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Effect of Bast Fibre Cultivation on Soil Fertility

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Abstract: An experiment was conducted to study the estimate of total biomass (shedded leaves plus roots) during bast fibre crop (jute, kenaf and mesta) cultivation and the performance of biomass in soil fertility. The newly released four varieties of Bangladesh Jute Research Institute were used in the trial viz. Deshi jute BJC-83, Tossa jute OM-1, kenaf HC-95 and mesta HS-24. Each of the new variety produces good amount of biomass and enriches the soil fertility. The highest biomass produced with HC-95 (7.30 t ha^{-1}) and lowest BJC-83 (5.23 t ha^{-1}). Appreciable performance recorded with each of the variety in enriching the soil fertility on post harvest soil. Highest organic carbon (1.31%) nitrogen (0.13%) phosphorus (18 ppm) and potassium (0.183 meq/100) were found with the variety HC-95. The percent increment of organic carbon (OC), nitrogen (N), phosphorus (P) and potassium (K) by the HC-95 were 87.14, 150.00, 63.64 and 30.71 respectively over the initial soil nutrient content. According to the performance of the production of biomass and soil enrichment the varieties were in the order of HC-95> HS-24> OM-1> BJC-83.

Key words: Bast fibre, biomass and soil fertility

Introduction

In Bangladesh the bast fibre crops (jute, kenaf and mesta) are being used for commercial cultivation (Anonymous, 1988) and as a whole 10% labour involvement of the country, 7% GDP accounts for in this sector (Ahmad *et al.*, 1998). The each and every parts of fibre plants is beneficial to human life, the young leaves are edible and has some medicinal value too, fibre is used for multiple use and the sticks are used as fuel, fencing and raw materials for paper pulp and hardboard (Siddiquee, 1998). Moreover bast fibre crops is friendly to environment and enrich the soil fertility (Sadannanda and Manapatra, 1972; Anonymous, 1995; Gani *et al.*, 1999) due to natural addition of plants leaves and roots in soil during cultivation.

As the bast fibre production is beneficial, so its cultivation is common practices in Bangladesh and includes the different variety of fibre crop in different cropping patterns (i.e., jute - rice-wheat, jute rice potato, jute rice mustard etc.). Nutrient improvement of soil varies with the species and varieties of crops as well as it depends on the amount of shaded plants biomass in soil (Alam *et al.*, 1991). It is important to know the variety wise production rate of biomass and their contribution in soil fertility. Some work has been done in Bangladesh regarding this point of view with different varieties of jute (Gani *et al.*, 1999) but there has no references with Kenaf and Mesta. Newly introduced popular varieties by Bangladesh jute Research Institute such as HC-95 (kenaf); HS-24 (mesta); OM-1 (Tossa jute) and BJC-83 (Deshi jute) has yet not been observed their performance on soil fertility. Therefore it is need to study with these varieties of bast fibre crops to assess the nutrient contribution in soil through biomass addition.

The objectives of the study are 1. To estimate the biomass of each variety.2. To asses the nutrient status of soil due to biomass addition of Individual variety. To establish a fertilizer rate for the succeeding crop (crop after bast fibre cultivation) on the basis of residual nutrient left in soil by the each variety.

Materials and Methods

A field trial was conducted at Jute Research Central Station, Manikganj during 1997 to 1999. The experiment was laid out in randomized block design with three replications and unit plot size was 3 x 3 m^2. The space between the plot, blocks and around the field was one meter. The following treatments were used in the experiment:

T_1 + leaves+roots (both leaves and roots were allowed to decompose)
T_2 +leaves-roots (only leaves were allowed to decompose)
T_3 +roots-leaves (only roots were allowed to decompose)
T_4 -leaves-roots (control leaves and roots were not allowed to decompose).

The each variety under bast fibre crops such as OM-1 (Toss Jute), BJC-83 (Deshi Jute), HS-24 (mesta) and HC-95 (Kenaf) was sown according to treatments to obtain individual varietal efficiency. The seeds were kept in line sowing and maintain the recommended distance in line to line (30 cm a part). All the intercultural practices such as weeding, thinning, insecticides and pesticides were done as and when necessary. A standard plant population was maintaining in the experimental plot for each variety. After 45 days of sowing the leaves shedding were started and to estimate the total biomass the shaded leaves of the control plots (T_4) were collected (for counting) 5 to 7 days intervals till the date of harvest (at the stage of 120 days of plant) and removed the roots in the same harvest date. The number and weight of the leaves and roots were recorded. To determine the influence of root in soil, the leaves were not allowed shaded in T_3 plots but roots were allowed to decompose. Similarly the leaves of T_2 plots were allowed to decompose to obtain the effect of leaves on soil and the roots were removed just after the harvest. In estimating the simultaneous effect of leaves and roots on soil, both were allowed to decompose in T_1 plots. After the harvest of plants, 70 days were allowed for root decomposition during the study. The soil samples collected three times, 1) Initial soil (before sowing) 2) at the date of harvest from control plots and 3) after 70 days of harvest from T_1, T_2 and T_3 plots at a depth of 0 to 15 cm.

The collected soil samples were processed for analysis, particle size analysis of the soils were made by combination of sieving and hydrometer method as described by Day (1965) and textural classes were determined by Marshall's Triangular coordinate curve. Soil organic carbon was determined by wet oxidation method (Walkly and Black, 1934) and nitrogen by Microkjeldahl method (Jackson, 1973), Soil pH, phosphorus (P) and potassium (K) were determined by ASI method (Hunter, 1984). The initial and post harvest soil analytical results are presented Table 1 and 3.

Results and Discussion

Biomass production: The Table 2 showed that among the four varieties of bast fibre crop (HC-95, HS-24, BJC-83 and OM-1) the HC-95 gave the highest plant height (4.68 m), base diameter (26.80 mm) and total biomass (shedded leaves 4.2

Table 1: Physio-chemical characteristics of Initial soil

Sand %	Silt (%)	Clay (%)	Textural class	pH	OC (%)	N (%)	C/N (%)	P(ppm)	Kmeq/100
28.6	56.2	15.2	silt loam	6.9	0.7	0.052	13.46	11	0.14

Table 2: Yield and yield contributing parameters, biomass produced and added to the soil/by the bast fibre crop

Variety	P. P	Plant height (m)	Base diameter (mm)	Fibre weight t ha^{-1}	No.of shaded	No.of root leaves	Wt.of shaded lakh/ha	Wt.of roots t ha^{-1}	Total biomass added t ha^{-1}
BJC-83	2.68	3.49	17.20	2.76	141.00	2.68	2.98	2.25	5.23
HC-95 (Kenaf)	2.46	4.68	26.80	3.30	85.20	2.46	4.20	3.10	7.30
OM1 (Tossa jute)	2.65	3.55	18.50	2.95	128.29	2.65	3.50	2.80	6.30
HS-24 (Mesta)	2.49	4.60	24.50	3.24	86.45	2.49	4.00	2.99	699

P.P = Plant population

Table 3: Effect of bast fibre cultivation on soil fertility

Treatments	Variety	pH	OC%	N%	C/N ratio	P(ppm)	K meq/100	Soil nutrient status due to
T_1: +leaves +roots	BJC-83	6.57	1.15	0.090	12.78	15.0	0.158	Total biomass
	HC-95	6.50	1.31	0.130	10.07	18.0	0.183	
	OM-1	6.52	1.27	0.098	12.95	16.0	0.160	
	HS-24	6.52	1.30	0.109	12.00	17.0	0.169	
T_2: +leaves -roots	BJC-83	6.59	0.76	0.058	13.10	14.0	0.150	Leaves decomposition
	HC-95	6.52	0.95	0.072	13.33	15.0	0.165	
	OM-1	6.55	0.84	0.065	12.92	15.0	0.158	
	HS-24	6.54	0.94	0.070	13.43	16.0	0.160	
T_3: -leaves +roots	BJC-83	6.62	0.71	0.056	12.68	13.0	0.140	Root decomposition
	HC-95	6.55	0.90	0.070	12.85	14.0	0.159	
	OM-1	6.58	0.81	0.063	12.86	15.0	0.150	
	HS-24	6.57	0.85	0.068	12.50	15.0	0.151	
T_4: -leaves - roots	BJC-83	6.82	0.68	0.058	12.00	13.0	0.139	Control plot
	HC-95	6.79	0.71	0.054	13.15	13.0	0.149	
	OM-1	6.80	0.69	0.061	13.31	14.0	0.145	
	HS-24	6.82	0.69	0.055	13.00	14.0	0.148	

Table 4: The percent increment of soil fertility over the initial soil by the bast fibre crop

Variety	OC	N	P	K
BJC-83	64.86	73.08	36.36	12.86
HC-95	87.14	150.00	63.64	30.71
OM-1	81.43	88.46	45.45	14.29
HS-24	85.71	109.62	54.55	20.71

t ha^{-1} + roots 3.1 t ha^{-1} = 7.3 t/ha) and lowest with BJC-83 where plant height (3.49 m), base diameter (17.20 mm) and biomass (sheded leaves 298 , 225 and 5.23 t ha^{-1}). The results (Table 2) noticed that increased base diameter and plant height influenced the increased weight of biomass. Comparatively less number leaves (85.20 lakh/ha) and roots weight (2.25 t ha^{-1}) producer kenaf HC-95 yielded higher biomass than higher number of leaves (86.45 Lakh/ha) and roots weight (2.99 t ha^{-1}) producer Mesta HS-24. Similar behavior (Table 2) observed with the Jute varieties OM-1 and BJC-83.The variety OM-1 yielded higher biomass (6.30 t ha^{-1}) while containing lower number of shedded leaves (128.29 Lakh/ha) and roots weight (2.80 t/ha) than higher numbered Leaves (141 Lakh/ha) and roots weight (2.25 t ha^{-1}) contributor variety BJC-83. The data (Table 2) revealed that the kenaf is most efficient than mesta, tossa jute and deshi jute in biomass production. These findings are co-relates with the findings of Rahman *et al*. (1995) and Gani *et al*. (1999). They found similar trends of results with the other varieties of kenaf, mesta, tossa and deshi jute.

Soil pH: It was found that the soil pH ranged from 6.5 to 6.82 in bast fibre cultivated plots which were slightly decreased than initial soil pH value (6.9) (Table 3). The decreasing trends are due to added biomass of bast fibre crops in soil. Findings are the agreement of Magdoff and Bartlett (1985).

Soil fertility status by bast fibre crop: In post harvest soil the higher OC, N, P and K were obtained with T_1 (+leaves, +roots), T_2 (+ leaves, -roots), T_3 (+ roots, -leaves) over the control T_4 (-leaves, -roots) and initial soil nutrient status with each variety. This is due to addition of biomass. The highest OC (1.31%), N (0.13%), P (18 ppm) and K (0.183 meq/100) were found with the variety HC-95 (T_1). The

percent increment of OC, NPK by the variety HC-95 was 87.14, 150, 63.64 and 30.71 respectively, over the initial soil. These results are in conformity with Anonymous (1996), Rahman *et al*. (1995), Gani *et al*. (1999). The study revealed that in the performance of yield contributing characteristics, efficiency of biomass production and soil enrichment the varieties can be arranged or are in the order of HC-95> HS-24> MO-1>BJC-83.

Study reveals that the bast fibre crops produce good amount of biomass and enrich the soil fertility.

It may be concluded that the new information of study will helpful for the scientists for further research. The information also be a guide line for agricultural extension people and cultivator for maintaining a fertilizer rate on the succeeding crop of new bast fibre varieties OM-1, BJC-83, HC-95 and HS-24. And the possibilities of under or over fertilization on succeeding crop might be zero reduced.

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