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Effect of Nitrogen Levels and Picking of Green Fruits on the Fruit and Seed Production of Okra (*Abelmoschus Esculentus* (L.) Moench)

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ABSTRACT

A field experiment on okra taking the variety BARI Dharos-1 with four nitrogen levels (0, 75, 125 and 175 kg/ha) and six levels of green fruit picking (no green fruit picking, first two, first four, first six, first eight and first ten green fruit picking) was conducted at the Agricultural Research Station, Raikhali, Rangamati Hill District to find out the optimum N level and suitable number of green fruit picking during the summer seasons of 2005 and 2006 for the highest economic benefit. The plants were grown for both vegetable and seed production. Growth parameters, green fruit as well as dry fruit characters, seed yield attributes were significantly affected by different levels of N and green fruit picking. Nitrogen levels and green fruit picking increased number of dry fruits per plant, number of seeds per fruit, weight of seeds per fruit and seed yield. Application of N @ 125 kg/ha gave the highest fruit and seed yield of okra followed by 175 kg N/ha. These two N levels also produced maximum 100-seed weight, percentage of germination and seed vigour. The treatment of picking of 10 green fruits produced the highest green fruit yield/ha. But picking of first 4 green fruits produced maximum seed yield, which was statistically at par with those of 2 and 6 green fruits picking. First 4 green fruit picking gave the highest seed vigour whereas first 6 green fruit pickings produced maximum 100-seed weight. Picking of first 4 green fruits accompanied with 175 kg N/ha gave the highest seed yield of 2.86 t/ha, which was closely followed by picking of first 2 or 6 green fruits with 125 kg as well as 175 kg N/ha. Picking of first 2 or 4 green fruits in combination with 125 kg N/ha also gave the similar seed yield. The combination of 125 kg N/ha and first 6 green fruit picking gave the highest gross income (Tk.193.56/ha), net return (Tk.126.35/ha) and maximum BCR of 2.88.

Key words: Nitrogen, picking, okra, fruit and seed yield, profitability.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.)Moench), commonly known as lady's finger, is a popular summer vegetable in Bangladesh. It originated in West Africa is an annual vegetable crop grown from seed in tropical and subtropical parts of the world (Thakur and Arora, 1986). It is a nutritious vegetable, which plays an important role to meet the demand of vegetables of the country when vegetables are scanty in the market (Ahmad, 1995). The green fruits are rich sources of vitamins, calcium, potassium and other minerals. In Bangladesh it is known as 'dherosh' which is also called

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'bhindi' in India and Pakistan (Rashid, 1999). Judicious application of nitrogenous fertilizers has great impact on growth and yield of crop plants. The requirement of nitrogen which varies according to environmental conditions has to be determined by actual field trial for any particular soil and climate. Okra being a vegetable crop, its response to nitrogen should be high and higher dose of nitrogen is required to keep the fruits soft and edible. The recommend dose of nitrogen for the highest fruit yield appeared in various books and journals ranges from 120 to 200 kg/ha (Amjad *et al*., 2001; Rahman *et al*, 1992; Paliwal *et al.,* 1999; Verma and Batra 1999 ; Rashid, 1999) and for seed production ranges from 100 to 200 kg N/ha (Birbal *et al*., 1995; Chattopadhyay and Sahana, 2000; Khan and Jaiswal 1988; Naik and Srinivas, 1992). There are reports that no difference in seed yield has been found if no picking of fresh fruit is done or only one or two pickings are made (Thakur and Arora, 1986). There are also reports that fruit setting in okra increases with a higher frequency of picking of fresh fruit (Natraj *et al*., 1992 ; Rashid 1999). Picking of green fruits encourages vegetative growth, fruit characters and ultimate seed yield and seed quality in okra (Singh *et al*., 1999; Khan and Jaiswal, 1988; Velumani and Ramaswamy, 1980). Seed crop is more profitable than fruit crop. As first some fruit pickings has no influence on seed production, picking green fruit plus seed yield give the best profit in okra cultivation. Such type of experimental results is not available in Bangladesh. In view of the above facts the present study was under taken to find out the optimum dose of nitrogen and number of green fruit picking on fruit as well as seed yield of okra for the highest economic benefit.

MATERIALS AND METHODS

The experiment was conducted at the Agricultural Research Station, Raikhali in the district of Rangamati during the summer seasons of 2005 and 2006. This trial was carried out for both vegetable and seed production for higher benefit. The experimental field belongs to AEZ 29 with the Piedmont plain soil having medium loamy to moderately fine texture (sandy clay loam). The soil was poor in organic matter and moderately acidic. Nitrogen, Phosphorus, Potassium, Sulfur, Boron and Zinc were low in soil. N, P, K and Zn were below critical limit and B was as same as critical limit (Table 1). The experiment was laid out in a split-plot design with three replications, having four N levels (N_0 = 0, N_1 = 75, N_2 = 125 and N_3 = 175 kg/ha) as main plot treatments, and six levels of number of green fruit picking (P_0 = no green fruit picking, P_1= first 2 green fruit picking, P_2 = first 4 green fruit picking, P_3 = first 6 green fruit picking. P_4 = first 8 green fruit picking and P_5 = first 10 green fruits picking) being 2 fruits/picking as sub-plot treatments. There were 24 treatment combinations all together. The unit plot size was 4 m × 2.4 m. The initial soil test analyses were given in Table 1.

Table 1. Some physical and chemical properties of the soil of experimental plots prior to Sowing of crops

Year	Texture	pH	OM	meq $100g^{-1}$				μg g^{-1}					
			%	Ca	Mg	K	NH4-N	P	S	B	Cu	Mn	Zn
2005	Sandy clay loam	5.8	0.82	2.3	1.5	0.18	0.19	11	12	0.2	8	40	1.5
2006	Sandy clay loam	5.7	0.88	2.5	1.6	0.18	0.18	10	12	0.2	7	35	1.4
Critical level	-	-	-	2.0	0.8	0.2	75	14	14	0.2	1	33	2

Manures and fertilizers were applied to the soil @ 100 kg P_2O_5, 150 kg K_2O, 20 kg S, 1.0 kg B, 4.0 kg Zn ,1.0 kg Mo and N as per treatment and 10 ton well rotten cowdung per hectare. The source of N, P_2O_5, K2O, S, B, Zn and Mo were Urea, TSP, MOP, gypsum, boric acid, ZnO and sodium molybdate. The total amount of cowdung, TSP, gypsum, boric acid, zinc and sodium molybdate and one-fourth quantity of urea and MOP were applied prior to planting seeds and the remaining three- fourth quantity of Urea and MP was top dressed into three equal installments 30, 45 and 60 days after planting. Seeds of the variety BARI Dheros- 1 were dibbled at the rate of 2 seeds/ hill on 4 April in both 2005 and 2006 maintaining 60 x 40 cm plant spacing. Prior to planting, seeds were soaked in tap water for 24 hours for uniform and better germination. After the germination was completed, thinning was done leaving one seedling in each hole. The harvesting of green fruit was

started on 22 May, 2005 and 25 May, 2006 but the harvest of fruits for seed was started 7 June in both the years and continued up to end of October. All the recommended cultural and plant protection measures were followed throughout the experimental period.

The data on growth parameters, green fruit characters, dry fruit characters, green fruit yield and seed yield were recorded from randomly selected 10 plants from the inner rows of the plots. The plot yield from the harvest area of 9.6 m^2 was calculated for both green fruit and seed and then it was converted to per hectare yield. For Percentage of germination and seed vigour index 100 fresh okra seed of each treatment was placed at trays with treated sands in the laboratory of ARS, Raikhali. Seed vigour index was calculated by using the formula suggested by Agarwal (1999) which is as follows-

Seed vigour index =

$$\frac{\text{No. of germinated seeds (first count)}}{\text{Days to first count}} + \frac{\text{No. of germinated seeds (2nd count)}}{\text{Days to 2nd count}} + \frac{\text{No. of germinated seeds (final count)}}{\text{Days to final count}}$$

The treatment means were separated by DMRT at 5% level of significance for interpretation of the results.

RESULTS AND DISCUSSION

Since there were no significant differences between the results of the two years in respect of different parameters pooled analyses were done and discussed accordingly.

Green fruit yield of okra was increased with the increase of nitrogen from 0 to125 kg N/ha (Table 2). Significantly higher fruit yield was recorded under 125 kg N/ha which was 12% higher than control. However, increase in nitrogen upto175 kg N/ha did not result into further increase in fruit yield over 125 kg N/ha. This is in agreement with Paliwal *et al*. (1999) and Rahman *et al*. (1992) but the result slightly differed with Talukder *et al*. (1999) and Verma *and* Batra (2001) who reported that application of 100 kg and 150 kg N/ha respectively gave the highest yield of fruit. Successive increase in nitrogen levels up to 125 kg/ha increased the fruit yield significantly over its lower levels. Nitrogen had linear response to seed yield from 0 to 125 kg N/ha and further increase of nitrogen (175 kg N/ha) did not increase seed yield (Table 4). Significantly highest seed yield was recorded under 125 kg N/ha, which was 104% and 36.8% higher than control and 75 kg N/ha. This is in partial agreement with Khan and Jaiswal (1988) and Naik and Srinivas (1992) who got the highest seed yield of okra from 150 and 200 kg N/ha, respectively. In Bangladesh Mozumder *et al*. (2002) and Uddin *et al*. (2006) got the maximum seed yield of okra at 100 and 80 kg N/ha, respectively. Birbal *et al*. (1995) and Chattopadhyay and Sahana (2000) obtained the highest seed yield from the application of 100 kg N/ha in India. Green fruit picking had linear increase of green fruit yield, the highest fruit yield being obtained from P_5 treatment (Table 2). This is in agreement with Bhuibhar *et al.* (1989) who received the highest yield of green fruit from the highest green fruit harvest (4 green fruit harvests). Isaac *et al*. (1998) also reported that green fruit picking improved fruit production in okra. Similar seed yield responses were noticed in P_0, P_1, P_2 and P_3 treatments and then seed yield decreased (Table 4). Velumani and Ramaswamy (1980) suggested harvesting 1 or 2 fresh fruits first formed without affecting seed yield and quality.

Nitrogen levels and green fruit picking combinedly put significant effect on plant height at first flowering, length of green fruit, fruit yield/plant, fruit yield/ha, number of dry fruits/plant, number of seeds/fruit, seed yield/plant and seed yield/ha but days to first flowering, days to first harvest of green fruit, diameter of green and dry fruit, weight of single green and dry fruit, weight of seeds/fruit, length of dry fruit did not show any significant interaction (Tables 3 and 5)**.** The N_2P_4 combination gave maximum plant height at 1st flowering (50.33 cm) which was at par with N_2P_3 and N_2P_5 combination (Table 3). Maximum length of green fruit was recorded in N_2P_5 (14.99 cm) closely followed by N_2P_1, N_2P2, N_2P_3, N_2P_4, N_2P_1, N_3P_1, N_3P_2, N_3P_3, N_3P_4 and N_3P_5, N_0P_5, N_1P_1 combinations. Maximum fruit yield per plant (166.45 g) as well as per hectare (5.60 t) was obtained from N_2P_5 treatment followed by N_3P_5 treatment.

Table 2. Effects of nitrogen and green fruit picking on growth, yield attributes and yield of green fruit of okra (pooled of 2005 and 2006)

Treatment	Days to 1st flowering	Days to 1st harvest of green fruit	Plant height at 1st flowering (cm)	Length of green fruit (cm)	Diameter of green fruit (cm)	Weight of single green fruit (g)	Fruit yield/ plant (g)	Fruit yield (t/ha)
Nitrogen								
N_0	30.72	38.57	35.55c	11.26b	1.25	11.02b	68.91c	2.44b
N_1	31.67	39.50	36.78c	11.33b	1.24	11.66ab	72.33b	2.48b
N_2	31.09	39.26	47.04a	12.19a	1.25	12.33a	78.43a	2.74a
N_3	31.61	39.39	44.67b	11.99ab	1.24	11.98a	72.30b	2.64a
CV (%)								
Green fruit picking								
P_0	31.38	-	39.63	-	-	-	-	-
P_1	31.45	38.86	40.04	13.70b	1.42b	13.73	23.68d	1.04e
P_2	31.14	38.91	39.68	13.78b	1.42b	13.91	57.10c	2.08d
P_3	31.50	38.45	39.92	13.94b	1.48a	14.08	88.21d	3.00c
P_4	31.12	38.49	40.68	13.93b	1.48a	14.28	116.68b	4.27b
P_5	31.05	38.16	40.36	14.43a	1.49a	14.38	151.65a	5.28a
CV (%)	4.30	6.21	6.01	4.61	4.61	6.31	4.40	6.60

Means having same letters or without letter in a column are not significantly different at 5% level of probability by DMRT
N = Nitrogen, P = Green fruit picking
N_0 = 0 kg/a, N_1 = 75 kg/ha, N_2 = 125 kg/ha, N_3 = 175 kg/ha
P_0 = No green fruit harvest, P_1 = First two green fruit harvest, P_2 = First four green fruit harvest,
P_3 = First six green fruit harvest, P_4 = First eight green fruit harvest, P_5 = First 10 green fruit harvest

Table 3. Combined effect of nitrogen and green fruit picking on growth, yield attributes and yield of green fruit of okra (pooled of 2005 and 2006)

Treatment combination		Days to 1st flowering	Days to 1st harvest of green fruit	Plant height at 1st flowering (cm)	Length of green fruit (cm)	Diameter of green fruit (cm)	Weight of single green fruit weight (g)	Fruit yield/ plant (g)	Fruit yield (t/ha)
N	P								
N_0	P_0	30.09	-	35.30gh	-	-	-	-	-
	P_1	29.82	36.94	36.24gh	12.69f	1.40	12.22	22.92k	0.89i
	P_2	31.79	38.10	35.37gh	13.45ef	1.45	12.60	52.80j	1.84h
	P_3	30.90	38.60	34.60gh	13.71cde	1.57	13.92	84.71h	2.98e
	P_4	30.17	36.23	35.30gh	13.51def	1.52	13.49	109.48f	3.93d
	P_5	31.54	37.38	33.69h	14.56a-d	1.60	14.55	145.54c	4.09b
N_1	P_0	31.58	-	36.27gh	-	-	-	-	-
	P_1	32.35	39.44	36.10gh	13.99a-e	1.46	14.40	24.05k	1.06i
	P_2	30.23	38.75	33.70h	13.54def	1.44	14.26	55.50ij	2.05gh
	P_3	32.86	38.72	35.20gh	13.26ef	1.51	13.75	88.88h	2.57f
	P_4	30.80	38.37	38.38fg	13.75b-e	1.53	14.52	114.95e	4.24c
	P_5	32.39	38.94	38.25fg	13.78b-e	1.48	13.72	152.71b	5.04b
N_2	P_0	31.88	-	43.88cd	-	-	-	-	-
	P_1	31.41	39.06	42.21cde	14.18a-e	1.47	14.23	26.21k	1.05i
	P_2	31.03	39.07	44.32cd	14.55a-d	1.45	15.11	60.50i	2.21g
	P_3	31.64	38.33	49.40a	14.98a	1.58	15.03	96.88g	3.27e
	P_4	31.31	39.02	50.33a	14.78ab	1.53	14.92	125.24d	4.39c
	P_5	29.29	37.48	48.42ab	14.99a	1.56	15.41	166.45a	5.60a
N_3	P_0	31.98	-	41.28def	-	-	-	-	-
	P_1	32.22	39.55	41.25def	14.22a-e	1.46	14.60	22.76k	1.14i
	P_2	31.49	39.50	43.96cd	13.94a-e	1.46	14.26	52.57j	2.14g
	P_3	30.97	37.71	40.05ef	14.12a-e	1.47	14.12	84.18h	3.14e
	P_4	32.19	39.56	40.98def	13.98a-e	1.56	15.08	119.28e	4.39c
	P_5	30.85	37.26	45.26bc	14.64abc	1.53	13.51	154.93b	5.15b
CV (%)		4.30	6.21	6.01	4.61	4.79	6.31	4.40	6.60

Means having same letter or without letter in a column are not significantly different at 5% level of probability by DMRT
N = Nitrogen, P = Green fruit picking
N_0 = 0 kg/a, N_1 = 75 kg/ha, N_2 = 125 kg/ha, N_3 = 175 kg/ha
P_0 = No green fruit harvest, P_1 = First two green fruit harvest, P_2 = First four green fruit harvest,
P_3 = First six green fruit harvest, P_4 = First eight green fruit harvest, P_5 = First 10 green fruit harvest

Table 4. Effect of nitrogen and green fruit picking on yield attributes and seed yield of okra (pooled of 2005 and 2006)

Treatment	Dry fruits (no.)	Weight of single dry fruit weight (g)	Seeds/ fruit (no.)	Weight of seeds /fruit (g)	Length of dry fruit (cm)	Diameter of dry fruit (cm)	Seed yield/ plant (g)	Seed yield (t/ha)
Nitrogen								
N_0	17.60d	5.72	33.95d	1.96d	15.98c	1.50	36.73c	1.24c
N_1	23.03c	5.58	37.68c	2.27b	17.75b	1.51	52.13b	1.85b
N_2	26.98a	6.12	42.48b	2.60a	18.27a	1.53	69.95a	2.53a
N_3	26.14b	5.94	43.30a	2.66a	18.63a	1.52	69.75a	2.54a
Green fruit picking								
P_0	24.25d	5.69	39.49b	2.47a	17.62	1.51	58.88b	2.15b
P_1	24.73c	5.74	39.89a	2.42a	17.44	1.48	60.75ab	2.20ab
P_2	24.77b	6.03	39.75a	2.42a	17.72	1.53	61.93ab	2.26a
P_3	25.47a	5.58	39.30c	2.40b	17.52	1.51	62.68a	2.25a
P_4	21.93e	5.86	38.91d	2.33d	17.91	1.52	51.90c	1.88c
P_5	18.65f	5.93	38.86d	2.30e	17.69	1.53	43.71d	1.60c
CV (%)	5.01	10.55	4.53	3.91	4.57	4.61	6.33	6.30

Means having same letter or without letter in a column are not significantly different at 5% level of probability DMRT
N = Nitrogen, P = Green fruit picking
N_0 = 0 kg/a, N_1 = 75 kg/ha, N_2 = 125 kg/ha, N_3 = 175 kg/ha
P_0 = No green fruit harvest, P_1 = First two green fruit harvest, P_2 = First four green fruit harvest,
P_3 = First six green fruit harvest, P_4 = First eight green fruit harvest, P_5 = First 10 green fruit harvest

Table 5. Combined effect of nitrogen and green fruit picking on yield attributes and seed yield of okra pooled of 2005 and 2006)

Treatment combination		Dry fruits (no.)	Weight of single dry fruit weight (g)	Seeds/ fruit (no.)	Weight of seeds /fruit (g)	Length of dry fruit (cm)	Diameter of dry fruit (cm)	Seed yield/ plant (g)	Seed yield (t/ha)
N	P								
N_0	P_0	18.14l	5.85	34.19lm	1.99	16.10	1.55	35.66ef	1.29f
	P_1	18.54l	5.72	34.52l	2.05	15.94	1.49	37.33ef	1.34f
	P_2	18.92kl	5.94	34.67lm	2.05	16.18	1.56	38.13e	1.39f
	P_3	19.46k	5.78	34.15m	2.02	15.99	1.55	38.76e	1.39f
	P_4	16.47m	5.49	33.50n	1.93	16.21	1.55	31.34fg	1.02g
	P_5	14.05n	5.71	33.50n	1.91	15.98	1.51	27.03g	0.98g
N_1	P_0	23.99i	5.55	38.00j	2.30	17.89	1.54	54.20c	1.95d
	P_1	24.47hi	5.88	38.37i	2.35	17.71	1.48	57.26c	2.00d
	P_2	24.96gh	5.89	38.20ij	2.33	17.97	1.54	57.95c	2.03d
	P_3	24.94gh	5.35	37.95j	2.34	17.77	1.46	57.38c	2.07d
	P_4	21.41j	5.50	37.23k	2.24	17.99	1.47	47.20d	1.67e
	P_5	18.20l	5.30	37.24k	2.22	17.74	1.51	39.74e	1.46f
N_2	P_0	27.83de	5.53	42.90f	2.64	18.34	1.53	73.04a	2.69ab
	P_1	28.39bcd	6.15	43.12de	2.68	18.16	1.52	74.90a	2.73ab
	P_2	28.95b	6.32	42.93ef	2.67	18.42	1.52	76.19a	2.75ab
	P_3	29.82a	5.74	42.67f	2.66	18.22	1.52	77.80a	2.79ab
	P_4	25.35g	6.80	42.25g	2.61	18.45	1.54	64.86b	2.40c
	P_5	21.14j	6.46	41.84h	2.55	18.29	1.56	53.90c	1.99d
N_3	P_0	27.01f	5.87	43.57bc	2.70	18.52	1.49	73.59a	2.67ab
	P_1	27.55f	5.38	44.00a	2.74	18.34	1.46	74.35a	2.71ab
	P_2	28.09cde	6.13	43.84ab	2.75	18.67	1.55	76.02a	2.86a
	P_3	28.84bc	5.82	42.98def	2.69	18.47	1.53	76.18a	2.78ab
	P_4	24.51hi	5.98	43.13de	2.70	19.39	1.53	64.20b	2.35c
	P_5	20.83j	6.40	43.55cd	2.65	19.12	1.54	54.15c	1.99d
CV (%)		5.01	10.55	4.53	3.91	4.57	4.61	6.33	6.30

Means having same letter or without letter in a column are not significantly different at 5% level of probability by DMRT
N = Nitrogen, P = Green fruit picking
N_0 = 0 kg/a, N_1 = 75 kg/ha, N_2 = 125 kg/ha, N_3 = 175 kg/ha
P_0 = No green fruit harvest, P_1 = First two green fruit harvest, P_2 = First four green fruit harvest,
P_3 = First six green fruit harvest, P_4 = First eight green fruit harvest, P_5 = First 10 green fruit harvest

Maximum number of dry fruits/plant was obtained from N_2P_3 (29.82) significantly followed by N_2P_3 (28.84) and the lowest from N_0P_0. Maximum number of seeds/fruit was recorded in N_3P_1 (44.00) that were statistically similar to N_3P_2 (Table 5). The highest seed yield/plant was obtained from N_2P_3 (77.80 g) closely followed by N_1P_0, N_2P_0, N_2P_1, N_2P_2, N_3P_0, N_3P_1, N_3P_2 and N_3P_3 combinations and the lowest seed yield/plant from N_0P_0 combination. The N_3P_2 combination produced the maximum seed yield (2.86 t/ha) which was statistically similar to N_1P_0, N_2P_1, N_2P_2, N_2P_3, N_3P_0, N_3P_1 and N_3P_3 combinations. Natraj *et al.* (1992) found no adverse effect on seed yield and quality by picking 4 fruits/plant and applying 125 or 175 kg N/ha.

Quality attributes of seed were shown in Table 6. Maximum 100-seed weight (61.39), germination percentage (95.47%) and seed vigour (41.2%) were obtained when N was applied @ 175 kg /ha. Application of N @ 125 kg/ha gave identical results to 175 kg N//ha in respect of 100-seed weight, germination percentage and seed vigour. The poorer results regarding 100-seed weight, germination percentage and seed vigour were obtained when no nitrogen was applied (Table 6). These are in agreement with the report of Uddin *et al.* (2006) who got the highest germination percentage, seed vigour and 100-seed weight from 80 kg N application among 0, 40, 80 and 120 kg N/ha.100-seed weight and seed vigour except percentage of germination were significantly affected by green fruit picking (Table 6). The treatment P_3 gave maximum 100-seed weight (60.82 g) whereas P_2 produced maximum seed vigour (40.82). But there were no significant differences among P_0, P_1, P_2 and P_3 treatments in terms of 100-seed weight and seed vigour.

Table 6. Effect of nitrogen and green fruit picking on seed quality of okra pooled of 2005 and 2006)

Treatment	100-seed weight (g)	Germination (%)	Seed vigour index
Nitrogen			
N_0	57.77c	91.98c	35.76c
N_1	60.06b	94.95b	38.65b
N_2	61.23a	95.32a	40.49a
N_3	61.39a	95.47a	41.20a
Green fruit picking			
P_0	60.45a	94.02	40.54a
P_1	60.53a	94.82	40.45a
P_2	60.79a	94.94	40.82a
P_3	60.82a	94.59	40.35a
P_4	59.57b	94.94	38.37b
P_5	58.67b	94.90	36.14c
N ^ P	ns	ns	ns
CV (%)	5.25	4.87	4.11

Means having same letter or without letter in a column are not significantly different at 5% level of probability by DMRT
N = Nitrogen, P = Green fruit picking
N_0 = 0 kg/a, N_1 = 75 kg/ha, N_2 = 125 kg/ha, N_3 = 175 kg/ha
P_0 = No green fruit harvest, P_1 = First two green fruit harvest, P_2 = First four green fruit harvest,
P_3 = First six green fruit harvest, P_4 = First eight green fruit harvest, P_5 = First 10 green fruit harvest

The cost-return analysis of okra production was given in Table 7. It revealed that maximum gross return from fruit was recorded in N_2P_5 combination whereas gross return from seed, recorded in N_3P_2 combination. The Table 5 also described that gross return of seed obtained from N_2P_2, N_2P_3 and N_3P_3 were very close to the N_3P_2 combination. The total gross return (Tk.193.56 thousand/ha) and net profit (Tk.126.35 thousand/ha) were found from N_2P_3 combination followed by N_3P_3 and N_3P_2 combination. The combinations of N_2P_3, N_3P_3 and N_2P_2 also gave maximum BCR of 2.88, 2.84 and 2.79, respectively. This is in agreement with Bhuibhar *et al*. (1989) who obtained the highest economic benefit from picking of 4 green fruits per plant. Singh *et al*. (1999) also reported that green fruit picking increased seed yield compared with intact control. The combinations of N_2P_0 and N_3P_0 gave total gross return of Tk. 161.40 thousand/ha and Tk. 160.20 thousand/ha, respectively; these two combinations gave BCR of 2.57 and 2.53. From the Table 7, it was also

clear that application of 125 kg N/ha produced maximum total gross return, net return and BCR irrespective of green fruit picking and first six green fruit picking (P_3) also gave maximum total gross return, net return and BCR irrespective of N application.

Table 7. Cost-return analysis of okra production (average of two years)

Nitrogen X Picking	Yield of green fruit (t/ha)	Gross return from fruit (000Tk.)	Yield of seed (t/ha	Gross return from seed (000Tk.)	Total gross return (000 Tk.)	Cost of production (000 Tk.)	Net profit (000 Tk.)	Benefit-cost ratio (BCR)
N_0P_0*	-	-	1.29	77.40	77.40	60.20	17.20	1.28
N_0P_1	0.89	7.71	1.34	80.40	87.52	64.61	22.91	1.35
N_0P_2	1.84	14.72	1.39	83.40	98.12	64.47	33.65	1.52
N_0P_3	2.98	23.84	1.39	83.40	107.24	64.61	42.63	1.66
N_0P_4	3.93	31.44	1.02	61.20	92.64	64.68	27.96	1.43
N_0P_5	4.09	32.72	0.98	58.80	91.52	64.68	26.84	1.41
N_1P_0	-	-	1.95	117.00	117.00	61.50	55.80	1.90
N_1P_1	1.06	8.48	2.00	120.00	128.48	65.91	62.57	1.95
N_1P_2	2.05	16.40	2.03	121.80	138.20	65.97	73.23	2.09
N_1P_3	2.57	20.56	2.07	124.20	144.76	65.91	78.85	2.20
N_1P_4	4.24	33.92	1.67	100.20	134.12	65.98	68.14	2.03
N_1P_5	5.04	40.32	1.46	84.00	124.12	65.98	58.34	1.88
N_2P_0	-	-	2.69	161.40	161.40	62.80	98.60	2.57
N_2P_1	1.05	8.40	2.73	163.80	172.20	67.21	104.99	2.56
N_2P_2	2.21	17.68	2.75	166.20	183.88	67.07	116.81	2.74
N_2P_3	3.27	23.16	2.79	167.40	193.56	67.21	126.35	**2.88**
N_2P_4	4.39	35.12	2.40	144.00	179.12	67.28	111.84	2.66
N_2P_5	5.60	44.80	1.99	119.40	164.20	67.28	96.92	2.44
N_3P_0	-	-	2.67	160.20	160.20	63.23	96.97	2.53
N_3P_1	1.14	9.12	2.71	162.60	171.72	67.64	104.08	2.54
N_3P_2	2.14	17.12	2.86	171.60	188.72	67.50	121.22	2.79
N_3P_3	3.14	25.12	2.78	166.80	191.92	67.64	124.28	**2.84**
N_3P_4	4.37	34.96	2.35	141.00	175.96	67.61	108.35	2.60
N_3P_5	5.15	41.20	1.99	119.40	160.60	67.61	92.99	2.37

Green fruit: Tk. 8.00/kg, Seed: 60.00/kg ; Urea: Tk. 13.33 kg-N
* Detailed of treatments is given in Table 1.

Based on the above results, it might be suggested that picking of first 6 green fruits coupled with either 125 or 175 kg N/ha gave the highest profit for okra production. But picking of 2-4 green fruits accompanied by 175 kg N/ha was most suitable for quality seed production.

LITERATURE CITED

Ahmad, K. U. 1995. “Phal-Phul O Shak-Shabji (In Bengali)”. 5th ed. Mrs Mumtaj Kamal, Mirpur, Dhaka, Bangladesh. 400 p.

Amjad, A., Anjum, M. A. and Hussain, S. 2001. Effect of different sowing dates and various doses of fertilizers on juvenility and productivity of okra. *Pakistan J. Agril. Sci.*, **38**(1-2), 29-32.

Bhuibhar, B. R., Mahakal, K. G., Kale, P. B. and Wankhade, S. G. 1989. Effect of time of sowing and number of pickings of green fruits on growth and seed yield of okra (*Abelmoschus esculentus* (L.)Moench). *PKV Res. J.,* **13**(1), 39-43.

Birbal, Nehra, B. K. and Malik, Y. S. 1995. Effect of spacing and nitrogen on fruit yield of okra (*Abelmoschus esculentus* (L.)Moench) cv. Varasha Uphar. *Haryana Agric. Univ. J. Res.,* **25**, 47-51.

Chattopadhyay, A. and Sahana, B. C. 2000. Response of okra seed crop to nitrogen and phosphorus fertilization in acidic soil of Old Alluvial Zone, West Bengal. *Res. on Crops,* **1**(2), 176-180.

Issac, S. R**.,** Pushpakumari, R. and Saraswathy, P. 1998. Influence of green fruit picking and nutrient sources on fruit production in okra (*Abelmoschus esculentus* (L.)Moench). *J. Tropical Agric.,* **36**(1-2), 50-52.

Khan, A. R. and Jaisal, R. C. 1988. Effect of nitrogen, spacing and green fruit pickings on the seed production of okra (*Abelmoschus esculentus* (L.)Moench). *Veg. Sci*., **15**(1), 8-14.

Mozumder, S. N., Rahman, S. M. M., Rahman, M. H., Zaman, M. M. and Begum, K. 2002. Effect of N, P, K, and Mo on seed production of okra. *Bangladesh J. Seed Sci. and Tech.*, **6**(1 & 2), 119-124.

Naik, L. B. and Srinivas, K. 1992. Influence of nitrogen and phosphorous on seed crop of okra. *Indian J. Agron*., **37**(4), 769-771.

Nataraj, S.E., Kulkarni, G. N. Vyakaranahai, B. S. and Shasidhara, S. D. 1992. Effect of nitrogen levels and picking fresh fruits on seed quality of okra (*Abelmoschus esculentus* (L.)Moench). *Karnataka J. Agril. Sci*., **5**(1), 51-53.

Paliwal, R., I. S. Naruka and J. K. Yadav. 1999. Effect of nitrogen and Sulphur on growth and yield of okra (*Abelmoschus esculentus* L. Moench.) cv. pusa sawani. *Prog. Hort*., **31**(1-2), 94-97.

Rahman, M. M., Roy, S. K. and. Quasem, A. 1992. Effect of plant population and nitrogen on the yield and yield attributes of okra. *Bangladesh Agro. J.,* **4**(1 & 2), 7-12.

Rashid, M. M. 1999. “Shabjibiggayan (In Bengali)”. Rashid publishing House, 94, Old DOHS, Dhaka-1206. p. 49.

Singh, R. K., Singh, G. P. and Singh, V. K. 1999. Effect of plant growth regulators and green fruit pickings on the seed production of Bhindi (*Abelmoschus esculentus* (L.)Moench). *J. Applied Biol*., **9**(1), 31-34.

Talukder, A. S. M. H. M., Nabi, S. M., Ahmed, A. U., Anwar, M. N. and. Shaheed, M. M. A. 1999. Influence of N, P, K, Zn and Mo on okra in Grey Terrace Soil. *Bangladesh J. Agril. Res.,* **24**(3), 505-510.

Thakur, M. R. and S. K. Arora. 1986. Bhendi. *In* “Vegetable Crops in India” (T. K. Bose and M. G. Som, Eds.). Naya Prakash, 200, Bidhan Sarani, Calcata. pp. 613-622.

Uddin, M. M., Mondal, M. F., Samsuzzaman, S. and Siddique, M. A. 2006. Effect of different levels of nitrogen, phosphorous and potassium on the yield and quality of okra seed. *In* “Research Report on Horticultural Crops 2005-2006” (M. N. uddin, M. A. Rashid and M. S. Mullah (Eds.). Horticulture Research centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. pp. 108-114.

Velumani, N. P. and Ramaswamy, K. R. 1980. Effect of picking fruits on plant height and seed yeld in okra (*Abelmoschus esculentus* (L.)Moench). *Seed Res*., **8**(1), 52-58.

Verma, I. M. and B. R. Batra. 2001. Effect of irrigation and nitrogen on growth and yield of okra. *South Indian Hort*., **49**, 386-388.