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## Effect of different levels of nitrogen and cuttings on growth, leaf yield and quality of spinach beet (*Beta vulgaris var. bengalensis*) cv. ALL GREEN

**Gyanendra Pratap Singh, M.L. Meena, Jay Prakash**

**Abstract**

A field experiment was conducted at Horticulture Research Farm, Lucknow (U.P.) India during *Rabi* season of 2013-14 to evaluate the effect of nitrogen fertilizer levels (0, 30, 60 and 90 Kg/ha.) and three cuttings at (30, 50 and 70 days after sowing) on green and seed yield of spinach beet cv. 'All Green'. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications for spinach beet crop consisted of 12 treatments namely, Control, N<sub>0</sub>C<sub>1</sub> kg, N<sub>0</sub>C<sub>2</sub> kg, N<sub>0</sub>C<sub>3</sub> kg, N<sub>1</sub>C<sub>1</sub>kg, N<sub>1</sub>C<sub>2</sub>kg, N<sub>1</sub>C<sub>3</sub>kg, N<sub>2</sub>C<sub>1</sub>kg, N<sub>2</sub>C<sub>2</sub>kg, N<sub>2</sub>C<sub>3</sub>kg, N<sub>3</sub>C<sub>1</sub>kg, N<sub>3</sub>C<sub>2</sub>kg and N<sub>3</sub>C<sub>3</sub>kg to find out the effect of the growth, leaf yield and quality traits of spinach beet and various horticulture characters namely; seed germination per cent (%), germination rate index, plant height (cm), leaf area (cm<sup>2</sup>), root length (cm), shoot length (cm), seeding vigour index, ten seedling dry weight (mg), leaves per plant, leaf moisture, ascorbic acid and leaf yield (q/ha). However, application of the nitrogen and cuttings had a significant influence on plant growth, leaf yield and quality traits of spinach beet and N<sub>3</sub>C<sub>2</sub> 90 kg N/ha gave the highest yield than other nitrogen. So, N<sub>3</sub>C<sub>2</sub> was superior among all treatments under investigation for response spinach beet production.

**Keywords:** Spinach Beet, Nitrogen, Cuttings, Growth, Yield, Quality

**Introduction**

India is the second largest producer of vegetables in world. Indian Council of Medical Research, New Delhi recommends intake of 125g leafy vegetables, 100g roots and 75g other vegetables/ day / adult for a balanced diet. Green leafy vegetables occupy an important among the food crops as these provide adequate amounts of many vitamins and minerals for humans. Amongst all the vegetables, the leafy vegetables have high protective food value. They are rich in mineral and hence can be called as "mines of minerals". Vitamin A and C are present in abundant quantities. Beside this, soft fibrous matter is specially providing necessary roughage in diet. It is widely grown leafy vegetable. It is rich and cheap source of iron, vitamin A, Calcium, protein, vitamin K, vitamin E (tocopherol), vitamin D, vitamin C (ascorbic acid), folic acid, thiamine, riboflavin, nicotinic acid, pyridoxine, Antioxidants as carotene, flavones, Indoles and isothiocyanates, Essential amino acid etc. Nitrogen is the essential for the vegetable growth of the plant resulting in higher green leaf yield. Information on leaf yield spinach beet as affected by nitrogen levels and cutting frequencies for Uttar Pradesh conditions are meagre. Hence, the present experiment was undertaken to study the effect of different levels of nitrogen on leaf yield of spinach beet. Therefore, to get good vegetative growth after cutting application of nitrogen is essential. For green leafy vegetable, crop is harvested by clipping of the leaves and young shoots and repeated cuttings are taken during growing season. For seed purpose the crop is grown without any clipping. Since in most of the leafy vegetables several cuttings are possible, they require a good amount of fertilizer for their quick growth requirement. An ample supply of nitrogen not only helps in the production of succulent leafy matter in all leafy vegetable but in their seed production also. The yield of Indian spinach depends on vegetative growth it may express in terms of number of leaves per plant, size of leaf and plant height etc. For obtaining more vegetative growth cutting of crop is important due to cutting of crop side shoots are arises which increases the number of leaves per plant and ultimately increased the yield which demands higher amount of nitrogen. However, information on nutrient management through different nitrogen level and their interactions with cutting on leaf yield and quality aspects of Indian spinach is still meagre.

## Materials and Methods

The present investigation was carried out at the Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareilly Road, Lucknow (U. P.) India during *Rabi* season of 2013-14. The treatments comprising of three levels of nitrogen fertilizer levels (0, 30, 60 and 90 Kg/ha.) and three cuttings treatment i.e., one cutting at 30 days after sowing (DAS), two cutting at 30 and 50 days after sowing (DAS) were experimented in Factorial Randomized Block Design (FRBD) with three replications spinach beet cv. 'All Green' were sown in middle October in plot size of 1.00 × 0.60 m with spacing of 20 cm × 05 cm. A basal dose of 60kg/ha each of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O along with half dose of nitrogen was applied as basal dressing through single super phosphate, muriate of potash and urea respectively. The remaining N was applied as top dressing in two splits 30 and 50 DAS. The cuttings were made leaving the plants 5cm from base. After completion of specified number of cuttings the crop was left for seed production. All recommended package and practices were followed to raise good crop. The treatments combinations comprised namely, for spinach beet crop consisted of 12 treatments namely, Control, N<sub>0</sub>C<sub>1</sub> kg, N<sub>0</sub>C<sub>2</sub> kg, N<sub>0</sub>C<sub>3</sub> kg, N<sub>1</sub>C<sub>1</sub>kg, N<sub>1</sub>C<sub>2</sub>kg, N<sub>1</sub>C<sub>3</sub>kg, N<sub>2</sub>C<sub>1</sub>kg, N<sub>2</sub>C<sub>2</sub>kg, N<sub>2</sub>C<sub>3</sub>kg, N<sub>3</sub>C<sub>1</sub>kg, N<sub>3</sub>C<sub>2</sub>kg and N<sub>3</sub>C<sub>3</sub>kg to find out the effect of the growth, leaf yield and quality traits of spinach beet and various horticulture characters namely; seed germination per cent (%), germination rate index, plant height (cm), leaf area (cm<sup>2</sup>), root length (cm), shoot length (cm), seeding vigour index, ten seedling dry weight (mg), leaves per plant, leaf moisture, ascorbic acid and leaf yield (q/ha). Economics of green leaves and seed production was also worked out. The statistical origin followed for the experiment was randomized block design in factorial concept (Sundaraja *et al.* 1972) [16].

## Result and Discussion

All parameters viz., seed germination per cent (%), germination rate index, plant height (cm), leaf area (cm<sup>2</sup>), root length (cm), shoot length (cm), seeding vigour index, ten seedling dry weight (mg), leaves per plant, leaf moisture, ascorbic acid and leaf yield (q/ha).

**Effect of different nitrogen levels & cuttings on seed germination (%) of spinach beet-** Table 1 showed that the treatment N<sub>3</sub>C<sub>2</sub> had better effect on seed germination percent at different doses of nitrogen. It might be due to the increasing level of nitrogen at 90Kg/ha which enable very good effect on seed germination percent of spinach beet. The dose of nitrogen allowed growing vigorously. This result was also supported with the works of Jana *et al.* (1999) [2] in palak and panwar *et al.* (2000) [6] in radish.

**Effect of different nitrogen levels & cuttings on germination rate index of spinach beet-** The data pertaining to germination rate index are presented in table 1. According to statically analysis of variance data showed that nitrogen had significant effect on germination rate index. According to mean value of experimental result (17.56) maximum germination rate index was noticed under the treatment N<sub>3</sub>C<sub>2</sub>. This result was found due to increasing level of nitrogen at 90 Kg/ha nitrogen dose. The similar result was reported by Biradar *et al.* (2006) [1].

**Effect of different nitrogen levels & cuttings on plant height (cm) of spinach beet-** Table 1 showed that nitrogen, significantly maximum plant height (39.057 cm) was recorded under the treatment N<sub>3</sub>C<sub>2</sub> followed by (36.43cm) under the treatment N<sub>0</sub>C<sub>1</sub>, which might be due to quick availability of nitrogen. The above result was supported by the work of Kaswan *et al.* (1995) in fenugreek. In respect of cutting there was no significant effect. Plant height was decreasing in second and third cutting, which might be due to the pruning. Pruning encourage the development of side shoot, which resulted in increasing side shoots and decreased plant height the above result was conformity with the Paatil and Naik (2004) in palak.

**Effect of different nitrogen levels & cuttings on leaf area (cm<sup>2</sup>) of spinach beet-** Table 1 showed the leaf area of spinach should significant interaction result. The maximum leaf area (118.90 cm<sup>2</sup>) was recorded under the treatment N<sub>3</sub>C<sub>2</sub>, which was found at per with the treatment (111.09 cm<sup>2</sup>) N<sub>0</sub>C<sub>3</sub>, (109.50cm<sup>2</sup>) N<sub>0</sub>C<sub>1</sub>, (109.16 cm<sup>2</sup>) N<sub>0</sub>C<sub>2</sub>. Minimum leaf area (99.89cm<sup>2</sup>) was recorded under the treatment N<sub>1</sub>C<sub>2</sub>. Maximum leaf area with 90 Kg N/ha might be due to quick availability of nitrogen to plant, nitrogen imparts vigorous vegetative growth which leads to the cell division and cell enlargement. The similar result was also found by Biemond (2004). The leaf area of spinach beet as influenced by cutting was no significant.

**Effect of different nitrogen levels & cuttings on root length (cm) of spinach beet-** Table 2 showed the highest root length (10.68 cm) was noticed under the treatment N<sub>3</sub>C<sub>2</sub> followed by (8.75cm) under the treatment N<sub>0</sub>C<sub>1</sub>. There were significant interaction levels of nitrogen and number of cutting. Lowest root length (7.41cm) N<sub>3</sub>C<sub>3</sub>. Results supported with the reports of Harisingh and Gill (1983) [13] and Sharma (1994) [10].

**Effect of different nitrogen levels & cuttings on shoot length (cm) of spinach beet-** Table 2 showed the significantly higher shoot length (99.66cm) was observed under the treatment N<sub>3</sub>C<sub>2</sub> followed by (8.17cm) under the treatment N<sub>0</sub>C<sub>1</sub>. The minimum shoot length (7.13cm) was observed under the N<sub>0</sub>C<sub>3</sub>. Similar results were found with the findings of Phor and mangal (1985) [7] in palak.

**Effect of different nitrogen levels & cuttings on seedling vigour index (cm) of spinach beet-** Table (2) showed the higher seedling vigour index (1706) was record under treatment N<sub>3</sub>C<sub>2</sub> higher nitrogen levels could be explained based on higher germination, root length and shoot length record in table 4.1.7. Palak significantly respond with nitrogen level. The results were also found by Biradar *et al.* (2006) [1].

**Effect of different nitrogen levels & cuttings on ten seeding dry weight (mg/100gm) of spinach beet-** Table 2 showed the seeding dry weight (6.17mg/100g) was observed under the treatment N<sub>3</sub>C<sub>2</sub> this might be due to higher weight of seed recorded in this treatment. There was significant effect of nitrogen. This result was supported with the finding of Biradar *et al.* (2006) [1].

**Effect of different nitrogen levels & cuttings on average leaf per plant of spinach beet-** Table 3 showed the green leaf yield increased with the increasing level of nitrogen and cutting. Maximum number of leaf per plant (15.36) was observed under the treatment  $N_3C_2$ . Interaction effect was no significant. Maximum number of leaf found at per with  $N_3C_3$  (13.66) followed  $N_3C_1$  (13.61) and  $N_2C_3$  (13.18). Whereas minimum  $N_0C_1$  (11.623). This might be due to nitrogen impacts; vigorous vegetative growth and pruning encourage optimum number of leaves. It was resulted in the plant of spinach beet in  $C_2$ ,  $C_3$ . The same result was observed with the finding of **Lal et al. (1979)**<sup>[5]</sup> in *Beta vulgaris*.

**Effect of different nitrogen levels & cuttings on moisture level of spinach beet-** Table 3 showed the leaf moisture in spinach beet was found significantly with nitrogen. The maximum leaf moisture (91%) was found under the treatment  $N_3C_2$ . Which was found at per (80.82)  $N_0C_1$ , (78.00)  $N_1C_1$ . This might with conformity with those **Kaswan et al. (1993)** in fenugreek, **Bhore et al. (2000)** in palak. The moisture content as cutting increase with leaf area and moisture content decrease similar result was found by **Bharad (2013)**.

**Effect of different nitrogen levels and cuttings on ascorbic acid (mg/100gm) of spinach beet-** Table 3 showed the maximum ascorbic acid (72.48) was estimated under the treatment  $N_3C_2$  which might be due to high nitrogen level. Similar result was founded by **Bhore et al. (2000)** in palak. An interaction of nitrogen and cutting was significant. It was also obtained by **Dhillion et al. (1987)**, **Rajpoot et al. (1989)** in palak.

**Effect of different nitrogen levels and cuttings on green leaf yield of spinach beet-** Table 3 showed the data on leaf yield per hectare was presented under the table and figure 4.1.12. The maximum leaf yield (291.44 q/ha) was recorded under the treatment  $N_3C_2$  followed by (270q/ha)  $N_2C_2$ . Minimum yield (200.057) was observed under the control treatment  $N_0C_1$ . Leaf yield was increased due to nitrogen which is the important constituent of plant metabolites such as fat, protein, and enzyme which are essential vigorous vegetative growth. Above result is conformity with those of **Bhore et al. (2000)** in palak, **Singh et al. (2003)** in beet palak. The yield was increased with cutting frequency. Similar result was founded with the finding of **Jana et al. (1999)**<sup>[2]</sup> in palak.

**Table-1** Effect of levels of nitrogen and cutting on green leaf, and growth of spinach beat

Cuttings	Nitrogen levels (kg/ha)																			
	germination (%)					germination rate index					plant height (cm)					leaf area (cm <sup>2</sup> )				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
<b>C<sub>1</sub></b>	77.21	68.69	75.35	77.87	74.78	15.18	14.60	14.22	14.58	14.65	36.43	35.06	34.77	36.07	35.58	109.51	109.16	103.90	108.14	107.68
<b>C<sub>2</sub></b>	78.78	69.65	77.48	83.77	77.42	15.20	16.01	15.01	17.56	15.95	35.44	34.91	34.82	39.06	36.06	106.56	99.89	104.23	118.10	107.19
<b>C<sub>3</sub></b>	79.81	68.14	76.14	73.61	74.43	14.13	14.35	15.70	14.41	14.65	35.03	36.07	35.70	35.99	35.70	111.10	104.22	105.07	108.19	107.14
<b>Mean</b>	78.60	68.82	76.32	78.42		14.65	14.65	14.65	14.6		35.63	35.35	35.10	37.04		109.05	104.42	104.40	111.48	
	S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)		
<b>Nitrogen(N)</b>	1.12	1.59	3.30			0.25	0.35	NS			0.46	0.65	1.34			0.75	1.05	2.19		
<b>Cutting(C)</b>	0.97	1.38	N.S.			0.22	0.30	0.63	N.S.		0.40	0.56	NS			0.65	0.91	NS		
<b>NXC</b>	1.95	2.75	N.S.			0.43	0.60	1.26			0.80	1.12	NS			1.29	1.83	3.79		

N.S. – Non Significant

**Table -2** Effect of levels of nitrogen and cutting on green leaf, and growth of spinach beat

Cuttings	Nitrogen levels (kg/ha)																			
	root length (cm)					shoot length (cm)					seedling vigour index					ten seedling dry weight (mg)				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
<b>C<sub>1</sub></b>	8.75	8.26	8.29	8.09	8.35	8.173	7.67	7.39	7.38	7.65	1307.67	1093.67	1182.33	1204.00	1196.92	3.39	3.89	5.41	4.36	4.26
<b>C<sub>2</sub></b>	8.48	8.10	8.47	10.68	8.93	7.25	7.91	7.50	9.66	8.08	1236.00	1138.00	1237.33	1706.33	1329.42	4.05	4.22	4.56	6.71	4.88
<b>C<sub>3</sub></b>	7.66	8.43	7.89	7.41	7.85	7.13	7.60	7.37	7.46	7.39	1147.00	1142.67	1163.67	1095.00	1137.08	4.78	4.88	4.37	4.98	4.75
<b>Mean</b>	8.30	8.27	8.21	8.73		7.52	7.72	7.42	8.17		1230.22	1124.78	1194.44	1335.11		4.07	4.33	4.78	5.35	
	S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)		
<b>Nitrogen(N)</b>	0.22	0.31	NS			0.16	0.23	0.48			26.44	37.39	77.56			0.17	0.24	0.49		
<b>Cutting(C)</b>	0.19	0.27	0.56			0.14	0.20	0.41			22.70	32.38	67.17			0.15	0.20	0.43		
<b>NXC</b>	0.38	0.54	1.12			0.28	0.40	0.83			45.79	64.76	134.34			0.29	0.41	0.86		

N.S. – Non Significant

**Table -3** Effect of levels of nitrogen and cutting on green leaf production and quality of spinach beat

Cuttings	Nitrogen levels (kg/ha)																			
	average leaves per plant					leaf moisture (%)					ascorbic acid (mg/100gm)					Green leaf yield (q/ha)				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
<b>C<sub>1</sub></b>	13.03	12.18	13.04	13.61	12.96	80.83	78.01	68.76	73.80	75.35	70.41	70.39	70.73	69.76	70.32	200.06	233.78	256.48	202.19	223.13
<b>C<sub>2</sub></b>	12.34	12.56	12.18	15.37	13.11	68.06	76.56	74.88	91.01	77.63	69.22	69.42	69.57	72.48	70.17	208.81	215.48	270.48	291.45	246.55
<b>C<sub>3</sub></b>	11.62	13.09	13.18	13.66	12.89	67.47	73.53	70.93	70.04	70.49	68.91	65.20	71.12	67.46	68.17	229.53	253.44	234.73	248.51	241.55
<b>Mean</b>	12.33	12.61	12.80	14.21		72.12	76.03	71.52	78.28		69.52	68.34	70.47	69.90		212.80	234.23	253.90	247.38	
	S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)			S.E.(m) ±	S.E.(d)	C.D. (P=0.05)		
<b>Nitrogen(N)</b>	0.33	0.46	0.96			1.23	1.74	3.60			0.50	0.71	1.48			6.68	9.44	19.59		
<b>Cutting(C)</b>	0.28	0.40	N S			1.06	1.50	3.12			0.44	0.62	1.28			5.78	8.18	16.97		
<b>NXC</b>	0.56	0.76	N S			2.13	3.01	6.24			0.87	1.24	2.56			11.57	16.36	33.93		

N.S. – Non Significant

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