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Comparative Effect of Water Hyacinth and Chemical Fertilizer on Growth and Fibre Quality of Jute

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Abstract: The study was conducted to estimate the chemical and physico-mechanical characteristics (quality of fibre) of jute fibre, the popular variety of O-9897 was grown with the application of water hyacinth, chemical fertilizer in soil and control under proper agricultural management. The water hyacinth responded comparatively better in enhancing the fibre quality than chemical fertilizer. Lower chemical constitutes the non-cellulosic portion (lignin and hemicellulose) in fibre indicates good quality, which found with water hyacinth. The percentage of lignin and hemicellulose in fibre with water hyacinth 12 and 20% with chemical fertilizer 13 and 21% and with control 13.6 and 21.20% respectively. The enriched physico-mechanical properties obtained with water hyacinth over the chemical fertilizer and control. The lower values of fineness (35 μ) and higher values of whiteness (22.3%), bundle strength (7.61 lbs/mg), tensile strength (80.30 lbs/mg) and breaking tenacity (39.50 lbs/mg) ascertain the high quality of fibre found with water hyacinth. And the values found in fibre with chemical fertilizer, fineness–36.50 μ, whiteness 21%, bundle strength-6.99 lbs/mg, tensile strength-78.98 lbs/mg and breaking tenacity- 39 lbs/mg. Thereby the study showed that chemical and physico-mechanical properties of fibre increased with water hyacinth. Study also indicates that the sole chemical fertilizer application in soil may not be possible to maintain the quality of fibre, it may be need an integration of organic matter and chemical fertilizer application in soil to enrich the fibre quality.

Key words: water hyacinth, jute, fibre quality, chemical fertilizer

Introduction

Jute occupies second position, being next only to cotton accounts for nearly 15% of the total output of natural fibres (Mian, 1996). It is a valuable resource for Bangladesh as foreign currency earner of the country. Jute has assumed a position of great importance in the world for its utilization in the past and also in the present century. In future demand of jute may be increased to rescue the synthetic threat and to save the global environment. The maximum utilization of jute in traditional products viz. ropes, sacking twine, hessian, carpet and geobags. But it needs to bring the jute in non- traditional mass useful products (fabrics). The quality of jute fibre differs from the quality of cotton due to some common characteristics such as high content of lignin, hemicellulose and some unfavorable (industrial aspects) physico-mechanical properties. Many workers (Chaman *et al.*, 1992; Mian, 1996; Rahman *et al.*,1992) reported the quality of jute in industrial aspect and giving efforts to the enrichment of fibre quality in different way. But there is no work in respect of fertilizer behavior on fibre quality of jute. Therefore study has been undertaken to observe: fibre quality with water hyacinth (organic matter), with chemical fertilizer application in soil, without fertilizer (control soil) to generate new information for researcher and make a suggestion of the jute growers in producing quality fibre.

Materials and Methods

The popular *Chorchorus olitorius* variety O-9897 was grown in the year 2001 at Jagir Experimental Station of Bangladesh Jute Research Institute for the study purpose. To establish the experimental objectives, seeds were sown at mid April in 3 plots where applied in soil, air dried decomposed water hyacinth @ 5 t ha^{-1}, recommended dose of chemical fertilizer (N-90, P-10, K-40 Kg ha^{-1}) and control (no water hyacinth and chemical fertilizer). All the cultural practices such as thinning, weeding, spraying of insecticides and pesticides were done properly at the growing period of jute plants. Different data of jute growth were taken (Table 1). The plants were harvested at 120 days of old. Modern technologies were followed for retting, extracting and drying. Randomly selected dried 20 kg fibre samples from each treated plot of water hyacinth, chemical fertilizer and control were taken for laboratory analysis (quality test). Some fibre samples of different treated plots were grinded and defatted by petroleum spirit to determine the chemical constituents (cellulose, hemicellulose and lignin) using standard procedure. Cellulose was determined by Cross and Bean method as described by Dorce (1950). Hemicellulose was estimated by the method of Callow (1952). The lignin component of the fibre was determined by using the method of Norman and Jenkins (1934). The physico-mechanical properties of fibre (bundle strength, whiteness, fineness, breaking tenacity and tensile strength) were determined following standard procedures: pressley bundle strength tester using zero gauge length was used to determine the bundle strength. The following empirical formulae (Anonymous, 1981) were used in assessing the breaking tenacity and tensile strength:

$$\text{Pressley index} = \frac{\text{Breaking load (lbs)}}{\text{Bundle weight (mg)}}$$

$$\text{Breaking tenacity} = \frac{\text{Breaking load (lbsX 5.36)}}{\text{Bundle weight (mg)}}$$

$$\text{Tensile strength} = \frac{\text{Breaking load (lbsX10.81)}}{\text{Bundle weight (mg)}} - 0.12$$

In whiteness estimation of fiber Leukometer was used (Anonymous, 1981). Fineness of the fiber was determined by airflow method as described by Grover and Hamby (1960). The number of replication maintained for determining the bundle strength, tensile strength and breaking tenacity were 20, whiteness 30 and for the fineness 5 respectively.

Results and Discussion

The results showed normal behavior of plant growth. The highest basal diameter (18.8 mm) and green biomass (56.90 t ha^{-1}) found with water hyacinth application in soil over the chemical fertilizer

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Table 1: Growth parameters of jute plant due to addition of water hyacinth and chemical fertilizer

Treated plots	Plant height/ plant (m)	Basal diameter/ plant (mm)	Wt. of green biomass (with leaves & stems) ton ha^{-1}
Water hyacinth @ 5 ton ha^{-1}	2.60	18.80	56.90
Chemical fertilizer N-90, P-10, K-40 Kg ha^{-1}	2.89	18.30	56.00
Control (no water hyacinth & chemical fertilizer)	2.00	16.10	32.00

Table 2: Influence of water hyacinth and chemical fertilizer on the chemical constituent of fiber

Treated plots	% of lignin	% of hemi cellulose	% of cellulose
Water hyacinth @ 5 ton ha^{-1}	12.00	20.00	65.20
Chemical fertilizer N-90, P-10, K-40 Kg ha^{-1}	13.00	21.00	65.40
Control (no water hyacinth & chemical fertilizer)	13.60	21.20	65.50

Table 3: Influence of water hyacinth and chemical fertilizer on physico-mechanical character of fiber

Treated plots	Fineness (μ)	Whiteness (%)	Bundle strength (lbs mg^{-1})	Tensile strength (lbs mg^{-1})	Breaking tenacity (lbs mg^{-1})
Water hyacinth @ 5 ton ha^{-1}	35.00	22.30	7.61	80.30	39.50
Chemical fertilizer N-90, P-10, K-40 Kg ha^{-1}	36.50	21.00	6.99	78.98	39.00
Control (no water hyacinth & chemical fertilizer)	36.56	20.20	5.80	70.90	37.00

and control (Table 1). It might be influence of micronutrients content of water hyacinth. Results also showed that plant height (2.89 m) with chemical fertilizer higher than water hyacinth, which might be the case of rapid nutrient released and quicker action of the chemical fertilizer. However the data (Table 1) reflected that water hyacinth enhanced the growth of jute plants. Anonymous, (2001) reported similar trends of results on the production of Jute seed of same variety O-9897 with different organic materials and chemical fertilizer. The percentage of lignin, hemicellulose and cellulose with water hyacinth- 12, 20 and 65.20%, with chemical fertilizer 13, 21 and 65.4% and with control 13.6, 21.2 and 65.50% respectively (Table 2). The lower content of cellulosic materials in fibre increased the fibre quality, which found with the water hyacinth in this study. The results co-relates with the findings of Mohiuddin *et al*. (1978) and Chaman *et al*. (1992). The highest value of physico-mechanical properties such as bundle strength (7.61 lbs/mg), tensile strength (80.30 lbs/mg), breaking tenacity (39.50 lbs/mg) and whiteness (22.30 %) was found with water hyacinth over the chemical fertilizer and control. It is the general agreement that higher values of above properties of fiber means the good quality of fibre, which found with water hyacinth application in soil. Lower value of fineness of the fiber indicates the super grade of the fibre, it also observed that the fibre fineness value least with water hyacinth (35.0 μ) than with chemical fertilizer (36.50 μ) and control (36.56 μ). All these findings are in agreement of Samad and Islam (1991) and Mian (1996). Study reveals that the sole chemical fertilizer might be able to maintain the fibre quality, rather integration of organic and chemical fertilizer may improve the fibre quality.

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