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Jute Seed Yield Response to Irrigation and Nitrogen Fertilization in Field-Grown Environment

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Abstract

The experiment focuses the optimum utilization of irrigation water and fertilizer application on Jute seed production. Four irrigation treatments and four nitrogen doses were tested on jute (var. O-9897) in Jute Agriculture Experimental Station (JAES), Manikganj, Bangladesh during the late Jute season. The highest seed yield of 745.50 kg/ha was obtained from 30 days of irrigation with the application of 100kg N/ha. The lowest seed yield 236.75 kg/ha was obtained from no irrigation and no fertilizer application. Irrigation at 45 days and 30 and 60 (twice irrigation) days didn't show better seed yield compared to 30 days of irrigation treatment.

1. Introduction

Among the jute growing countries of the world, Bangladesh ranks seconds in respect of production. In 2003-2004, 0.794 million tons of jute were produced from 0.39 million hectares of land which covered 4.73 percent of total cropped area [1]. It is mainly grown for fibre rather than for seed. Nowadays, attention has also been given on its seed production technological researches. Most of the Bangladeshi farmers grow jute seed along with the fibre crop. Farmers harvest their jute crop in time for fibre and keep some jute plants at the corner of the field for seed production. Every year farmers face jute seed problem. Only 15.84 percent need of jute seeds are met by Bangladesh Agricultural Development Corporation [2]. Rest quantity of jute seed is solely produced and utilized by the farmers themselves. Sometimes farmers failed to produce quality seed because of improper management, imbalance fertilizer application or lack of appropriate production practices. Quality seeds of an improved variety itself provide 20 percent additional yield of the crop [3]. These seed crop due to long stay in the field are affected by hailstorm, diseases and insect pests thus produce lower yield of poor quality seeds. In recent years, the agro-ecological condition of the country has abruptly changed and jute seed production as a part of fibre crop is no longer remunerative. Farmers are also very reluctant to grow jute seed. So, the country has been facing acute shortage of quality jute seed every year. Quality seed of an improved variety itself provide 20 percent additional yield of the crop [3]. To overcome jute seed problems and to ensure supply of required quality seeds, Bangladesh Jute Research Institute has been advocation late or off season seed production for higher seed yield

and economic return, which to be sown in the month of August and September and harvested in December and January [3]. In jute production system, water management includes application of irrigation and draining out the excess water is needed from the jute fields. Irrigation is the artificial application of water to the crop field for its proper growth [4]. Nitrogen is one of the key nutrients needed for crop production; however, it is the most mobile and volatile and the most exhausted nutrients due to its ability to exist in different forms and its easy leach ability [5, 6, 7]. In the absence of site-specific recommendations, N management poses a serious challenge in the highlands [8]. Nitrogen management in agroecosystems has been extensively studied due to its importance in improving crop yield and quality [9, 10, 11, 12, 13, 14, 15, 16, 17, 18]. One of the ways of addressing nitrogen limitation is use of inorganic fertilizers [19]. However, there exists inadequate use of fertilizers to replenish the mined nutrients [20]. Jute growers are habituated to follow the technology or practice which has been developed through experiences and tradition and they are reluctant to change their practices [21]. Farmers will pay due attention o the research findings about which they have some experiences and seem to be more economical. Therefore, the present research was undertaken with a view to upgradation of nitrogen fertilizer requirement and frequency of irrigation for seed production of the Jute variety O-9897.

2. Materials and Methods

The field trial was conducted at JAES, Manikganj under Bangladesh Jute Research Institute (Annual Report, Agriculture Research on Jute, Bangladesh Jute Research Institute 2007-2008 and 2008-2009) to examine the nitrogen fertilizer requirement and frequency of irrigation for seed production of the Jute variety O-9897. The experiment was designed by split plot design with 4 nitrogen doses 0 (F_1), 50 (F_2), 100 (F_3), 150 (F_4) kg/ha and the irrigation schedules were (I_0) no irrigation, (I_1) irrigation at 30DAS (I_2) irrigation at 45 DAS (I_3) irrigation at 30 and 60 DAS. The unit plot size was 2.1m x 2.1m, space between plots, blocks and around the field was 1.0m. There were 20cm deep drain around each plot, block and around whole plot to drain out excess rain water. Experiment was set up in the month of august in every year. A common dose of PKSB from TSP, MP, Gypsum and borax respectively were applied to the plot at the time of sowing as per treatment. The pods and seeds were dried in the air and cooled in desiccators. The data of different parameters of jute seed yield e.g., number of branch per plant, number of pod per plant, number of seed per pod, thousand seed weight and seed yield were recorded.

3. Identification of Lignin

Formation of lignin in the Jute plant was detected using phloroglucinol test. The fibres were separated from the jute plant and the presence of lignin was examined by treating carefully with phloroglucinol reagent.

4. Determination of Chemical Constituents

Chemical constituents of jute fibres from 15 days to 90 days of growth age were determined. The standard analytical procedures for estimation of alpha cellulose [22], Hemicellulose [23], Lignin contents [24, 25, 26], Fatty materials and ash content [27] were followed.

5. Results and Discussion

The seed yield parameters like branch per plant, number of pod per plant, number of seed per pod were more or less influenced with different irrigation and fertilizer treatments (Figure 1 and Figure 2). There was a significant effect of irrigation and nitrogen fertilizer on seed yield of O-9897. The highest seed yield obtained when irrigated at 30 DAS which was statistically significant and highest (Figure 1). 100 kg N/ha showed best performance for seed production (Figure 2). Similar results were also found for rice crop [28]. The higher seed yield from crops having higher number of branches and number of pods per plant [29]. This result also supported by other previous findings [30].

The highest seed yield of 745.50 kg/ha was obtained from 30 days of irrigation with the application of 100 kg N/ha (Table 1). The lowest yield of 236.75 kg/ha was obtained from no irrigation and no nitrogen fertilizer application. Irrigation at 45 days and 30 & 60 (twice irrigation) days didn't show better seed yield compared to 30 days of irrigation treatment (Table 1).

Table 1. *Interaction between irrigation and fertilizer on jute seed yield.*

Treatments	Number of branch/plant	Number of pod/plant	Number of seed/pod	1000 seed wt (g)	Seed yield (kg/ha)
I_0xF_1	2.0	6.0	119.11	1.890	236.75
I_0xF_2	2.75	9.0	120.33	1.883	377.13
I_0xF_3	2.85	10.18	125.52	1.902	401.36
I_0xF_4	2.82	9.96	122.27	1.914	390.33
I_1xF_1	2.1	6.20	140.20	1.902	301.15
I_1xF_2	3.33	15.15	150.50	1.966	602.0
I_1xF_3	3.5	16.9	164.29	2.011	745.50
I_1xF_4	3.42	16.17	160.21	1.980	711.03
I_2xF_1	2.11	5.90	134.05	1.901	300.0
I_2xF_2	3.34	15.97	147.07	1.961	577.80

Treatments	Number of branch/plant	Number of pod/plant	Number of seed/pod	1000 seed wt (g)	Seed yield (kg/ha)
I_2xF_3	3.42	16.33	167.66	1.980	729.03
I_2xF_4	3.41	16.03	149.81	1.980	699.36
I_3xF_1	2.2	6.1	120.05	1.882	296.18
I_3xF_2	3.26	14.65	148.27	1.971	566.25
I_3xF_3	3.44	16.7	167.62	2.00	740.55
I_3xF_4	3.38	16.65	164.22	1.990	703.75
CV (%)	8.2	10.6	12.42	10.25	14.30

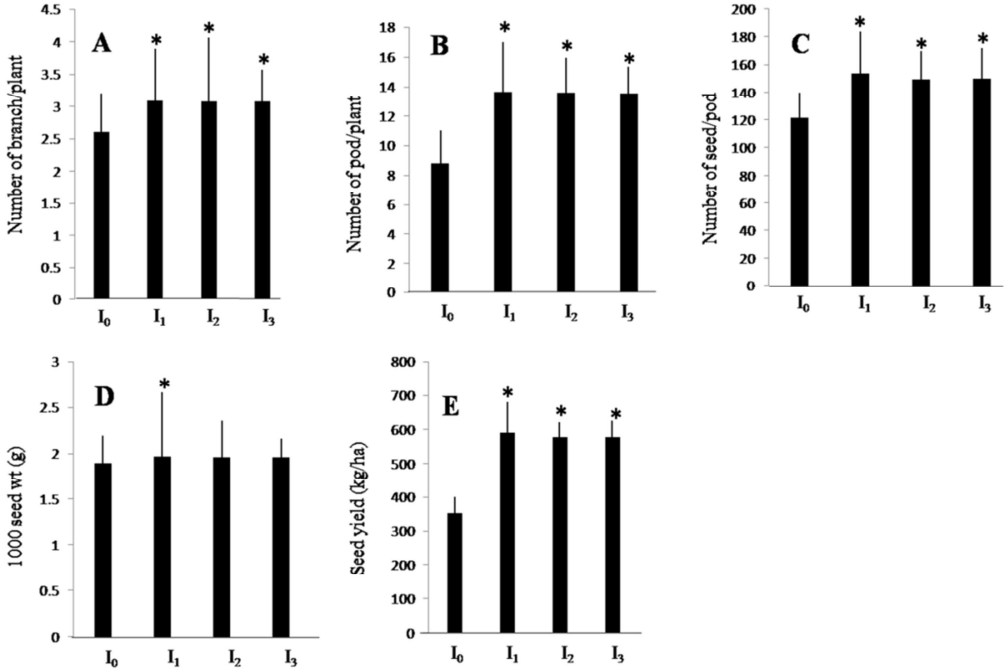

Figure 1. *Seed yield and yield contributing characters of the variety O-9897 in different irrigation treatments. (A) Number of branch/plant, (B) Number of pod/plant, (C) Number of seed/pod, (D) 1000 seed wt (g), (E) Seed yield (kg/ha). The results are expressed as the mean ± S. E. M. Asterisks indicate p>0.05 significance by the Student's t-test.*

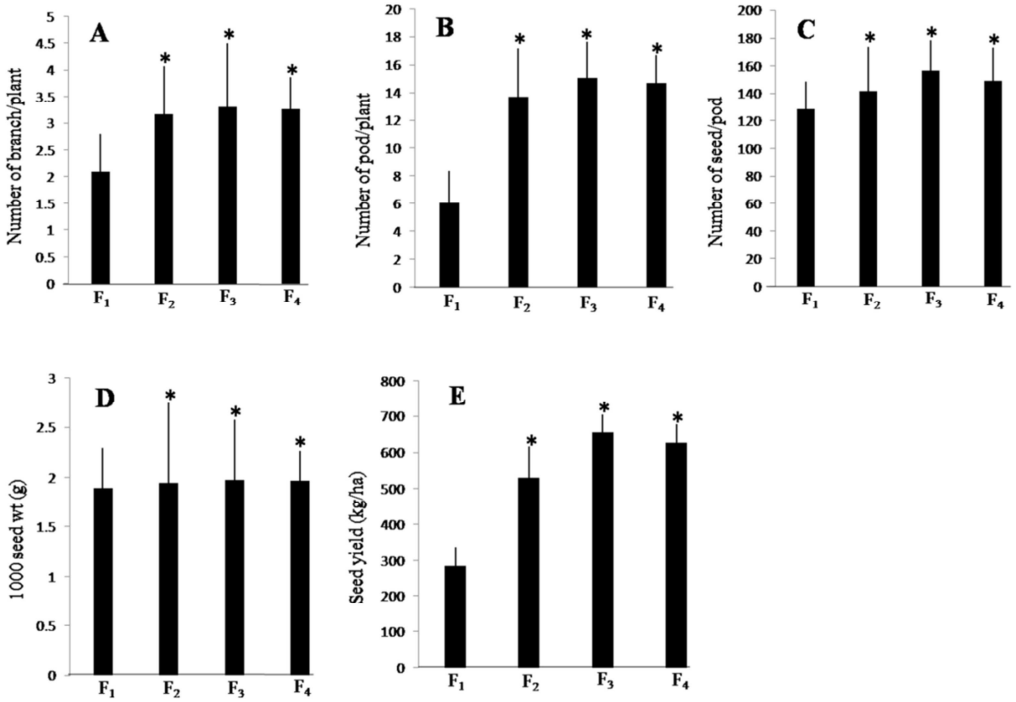

Figure 2. *Seed yield and yield contributing characters of the variety O-9897 in different doses of nitrogen fertilizers. (A) Number of branch/plant, (B) Number of pod/plant, (C) Number of seed/pod, (D) 1000 seed wt (g), (E) Seed yield (kg/ha). The results are expressed as the mean ± S. E. M. Asterisks indicate p>0.05 significance by the Student's t-test.*

In addition the chemical composition measured for the Jute variety O-9897 because Jute quality depends on its lignin content and biological growth started from lignin formation. Cellulose and Hemicellulose were comparatively lower in the fibre in the early stages and gradually increased (Table 2). Lignin and fat content were predominantly higher than the average values in mature fibre, because of the fact that they were naturally needed for the hardness of the plants to stand up during the growth periods.

Table 2. *Chemical composition of jute fibre at different stages.*

Name of constituents	% of Chemical constituents at different age of growth (days)			
	15	30	45	60
Alpha cellulose	33.15	43.30	48.60	50.45
Hemicellulose	10.05	16.80	17.65	19.30
Lignin	23.50	16.20	13.40	12.10
Fat	2.5	0.80	0.48	0.57
Ash	-	2.25	1.60	0.52

6. Conclusion

In conclusion, it can be assumed that the highest seed yield was mainly contributed by its higher number of branch per plant, higher number of pod per plant and higher number of seed per pod. Therefore irrigation and fertilizer must be substantial issue for optimum seed production. Irrigation after thirty days of sowing and 100 kg N/ha would be a better choice for late seed production for the Jute variety of O-9897.

Competing Interest

The author declared no competition of interest exists.

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