × Combination	Source	Combination	Source × Combination
SEm (±)	0.05	0.05	0.11	0.02	0.02	0.04
LSD (0.05)	0.15	0.15	0.32	0.06	0.06	0.13

Note: ON = Organic nitrogen, IN = Inorganic nitrogen, CDM = Cow dung manure, NC = Neem cake, MOC = Mustard oil cake, VC = Vermicompost, PM = Poultry manure

Table 4: Influence of different sources of nitrogen on number of betel leaf yield

Treatment combinations (ON:IN)	Number of betel leaf yield vine^{-1}year^{-1}						Estimated leaf yield ha^{-1} year^{-1} (Lakh)					
	CDM	NC	MOC	VC	PM	Mean	CDM	NC	MOC	VC	PM	Mean
100 : 0	51.9	51.2	63.1	59.7	49.7	**55.1**	53.5	52.8	65.1	61.5	51.2	**56.8**
60 : 40	54.4	51.2	66.2	63.8	52.5	**57.6**	56.1	52.7	68.1	65.7	54.1	**59.4**
50 : 50	68.4	49.6	75.1	74.9	58.2	**65.3**	70.5	51.1	77.4	77.2	59.9	**67.3**
40 : 60	63.2	49.1	73.4	68.2	53.2	**61.4**	65.1	50.6	75.6	70.3	54.8	**63.3**
0 : 100	58.3	58.1	58.7	58.7	57.7	**58.3**	60.0	59.8	59.7	60.5	59.4	**60.0**
Mean	**59.3**	**51.9**	**67.3**	**65.1**	**54.3**		**61.0**	**53.5**	**69.3**	**67.0**	**55.9**	

	Number of betel leaf yield vine^{-1}year^{-1}			Estimated leaf yield ha^{-1} year^{-1} (Lakh)		
	Source	Combination	Source × Combination	Source	Combination	Source × Combination
SEm (±)	**0.13**	**0.13**	**0.30**	**0.05**	**0.05**	**0.11**
LSD (0.05)	**0.38**	**0.38**	**0.85**	**0.13**	**0.13**	**0.30**

Note: ON = Organic nitrogen, IN = Inorganic nitrogen, CDM = Cow dung manure, NC = Neem cake, MOC = Mustard oil cake, VC = Vermicompost, PM = Poultry manure

Significant variation was also noted in the interaction effect. Maximum number of leaf (75.12 vine^{-1}year^{-1}) was found when organic: inorganic N was applied in 50:50 combination through mustard oil cake and urea. Lowest number of leaves vine^{-1} (49.14) was produced by neem cake with 40:60 combination of organic and inorganic form of N.

Sources of nitrogen and combination of organic and inorganic nitrogen of mustard oil cake and urea at 1:1 ratio i.e. in 50:50 combination had produced significantly superior result in leaf yield per vine. Although on the basis of content and utilization of nitrogen, organic manures are less efficient than the inorganic fertilizers, combined use of those sources was considered to be superior than use of either organic or inorganic nitrogen alone. In Orissa, Das *et al.,*(1989) obtained maximum leaf yield in cv. Godi Bangla cultivar when mustard oil cake and urea were applied in 1:1 ratio. Maiti *et al,* (1995) also observed that application of 200 kg N ha^{-1}year^{-1} through inorganic and organic sources (1:1) in the form of urea and mustard oil cake was best. Saikia *et al,* (1995) in a field experiment with cv. Local Bangla reported that 200 kg N ha^{-1} in the form of urea: mustard oil cake (1:1) had produced maximum leaf vine^{-1} (24.15).

Estimated leaf yield ha^{-1}

Data presented in table- 4 indicates that within the combination maximum number of leaf (67.30 lakh ha^{-1}) was recorded at 50:50 combination and it was minimum (56.77 lakh ha^{-1}) at 100:0 combination. Among the sources, mustard oil cake produced maximum (69.32 lakh ha^{-1}) and neem cake produced the lowest (53.49 lakh ha^{-1}). In case of interaction highest number of leaf (77.37 lakh ha^{-1}) was recorded from mustard oil cake at 50:50 combination and it was at par with vermicompost (77.17 lakh ha^{-1}) at same combination.

The reason behind those observations may be that urea hastened decomposition of mustard oil cake by providing a part to the microorganism to mobilize nitrogen slowly and progressively from the organic sources. This promoted to attain faster growth rate at early period, which reflected on overall impact of vine and leaf yield.

REFERENCES

Arulmozhiyan, Manuel, R.W.W. and Velmurugan, S. 2002. Effect of organics vs inorganics on betelvine cv. Vellaijodi in open system cultivation. *South Indian Hort.*, **50**: 169 – 72.

Das, J.N., Dash, S.C. and Acharya, A. 1989. Effect of nitrogen on yield and incidence of diseases on betelvine in Orissa. *Orissa J. Agric. Res.*, **2** : 177 – 79.

Dey, M., Pariari, A., Sharangi, A. B. and Chatterjee, R. 2003. Response of different nitrogen sources on growth and yield of betelvine (*Piper betle* L.). *South Indian Hort.*, **51**: 244 – 48.

Maiti, S., Kadam, A. S., Sengupta, K., Punekar, L. K., Das, J. N., Saikia, L., Biswas, S. R. and Reddy, K. M. 1995. Effect of sources and levels of nitrogen on growth and yield of betelvine (*Piper betle* L.). *J. Pl. Crops*, **23** : 122 –25.

Saikia, L., Bhuyan, C. K. and Dutta, P. K. 1995. Study on growth, yield and keeping quality of betelvine (*Piper betle* L.) cv. Local Bangla as influenced by source and level of nitrogenous fertilizers. *Indian Cocoa, Arecanut and Spices J.*, **19**: 46 – 50.

Sengupta, S. K., Chaurasia, R. K., Bhatt, J. 2004. Influence of organic and inorganic nutrition on the productivity of betelvine crop and storage life of betel leaves (*Piper betel* L.). *South Indian Hort.*, **52**: 263-69.