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Growth and Yield of Banana Cultivars in Relation to Nitrogen Fertilization in Brown Hill Soils

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Abstract: Field studies were conducted in brown hill soils of Hill Tracts Agricultural Research Station of Ramgarh, Khagrachari hill district to find out optimum dose of nitrogen and suitable cultivar for maximizing yield of banana in hilly region. There were four levels of nitrogen (0, 100, 200 and 300 g N Plant^{-1}) and three banana cultivars (Amritsagar, Kabri and Champa) in the study. The growth and yield of banana were significantly increased with the increase of N levels. The maximum number of fingers, number of hands bunch^{-1} and highest weight of bunch and total fruit yield were recorded in 300 g N plant^{-1} in both the years of 1996-97 and 1997-98 respectively. While untreated plants (0g N Plant^{-1}) failed to produce optimum fruit yield. In interaction effect, Champa exhibited best performance when nitrogen was applied @ 300 g N Plant^{-1} followed by Kabri (Bangla) and Amritsagar in both the years. It was revealed from the correlation study that nitrogen had a strong positive correlation with the yield contributing characters of banana except days to flowering and to harvest.

Key words: Banana, Nitrogen, brown hill soils, cultivars

Introduction

Banana is an important quick growing fruit commonly grown in the Chittagong Hill Tracts regions. It is very nutritious and delicious fruit. It contains almost all the essential nutrients including minerals and vitamins (Khader *et al*., 1985). The peasants grow this fruit extensively as a cash crop using little or no manures and fertilizers. The hilly people are quite ignorant of fertilizing banana. They do not have any recommended dose of fertilizers. As a result, average fruit yield of banana appears to be very disappointed. But there is a great potential and ample scope in developing banana cultivation through judicial use of fertilizers in hilly regions. Simonds (1966) and koen (1976) in their reports found that optimum fertilization and manuring are prime need for the growth and yield of banana. There are many desert banana varieties in Bangladesh. But their performance are not same in all the regions due to differences in genetic make-up and micro-climatic variation (Ahmad *et al*., 1973). Both native and exotic cultivars of banana are highly responsive to Chemical fertilizers particularly at early stages of crop. Among the cultivars, Champa, Kabri (Bangla) and Amritsagar are widely cultivated in hill tracts region. As a quick growing fruit, banana uptakes/removes more nutrients from the soil as compared to any other crop due to their rapid and vigorous growth and higher fruit yield. Here nitrogen plays a pivotal role in synthesizing amino-acid and metabolic activities to bring earlier fruit maturity and high yield potential (Lahab, 1972). In other studies, Srinivas (1997), Tirkey *et al*. (1998) and Shailendra *et al*. (1997) reported that fruit yields significantly increased with the increase rates of Nitrogen. Despite evidences of benefits of fertilization, very limited research works have been done in fertilizer use on banana cultivation in brown bill soils of hill tracts region. Hence the present study was planned to find out the optimum dose of nitrogen for evaluating banana cultivers in the hilly region.

Materials and Methods

The field studies were carried out at Hill tracts Agricultural Research Station, Ramgarh, Khagrachari hill district in two consecutive years of 1996-97 and 1997-98 cropping seasons. The experimental soils were sandy clay loam having pH 4.2-4.5. The physical and chemical properties of the experimental soils were given below (Table 1). The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m x 4 m with a spacing of 2.5 m x 2.5 m maintained by planting sword suckers of healthy plants. There were twelve treatments combination comprising four levels of nitrogen (0, 100, 200 and 300 g N plant^{-1}) and 3 banana cultivars (Amritsagar, Kabri and Champa) were taken in the study. The blanket dose of phosphorus and potassium along with cowdung @ 200 g P, 300 g K and 10 kg CD Plant^{-1} were applied into the pits before ten days of planting. Nitrogen was applied in three equal installments. First split of nitrogen was applied to the plants just at the beginning of the monsoon shower. Second and last installment was applied at vegetative and flowering/booting stages respectively by ring placement method. The suckers were planted on late

Table 1: Physical and chemical properties of experimental soils prior to fertilization

				meq 100 gm^{-1}			μg ml^{-1}	Total						
Year	Texture	pH	OM%	Ca	Mg	K	N%	P	S	B	Cu	Fe	Mn	Zn
1996-97	Sandy Clay Loam	4.2	1.04	1.07	0.41	0.08	0.055	3.6	15.0	0.33	4.01	165	17.7	0.96
1997-98	Sandy Clay Loam	4.5	1.70	2.0	0.80	0.11	0.090	2.5	14.0	0.35	3.52	76.2	18.50	1.10
Critical level	-	-	-	2.0	0.8	0.2	-	14.0	14.0	0.2	1.0	10.0	5.0	2.0

Source: Soil Science Laboratory, BARI

October in both the years following residual moisture. Necessary intercultural operations were performed in time. Data on different yield and yield contributing Characters were recorded from randomly selected plants in each treatment. The collected data were computed for statistical analysis. The differences between treatment means were compared by least significant difference (LSD) at 5% level of significance.

Results and Discussion

Effect of Nitrogen: The means of observation of yield and yield contributing characters are presented in Table 2. It was revealed in the table showed that all the parameters except plant height were significantly increased with the increase of N up to 300 g $plant^{-1}$ in both the years. Nitrogen had a noticeable response to the vegetative growth of banana. Number of leaves and plant height were increased with the increase of N levels. Maximum number of leaves and largest plant height were recorded in 300 g N $plant^{-1}$ in both the years of 1996-97 and 1997-98. Where control treatment (0 g N $plant^{-1}$) produced poor number of leaves and small sized plants Table 2. This indicated positive influence of N to the growth of plants. Jmbulingum *et al.* (1975) and Hossain and Hoque (1988) found similar findings in their study. Days to flowering and days to harvest were sharply influenced by nitrogen. Higher rate of N reduced the number of days from planting to harvest significantly. The longest days from planting to flowering (430 and 428 days) and flowering to harvest (124 and 122 days) were observed in untreated control plants (0 g N) in 1996-97 and 1997-98. Where lowest number of days to flowering (409 and 402 days) and flowering to harvest (106 and 101 days) recorded in 300 g N $plant^{-1}$ in both the years This result is in conformity with Hasan *et al.* (1999) and Mohammad *et al.* (1989) who reported that tall cultivar like Champa requires more time to harvest if nitrogenous fertilizer is not used. Early flowering and fruit maturity responded to nitrogen and potassium were also stated by Chattopadhyay (1980). Nitrogen had a tremendous effect on yield and yield attributes of banana. Number of hands, number of fingers, bunch weight and fruit yield were significantly influenced by N application. Maximum bunch weight (10.55 and 10.60 kg) and highest fruit yields (32.0 and 33.13 t ha^{-1}) were recorded in 300 g N $plant^{-1}$ in 1996-97 and 1997-98 respectively. Where as control treatment (0 g N) failed to perform optimum yield (10.33 and 11.03 t ha^{-1}) in both the years. Dawood *et al.* (1999) found highest yield in 138 g N $plant^{-1}$ where Singh and Suryanaryana (1999) and Manica *et al.* (1978) recorded highest bunch weight and fruit field in 200 g N and 300 g N $Plant^{-1}$ respectively.

Effect of cultivars: The means of growth and yield contributing characters are shown in Table 2. Green leaves, plant height, days to flowering, days to harvest, number of hands per bunch, number of fingers per bunch weight of bunch and fruit yield were significantly influenced by different genetic make-up of the cultivars. Among three cultivars of banana (Amritsagar, Kabri and Champa), Champa showed best performance in all respects followed by Kabri (Bangla) and Amritsagar. Maximum number of leaves, higher plant height and shortest growth and maturity periods (days) were observed in Champa followed by Kabri where Amritsagar exhibited poor performance. Highest number of fingers (24 and 122), larger bunch weight (12.41 and 12.30 kg) and highest fruit yield (23.01 and 31.12 t ha^{-1}) were recorded by Champa followed by Kabri (107.5 and 108.01 fingers), (8.92 and 8.87 kg) and (21.10 and 22.0 t ha^{-1}) and Amritsagar (87.97 and 88.00 fingers), (7.62 and 7.5 kg) and (15.49 and 16.02 t ha^{-1}) respectively in both the years of 1996-97 and 1997-98. Russo (1996) and Joubert *et al.* (1997) found similar findings by evaluating different cultivars in their investigation.

Interaction effect of nitrogen and banana cultivars: The means of observation accommodated in Table 3 reflected that most of the yield and yield attributes were highly influenced by nitrogen and cultivars of banana. It was clearly indicated that means of the parameters increased profusely with the increase of N levels for the three cultivars but their response to nitrogen was quite differed. The number of green leaves and plant height were found increased up to 300 g N $plant^{-1}$ for all the varieties. The maximum number of leaves (6.40 and 6.36) and larger plant height (3.49 m and 3.47 m) were recorded in 300 g N $plant^{-1}$ by Champa variety followed by Kabri (4.96 and 4.98) and (3.36 m and 3.40 m) respectively in both the years. This result confirmed with the findings of Manson (1985). On the contrary, days to flowering and days to

Table 2: Main effects of nitrogen and cultivars on the growth and yield of banana at HARS, Ramgarh during 1996-97 and 1997-98

N Level	No. of green leaves		Plant height (m)		Days to flowering		Days to harvest		No. of hands/bunch		No. of fingers/bunch		Wt. of bunch (kg)		Fruit yield t ha^{-1}	
g plant^{-1}	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98
0	3.28	3.23	1.19	1.21	430	428	124	122	6.93	6.89	99	98	8.64	8.61	10.33	11.03
100 g	4.76	4.74	2.67	2.66	425	421	122	120	7.42	7.44	102	103	9.61	9.63	20.49	21.12
200 g	4.95	4.96	2.80	2.81	416	428	118	117	7.49	7.48	108	111	9.80	9.83	26.87	25.50
300 g	6.17	6.15	3.84	3.86	409	402	106	101	7.96	7.98	114	115	10.55	10.60	32.0	39.13
LSD	*	*	NS	NS	*	*	*	*	*	*	*	*	*	*	*	*
Effect of Cultivars																
Amritsagar	3.95	3.93	1.83	1.80	446	443	128	126	6.42	6.41	87	88	7.62	7.59	15.49	16.02
Kabri	4.69	4.70	3.35	2.33	428	443	118	117	7.64	7.62	107	108	8.92	8.87	21.10	22.0
Champa	5.72	5.74	3.48	3.51	386	384	105	104	8.30	7.99	124	122	12.41	12.3	29.01	31.12
LSD (0.05)	*	*	NS	NS	*	*	*	*	*	*	*	*	*	*	*	*

* =Significant at 5% level
NS= Not significant

Table 3:Yield and yield contributing Characters of Banana as influenced by nitrogen and banana cultivars at HARS, Ramgarh during 1996-97 and 1997-98

Banana cultivar	N g plant^{-1}	No. of green leaves		Plant height (m)		Days to flowering		Days to harvest		No. of hands/bunch		No. of fingers/bunch		Wt. of bunch (kg)		Fruit yield t ha^{-1}	
		1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98	1996-97	1997-98
Amritsagar	0	3.61	3.62	2.20	2.22	460	461	136	137	5.51	5.50	80	80	6.83	6.80	10.27	10.22
	100 g	3.90	3.88	2.70	2.71	449	448	132	131	6.57	6.52	82	83	7.77	7.68	15.70	16.01
	200 g	4.14	4.12	2.81	2.80	445	446	124	123	6.65	6.67	94	93	7.90	7.88	17.5	17.43
	300 g	4.15	4.32	2.84	2.86	430	433	122	121	6.93	6.95	97	96	7.99	8.01	18.50	18.61
Kabri	0	4.18	4.12	3.10	3.02	442	441	121	120	7.53	7.50	100	101	8.04	8.07	19.63	10.06
	100 g	4.71	4.68	3.1	3.22	436	437	119	120	7.61	7.62	107	104	8.76	8.75	20.08	20.12
	200 g	4.91	4.87	3.31	3.30	422	420	117	117	7.67	7.70	109	108	8.86	8.88	21.87	21.88
	300 g	4.96	4.98	3.36	3.40	411	413	115	116	7.73	7.75	113	110	10.00	10.01	23.17	24.12
Champa	0	5.04	4.96	3.26	3.37	404	403	114	116	7.76	7.77	118	116	11.06	11.0	25.09	12.00
	100 g	5.65	5.64	3.67	3.32	394	396	113	113	8.09	8.08	121	122	12.00	12.60	25.70	25.73
	200 g	5.79	5.68	3.43	3.46	376	375	111	112	8.15	8.20	124	122	12.65	12.70	29.24	29.02
	300 g	6.40	6.36	3.49	3.47	370	369	109	106	9.21	9.20	133	131	13.62	13.80	36.00	37.02
LSD (0.05)		0.06	0.08	NS	NS	30.29	30.27	1.77	1.79	0.31	0.30	6.26	6.27	0.08	0.09	0.75	0.77
CV%		7.0	6.66	-	-	4.3	5.0	6.00	6.00	2.70	3.0	3.50	4.20	5.0	4.70	2.5	3.6

Table 4: Correlation between nitrogen and yield contributing parameters of Banana

Nitrogen vs yield parameters	Regression equation	Correlation co-efficient (r values)
Nitrogen vs green leaves	Y = 0.002 x + 4.275	0.99 **
Nitrogen vs plant height	Y = 0.0015 x + 2.22279	0.93 *
Nitrogen vs days to flowering	Y =-0.0456 x + 431.97	0.89 NS
Nitrogen vs days to harvest	Y =-0.0346 x + 126.59	0.69 NS
Nitrogen vs No. of hands/bunch	Y = 0.0021 x + 6.8963	0.93 *
Nitrogen vs No. fingers/bunch	Y= 0.0378 x + 96.972	0.91 *
Nitrogen vs weight of bunch	Y=0.004 x + 8.60	0.97 **
Nitrogen vs fruit yield t ha^{-1}	Y= 0.0472 x + 10.297	0.98 **
N= 4	r value : $P_{0.05=0.95}$ $P_{0.01=0.99}$	

** = Highly significant at 1% level
* = Significant at 5% level
NS = Not significant

harvest were markedly reduced by the increase of nitrogen. Which indicated nitrogen response to banana was more pronounced than other nutrients. The lowest number of days from planting to flowering (370 and 369 days) were recorded in 300 g N $plant^{-1}$ by Champa. Where untreated (0 g N) Amritsagar exhibited longer duration towards maturity (460 and 461days) and (136 and 137 days) in 1996-97 and 1997-98 respectively. Yield contributing characters like number of hands, number of fingers per bunch, bunch weight and total fruit yield increased with the increase of nitrogen level. Agrawal *et al*. (1998) and Martinez *et al*. (1997) found noticeable effects on fingers/hand, bunch weight and bunch weight per ha. by applying N and K. Maximum number of fingers (133 and 131), largest bunch weight (13.62 and 13.80 kg) and highest fruit yield (36.0 and 37.02 t ha^{-1}) were obtained from Champa by applying 300 g N followed by Kabri and Amritsagar respectively in both the years (Table 3). This result is in agreement with the findings of pawar *et al.* (1997). While Agrawal (1998) found highest fruit yield by 450 g N $plant^{-1}$ and 300 k $plant^{-1}$ respectively.

Correlation studies: The relationship of nitrogen with the yield attributes of banana was presented in Table 4. It was revealed from the correlation studies showed that all the parameters except days to flowering and days to harvest were positively correlated with the levels of nitrogen. The higher value of r (0.96-0.99) suggested that there was a fairly strong relationship of nitrogen with green leaves, weight of bunch and fruit yield. It meant with the increase of N, other yield parameters also increased. On the other hand, days to flowering and days to harvest were negatively correlated.

In two years study, it was summarized that 300 g N per plant may be suggested in boosting and popularizing banana cultivation specially for Champa cv. in brown hill soils of Chittagong Hill Tracts region.

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