

Jute fibre production considering chemical constituents and economic cost analysis

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Abstract

A study was undertaken to clarify jute fibre production in relation to chemical composition and low economy using the jute variety BJC-7370. The highest fibre yield (3.2 t/ha), stick yield (6.5 t/ha) and the best quality fibre was found with combination of N₁₀₀P₅K₃₀S₁₀ kg/ha treatment. Quantitative analyses of the chemical composition of the fibre were made from the stage of 15th day growth of the plant upto 120th day. The presence of lignin and formation of fibre were detected at the very early age of the jute plant. Study revealed that fibre reached its optimal values from the age of 60 days. From the economic point of view, it was found that combination of N₁₀₀P₅K₃₀S₁₀ kg/ha showed higher BCR. So, the growers can be considered as the best combination N₁₀₀P₅K₃₀S₁₀ kg/ha for the jute variety BJC-7370 in terms of BCR, yield and quality.

Keywords: Jute fibre, BCR and Chemical composition

Introduction

Jute is one of the leading cash crops of Bangladesh. Out of country's total supply of raw jute in 1987-1988, 64.8 percent was used for mill consumption, 7.6 percent for house hold use and 27.8 percent for closing carryover (FAO, 1988) ^[1] whereas in 1999-2000, 75.74 percent was used for mill consumption, 9.43 percent for house hold use and 14.82 percent for closing carryover (FAO, 2001) ^[2]. The crop occupies a key position in the economy of Bangladesh by ensuring a considerable amount of foreign exchange, taxes, levies, sales and custom duties. Bangladesh occupied a major share of the world's total raw jute production until early seventies. But since 1972-1973 the country has been losing its monopoly in the world jute trade. The share of Bangladesh in the world jute production has fallen from 47.7 percent in 1972-1973 to 26.9 percent in 1986-1987 and 24.1 percent in 1999-2000 (FAO, 1988) ^[1] and (FAO, 2001) ^[2]. Now a day the area under jute cultivation is being reduced due to some constraints. Jute are reduced by 15 percent from the year 1986 to 1996 (BBS, 1999) ^[3]. In recent years, there is an increasing trend of production per unit area (BBS, 1997) ^[4]. Jute fibre is produced mainly from white jute (*C. capsularis*), and tossa jute (*C. olitorius*). In Bangladesh, jute sector accounts as a whole for 10% labour and 7% of GDP. Jute and jute- based products are put to a wide range of uses. Food and Agricultural Organization (FAO) has declared 2009 as the International Year for Natural Fibre which reflects the importance of this group of commodities to many countries. Considering all these facts, improvement of fibre yield and quality of jute is the prime need of Bangladesh. In this aspect, research regarding development of new high yielding variety of jute is very important. Importance of fertilizers on the growth, yield and quality of fibre crops is well established ^[5-15]. It is necessary to find a fertilizer combination which is economically profitable and at the same time gives yield very close to maximum yield potential. Therefore, much attention should be given towards the improvement of yield and quality

of jute fibre to bring back the past glory of Bangladeshi jute. Considering the above facts, the present study has been undertaken to observe the growth, yield and quality of the pre-released jute variety, BJC-7370 with chemical fertilizer to achieve the maximum yield potential relating to chemical constituents and economic potentiality.

Materials and Methods

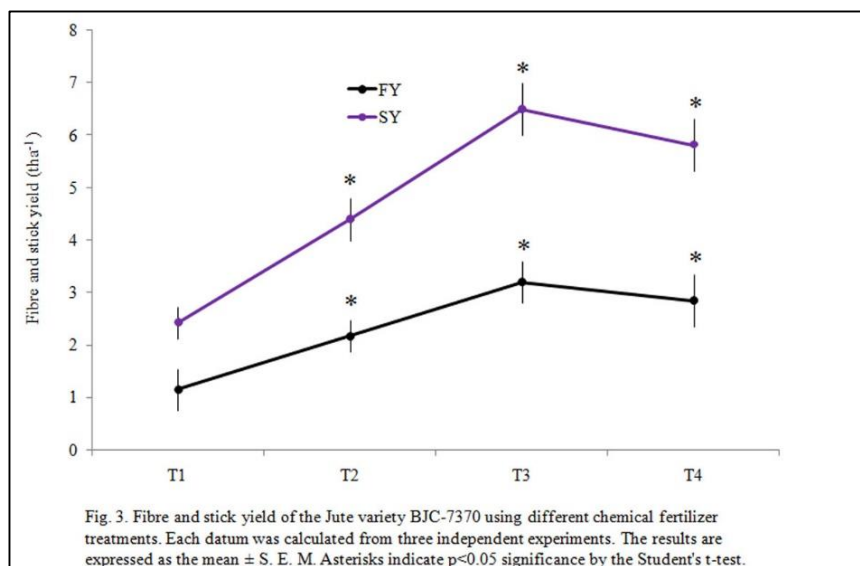
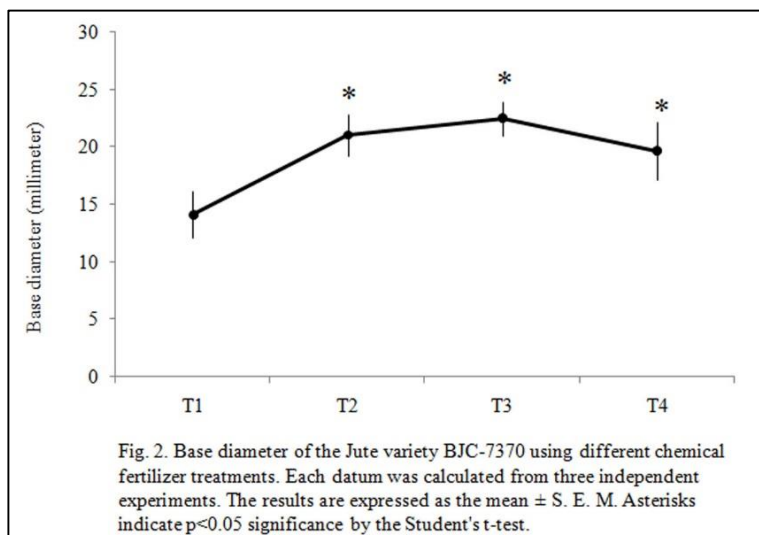
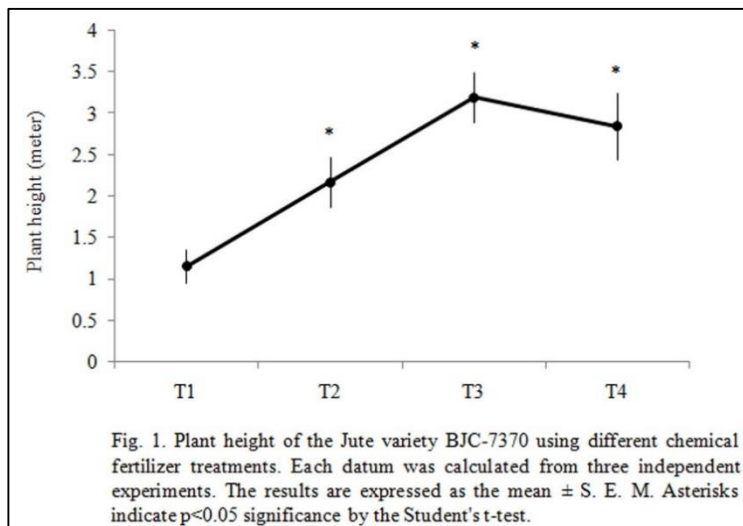
The experiment was laid out in randomized complete block design (RCBD) with three replications. A total 4 treatments (T₁:N₀P₀K₀S₀; T₂:N₅₀P₅K₃₀S₁₀; T₃:N₁₀₀P₅K₃₀S₁₀; T₄:N₁₅₀P₅K₃₀S₁₀) combinations along with a control were distributed randomly in each plot. The dimension of unit plots was 3 m × 3 m having 1 m space between the plots, blocks and around the field. There was 20 cm deep drain around each block and plot. At the beginning of the experiment, the land was well prepared and fertilizers were applied as per treatment. Required amounts of chemical fertilizers were applied in the form of urea, TSP, MOP and gypsum. Urea was applied in two splits: half amount was applied at sowing and the rest half was top dressed at 45 DAS (days after sowing) while all other fertilizers were applied at the time of sowing. Jute seeds were broadcasted at the rate of 8 kg/ha. All cultural operations were done as and when necessary. The crop was harvested on 120 DAS. After shedding of leaves, the bundles were steeped plot-wise in pond water for 15-20 days for retting and fibre was extracted. At harvesting time, six plants were selected at random from each plot and tagged in the field to note plant height (PH), base diameter (BD), fibre yield (FY) and stick yield (SY). Statistical and economic analyses were also carried out. Formation of lignin in the Jute plant was detected using phloroglucinol test. The fibres were separated from the jute plant and the presence of lignin was examined by treating carefully with phloroglucinol reagent. Chemical constituents of jute fibres from 15 days to 120 days of growth age were determined. The standard analytical procedures for estimation of alpha cellulose, ^[16] Hemicellulose, ^[17] Lignin

contents, [18-a, b, c], Fatty materials and ash content [19] were followed.

Results and Discussion

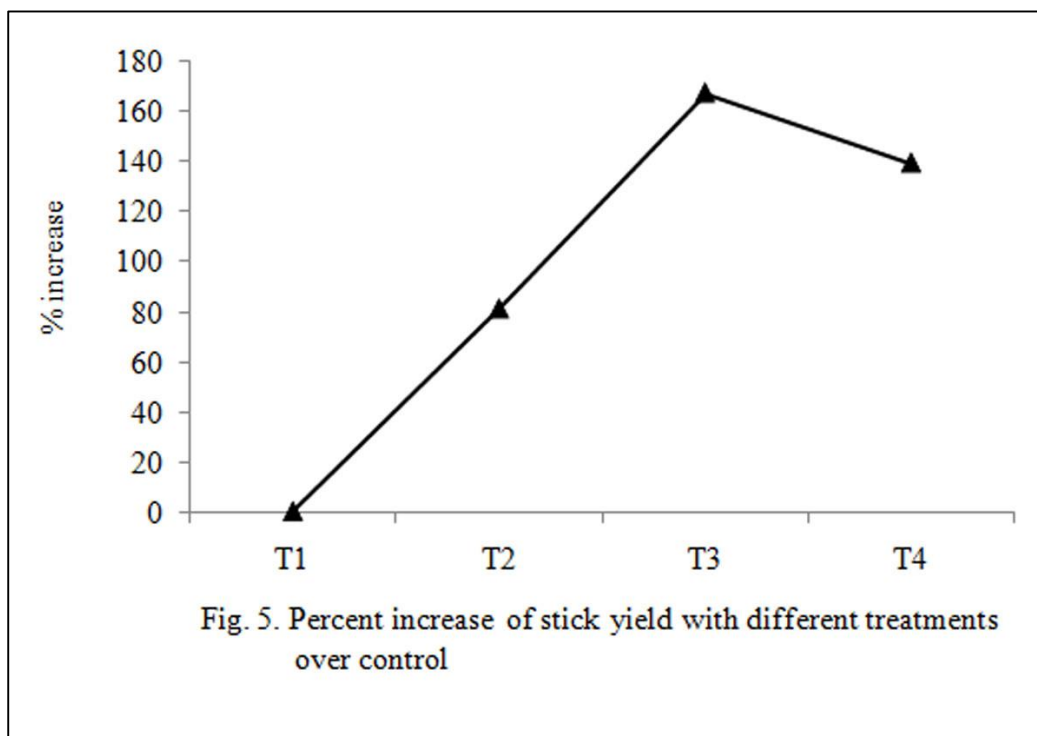
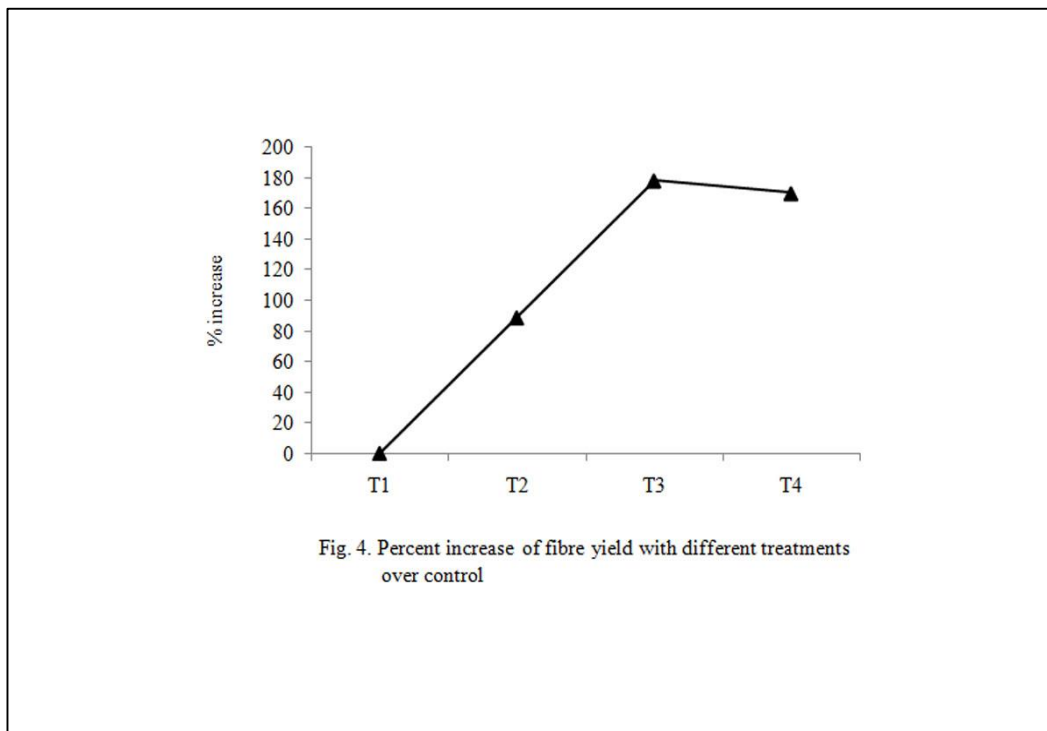
Application of combined chemical fertilizers showed

significant positive effect on all the growth parameter like plant height (Fig. 1), base diameter (Fig. 2). The maximum PH (3.1 m) and BD (22.50 mm) were found by the treatment T₃ (N₁₀₀P₅K₃₀S₁₀).



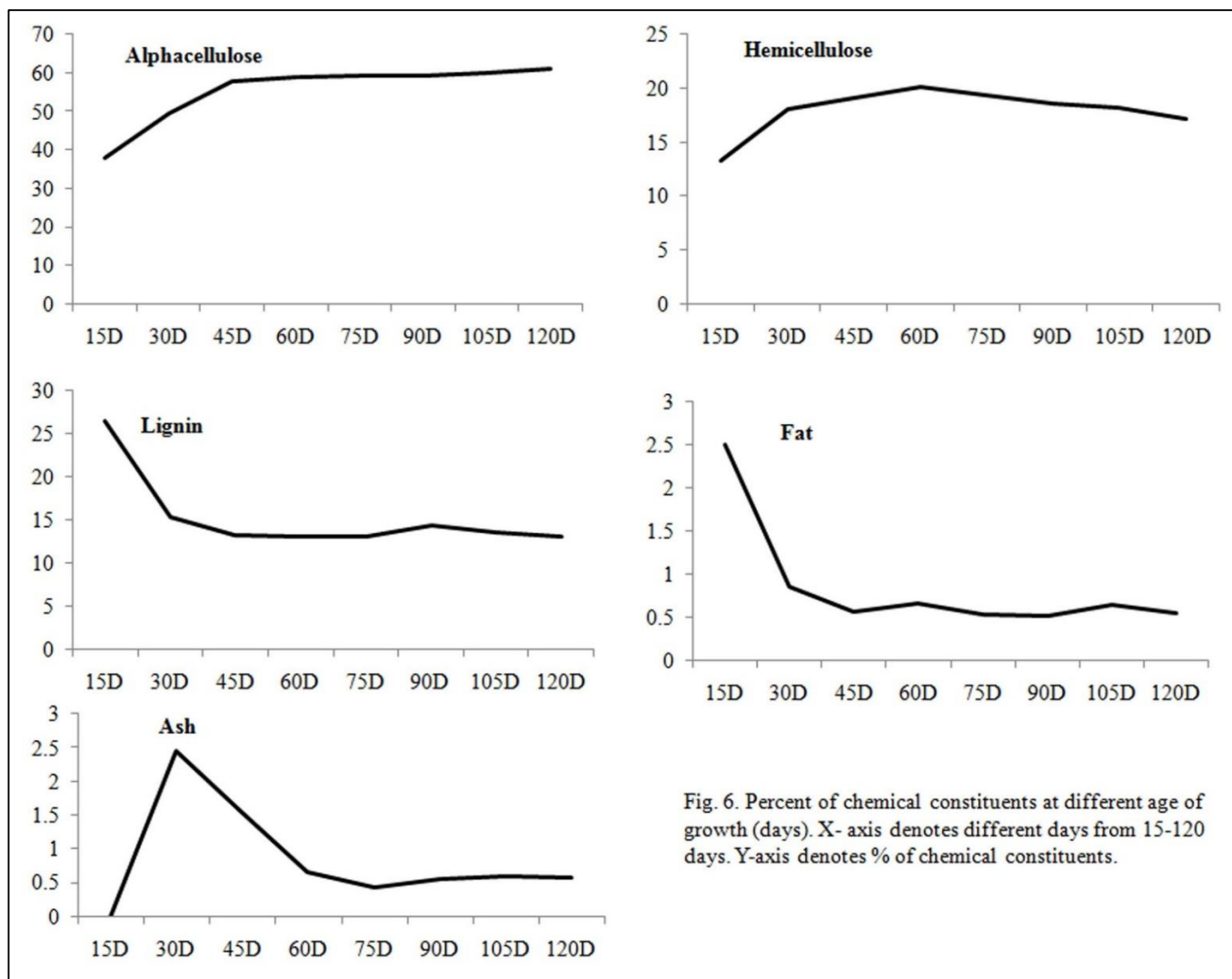
Application of different treatments showed statistically significant positive effect on fibre yield (FY) and stick yield (SY) of jute. Highest FY (3.2 t/ha) and SY (6.5 t/ha) were

accounted with T₃ (N₁₀₀P₅K₃₀S₁₀ kg/ha) treatment (Fig. 3), which were 178.3 and 167.5% higher than control (Figs 4 and 5).



Based on FY and SY, the treatment can be ranked in the order of T₃> T₄> T₂> T₁. The best FY and SY were found with the combination of N₁₀₀P₅K₃₀S₁₀. The same result found for different *C. capsularis* varieties [20-23]. The lignin on jute fibre is very important to determine its quality. The biological growth of jute plants started with the formation of lignin. At early stage plant growth of jute fibres

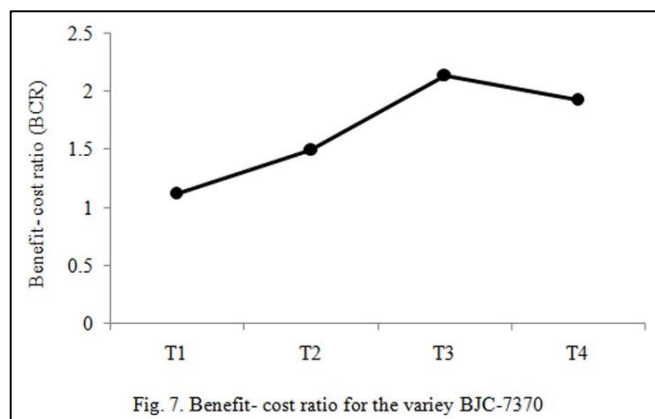
were so tender and adhered to cuticular and other cellular tissues that they were hardly separated and the results of their chemical constituents were not reproducible. The fibre bundles were, however, separated by careful retting of the 15 days old plants and the different chemical constituents of fibre were determined periodically at an interval of 15 days. The results are shown in Fig. 6.



It was shown that cellulose and hemicellulose were comparatively lower in the fibre in the early stages and gradually increased (Fig. 6) until it reached the age of about 60 days when they were leveled off upto the age of 90 days. It can be explained that the molecular formation of cellulosic materials was not completed at the early stage and so, the components were of low molecular weight/D.P. and dissolved in strong alkaline solution during their analysis. Lignin and fat content were predominantly higher than the average values in mature fibre, because of the fact that they were naturally needed for the hardness of the plants to stand up during the growth periods. It was also shown that the age of 45 days of the fibre seemed to be critical as regards its chemical composition, because all the chemical constituents of the fibre attained the molecular maturity and showed regular pattern of percentage of their contents when the age of the fibre was at near 60 days upto the age of 90 days. The fibres after 90 days of growth seemed to be over matured when alpha cellulose content was gradually increased and hemicelluloses decreased indicating development of some molecular, physical and structural complexity in the fibre. The results suggest that more molecular incrustation and compactness of the chemical structure of the fibre took place when the plants were left for over maturity.

Economic analysis was made considering the variable cost of fertilizers, seeds, labor and price of fibre and stick. This

reveals that T₃ (N₁₀₀P₅K₃₀S₁₀ kg/ha) treatment was the most cost effective treatment as it gives the highest benefit cost ratio (BCR) of 2.14 (Fig. 7) which is highly profitable.



The entire treatments had significant positive impact over control (T₁) on growth and yield and quality parameters and effect of combined fertilizers on them were explained. The most important parameter, fibre yield (3.2 t/ha) and stick yield (6.5 t/ha), were recorded highest with N₁₀₀P₅K₃₀S₁₀ kg/ha (T₃) treatment. From the results of economic analysis, combination of N₁₀₀P₅K₃₀S₁₀ kg/ha showed higher BCR (2.14). Considering

all these aspects, specially yield and BCR, T₃ (N₁₀₀P₅K₃₀S₁₀ kg/ha) treatment seems to be the best combination for this Jute variety BJC-7370.

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