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Effect of NPK Fertilizers and Cowdung in Combination with Foliar Spray of Chemicals on Jute Fibre

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Abstract: The experiment was performed in the experimental land of the Institute of Biological Sciences, Rajshahi during the period of April-May, 2007 and 2008. The physical and chemical characteristics of jute fibre under different foliar treatments were investigated at mature stage. The results showed significantly increase in most of the chemical composition under different foliar treatments. Moisture content, dry matter and ash contents of jute fibre obtained from experimental land compared to those of control jute fibre after application of NPK-fertilizers and cowdung in combination with foliar spray. The moister content of jute fibre decreased whereas ash content increased significantly under different treatments. The moisture and ash contents of jute fibre were varied between 12 to 14% and 0.5 to 0.7%, respectively. On the other hand the dry matter content of jute fibre increased slightly under different treatments. The aqueous extract, fatty and waxy matter, pectic matter, α-cellulose, hemicellulose, lignin contents and tensile strength of jute fibre as compared to those of control were as follows: The maximum increase of aqueous extract 20.65% (treatment T_2), the maximum increase of fatty and waxy 22.54% (treatment T_2), pectic matter 5.49% (treatment T_6), α-cellulose 61%, hemicellulose 29%, lignin contents 7.29% (treatment T_6) and tensile strength 15.55%.

Key words: Physio-chemical compositions, treated jute fibres

INTRODUCTION

Bangladesh is facing shortage of jute fibre. Scarcity of jute fibre and high cost of chemical fertilizer also are of the factor which causes the disinterested of farmers in producing jute (Annoss, 2003). Thus, it is necessary to improve the quality of jute fibre. There are several efforts have been done and also to be extended to improve the quality of jute fibre through minimize its production cost with chemical fertilizer and to raise the soil fertility of depleted soil of Bangladesh (Karim and Razi, 1995) so that the farmers may become benefited and take interest to grow jute fibre.

Islam (1988) found that most of the cultivable soils of Bangladesh are deficient in nitrogen, phosphorus, potassium, sulfur, boron, manganese and zinc. Islam (1992) also reported that the soils of different parts of the country are suffering from deficient of Sulphar. Soil of Bangladesh contains low organic matter due to increase of cropping intensity with HYV (Karim and Razi, 1995). To increase soil productivity, it is essential to apply organic materials for obtaining sustainable yield (Robindra *et al.*, 1985). But there are little availability of conventional sources of organic materials such as cow dung, weed, green manure and compost due to some unavoidable circumstances (Gani *et al.*, 2001). So, non conventional sources of organic materials (city waste compost, sewage sludge, sow dust etc.) may be use to increase the soil fertility and yield and there by reduce the production cost. The plant growth is directly related to plant nutrition i.e., fertilization. In fact fertilizer alone contributes 50% of yield and the rest from all other factors combined together (Mukherjee, 1965).

Chemical fertilizers particularly nitrogen and potassium play a crucial role in growth jute plant. Nitrogen has also play a significant role in the construction of aminoacid compounds and proteins (Miller and Donahue, 1990; Salisbury and Ross, 1992), whilst potassium has its role in electron (e^{-1}) transport in the photosynthetic e^{-1} transport chain in supplying assimilates to Overnell (1975) and Suksri (1998) in addition. The improvement of the soil fertility with the use of soil amendments such as organic matter, crop residues and other sources e.g., cattle manure, poultry manure is urgently needed. The investigation reported here aim to improve the quality of jute fibre particularly growth of jute plant with respect to chemical components.

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In the present investigation, we first studied the effect of NPK-fertilizers in combination with foliar spray of urea and chemicals on jute plant and quality of jute fibre. The overall experimental data indicated that treatment of jute plant cultivated lands with NPK-fertilizers and cowdung as well as by foliar spray of urea, chemical and mineral mixtures might be helpful in improving the quality of jute plant and jute fibre.

MATERIALS AND METHODS

The experiment was carried out at the experimental land of the Institute of Biological Sciences, Rajshahi University, Bangladesh during the season April-May, 2007 and 2008. The experiment was laid in a Randomized Complete Block Design (RCBD) with 10 treatments and one control. The plot sizes being used were 4×5 m with a walking path between the plots of 0.50 m. The treatments being used denoted as T_1 is control while T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10} and T_{11} are the experimental. Before sowing of jute seed, cow-dung and NPK-fertilizers were applied at the ground level. Each plot received cow-dung at the rate of 250 kg ha^{-1} and NPK-fertilizers 200 kg ha^{-1}.

Firstly, after 30 days of sowing foliar spray of 0.1% of urea solution and 0.1% KNO_3 solution were performed on jute leaves in different blocks systematically.

Secondly, after 50 days sowing foliar spray of 0.1% of chemicals were applied on jute leaves. The NPK-fertilizers were applied in the form of urea (N), triple super phosphate (P) and murate of potash (K) in a broad cast method and as chemicals KCl, $Ca_3(PO_4)_2$ and Na_2HPO_4 were used. The experiment was repeated in two seasons.

After 70 days of sowing matured jute fibres were collected from the experimental research field using the traditional procedures and used for experimental purposes.

The physical properties were determined by the following procedures viz. moisture content and dry matter content (by conventional procedure), ash content (AOAC, 1980).

The data obtained was statistically analyzed by the method of analysis of variance (ANOVA) and the differences due to treatment means were determined using Dancan's Multiple Range Test (DMRT) by MSTAT programme (Nissen, 1988).

RESULTS AND DISCUSSION

The quality characteristics of treated jute fibre at matured stage was analyzed and was compared with that of a control group after using the NPK-fertilizers at ground level as well as by foliar spray of urea and mineral mixtures on the growing plant and the results are shown in Table 1 to 4.

Moisture, dry matter and ash content: The physical properties of jute fibre under different treatments analyzed by the method of analysis of variance (ANOVA) and the results obtained showed significant difference among the treatments. Moisture plays an important role in the growth activities of plants, herbs etc. water is indispensable to absorption and transportation of food to carry on photosynthesis, metabolism of materials and the regulation of temperature. The moisture of plant, as in all other living system, contributes as much as to the essential properties of life as to the more constituents like protein, carbohydrate etc. Moisture is also essential for most of the physiological reactions in plan tissue and its absence, life does not exist (Rangaswami, 1976). Researchers observed that water in the leaves improve the plant quality and better consumption. Due to the presence of moisture in jute fibre, bacterial affects become the moisture content of jute fibre was varied favorable; as a result, jute fibre degrades.

Table 1: Moisture, dry matter and ash contents of jute fibre under different treatments

	Moisture		Dry matter		Ash	
Treatments	g %	Decrease (%)	g %	Increase (%)	g %	Increase (%)
T_1	13.76±0.12f	-	86.24±0.12a	-	0.506±0.05a	-
T_2	13.66±0.23e	0.73	86.34±0.23a	0.12	0.516±0.07c	1.98
T_3	13.55±0.14de	1.53	86.45±0.14b	0.24	0.511±0.06b	0.99
T_4	13.13±0.22c	4.58	86.87±0.22d	0.73	0.521±0.03c	2.96
T_5	12.97±0.31bc	5.74	87.03±0.23e	0.91	0.586±0.04f	15.81
T_6	12.89±0.41a	6.32	87.11±0.41f	1.00	0.620±0.02gh	22.53
T_7	13.38±0.20e	2.76	86.62±0.20bc	0.44	0.523±0.05d	3.36
T_8	13.29±0.15e	3.42	86.71±0.15c	0.54	0.533±0.03e	5.34
T_9	1323.00±0.24d	3.85	86.77±0.24c	0.61	0.601±0.04g	18.77
T_{10}	12.86±0.23a	6.54	87.14±0.23g	1.04	0.662±0.02i	30.83
T_{11}	12.92±0.33b	6.10	87.08±0.23f	0.97	0.635±0.08h	25.49

In columns, the common letter(s) is not significantly different at 5% level of significance by DMRT (Duncan's Multiple Range Test). T_1: Control; T_2: Control +cowdung; T_3: Control+cowdung+KNO_3; T_4: Control+ cowdung+urea; T_5: Control+cowdung+KNO_3+minerals*; T_6: Control+cowdung+urea+minerals*; T_7: Control+NPK-fertilizers; T_8: Control+NPK-fertilizers+KNO_3; T_9: Control+NPK-fertilizers +urea; T_{10}: Control+NPK-fertilizers+KNO_3+Minerals*; T_{11}: Control+NPK-fertilizers+urea+minerals*; *KCl, $Ca_3(PO_4)_2$, Na_2HPO_4

Table 2: Aqueous extract, fatty and waxy matters and pectic matter of jute fibre under different treatments

	Aqueous extract		Fatty and waxy matters		Pectic matter	
Treatments	g %	Decrease (%)	g %	Increase (%)	g %	Increase (%)
T_1	4.02±0.12d	-	0.812±0.01ef	-	0.513±0.05de	-
T_2	4.85±0.13f	+20.65	0.995±0.02g	+22.54	0.505±0.03c	-1.56
T_3	4.11±0.15e	+02.24	0.876±0.02f	+07.88	0.511±0.05d	-0.38
T_4	4.09±0.14de	+01.74	0.798 ±0.04e	-01.72	0.479±0.02a	-6.63
T_5	3.85±0.12b	-04.23	0.689±0.09c	-15.15	0.488±0.01b	-4.87
T_6	3.93±0.14c	-02.23	0.522±0.05a	-35.71	0.541±0.04f	+5.49
T_7	4.01±0.13d	-00.25	0.544±0.03a	-33.00	0.517±0.03e	+0.78
T_8	3.67±0.12a	-08.71	0.687±0.04b	-15.39	0.509±0.02c	-0.78
T_9	3.84±0.17b	-04.48	0.762±0.02d	-06.15	0.515±0.05e	+0.39
T_{10}	3.89±0.15c	-03.23	0.683±0.04b	-15.88	0.478±0.06a	-6.82
T_{11}	3.95±0.13c	-01.74	1.034±0.03h	+2734.00	0.489±0.04b	-4.68

In columns, the common letter(s) is not significantly different at 5% level of significance by DMRT (Duncan's Multiple Range Test)

Table 3: α-cellulose and hemicellulose contents of jute fibre under different treatments

	α-cellulose		Hemicellulose	
Treatments	g %	Decrease (%)	g %	Increase (%)
T_1	61.12±1.25f	-	24.21±0.82a	-
T_2	60.13±1.22f	1.62	26.89±0.42c	11.07
T_3	59.98±1.14d	2.01	27.26±0.56f	12.59
T_4	58.95±2.13a	3.55	29.02±0.71i	19.86
T_5	59.99±1.15d	1.85	27.05±0.52d	11.73
T_6	59.01±2.12b	3.45	28.11±0.43g	16.11
T_7	60.13±1.14f	1.62	25.13±0.28b	3.80
T_8	60.02±2.15e	1.79	25.24±0.45b	4.25
T_9	59.46±1.18c	2.73	27.19±0.56e	12.31
T_{10}	59.00±1.17b	3.47	28.44±0.64h	17.47
T_{11}	60.01±2.13e	1.82	26.45±0.66c	9.62

In columns, the common letter(s) is not significantly different at 5% level of significance by DMRT (Duncan's Multiple Range Test)

Table 4: Lignin content and tensile strength of jute fibre under different treatments

	Lignin		Tensile strength	
Treatments	g %	Decrease (%)	g %	Increase (%)
T_1	11.51±0.12a	-	13.55±0.95ef	-
T_2	11.54±0.13b	00.26	12.61±1.29d	-06.59
T_3	11.66±0.15c	01.30	13.55±1.10f	+00.30
T_4	11.78±0.12d	02.35	14.43±1.52i	+06.89
T_5	11.94±0.14e	03.74	14.28±0.87h	+05.78
T_6	12.35±0.13h	07.29	15.60±0.91j	+15.55
T_7	11.54±0.12b	00.26	11.56±0.86a	-14.37
T_8	11.62±0.13c	00.95	11.94±0.90c	-11.55
T_9	11.88±0.14d	03.21	13.13±1.02e	-02.74
T_{10}	12.01±0.13f	04.34	11.63±1.35b	-13.85
T_{11}	12.22±0.14g	06.16	14.10±0.87g	+4.44

In columns, the common letter(s) is not significantly different at 5% level of significance by DMRT(Duncan's Multiple Range Test)

From Table 1 it was observed that the moisture content of jute fibre was varied from 12.86±0.23%. The highest moisture content was recorded in T_1 (control) and the lowest amount was found in treatment T_{10}. The order of moisture content of fibre was found as- $T_1>T_2=T_7=T_8=T_3=T_9>T_4=T_5=T_{11}>T_6=T1_0$ where, as treatments T_2,T_3,T_7,T_8 and T_9; T_4, T_5, T_{11}, T_6 and T_{10} were intercorrelated at 5% level of significance by DMRT. It can be concluded from the results that the moisture content of jute fibre was decreased moderately after application of NPK-fertilizers as well as cowdung and by foliar spray of urea and mineral mixtures, indicating also the accumulation of chemicals in the jute fibre.

The amount of dry matter in jute fibre under different treatments is shown in Table 1. The dry matter content was varied from 86.24±0.12 g % to 87.14±0.23 g % in different treatments. The maximum dry matter content was recorded in treatment T_{10} which was 1.04% higher than control. The mean values of dry matter under different treatments were found in order of -$T_{10} >T_6 = T_{11} > T_5 > T_4> T_9 = T_8= T_7 = T_3 = T_2> T_1$ but T_2, T_3, T_7, T_8, T_9, T_6 and T_{11} were intercorrelated at 5% level of significance by DMRT. This result indicates that the dry matter content of jute fibre depends on the absorption of used chemicals.

The ash and aqueous extract contents of jute fibre under different treatments are shown in Table 1. From the results (Table 1) it was seen that the maximum amount (0.662±0.02 g %) of ash content of jute fibre was obtained from treatment T_{10} whereas the minimum amount (0.506±0.05 g %) was from T_1 (control). The sequence of order of ash content was found as -$T_{10}> T_{11} = T_6 = T_9 > T_5 > T_8 >T_7 > T_4 = T_2 > T_3 > T_1$ but treatments T_2 and T_4 and T_6, T_9 and T_{11} were jointly affected at 5% level of significance by DMRT. The increase in ash content of experimental jute plants fibre might be due to the accumulation of inorganic elements, minerals etc.

Aqueous extract, fatty and waxy matters and pectic matter: The data in Table 2 indicated that the maximum (4.85±0.13 g %) aqueous extract content of jute fibre was obtained in fibre from treatment T_2 and the minimum amount (3.67±0.12 g %) was recorded in that from treatment T_8. The highest increase of aqueous extract of jute fibre was about 21% (T_2). The aqueous extract of jute fibre under different treatments was found as -$T_2>T_3$ =T4 = $T_1 = T_7 > T_{11} = T_6 = T_{10} > T_5 = T_9 > T_8$ but T_1, T_3, T_4 and T_7 and T_6, T_{10} and T_{11} were jointly affected at 5% level of significance by DMRT.

The maximum amount (1.034±0.03 g %) and the minimum amount (0.522±0.05 g %) of fatty and waxy matters were recorded in treatment T_{11} and T_6, respectively (Table 2). The order of fatty and waxy matters of jute fibre was found as -$T_{11} > T_2 > T_3 = T_1 > T_4 > T_9 > T_5 > T_8 = T_{10} > T_7 = T_6$ but T_1, T_3 and T_4; T_8 and T_{10} and T_7 and T_6 were jointly affected at 5% level of significance by DMRT.

Interestingly, the fatty and waxy matters of fibre was increased significantly after application of cow-dung as well as cow-dung plus potassium nitrate at ground level during cultivation while its content was decreased in all other treatments such as cow-dung plus urea, NPK-fertilizers etc. indicating the metabolic activities of some factors associated with the synthesis of fatty and waxy matters.

The maximum (0.541±0.04 g %) pectic matter of jute fibre was observed in treatment T6 while the minimum (0.478±0.06 g %) pectic matter was in treatment T_{10} (Table 2). The order of pectic matter was found as -$T_6 > T_7 = T_9 = T_1 = T_3 > T_8 = T_2 > T_{11} = T_5 > T_4 = T_{10}$ but T_4 and T_{10}; T_5 and T_{11}; T_2 and T_8 and T_1 , T_3, T_9 and T_7 were jointly affected at 5% level of significance by DMRT.

α-cellulose and hemicellulose: From Table 3 it was observed that jute fibre obtained from treatment T_2 and T_7 contained the maximum (60.13±1.14 g %) amount while the treatment T_4 contained the minimum amount (58.95±2.13 g %) of α-cellulose in jute fibre (Table 3). The percentage of decrease of α-cellulose in jute fibre obtained under the treatments such as T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10} and T_{11} were 1.62, 2.01, 3.55, 1.85, 3.45, 1.62, 1.79, 2.73, 3.47 and 1.82%, respectively. The present data clearly demonstrated the α-cellulose contained of jute fibre was decreased moderately under different chemical treatments and the percentage of decrease was found to be 1.62-3.55% less as compared to that present in jute fibre of control plant.

Results in Table 3 showed that hemicellulose content in jute fibre was varied from 24.21±0.82 g % to 29.02±0.71 g %. The highest hemicellulose was observed in treatment T_4 and the increase was about 20% were as the lowest amount was in T_1 (control). The order of hemicellulose was found in order of -$T_4 > T_{10} > T_6 > T_3 > T_9 > T_5 > T_2 = T_{11} > T_8 = T_7 > T_1$ but T_2 and T_{11} and T_7 and T_8 were jointly affected at 5% level of significance by DMRT. It might be concluded from the results that hemicellulose contents of jute fibre under different treatments increased significantly.

Lignin content and tensile strength: The data in Table 4 showed that lignin content of jute fibre was varied from 11.51±0.12 g % to 12.35±0.13 g %. The maximum lignin content of jute fibre was found in treatment T_6 and the minimum lignin content was recorded in T_1 (control). The order of lignin content was found as- $T_6 > T_{11} > T_{10} > T_5 > T_9 = T_4 > T_3 = T_8 > T_7 = T_2 > T_1$ but T_2 and T_7; T_8 and T_3 and T_4 and T_9 were jointly affected at 5% level of significance by DMRT. Although, lignin content of jute fibre was increased under all the treatments but among the treatments T_6 contained the highest amount followed by T_{11} then T_{10} and son in decrease order. It may also suggest from the results that the lignin content of fibre increased pronouncedly after foliar application of urea and mineral mixtures to the growing jute plant.

The tensile strength of jute fibre was varied from 11.56±0.86 g % to 15.60±0.91 g %. The highest tensile strength of jute fibre was recorded in treatment T_6 and the lowest tensile strength of jute fibre was observed in treatment T7. the order of tensile strength of jute fibre was found as -$T_6 > T_4 > T_5 > T_{11} > T_3 = T_1 = T_9 > T_2 > T_8 > T_{10} > T_7$ but T_1, T_3 and T_9 were intercorrelated at 5% level of significance by DMRT. Tensile strength of jute fibre was varied depending on the chemical used which is due to variation of different constituents in jute samples.

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