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THE INFLUENCE OF NITROGEN AND ZINC ON THE YIELD OF JUTE CV. 0-4

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An experiment in 1989 examined the influence of nitrogen and zinc rates on the yield and yield components of jute cv. 0-4. Nitrogen from 0- 67.5 kg/ha in increments of 22.5 kg progressively increased both fibre and stick yields. Significant difference in yield was first observed at the 45 kg N/ha level compared to the control, which persisted up to the highest rate. This influence on yield was attributable to significant increases in both plant height and stem diameter of individual plants. Nitrogen did not influence the bark thickness, bark-stick ratio and harvest index. Zinc rate did not produce any significant effect on the yield and yield parameters. Strong correlations between yield and yield parameters except bark thickness were observed, but plant diameters were found to be the major determinants to final yield.

Key words: Influence, Nitrogen, Zinc, Jute.

Introduction

The development of a number of high yielding varieties by the Bangladesh Jute Research Institute (BJRI) has substantially boosted the yield level of jute crops. However, on individual farms, high fibre yields will be achieved from these improved varieties only when plant nutrition is adequate. Many experiments have demonstrated that high applications of fertilizers, especially nitrogen, can increase the yield nearer to that of the varietal potential [1-3]. On the basis of these empirical observations, BJRI [4] has made a general recommendation that 45 kg/ha of nitrogen should be applied to its varieties except 0-9897 for the purpose of obtaining high fibre yield. There are some other opinions that nitrogen requirement of jute depend greatly on variety, growing season and site [5-6]. Further, an experiment in 1988 conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University revealed that the nitrogen requirements of jute cv. 0-9897 at this site was far greater than the optimum recommended rate [7]. Now, jute cv. 0-4 is a widely cultivated variety of *Corchorus olitorius* L. with the highest yield so far recorded to be 4.5 t/ha compared to 4.61 t as obtained from cv.0-9897 BJRI [8]. Therefore, it may of interest to examine the influence of different rates of nitrogen on cv. 0-4.

In recent years, the soils in many areas of Bangladesh have been found to be zinc deficient, particularly for jute and as such there is a general recommendeation to apply 11 kg/ha of zinc sulphate (i.e. 4.4 kg Zn/ha, BJRI) [8]. However, findings of other researchers have indicated that zinc applications do not significantly increase the fibre yield of jute crops [9-10]; The present work was, therefore, undertaken to evaluate the influence of nitrogen and zinc on the yield and yield parameters of jute cv. 0-4.

Materials and Methods

The study was conducted at the Agronomy Field Laboratory of the Bangladesh Agricultural University, Mymensingh during the period from May - August 1989. The site belongs to the Sonatola Soil Series under the old Brahmaputra Alluvium Tract, soils of which are characterized by silty loam in texture with the top soils having 14, 69 and 17% of sand, silt and clay, respectively [11]. The site was medium high land, situated above the normal flood level. The soil pH was 6.8 and the overall fertility level of soil is medium having moderate organic matter content and the status of both P and CEC is medium but low in K status as found within the BARC's [12] classification of Agro- Ecological Zones of Bangladesh.

There were 4 levels of each of nitrogen (0, 22.5, 45 and 67.5 kgN/ha) and zinc (0, 2.2, 4.4 and 6.6 kgZn/ha) used in the experiment. These sixteen treatment combinations were replicated four times within a randomized block design with each plot measuring 8 x 2.5 m.

The land was worked with a tractor-drawn disc plough after harvesting of the previous crop (mustard) and subsequently, ploughings and ladderings were done until a good tilth attained. Registered seeds of cv. 0-4 obtained from BJRI, Dhaka were sown in lines 30 cm apart on 01 May at a rate of 5 kg/ha. At the final land cultivation, a basal dressing of 10 and 46 kg/ha of P and K was applied using triple super phosphate and potassium chloride, respectively. Nitrogen, as urea, was applied in two splits, one during sowing and the other following second weeding on 10 June. Zinc was applied as Zinc sulphate to the treatment plots on 30 April. A uniform plant population was achieved in each plot at the end of second thinning.

The crop received a total rainfall of 173 cm from May to August against the long term average value of 171 cm (Table 1). The usual high rainfall in the season is sufficient to grow jute without irrigation. The rain in April 1989 was smaller to add to the soil reserve but the occurrence of showers in the first week of May helped the seeds germinate and seedlings establish without any difficulty. No marked variation in temperature during the crop growing season was observed between 1989 and the long term average.

Final harvest was made on 30th August when about 25% of the plants had set of pods. Prior to harvest, three quadrat areas, each measuring 3 rows of 50 cm, were taken from each plot by cutting plants at ground level to record plant population, bark- stick ratio and harvest index. A further random sample of ten individual plants was taken from over the plots to determine yield parameters. Yields from ten plants and quadrat areas were added to the whole plot figures to minimize procedural variations.

Data recorded from yield and yield components were compiled and subject to statistical analysis and the means adjudged by Duncan's New Multiple Range Test. Correlation coefficients were also determined to observe associations between the yield and yield parameters. Marginal return was calculated by accounting of the 1989 market price of urea, zinc sulphate and jute fibre, respectively at the rate of Tk. 5.0, 25.0 and 10.18/kg.

TABLE 1. MONTHLY MEAN TEMPERATURE °C AND TOTAL RAINFALL (cm) DURING THE CROP GROWING SEASON FOR 1989 AND THE LONG TERM AVERAGE.*

		Month				
		April	May	June	July	August
Temperature						
1989	Minimum	23.29	24.97	25.98	26.00	26.38
	Maximum	34.10	32.85	31.18	30.77	31.57
Long term	Minimum	22.31	23.75	25.75	26.02	26.23
	Maximum	32.68	31.34	31.42	30.90	31.45
Rainfall						
1989		2.4	37.5	39.4	77.6	18.8
Long term		14.2	37.9	43.7	53.1	35.8

* The long term average were derived from the 1970-1989 values. Source: Anon. (1989).

Results and Discussion

Effects of nitrogen on yield and yield component: Fibre and stick yields. Nitrogen rate significantly influenced both the fibre and stick yields in a similar manner (Table 2). Each increment of nitrogen progressively increased the fibre yield and the difference between treatments became significant first at 45 kgN/ha compared to the control. The use of 67.5 kgN/ha, on the other hand, produced the highest fibre yield (3.8 t/ha), which was statistically significant over all other treatments. The increases of fibre yield were 20, 36 and 68% respectively from applications of 22.5, 45 and 67.5 kgN/ha compared to the control, where a fibre yield of only 2.3 t/ha was recorded. This indicates that the nitrogen requirement for cv. 0-4 at this site is far greater than the BJRI's recommendation of 45 kgN/ha. Economics of fertilizer use support that the highest marginal return was obtained from 67.5 kg/ha of nitrogen application. Pandey *et al.* [5] also reported the highest fibre yield (2.3 t/ha) from an application of 67.5 kgN/ha for cv. JRO-637.

The trend in dry stick yield as influenced by nitrogen rate was similar to that of fibre yield. Stick yields were higher by 0.6, 2.0 and 4.0 t/ha respectively from the use of 22.5, 45 and 67.5 kgN/ha compared to the nil treatment. In 1968, Dargan [13] obtained the highest stick yield of 23.8 gm/plant from application of 60 kgN/ha.

Table 2 further shows that the influence of nitrogen rate on the fibre and stick yields was accompanied by the following variation in the yield parameters:

Plant population. Nitrogen rate did not significantly influence plant population, although a slight decrease in the population was observed with increasing rate of nitrogen. Islam *et al.* [7] observed a similar trend with applications of nitrogen, but these differences were not significant at harvest.

Plant height. A progressive increase in plant height was observed with increasing levels of nitrogen. The pattern was

TABLE 2. ECONOMICS OF FERTILIZER USE AND EFFECT OF NITROGEN AND ZINC RATES ON THE YIELD AND CONTRIBUTING CHARACTERS OF JUTE CV. 0-4.

Treatment	Fibre yield (t/ha)	Marginal* Yield (t/ha)	Marginal* Cost (Tk.)	Marginal* Return (Tk.)	Stick yield (t/ha)	Plant population (/m²)	Plant height (m/plant)	Basal diameter (mm/plant)	Overall diameter (mm/plant)	Bark thickness (mm/plant)	Bark stick ratio	Harvest index
N-Rate (kgN/ha)												
0.0	2.26c	–	–	–	5.74c	102.0	2.56c	9.4c	7.4c	0.89	0.81	0.28
22.5	2.71bc	0.45	250	4331	6.34bc	94.8	2.63bc	9.7bc	7.8bc	0.86	0.78	0.30
45.0	3.08b	0.37	250	3517	7.71b	88.4	2.80ab	10.4ab	8.4ab	0.90	0.87	0.29
67.5	3.80a	0.72	250	7080	9.74a	84.6	2.87a	10.9a	8.9a	0.93	0.80	0.28
Zn-Rate (kgZn/ha)												
0.0	2.82	–	–	–	7.32	97.1	2.62	9.7	7.7b	0.85	0.85	0.27
2.2	2.88	0.04	138	269	7.32	86.1	2.72	10.0	8.07ab	0.88	0.79	0.29
4.4	3.41	0.53	138	5257	8.41	100.7	2.82	10.7	8.6a	0.94	0.80	0.29
6.6	2.75	-0.66	138	-6881	6.48	86.0	2.69	10.0	8.1b	0.90	0.82	0.30
SE(±)	0.202	–	–	–	0.483	5.46	0.559	0.26	0.22	0.402	–	–

Means followed by common letter(s) do not differ significantly ($P \leq 0.05$). * Except the cost of fertilizer N and Zn other input costs considered to be constant.

such that each subsequent applications did not differ between them but the difference between alternate treatments were significant. Nitrogen rate produced taller plants by 7, 17 and 31 cm, respectively from applications of 22.5, 45 and 67.5 kg N/ha compared to the control. Ali and Razzaque [2] observed an increase in plant height by 58 cm for var. D-154 from application of 60 kgN/ha over the control (2.2 m).

Plant diameter. The influence of nitrogen on both basal and overall diameters was similar to that on plant height. The highest (10.9 mm/plant) and lowest (9.4 mm/plant) basal diameters were obtained from 67.5 and 0 kg levels of nitrogen application, respectively. The variation in overall diameter between treatments were comparatively small, although some of the values differed significantly.

Bark thickness. Nitrogen treatments did not make any difference in bark thickness with the plants attaining an overall mean bark thickness of 0.90 mm/plant.

Bark-stick ratio and harvest index. Bark-stick ratio showed no definite pattern with increasing levels of nitrogen application. Nitrogen rate did not produce any effect on the harvest index.

Effect of zinc on yield and component. Applications of zinc fertilizer from 0 - 6.6 kgZn/ha with increments of 2.2 kg did not significantly influence either the fibre yield or stick yield (Table 2). However, a trend in increase of these parameters together with a high marginal return was noted up to an application of 4.4 kg/ha of zinc fertilizer. A similar effect was apparent in all yield components except overall diameter, where a significant increase was achieved at 4.4 kgZn/ha level compared to the control. This influence, however, cannot explain much since yield differences from zinc applications were not enough to be significant. The result of the present experiment with respect to zinc application in jute contrasts to that of Ahmad [14], who found a significant response of yield as well as yield components from the 0-4 cultivar of jute. This variation between the present study and that of Ahmad [14] could be due to either differences in the environment or native fertility status of the soil.

The results obtained from this experiment, therefore, indicate that zinc status in this site as observed from crop performance is not as critical as proper N nutrition for the production of jute cv. 0-4.

Correlations between yield and parameters. All parameters except bark thickness were strongly correlated ($P<0.001$) to both fibre and stick yields (Table 3). The associations between basal diameter and each of fibre and stick yields were greater than that of plant height, overall diameter, bark weight and bark thickness. The highest correlation value ($r=0.967$) was obtained between the plant height and overall diameter.

Taking all the characters under consideration, correlations coefficients were further partitioned into components of direct and indirect effects by path analysis following the description of Dewey and Lu [15]. This reveals that basal diameter had the maximum direct effect on the fibre yield (0.910) followed by overall diameter (0.829) (Table 4). The significant positive correlations of bark weight and plant height with fibre yield were actually visualized through the positive indirect effects of basal and overall diameters. This strongly signifies that plant diameters (both basal and overall) are actually the major determinants to fibre yields of jute crop.

The interaction effect between nitrogen and zinc rates was not significant for yields and yield components either.

The present study revealed that nitrogen rate progressively increased both the fibre and stick yields of jute cv. 0-4 from the 0 up to 67.5 kgN/ha. Since, 67.5 kg/ha was the highest rate included as treatment, a response of the crop beyond this level for the cultivar under study may be expected. Therefore, future research in this aspect should be planned by including treatments beyond 67.5 kgN/ha for the cultivar and site under consideration. Further, zinc application in this experiment did not produce any significant yield improvement which, therefore, contrasts to the BJRI's recommendation. At the present moment, however, it would be rather difficult to arrive at a definite conclusion whether to apply zinc fertilizer on jute cv. 0-4 at this site. For this, more research work should be continued over seasons, especially by accounting of soil status and plant tissue content with respect to zinc treatments.

TABLE 3. CORRELATION COEFFICIENTS BETWEEN PLANT CHARACTERS OF JUTE CV. 0-4.

Characters	Plant height	Basal diameter	Overall diameter	Bark weight	Bark thickness
Fiber yield	0.847***	0.893***	0.884***	0.837***	0.339
Stick yield	0.834***	0.874***	0.859***	0.858***	0.292
Plant height	–	0.947***	0.967***	0.971***	0.327
Basal diameter	–	–	0.963***	0.959***	0.486
Overall diameter	–	–	–	0.956***	0.452
Bark weight	–	–	–	–	0.461

*** $P< 0.001$

TABLE 4. DIRECT AND INDIRECT EFFECTS OF COMPONENT CHARACTERS ON THE FIBRE YIELD OF JUTE CV. 0-4.

Variable	Indirect effects through					Total
	Bark thickness	Bark weight	Overall diameter	Basal diameter	Plant height	correlation with yield
Bark thickness	<u>-0.229</u>	-0.021	0.375	0.442	-0.228	0.339
Bark weight	-0.105	<u>-0.046</u>	0.793	0.873	-0.677	0.837***
Overall diameter	-0.103	-0.044	<u>0.829</u>	0.876	-0.674	0.884***
Basal diameter	-0.111	-0.043	0.798	<u>0.910</u>	-0.660	0.893***
Plant height	-0.075	-0.048	0.802	0.862	<u>-0.697</u>	0.847***

Underlined values indicate direct effects; Residual effects: 0.4011; ***$P< 0.001$

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