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EFFECTS OF SHADE AND NITROGEN LEVELS ON QUALITY BNGLADHONIA PRODUCTION

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Abstract

A field experiment was conducted to determine the optimum shade level and nitrogen fertilizer for quality Bangladhonia *(Eryngium foetidum L.)* production at the Bangahandhu Sheikh Mujibar Rahman Agricultural University (BSMRAU) Research Farm during December 2002 to May 2003. The treatments consisted of four shade levels (0, *25*, 50, and *75%* shades) and five nitrogen rates (0, 115, 138, 161, and 184 kg N/ha). Shades were artificially created by using nylon nets of different mesh sizes and colours. Fifty percent shade and application of 161 kg N/ha independently as well as in combination gave the maximum fresh yield of Bangladhonia. β-carotene and vitamin C contents in Bangladhonia leaves were maximum in full sun light (0% shade) followed by 25 and 50% shade. Application of 161 kg N/ha produced the highest amount of β-carotene and vitamin C followed by 184 kg N/ha. The lowest amount of leaf fibre (1.30%) was recorded from 75% shade closely followed by 50% shade (1.76%), whereas the maximum amount of leaf protein was found at 50% shade. Application of 184 kg N/ha gave the highest amount of leaf protein and less leaf fibre that was followed by 161 kg N/ha. The results revealed that Bangladhonia performed better in terms of fresh yield and quality under 25-50% shade condition.

Key Words: Bangladhonia, shade, nitrogen, yield, quality.

Introduction

Bangladhonia *(Eryngium foetidum* L.) belongs to the family Apiaceae and is originated mainly in Tropical America, West Indies, Vietnam, Assam, and Bangladesh (Nienga, 1995, Rashid, 1999). The crop is also known as Bilatidhonia in Bangladesh (Islam *et al.,* 2003). In Bangladesh, Bangladhonia is mainly cultivated as condiments, the tender leaves and stems are used for consumption. Shading reduces photosynthetically active radiation (PAR), which is one of the major factors regulating photosynthesis, dry matter production and crop yield (Rao and Mitra, 1988). The crops where reproductive growth is not very important performed well under shade (Singh, 1994). Many vegetables and spices show the best performances in respect of quality and yield under shading.

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Shading delays flowering and produces more leaves in plants. Under shaded habitat, Bangladhonia produces dense green, soft and succulent leaves, which are the indicators of high quality leaves. Nitrogen encourages cell elongation, above ground vegetative growth, increases chlorophyll content and imparts green colour of plant leaves (Brady, 1990) that makes the Bangladhonia leaves succulent and soft (Islam *et al.,* 2003). There is limited information about nitrogen fertilization and shading management for the production of Bangladhonia in Bangladesh context. In the view of the above facts, the present study was undertaken to determine the optimum shade level and nitrogen dose for quality Bangladhonia production.

Materials and Method

The study was conducted at the Research Farm of the Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) during the period from December 2002 to May 2003. The soil of the experimental field was originally Shallow Red Brown Terrace of Madhupur clay under Salna Series. The field belongs to silt loam soil, which was medium in organic matter and moderately acidic. Texturally the soil was silt-loam, with 6.1 pH, 1.54% organic matter, 0.078% total N, 17 mg/kg available P and 0.27 me% exchangeable K.

Since there is no released variety of Bangladhonia, the cultivar used by the hilly farmers was used in the present study. The experiment was laid out in a split-plot design with three replications having four shade levels (0, 25, 50, and 75% shade) in main plot and five nitrogen levels (0, 115, 138, 161, and 184 kg N/ha) in subplots. In S_o treatment, sunlight was allowed to fall over the Bangladhonia plants without any barrier which was considered as 0% shade. In S_1, S_2, and S_3 treatments, by using nylon nets, the light level in the form of PAR were reduced to 75%, 50%, and 25% PAR, which were designated as 25%, 50%, and 75% shades. Nylon nets having different pore sizes and colours tested previously were used in the present field experiments (Miah *et al.,* 1999). A single layer of nylon blue net was used to create approximately 50% shade, whereas two layers of the same for 75% shade and single layer of white net was used for 25% shade. After laying out the experimental plots, nylon nets were hanged upto 1.5 meter in height from the soil level over the S_1, S_2, and S_3 plots for maintaining 25%, 50%, and 75% shade, respectively, with the help of bamboo sticks. No net was used in the control (S_0) plots. Seeds of Bangladhonia were broadcast @ 40 kg/ha on 14 December 2002. After sowing of seeds, the plot was covered with rice straw. Seed germination took place at 22 days after sowing. Manure and fertilizers were applied @ cowdung 14 t, 75 kg P_20_5, 120 kg K_20 per hectare and nitrogen as per treatments. Nitrogen, P, and K were applied in the form of urea, TSP, and MoP. The full amount of cowdung and TSP were applied during land preparation. Urea and MoP were applied in five equal installments at 35, 65, 95, 125, and 155 days after sowing of seeds. Irrigation and other cultural practices were made as and when necessary. Irrigation was given to the plants after each top dressing of urea and MoP by water can. Flower pruning was done whenever seen in the crop field. Harvesting was done from the 4th week of February to the 4th week to May at an interval of 15 days when the leaves became most succulent, soft, and more green. Harvesting was made by uprooting the longer plants from each plot.

Data on plant height, number of leaves per plant, length of leaf, fresh weight per plant, leaf area of the biggest leaf were recorded. These parameters were taken from 10 plants from each plot at 15-day intervals. Moreover, plant height, no. of leaves/plant, length of leaves, individual leaf area, fresh weight/plant, and fresh weight/leaf were calculated from the average of 6 harvests and considered as yield contributing characters. Leaf area was measured by using green leaf area meter (model GA-5). Total fresh yield was calculated from summation of six harvests of each plot. The plot yield was then converted to per hectare yield. β-carotene and vitamin C were estimated according to the methods of Shiraishi (1972) and Pleshkov (1976), respectively. N content in leaf was determined by Micro Kjeldahl method and then protein percent was estimated by multiplying total N × 6.25. Fibre (%) was estimated according to the procedure followed by Zaman (2002). The data recorded on different plant parameters were statistically analyzed. Treatment means were separated by Tukey’s Honestly Significance Difference Test (Tukey’s W-Test) at *5%* level of probability.

Results and Discussion

Effects of shade levels

Plants grown under shade grew vigorously than those in the open field (unshaded condition). Plant height, number of leaves/plant, length of leaf, leaf area, and fresh weight/plant were significantly increased upto 50% shading (Table l). The tallest plants were obtained from 50% shade level (22.71 cm) closely followed by plants under 75% shade (22.50 cm). Plant grown in low light levels was found to be more apical dominant than those grown in high light environment resulting in taller plants under shade (Hillman, 1984). Significantly maximum number of leaves/plant (8.21), length of leaf (20.75 cm), leaf area (56.26 cm^2), and fresh weight/plant (13.82 g) were recorded from 50% shading and for further shade level (75%), they declined. Plants under shade tended to have higher leaf area, because under low light intensities cells expand more to receive light for photosynthesis (Anon., 1999). Fresh yield per hectare was significantly influenced by different shade levels (Table 1). Fresh yield increased gradually upto 50% shade. For further increment of shade level (75%), the yield declined. The highest fresh yield was recorded from 50% shade (57.59 t/ha), which was statistically similar to that of 75% shade (55.04 t/ha). Significantly the lowest yield of Bangladhonia was recorded from 0 % shade (45.21 t/ha). There was no significant variation between 0% and 75% shade. Chlorophyll increased progressively with the increase of shade levels (Fig. 1). The maximum amount of chlorophyll was recorded at 75% shade followed by 50% shade. It has been postulated that shading increased the quantity of chlorophyll and thus increases the photosynthetic efficiency of the plants and ultimately the yield increases (El-Aidy *et al.*, 1983).

Table 1. Effects of shade and nitrogen levels on the yield and yield contributing characters of Bangladhonia.

Treatments	Plant height (cm)	Leaves /plant (no.)	Length of leaf (cm)	Leaf area of the biggest leaf (cm^2)	Fresh wt /plant (g)	Fresh yield (t/ha)
Shade levels (%)						
S_0: 0 (unshaded)	12.93c	6.96b	12.0lc	39.78d	9.65b	45.2 lb
S_1:25 b	17.26	8.15a	16.8Th	51.78c	12.77a	55.04a
S_2: 50	22.71a	8.21a	20.75a	56.26a	13.82a	57.59a
S_3: 75	22.50a	5.89c	18.7Oab	54.20b	l0.05b	45.20h
CV (%)	7.23	4.16	6.13	3.97	6.14	6.28
Nitrogen levels (kg/ha)						
N_0: 0	17.00b	7.0lc	12.67c	44.96d	10.24d	30.00c
N_1: 115	18.95ab	7.72b	16.50b	49.60c	11.72c	48.07b
N_2: 138	18.60ab	7.85b	18.35b	50.28c	12.23bc	50.55b
N_3: 161	20.52a	8.50a	21.52a	55.54a	14.53a	55.96a
N_4: 184	19.69a	8.00b	20.l5ab	52.42b	12.91b	50.65b
CV (%)	7.23	4.16	6.13	3.97	6.14	5.62

Figures with similar letters did not differ significantly at 5% level of probability by Tukey's W Test.

β-Carotene, vitamin C, protein, and fibre content of the leaf were significantly influenced by different shade levels (Table 2). β-Carotene, vitamin C and leaf fibre decreased gradually with the increase of shading density. But protein content of the leaf increased with the increase of shade levels upto 50% shade and then declined. The highest amount of β-carotene (8.82 mg/100g), vitamin C (71.76 mg/100 g), and fibre (2.29%) were recorded from 0% shade (unshaded condition). The second highest β-Carotene and vitamin C were recorded from 25% shade, which was statistically similar to 50% shade. The lowest leaf fibre (1.30%) was obtained from 75% shade. The highest amount of protein (%) was found in 50% shade (6.09%) closely followed by 75% shade. Lee and Kader (2000) opined that the lower the shading density during the growing season the greater the vitamin C in leaf tissues.

Table 2. Effects of shade and nitrogen levels on the qualitative characters of Bangladhonia.

Treatments	β-carotene (mg/100g)	Vitamin C (mg/100g)	Protein (%)	Fibre (%)
Shade (%)				
S_0: 0	8.82a	71.276a	4.09b	2.29a
S_1:25	6.94b	71.29ab	5.00b	l.95b
S_2:50	6.85b	68.l0bc	6.09a	1.76b
S_3: 75	4.72c	66.29c	5.85a	1.30c
CV (%)	6.77	3.64	5.25	5.75
Nitrogen levels (kg/ha)				
N_0 : 0	5.44d	67.33bc	4.36e	2.04a
N_1: 115	6.04c	66.29c	4.74c	1.901b
N_2: 138	7.04b	70.24ab	5.20b	1.8Obc
N_3: 161	7.98a	71.28a	5.71a	l.72cd
N_4: 184	7.66a	70.51a	6.29a	1.65d
CV (%)	6.77	3.64	5.25	5.75

Figures with similar letters did not differ significantly at 5% level of probability by Tukey's W Test

Effects of nitrogen levels

Plant height, number of leaves/plant, length of leaf, leaf area, fresh weight of the plant, and fresh yield per hectare increased significantly with the increase of N upto 161 kg N/ha beyond which their values declined (Table 1). Superior values in respect of yield and yield contributing characters were obtained from the application of 161 kg N/ha. Significantly, the maximum plant height (20.52 cm), number of leaves/plant (8.50), length of leaf (21.52 cm), leaf area (55.54 cm^2), fresh weight/plant (14.53 g), and fresh yield (55.96 t/ha) were recorded when N was applied to the soil @ 161 kg/ha, while the lowest results were obtained without nitrogen application. These results are in good agreement with the findings of Islam *et al.* (2003).

Chlorophyll content in leaf increased linearly with the increase of nitrogen dose (Fig. 1). The highest chlorophyll content was recorded at 184 kg N/ha closely followed by 161kg N/ha. β-Carotene, vitamin C, and protein content significantly increased, but leaf fibre decreased with the increase of N levels (Table 2). The highest amount of vitamin C (70.51 mg/100g), and leaf protein (6.29%) were obtained from 184 kg N/ha, whereas the maximum amount of β-carotene (7.98 mg/100 g) and leaf fibre were observed with 161kg and 0 kg N/ha, respectively. There was no significant difference between 161 kg and 184 kg N in respect of β-Carotene, vitamin C, and protein content. The lowest amount of β-Carotene, vitamin C, and protein content of the leaf were recorded when no N was applied. But the lowest amount of leaf fibre was produced from the application of 184 kg N/ha closely followed by 161 kg N/ha. It was reported that nitrogen application at the highest rates promoted β-carotene and vitamin C accumulation and increased their contents in cabbage (Humadi and Abdul Hadi, 1988).

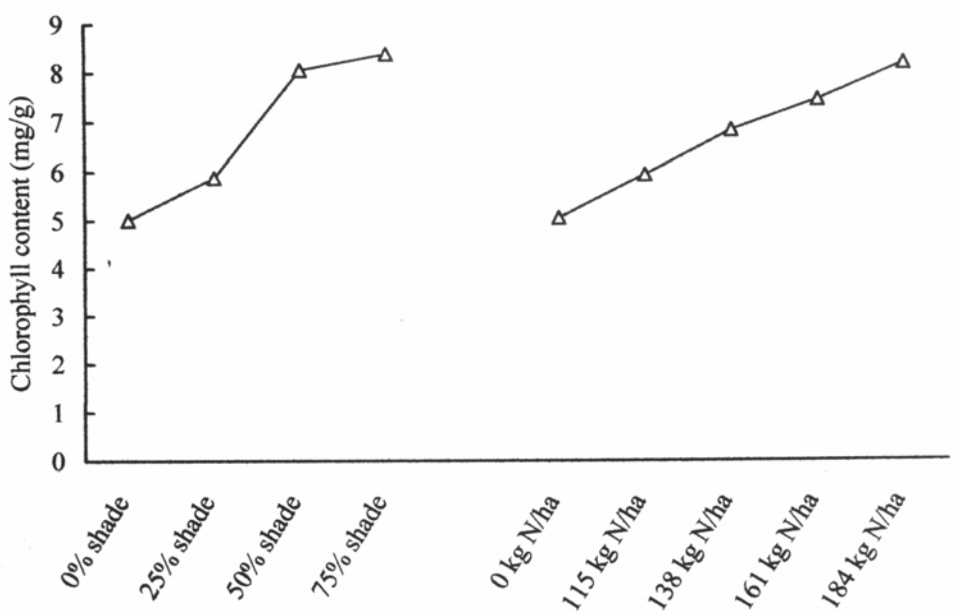

Fig. 1. Effect of shades and nitrogen on chlorophyl content of Bangladhonia leaf.

Combined effects of shade and N levels

All the yield attributes and yield were significantly influenced by the interaction effect of shade and nitrogen levels (Table 3). Maximum plant height (24.30 cm), number of leaves (9.23), length of leaf (22.97 cm), leaf area (63.39 cm^2), and fresh weight (16.56 g/ plant) were obtained from N_3S_2 combination and their lowest values were recorded from N_0S_0 combination. The N_3S_2 gave the highest fresh yield (64.69 t/ha) closely followed by N_3S_1 (62.64 t/ha) and the lowest fresh yield (37.06 t/ha) was recorded from N_0S_0 combination. These findings indicated that the maximum fresh yield was obtained when N_3 interacted with either S_1 or S_2. The N_3S_2 produced maximum plant height, number of leaves/plant, individual leaf area, and plant fresh weight and hence, it gave the highest fresh yield of Bangladhonia.

Table 3. Combined effect of shade and nitrogen levels on the yield attributes and yield of Bangladhonia.

Treatment combination		Plant height (cm)	Leaves/ plant (no.)	Length of leaf (cm)	Leaf area of the biggest leaf (cm)	Fresh wt/ plant (g)	Fresh yield (t/ha)
Shade levels (%)	Nitrogen levels						
S_0: 0	N_0	11.26g	6.40gh	8.92g	31.71h	7.70e	37.06h
	N_1	13.l3fg	6.76fgh	13.28f	40.71g	8.80de	43.24fgh
	N_2	12.90fg	6.86c-g	13.9lef	41.97fg	9.74cde	45.87e-h
	N_3	13.80f	7.46e-h	14.84ef	42.66fg	11.28b-e	50.96c-f
	N_4	13.57fg	7.30d-h	15.80e	41.88fg	10.74b-e	48.96d-g
S_1: 25	N_0	16.40e	7.40d-h	15.78e	44.36f	9.45cde	49.97c-g
	N_1	16.37e	8.30a-e	17.85d	52.48e	13.0la-d	50.70c-g
	N_2	16.36e	8.33a-e	18.45cd	52.57e	13.58abc	54.l0b-e
	N_3	18.23de	*8.53ab*	18.89bcd	56.92bc	14.96ab	62.64ab
	N_4	18.90cd	8.16b-e	20.73b	52.88e	10.03cde	49.16d-g
S_2: 50	N_0	20.88bc	7.43c-h	19.43bcd	52.86de	11.42b-e	49.16d-g
	N_1	22.54ab	8.06b-e	20.30bc	*52.72de*	12.91a-d	53.02cde
	N_2	22.87ab	7.86b-f	20.06bc	52.96de	12.87a-d	*56.42b*
	N_3	24.30a	9.23a	22.97a	63.39a	16.56a	64.69a
	N_4	22.98ab	8.46abc	20.20bc	59.41b	1194a-e	50.77c-g
S_3: 75	N_0	23.45ab	6.83fgh	20.33bc	50.95e	12.37a-d	41.69gh
	N_1	23.76a	7.76b-g	20.87bc	52.50e	12.17a-e	45.35e-h
	N_2	23.68a	8.36a-d	20.30bc	53.64de	12.73a-d	45.84e-h
	N_3	22.26ab	8.76ab	20.31bc	59.22b	1l.93a-e	45.58e-h
	N_4	23.28ab	8.lOb-e	20.42bc	55.79cd	12.70a-d	47.55d-g
CV (%)	-	7.23	4.16	6.13	4.97	6.14	*5.62*

Figures with similar letters do not differ significantly at *5%* level of probability by Tukey's W Test.

N_0=0 kg N/ha, N_1= 115 kg N/ha, N_2=138 kg N/ha, N_3 = 161 kg N/ha and N_4= l84 kg N/ha.

There *was a* significant effect on β-carotene and protein content of Bangladhonia leaf (Table 4). The 0% shade level coupled with 161 kg N/ha (N_3S_0) gave the highest amount of β- carotene (10.47 mg/100 g) closely followed by shading density with 184 kg N/ha (N_4S_0) and its lowest amount (3.20 mg/100 g) was obtained from the combination of 75% shade and no N (N_0S_3). The 75% shade accompanied with 184 kg N/ha (N_4S_3) gave the highest amount of protein (8.08%) followed by 50% shade with 184 kg N/ha (N_4S_2 (7.25%). The interaction effect of shade and nitrogen levels on vitamin C and fiber content was found insignificant (Table 4).

Table 4. Combined effect of shade and nitrogen levels on some qualitative characters of Bangladhonia.

Treatment combination		β-carotene (mg/100 g)	Vitamin C (mg/ 100 g)	Protein (%)	Fibre (%)
Shade (%)	Nitrogen levels				
	N_0	7.3lcd	68.13	4.16g	2.60
	N_1	7.08cd	71.13	4.13g	2.40
S_0: 0	N_2	9.22ab	72.90	5.20f	2.16
	N_3	l0.47a	74.28	5.83ef	2.20
	N_4	10.16a	72.36	5.70f	2.10
	N_0	6.28de	67.23	4.06gh	2.23
	N_1	3.l6de	70.24	4.37g	2.03
S_1: 25	N_2	6.96cd	71.57	3.46h	1.93
	N_3	7.77c	74.05	4.42g	1.80
	N_4	7.l6cd	73.32	4.l6g	1.76
	N_0	5.06ef	67.62	3.95gh	1.93
	N_1	6.83cd	65.56	5.75ef	1.80
S_2: 50	N_2	7.I4cd	68.29	6.37de	1.76
	N_3	7.46cd	69.74	7.l5bc	1.70
	N_4	8.20bc	69.25	7.24b	1.60
	N_0	3.20g	66.35	5.26f	1.40
	N_1	4.l0fg	60.73	6.56cd	1.40
S_3: 75	N_2	4.94ef	68.17	3.94gh	1.36
	N_3	6.21de	69.04	5.45f	1.20
	N_4	5.l4ef	67.12	8.08a	1.13
CV (%)		6.77	3.64	5.25	5.75

Figures with similar letters or without letter did not differ significantly at 5% level of probability by Tukey's W Test

N_0=0 kg N/ha, N_1= 115 kg N/ha, N_2=138 kg N/ha, N_3 = 161 kg N/ha and N_4= l84 kg N/ha.

Based on the above results and discussion, it could be concluded that for optimizing the maximum yield and good quality, Bangladhonia needs to be grown in those places where 25-50% shade is available coupled with the application of 161 kg N/ha.

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