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NUTRIENT REQUIREMENT OF ADVANCED *Olitorius* BREEDING LINE O-0512-6-2 FOR MAXIMUM GROWTH AND YIELD

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Abstract

The research work was conducted at Jute Agriculture Experimental Station (JAES) Manikganj and Jute Agriculture Regional Station (JARS) Faridpur of Bangladesh. The present study aimed at determining the nutritional requirement for optimum growth and yield of an advanced *olitorius* breeding line of O-0512-6-2 in Bangladesh. The experiment was laid out in RCBD with 10 treatments having three replications during the year 2019, 2020 and 2021. The results indicated significant effect on yield and yield contributing characters over control with different fertilizer (NPKS) levels of advanced *olitorius* breeding line of O-0512-6-2. The highest number of plant height, base diameter, green weight with leaves and without leaves was observed by the treatment T_3 ($N_{100}P_{10}K_{25}S_{20}$) which is statistically significant. The highest fiber yield (2.75 t ha^{-1}) and stick yield (6.50 t ha^{-1}) at Manikganj and highest fiber yield (2.58 t ha^{-1}) and stick yield (6.09 t ha^{-1}) at Faridpur was also obtained by the combined dose of $N_{100}P_{10}K_{25}S_{20}$ (T_3) kg ha^{-1}. Therefore, this combination $N_{100}P_{10}K_{25}S_{20}$ Kg ha^{-1} seemed to be optimum for maximum growth and yield of advanced *olitorius* breeding line of O-0512-6-2.

Introduction

Jute is an eco-friendly and the major cash crop in Bangladesh. Bangladesh produces 33 % of the total worldwide production of jute. Bangladesh's top priority is to improve jute fiber yield and quality. Bangladesh generated jute fiber on an average of 7.45 lakh ha of land per year (BBS, 2021). Jute holds an important position in the industrial sector of the economy of Bangladesh (Islam and Ali, 2017). However, from 2010-2011 and onwards, the area and development grew dramatically as people became more environmentally conscious and shifted to natural fibers to avoid harmful effects of synthetic fibers on the environment. As a result, demand for jute fiber has risen in recent years, both domestically and internationally. Jute fiber is produced mainly from white jute (*Corchorus capsularis*) and tossa jute *(Corchorus olitorius*). Demand of jute fiber is being increased in the recent years both in home and abroad (Islam and Ali, 2018). Jute fiber is used to make many different sorts of bags, wools, ropes, sacks, and coverings. The superior quality jute fiber is used for making carpets, twine, curtains, cloth etc. Jute sticks, the byproduct, are used as fuel, fencing and raw materials for paper pulp and hardboard. Jute leaves, which are high in vitamins, carotenoids, calcium, potassium, and dietary fibres, are used in soups and folk medicine to cure fevers, chronic cystitis, colds, and tumours. Aside from its diverse uses, cultivation of this crop improves soil fertility by supplying a large quantity of green biomass through leaves, twigs, and thinned out plant, which includes a significant number of macro and micro nutrients (Singh *et al.*, 2015). Bangladesh jute research institute (BJRI) has been developed some tossa varieties/ strains.

The importance of macronutrients (N, P, K and S) on the growth, yield and quality of fiber crops is well established. Judicial application of NPK and S may increase the yield of a variety. The importance of N, P, K and S on the growth, yield and quality of fiber crops is well established (Ali et al., 2017a, 2017b). Balanced nutrition is a crucial component of developing plants and comprises providing the plant with enough of the vital minerals N, P, K, Mg, Ca etc. (Senjobi *et al.*, 2013). Determination of nutrients rate for the new varieties/ strains are also pre-requisite for final release. Yet this fertilizer plays an

important role to increase the fibre growth and yield. It is necessary to find a fertilizer combination which is economically profitable and at the same time gives maximum yield and yield potential. So, an experiment has been undertaken to observe the effects of macronutrients (N, P, K and S) on growth, yield and quality of the advanced tossa jute breeding line O-0512-6-2.

Materials and Methods

In Bangladesh, the experiment was carried out at Jute Agriculture Experimental Station (JAES) Manikganj and Jute Agriculture Regional Station (JARS) Faridpur of Bangladesh during 2019-2021. The experiment was laid out in randomized complete block design (RCBD) with 10 treatments of NPK and S (Kg ha^{-1}) having three replications. Total 10 treatments combination along with a control distributed randomly in each plot as one replication. The dimension of unit plot was (2.1 m×2 m) having 1 m space between plots, blocks and around the field. There was 20 cm deep drain around each block and plot. The land was well prepared and fertilizers were applied as per treatments. The following treatments combinations were used in the experiment:

T_1: $N_0P_0K_0S_0$	T_6: $N_{100}P_{15}K_{30}S_{30}$
T_2: $N_{75}P_{10}K_{25}S_{20}$	T_7: $N_{100}P_{15}K_{30}S_{40}$
T_3: $N_{100}P_{10}K_{25}S_{20}$	T_8: $N_{100}P_{20}K_{30}S_{20}$
T_4: $N_{125}P_{10}K_{25}S_{20}$	T_9: $N_{100}P_{20}K_{30}S_{30}$
T_5: $N_{100}P_{15}K_{30}S_{20}$	T_{10}: $N_{125}P_{20}K_{35}S_{40}$

Required amount of N, P, K and S fertilizers were applied in the form of urea, TSP, MoP and gypsum. The experiment was sown on first week of April and harvested first week of August. Half urea and total amount of TSP, MoP and gypsum were incorporated to the experimental plot as per treatment design at the time of final land preparation. Remaining half of urea was top dressed at 45 days after sowing (DAS).

Table 1. Soil initial analysis report at the experimental plot of Manikganj

p^H	OM	Total N (%)	Phosphorus (µg g^{-1})	Potassium (meq/100 g)	Sulfur (µg g^{-1} soil)
6.7	2.8	0.094	10	0.13	7.0
Neutral	Medium	Very Low	Low	Low	Very low

Table 2. Soil Initial Analysis Report at the experimental plot of Faridpur

p^H	EC (dS m^{-1})	OM	Nitrogen (%)	Phosphorus (µg g^{-1} soil)	Potassium (meq/100 g)	Sulfur (µg g^{-1} soil)
7.4	12.71	1.8	0.088	6.28	0.06	9.91

Weeding, thinning, insect pest and disease management were done in time. Plant population, plant height, base diameter, green weight with leaves, green weight without leaves, fiber yield and stick yield were recorded from each plot. All collected data were analyzed statistically following the ANOVA technique and the means were adjusted by DMRT (Gomez and Gomez ,1984).

Results and Discussion

Nitrogen, phosphorus, potassium and sulfur are the main essential macronutrients for most of the biological process in a plant. Their individual effects and interactions on fiber plants were showed in many studies (Maity *et al.*, 2007). Fiber yield and yield contributing characters were affected by different treatment combinations. This experiment used 10 treatment combinations.

In Manikganj, the highest plant height (3.04 m), base diameter (17.42 mm), green weight with leaves (39.02 t ha^{-1}) and green weight without leaves (35.81 t ha^{-1}) were observed with the application of treatment T_3 ($N_{100}P_{10}K_{25}S_{20}$). (Table 3) Significant effect of increasing dose of fertilizer application on fiber yield and stick yield was also observed.

Table 3. Yield and yield contributing characters of advanced *olitorius* breeding line O-0512-6-2 with different levels of NPK and S at Manikganj

Treatment	Plant Population m^{-2}	Plant height (m)	Base diameter (mm)	Green weight with leaves (t ha^{-1})	Green weight without leaves (t ha^{-1})
T_1:$N_0P_0K_0S_0$	28.33	2.66bc	15.79ab	31.26bc	28.97b
T_2:$N_{75}P_{10}K_{25}S_{20}$	27.69	2.80abc	16.11ab	28.72c	27.19b
T_3:$N_{100}P_{10}K_{25}S_{20}$	32.81	3.04a	17.42a	39.02a	35.81a
T_4:$N_{125}P_{10}K_{25}S_{20}$	27.93	2.87abc	16.05ab	33.29ab	31.03a
T_5:$N_{100}P_{15}K_{30}S_{20}$	27.38	2.91ab	16.13ab	32.50bc	30.83ab
T_6:$N_{100}P_{15}K_{30}S_{30}$	31.00	2.94ab	17.06ab	28.80bc	28.21b
T_7:$N_{100}P_{15}K_{30}S_{40}$	39.26	2.88abc	16.02ab	29.16bc	28.82b
T_8:$N_{100}P_{20}K_{30}S_{20}$	32.46	2.83abc	15.78ab	33.12bc	29.04b
T_9:$N_{100}P_{20}K_{30}S_{30}$	33.81	2.86abc	15.90ab	32.85bc	28.91b
T_{10}:$N_{125}P_{20}K_{35}S_{40}$	35.04	2.61c	15.42b	34.60ab	32.59ab
CV (%)	14.47	2.64	6.71	10.59	12.18

Significantly highest fiber yield (2.75 t ha^{-1}) and stick yield (6.50 t ha^{-1}) was observed with the treatment combination of T_3 ($N_{100}P_{10}K_{25}S_{20}$) (Fig. 1, 2).

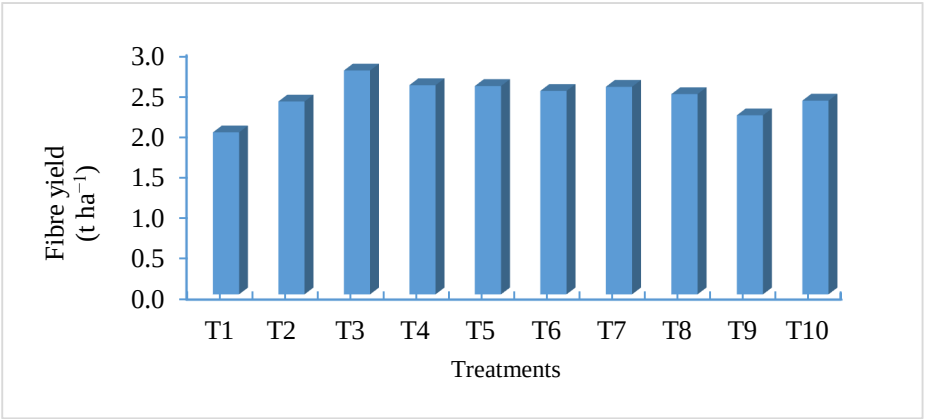

Fig. 1. Fiber yield of advanced *olitorius* breeding line O-0512-6-2 using different chemical fertilizer treatments. Each datum was calculated from three independent experiments in Manikganj.

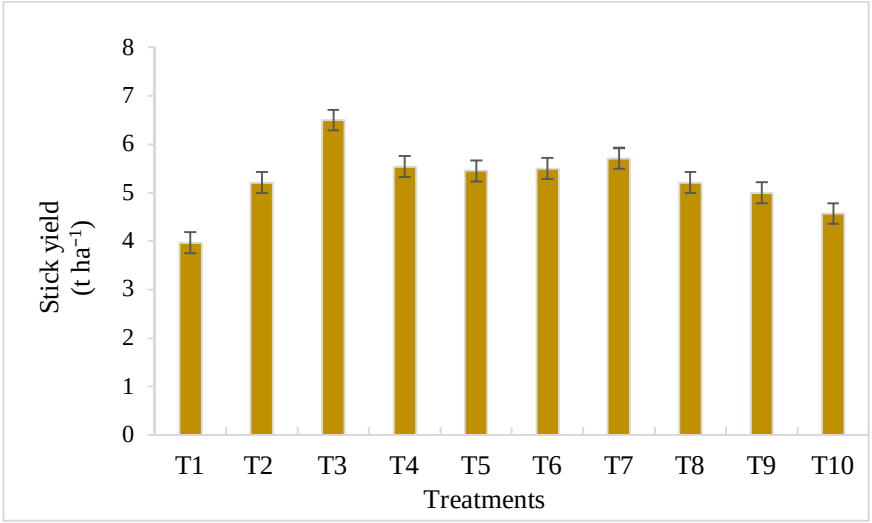

Fig. 2. Stick yield of advanced *olitorius* breeding line of O-0512-6-2 using different chemical fertilizer treatments. Each datum was calculated from three independent experiments in Manikganj.

In case of plant population, the highest number of plant (39.26) was observed with the application of treatment T_7 ($N_{100}P_{15}K_{30}S_{40}$) which is statistically non-significant. In Faridpur, the effect of different doses of fertilizer application on advanced breeding line O-0512-6-2 growth and yield metrics were observed. The plant height (2.99 m), highest base diameter (13.88 mm), green weight with leaves (33.18 t ha^{-1}) and green weight without leaves (29.45 t ha^{-1}) were observed by the treatment combination of T_3 ($N_{100}P_{10}K_{25}S_{20}$) (Table 4).

Table 4. Yield and yield contributing characters of advanced *olitorius* breeding line O-0512-6-2 with different levels of NPK and S at Faridpur

Treatment	Plant Population m^{-2}	Plant height (m)	Base diameter (mm)	Green weight with leaves (t ha^{-1})	Green weight without leaves (t ha^{-1})
T_1:$N_0P_0K_0S_0$	18.33	2.47	12.23ab	21.47bc	17.32b
T_2:$N_{75}P_{10}K_{25}S_{20}$	21.33	2.87	11.45b	26.72c	21.63b
T_3:$N_{100}P_{10}K_{25}S_{20}$	24.34	2.99	13.88a	33.18a	29.45a
T_4:$N_{125}P_{10}K_{25}S_{20}$	27.93	2.99	12.67ab	31.47ab	26.27a
T_5:$N_{100}P_{15}K_{30}S_{20}$	27.23	3.10	12.67ab	27.33bc	23.03ab
T_6:$N_{100}P_{15}K_{30}S_{30}$	21.20	2.82	12.70ab	24.13bc	19.42b
T_7:$N_{100}P_{15}K_{30}S_{40}$	29.26	2.94	13.27ab	25.63bc	21.55b
T_8:$N_{100}P_{20}K_{30}S_{20}$	26.26	3.16	13.68a	26.88bc	21.33b
T_9:$N_{100}P_{20}K_{30}S_{30}$	23.31	3.08	13.08ab	26.67bc	22.47b
T_{10}:$N_{125}P_{20}K_{35}S_{40}$	24.04	3.17	12.69ab	29.18ab	27.89ab
CV (%)	14.47	7.44	9.02	8.52	10.32

Significant effect of additional fertilizer application on fiber and stick yield was also observed. The highest fiber yield (2.58 t ha^{-1}) and stick yield (6.09 t ha^{-1}) which was statistically significant and obtained by treatment T_3 ($N_{100}P_{10}K_{25}S_{20}$) (Fig. 3, 4). So, the combined dose of NPK and S 100-10-25-20 kg ha^{-1} is a suitable dose for the cultivation of advanced breeding line O-0512-6-2 for maximum growth and production. These results are strongly supported by the previous research results (Sarker *et al.*, 2000; Ali *et al.*, 2017).

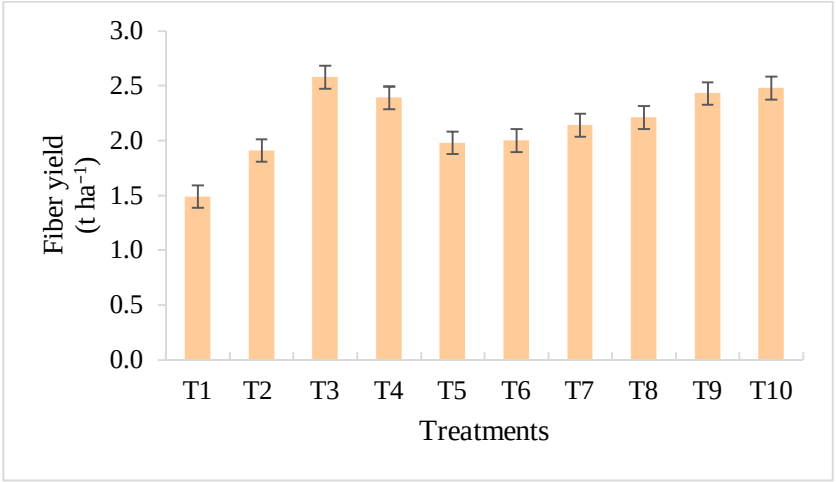

Fig. 3. Fiber yield of advanced *olitorius* breeding line of O-0512-6-2 using different chemical fertilizer treatments. Each datum was calculated from three independent experiments in Faridpur.

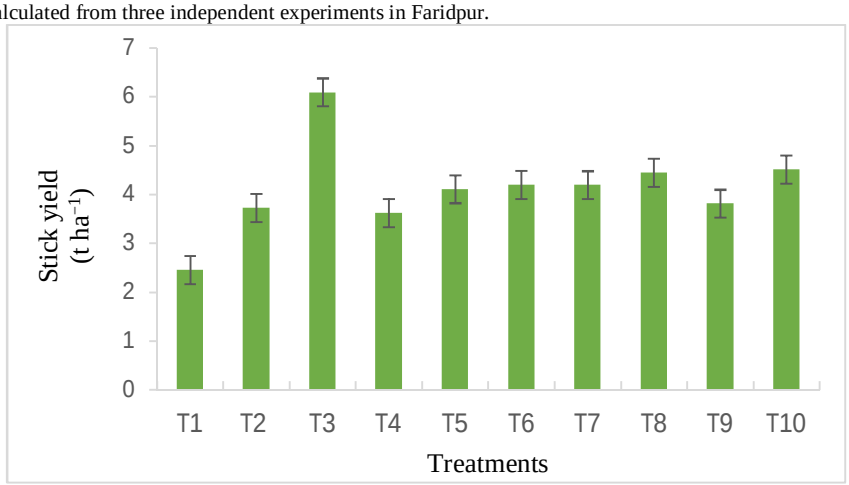

Fig. 4. Stick yield of advanced *olitorius* breeding line of O-0512-6-2 using different chemical fertilizer treatments. Each datum was calculated from three independent experiments in Faridpur.

Conclusion

The use of combined chemical fertilizers had a considerable favorable impact on all yield contributing characteristics as well as yield. The present study revealed the positive impacts of combined dose of NPKS on the fiber yield and yield component of advanced *olitorius* breeding line O-0512-6-2 in both locations. The combined dose of $N_{100}P_{10}K_{25}S_{20}$ is a suitable dose for the cultivation of advanced *olitorius* breeding line of O-0512-6-2 in Bangladesh.

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