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Early Vegetative Growth and Fibre Yield in Tossa Jute (*Corchorus olitorius* L.)

[1]F. A. Hayder Talukder, [1]Sontosh Chandra Chanda, [2]A. K. M. Golam Sarwar,
[3]P.K. Bhander and [4]M.N. Islam
[1] Agronomy Division, Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka-1207.
[2] Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, Bangladesh
[3] Seed Technologist, ACI Ltd. BRAC Centre, Mohakhali, Dhaka, Bangladesh
[4] Entomology Division, Bangladesh Jute Research Institute,
Manik Mia Avenue, Dhaka-1207, Bangladesh

Abstract: An experiment was conducted with Tossa Jute (*Corchorus olitorius* L.) cultivars O-9897 and O-4 to study the early vegetative growth and fibre yield. Both the cultivars showed congrous gain in plant height. Leaf spread increased up to 40 days and declined thereafter. Leaf number per plant, length and breadth of leaf increased with the increase in age of the plants. Total dry matter production per plant increased rapidly up to 30 days in both the cultivars. At the time of first harvest at 20 days after emergence (DAE), the leaf dry weight became double (2.37 g) as compared to that of the stem (1.31 g). Stem dry weight increased rapidly during the period of 20 to 30 days and thereafter the stem maintained higher dry weight till the senescence of the plant. The RGR, NAR and LAR were relatively higher at the early stage of growth and then began to decrease sharply with the increase in age of the plants in both the cultivars. Both RGR and NAR increased a little at 50 to 60 DAE. There were significant positive correlations between early growth attributes viz., plant height, leaf number per plant, length and breadth of leaf and LAI, and fibre yield. It is concluded that there is an ample scope of increasing fibre yield through vigourous vegetative growth at early stage.

Key words: Jute, early vegetative growth, dry matter partitioning, fibre yield

Introduction

Jute fibre, obtained from the bark (secondary phloem), is the cheapest and the most important of all the natural fabrics next to cotton due to its high productivity and superior quality. In jute the fibre of commerce is laid on the stem during the process of vegetative growth (Palit and Bhattacharyya, 1982). The enhancement of reproductive phase with gradual cessation of vegetative growth, especially in height of the stem, reduces the yield capacity of Jute. Hence, it is important to have vigourous vegetative growth prior to the onset of flowering for higher productivity of fibre. There are several parameters e.g. plant height, base diameter, expansion of leaf etc. to measure growth over time. Recently, dry matter production and partition are widely used to measure growth over time (Erickson, 1976). There are some reports on leaf growth (Saha and Paul, 1985), growth attributes analysis (Hossain *et al.*, 1983; Hossain and Paul, 1984; Johansen *et al.*, 1985; Khandakar *et al.*, 1990) and source-sink control (Palit and Bhattacharyya, 1982) in jute. However, the information on early vegetative growth in relation to yield in jute is lacking. Therefore, the present piece of research work was undertaken to find out :

i) Differences in early vegetative growth attributes of different cultivars.
ii) Dry matter production and partitioning in stem and leaf at different ages of the plants.
iii) Relationships between early vegetative growth attributes and fibre yield.

Materials and Methods

The experiment was carried out at the field laboratory of Agronomy Division, Bangladesh Jute Research Institut, Dhaka, during the jute growing season in 1997 and 1998.A randomized complete block design (RCBD) was followed , where each treatment was replicated thrice. The size of each plot was 3.33m x 3.33m. Seeds were sown in line on 7th April in both the years with 30 cm row to row and 7 cm plant to plant distance. The crop was grown following the recommendation of BJRI (Anon, 1992). Plant protection measures were taken as and when required. Five plants were harvested as working sample from each line after 20 days of emergence (DAE) and collection of working sample continue up to 60 DAE with 10 days interval. Data were collected on plant height, number of leaves per plant, length and breadth of leaves, leaf spread, total dry matter (TDM) produced in above ground portion. The above ground plant parts were separated into leaf and stem. The separated plant parts were oven dried at 84^{0}C for 72 hrs. and dry weight of stem and leaves at each harvest were recorded. Leaf area was measured by the formula of Saha and Paul (1984). Various growth attributes were calculated following the classical growth analysis methods of Radford (1967). Data were analyzed statistically using the Excel computer package.

Results and Discussion

Plant height increased and differed significantly at different harvests (Table 1). In both the cultivars, plant height increment was rapid in early growth period compared to later ones. The rate of increase in plant height of O-4 was higher than that of O-9897 throughout the study period. However, there was no significant difference in height in both the cultivars. The leaf number per plant, length and breadth of leaves followed the similar trend (Table 1). The rate of increase in leaf number per plant was higher up to 40 DAE in O-9897 and decrease later on. The average life span of Tossa jute leaves was found to be 30 to 35 DAE. This result is in full agreement with Palit and Bhattacharyya (1982). Leaf spread increased up to 40 DAE and thereafter declined (Table 1).

There was significant difference in leaf area index (LAI) with the advancement of time (Fig. 1). The LAI increased congruously up to 40 DAE and declined thereafter. This might be due to the senescence of leaves at 30 to 35 DAE. In both the cultivars, RGR, NAR and LAR were higher in the early stage of growth and declined with the advancement of age (Fig. 2, 3 & 4). Similar findings were also reported by Khandakar *et al.* (1990). Hussain and Paul (1984) indicated

Table 1: Different growth parameters at different harvest

Harvest (DAE)	Variety	Plant height (cm)	Leaf spread (cm)	Number of leaves	Leaf length (cm)	Leaf breadth (cm)
		x ± S.E	per plant x ± S.E	x ± S.E	x ± S.E	
20	O-9897	10.81 ± 1.45	9.29 ± 2.02	6.98 ± 0.66	3.63 ± 0.56	1.53 ± 0.16
	O-4	11.20 ± 1.72	8.60 ± 1.70	5.99 ± 0.56	3.47 ± 0.61	1.53 ± 0.14
30	O-9897	29.44 ± 6.18	15.99 ± 2.40	9.56 ± 1.86	8.50 ± 0.78	3.17 ± 0.30
	O-4	30.61 ± 7.21	17.62 ± 2.52	10.39 ± 2.180	8.84 ± 0.96	3.28 ± 0.28
40	O-9897	48.28 ± 8.78	20.98 ± 2.14	14.48 ± 2.41	11.43 ± 0.91	4.91 ± 0.41
	O-4	49.99 ± 10.43	20.00 ± 1.95	12.59 ± 2.24	11.62 ± 0.81	4.67 ± 0.35
50	O-9897	67.73 ± 11.44	20.44 ± 1.91	15.40 ± 2.32	12.04 ± 0.63	5.39 ± 0.30
	O-4	69.73 ± 13.72	18.48 ± 1.86	14.30 ± 2.11	12.76 ± 0.45	4.94 ± 0.17
60	O-9897	82.41 ± 17.56	19.47 ± 1.62	17.15 ± 3.43	14.33 ± 0.78	6.11 ± 0.35
	O-4	86.30 ± 18.65	20.89 ± 1.73	18.23 ± 3.81	13.19 ± 0.41	5.54 ± 0.17

Table 2: Co-efficient of determination (R^2) among different physiological parameters

	RGR x NAR	RGR x LAR	RGR x LAI	NAR x LAR	NAR x LAI	LAR x LAI
O-9897	0.998**	0.672^{NS}	0.973*	0.4321^{NS}	0.933*	0.579^{NS}
O-4	0.961*	0.0872^{NS}	0.882^{NS}	0.0409^{NS}	0.836^{NS}	0.186^{NS}

** significant at P < 0.01 levels * significant P < 0.05 levels NS = non-significant

Table 3: Dry matter partitioning into different parts at different harvest

Harvest (DAE)	Variety	Dry weight per plant (g)		
		Total	Stem	Leaf
20	O-9897	2.97	0.81	2.16
	O-4	3.68	1.31	2.37
30	O-9897	15.54	11.61	3.93
	O-4	18.68	13.62	5.06
40	O-9897	22.12	13.58	8.54
	O-4	23.72	16.31	7.41
50	O-9897	26.77	19.84	6.93
	O-4	24.72	19.66	5.08
60	O-9897	33.31	26.52	6.80
	O-4	38.29	30.17	8.12

Table 4: co-efficient of determination (R^2) among different growth characters and yield

	Plant height	Leaf spread	Leaf Number	Leaf length	Leaf breadth	LAI
O-9897	0.9795**	0.7925^{NS}	0.9533*	0.9874**	0.9788**	0.8095*
O-4	0.9712**	0.6909^{NS}	0.9539*	0.9003*	0.8987*	0.9539*

** significant at P < 0.01 levels * significant P < 0.05 levels NS = non-significant

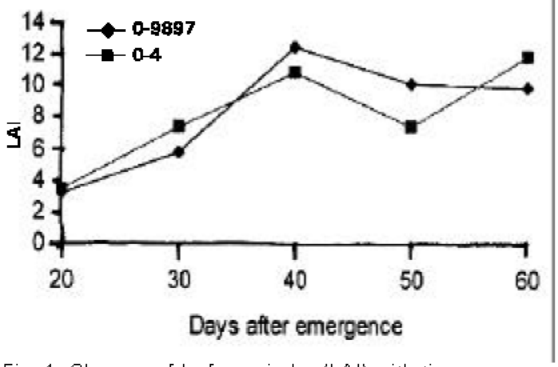

Fig. 1: Changes of leaf area index (LAI) with time

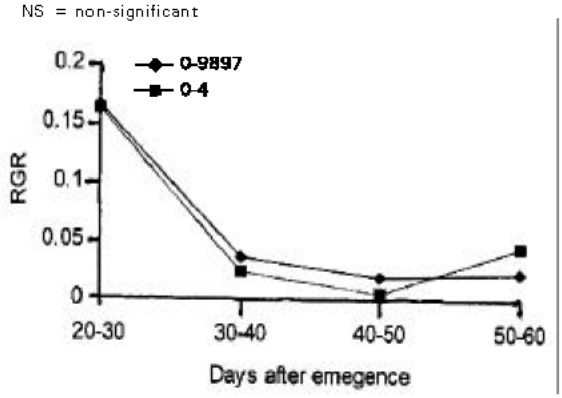

Fig. 2: Changes of relative growth rate (RGR) with time

that in early stages of growth RGR of jute crop remained higher and it declined in advancement of age. Canopy closure, as well as, lower average canopy photosynthesis rate had influenced the decline in RGR (Hussain and Paul, 1984). The NAR was the highest from 20 to 30 DAE. This result is in full agreement with that of Johansen *et al.* (1985). Both RGR and NAR declined sharply at 30-40 and 40-50 DAE and then increased a little at 50-60 DAE (Fig. 2 & 3). This might be due to the increase in total leaf number and in length and breadth of leaves, which helped to increase photosynthesis. The LAR declined at lower rate compared to those of RGR and NAR.

The NAR, RGR and LAR of O-9897 at earlier stages of growth appeared to be slightly higher as compared to O-4. This might be due to higher values of LAI of O-9897 at earlier stages of growth. Simple correlation analysis indicated that significant positive correlations were found among RGR, NAR and LAI, and between NAR and LAI (Table 2). Hussain and Paul (1984) reported similar results.

Total dry matter production per plant increased rapidly at 30 DAE in both the cultivars (Table 3). At first harvest (at 20 DAE) the leaf dry weight was double as compared to that of stem. It was 2.16 g and 2.37 g in leaf and 0.81 g and 1.31

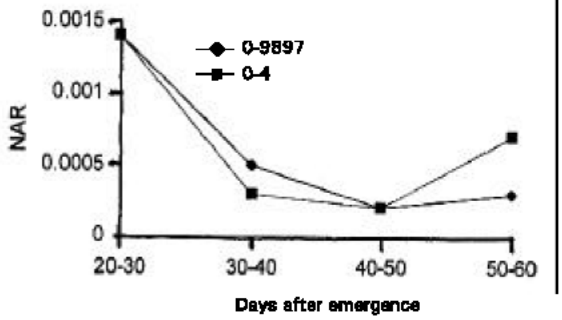

Fig. 3: Changes in net assimilation rate (NAR) with time

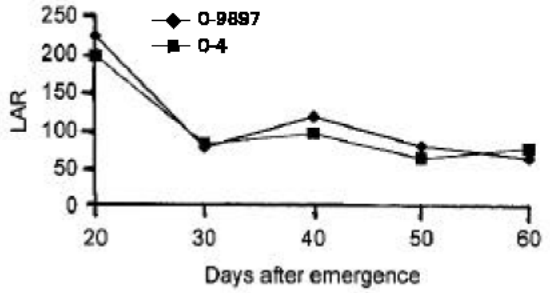

Fig. 4: Changes of leaf area ratio (LAR) with time

g in stem of O-9897 and O-4 respectively. After 20 days, the stem dry weight increased rapidly and maintained higher dry weight till the senescence of the plant. The result is contradictory to the results of Hossain *et al.* (1983) and Talukder (1992). They reported that the partitioning of dry matter in leaves was higher at early stages of growth up to 50 days. Johansen *et al.* (1985) observed that dry matter of leaf, bark and stick showed differential partitioning of dry matter depending on the age of plant. They also observed that partitioning of dry matter in leaf was higher in early stages. The stem dry weight received a major portion of TDM production by the plant.

From Table 4, it is also evident that there are significant positive correlations among the early growth characters and yield of Jute. Johansen *et al.* (1985) reported that the plant height is more closely related to dry matter produced than is base diameter. They also reported that the proportion of fibre (harvest index) reached a maximum of 18-20% at about 75 DAS for D-154 and 60 DAS for O-4.

The results showed that the early growth attributes is very important for higher fibre yield. It concluded that there is an ample scope of increasing fibre yield through vigourous vegetative growth at early stage.

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