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Performance study on yield and yield attributes of seven white jute breeding lines at different regions of Bangladesh

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Abstract

The study was conducted to know the performance of growth, yield contributing parameters and yield of seven white Jute breeding line and two checks (CVL-1 and CVE-3) at five different jute research regional stations of Bangladesh Jute Research Institute (BJRI) during the period from March to September 2014. The experimental data was laid out in a completely randomized block design with three replications and the means were adjudged by DMRT at 5% level of probability. The performances of experimental lines were showed statistically significant variation among the studied whole growth, yield and yield attributing traits. Analysis of variance revealed significant differences among the treatments for fibre yield and stick yield at Rangpur plant height, base diameter, fibre and stick yield at Manikganj plant height and fibre weight at Chandina, Faridpur and plant height at Kishoreganj. It was revealed by the pooled mean performance that among the genotypes, the line C-5018 m produce the tallest plant among the lines. The Line C-5030 recorded both the highest plant population (0.241 m/ha) and base diameter (21.79 mm). The line C-5133 showed highest Green weight with leaves (43.12 t/ha) whereas C-5149 recorded the greatest Green weight without leaves (35.02 t/ha). The most important parameter is the fiber yield and the highest-fibre weight (2.83 t/ha) was recorded by the line C-5149 among the seven breeding line. The line C-5149 also recorded the highest amount of stick yield (6.01 t/ha). However, pooled mean over stations revealed that no progenies, C-5018, C-5030, C-5036, C-5044, C-5133, C-5136, C-5149 out-yielded both the check varieties CVL-1 (2.83 t/ha) and CVE-3 (2.54t/ha) whereas C-5149(2.83t/ha) shows the equivalent result as CVL-1. It was also revealed that C-5030(2.61t/ha), C-5136(2.70t/ha) and C-5149(2.83t/ha) out yielded check variety CVE-3 (2.54t/ha).

Key words: White jute, breeding line, high yielding, fibre quality, Bangladesh

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Introduction

Jute crop is a versatile and environmental-friendly biodegradable natural fibre widely grown in summer season in Asia. It is called golden fibre which one is an important cash crop in Bangladesh. In respect of fibre production, Bangladesh is the second-ranked country of the world. In 2010-2011, 0.803 million ha land cultivated for jute. Production of raw jute was 1.5 million MT by volume in 2010-2011. Jute cultivation area was 6% of the total land area of 13 million ha, of which 8.44 million ha belongs to agricultural land. Jute cultivation area was 10% of agricultural land area. Jute production was 26% as of all crops (IJSG, 2012).

Despite the lower yield potential and inferior fibre quality of *C. capsularis* (white jute) compared to *C. olitorius* (tossa jute), the former with fibre having fineness below 10 deniers has great demand in the diversified and 'value-added' jute markets (Ghosh, 1983). Mainly white jute is used for preparing 100% food-grade mineral oil-free jute bags, shopping and handbags, floor coverings, decorative and household fabrics, geotextiles, composites, and reinforcements. In recent years, jute yields have plateaued or even declined, although production technology has advanced (Khatun *et al.,* 2010). Hence, there is a need for improving fibre yield and quality of white jute varieties. To develop an appropriate breeding programme it is essential to assess the nature of inheritance of yield and its component traits and the potential performance of the parents in hybrid combinations. Combining ability studies help in identifying potential lines, which on hybridization would give rise to desirable segregates (Kumar *et al.,* 1995). Various mating designs have been used for assessing the breeding value of parents. Estimation of variance and combining ability effects and analysis through diallel and partial diallel cross technique have been suggested by (Griffing *et al.,* 1956).

Jute is environment-friendly as well as being one of the most affordable fibres; jute plants are easy to grow, have a high yield per acre and, unlike cotton, have little need for pesticides and fertilizers. Jute is a bastfibre, like flax and hemp, and the stems are processed similarly. Jute is extracted from the bark of the white jute plant, *Corchorus capsularis* and to a lesser extent from Tossa jute (*C. olitorius*). Jute fibres are very long (1 to 4 metres), silky, lustrous and golden brown. In contrast to most textile fibres which consist mainly of cellulose, jute fibres are part cellulose, part lignin. Cellulose is a major component of plant fibres while lignin is a major component of wood fibre; jute is therefore partly a textile fibre and partly wood. Jute is the most important bastfibre crop of the world being cultivated in Eastern India, Bangladesh, Nepal and some South-East Asian countries, and is second only to cotton in terms of production and variety of uses (Islam *et al.,* 2013). Now a day, jute is facing tough competition from synthetic fibres, it is apparent that production of one ton of polypropylene emits 3.7 tonnes of CO2, whereas one hectare of jute consumes around 15 tonnes of CO2 in 100 days indicating the environment-friendly effect of jute fibre. So in recent days, the demand for natural fibre-based products is increasing continuously. There is a great demand for quality fibre in the industry for the production of value-added diversified jute based products. Many Scientists were experimented to evaluate the preliminary yield performance of their newly developed lines (Sanjoy *et al.,*2018; Hassan *et al.,*2018; Mollah *et al.,*2017; Islam *et al.,*2017; Hossain *et al.,*2015).

To develop new varieties of white jute suitable for two main regions early and late sowing and varieties with higher yield potential than the existing cultivars. Keeping these objectives in mind eight new promising breeding lines were derived through ten parent diallel crosses and subsequent selection and tested for assessment of their yield and other attributes under different agro-ecological conditions. The Objectives of this experiment was to develop breeding lines with a distinct character, higher yield and quality fibre.

Materials and Methods

The study was conducted at the regional stations of Bangladesh Jute Research Institute, Dhaka, Bangladesh. This experiment was carried out with seven progenies (C-5018, C-5030, C-5036, C-5044, C-5133, C-5136 and C-5149) and two check varieties, CVL-1 and CVE-3 at four regional stations (Rangpur, Chandina, Faridpur and Kishoreganj) and JAES, Manikganj to study their yield and yield attributes. These progenies were grown in a randomized complete block design with three replications having unit plot size of (2.1m x 3.0m) = 6.30 sq. m. Other cultural and intercultural practices were followed as per BJRI recommendation. At the age of 120 days after sowing data were recorded for plant population, plant height,

base diameter, green weight with and without leaves, fibre weight and stick weight. Proper intercultural operations and standard agronomic practices were followed for uniform growth. Location-specific three-year average data of fibre yield and yield attributing characters were analyzed with the help of computer statistical package (MSTAT). The mean differences among the treatments were adjusted as per the Least Significant Difference (LSD) and T-test at 0.05 level (Gomez and Gomez, 1984).

Results

The mean performance of seven breeding line along with two checks is described in Table 1. Analysis of variance revealed significant differences among the genotypes for fibre weight and stick weight at Rangpur. The breeding line C-5018 was given significantly higher fibre weight (2.87 t/ha) than check variety CVL1 (2.77 t/ha) and CVL3 (2.79 t/ha). On the other hand, the line C-5133 was recorded the lowest fibre yield (2.34 t/ha). The breeding line C-5136 (7.89 t/ha) followed by the check CVL3 (7.57 t/ha) showed the greater yield of stick weight. Conversely, the lowest yield of stick was recorded by line C-5018 6.78 t/ha. At Manikganj, the genotypes are significant differences with plant height, base diameter, fibre and stick weight. The higher plant height was found in the line C-5018 3.225m which is significantly greater than check variety CVL1 (3.143 m) and CVL3 (3.213 m).

Table 1. Mean performance of seven breeding lines and two check varieties (CVL-1 and CVE-3) at different regional stations.

Stations	Varieties/ lines	Plant population (m/ha)	Plant height (m)	Base diameter (mm)	Green weight with leaves (t/ha)	Green weight without leaves (t/ha)	Fibre weight (t/ha)	Stick weight (t/ha)
Manikganj	C-5018	0.167	3.225	19.67	31.18	26.86	1.90	4.22
	C-5030	0.268	3.068	20.31	34.66	30.46	2.41	5.24
	C-5036	0.197	3.141	20.24	26.76	23.57	1.65	3.53
	C-5044	0.185	3.137	20.95	33.87	29.40	1.58	3.46
	C-5133	0.179	3.211	20.67	34.56	29.78	1.63	3.41
	C-5136	0.178	3.146	20.32	22.34	18.75	1.85	3.47
	C-5149	0.174	3.134	19.96	23.20	19.87	2.25	5.28
	CVL-1	0.196	3.143	19.75	27.50	22.32	2.32	4.78
	CVE-3	0.243	3.213	19.68	35.59	30.70	2.52	4.43
	LSD (5%)	**NS**	**0.122**	**NS**	**NS**	**NS**	**0.458**	**1.21**
	LSD (1%)	**NS**	**0.179**	**NS**	**NS**	**NS**	**0.645**	**1.24**
Rangpur	C-5018	0.189	3.26	20.31	46.31	38.21	2.87	6.78
	C-5030	0.186	3.34	20.69	47.78	39.80	2.77	7.41
	C-5036	0.169	3.45	19.87	49.44	41.32	2.67	7.34
	C-5044	0.187	3.31	19.32	48.58	40.44	2.69	7.32
	C-5133	0.195	3.36	19.42	42.36	35.45	2.34	6.97
	C-5136	0.198	3.43	19.68	54.28	44.34	3.22	7.89
	C-5149	0.196	3.37	19.79	48.47	40.31	2.65	7.40
	CVL-1	0.175	3.24	19.99	47.45	39.25	2.77	7.57
	CVE-3	0.186	3.42	20.42	50.42	41.40	2.79	7.33
	LSD (5%)	**NS**	**NS**	**NS**	**NS**	**NS**	**0.46**	**0.89**
	LSD (1%)	**NS**	**NS**	**NS**	**NS**	**NS**	**0.72**	**1.51**

Chandina	C-5018	0.154	3.73	22.46	37.56	32.90	1.89	4.25
	C-5030	0.254	3.58	23.31	51.34	46.67	2.78	5.26
	C-5036	0.234	3.66	21.69	45.41	40.85	2.67	5.96
	C-5044	0.196	3.72	21.84	43.87	39.32	2.46	5.33
	C-5133	0.253	3.74	24.52	54.37	49.70	2.67	6.42
	C-5136	0.193	3.67	21.56	44.74	41.23	2.21	4.78
	C-5149	0.213	3.68	20.54	57.84	52.99	2.33	5.28
	CVL-1	0.241	3.56	23.33	39.89	35.63	2.53	4.99
	CVE-3	0.178	3.64	22.55	43.27	38.77	1.79	4.36
	LSD (5%)	**NS**	**0.17**	**NS**	**NS**	**NS**	**0.58**	**NS**
	LSD (1%)	**NS**	**0.32**	**NS**	**NS**	**NS**	**0.89**	**NS**
Faridpur	C-5018	0.364	3.52	22.24	39.78	35.78	3.78	8.79
	C-5030	0.356	3.46	22.32	53.33	38.36	3.93	8.66
	C-5036	0.363	3.28	23.28	55.31	36.23	4.11	8.87
	C-5044	0.345	3.31	22.29	53.71	38.44	4.33	9.32
	C-5133	0.358	3.35	23.32	64.42	40.47	4.77	8.90
	C-5136	0.363	3.23	24.11	56.25	41.89	4.89	9.12
	C-5149	0.358	3.42	22.13	61.76	43.96	5.92	9.67
	CVL-1	0.372	3.52	23.17	49.43	42.79	5.22	9.74
	CVE-3	0.431	2.89	22.59	53.14	32.80	4.59	9.79
	LSD (5%)	**NS**	**0.41**	**NS**	**NS**	**NS**	**0.60**	**NS**
	LSD (1%)	**NS**	**0.63**	**NS**	**NS**	**NS**	**0.79**	**NS**
Kishoreganj	C-5018	0.131	2.72	21.72	21.67	17.93	1.21	2.43
	C-5030	0.141	2.94	22.31	24.31	19.58	1.18	2.90
	C-5036	0.152	2.58	21.79	21.25	17.93	1.16	2.43
	C-5044	0.134	2.56	20.87	21.12	17.61	1.13	2.65
	C-5133	0.132	2.73	19.78	19.89	16.43	1.1`	2.35
	C-5136	0.164	2.69	20.21	24.76	20.28	1.31	2.74
	C-5149	0.142	2.76	21.47	20.66	17.98	0.99	2.44
	CVL-1	0.157	2.46	20.13	24.87	20.54	1.32	2.79
	CVE-3	0.145	2.64	20.63	21.79	18.23	1.12	2.67
	LSD (5%)	**NS**	**0.21**	**NS**	**NS**	**NS**	**NS**	**NS**
	LSD (1%)	**NS**	**0.32**	**NS**	**NS**	**NS**	**NS**	**NS**

The lowest plant height was recorded by the line C-5030 (3.068m). The highest fibre weight was found in the check variety CVE-3 (2.52 t/ha) followed by the breeding line C-5030 (2.41 t/ha). Among the other lines, the line C-5044 (1.58 t/ha) observed significantly the lowest fiber weight. The line C-5149 (5.28 t/ha) showed the greatest stick weight which is closely followed by C-5030(5.24 t/ha). The line C-5018 (4.22 t/ha) observed significantly the lowest stick weight among the genotypes. Significant differences were found among the genotypes for plant height and fibre weight at Chandina and Faridpur. C-5133 (3.74 m) followed by C-5018 (3.73m) were recorded the highest plant height whereas the breeding line C-5030 (2.78 t/ha) and C-5036 (2.67 t/ha) showed the greater fibre weight in Chandina. Similarly, the breeding line C-5018 (3.52 m) and C-5149 (5.92 m) showed the highest plant height and fibre weight, respectively in Faridpur.

Conversely, the check CVL-1 (3.56 m) showed significantly the smallest plant height (3.56 m) and the check CVE-3 was recorded lowest fibre yield (1.79t/ha) among the genotypes in Chandina. Again, the smallest plant height was found in check CVE-3 (2.89m) followed by line C-5136 (3.23m) in Faridpur. Similarly, the line C-5018 showed significantly the smaller amount of fiber weight (3.78t/ha in Faridpur. The result showed a significant difference only for the plant height at Kishoreganj. Here, the breeding line C-5030 (2.94m) followed by C-5149 (2.73m) was recorded the highest plant height whereas the smallest plant was found in check (CVL-1 2.46m).

Discussion

The pooled mean of seven breeding lines and two check varieties of white jute at different regional stations are shown in Table 2. The maximum number of plant population (0.241 m/ha) was recorded by the C-5030 and the lowest (0.201 m/ha) was recorded by C-5018. However, only the line C-5030 yielded higher plant population than both the check varieties CVL-1 (0.2282 m/ha) and CVE-3 (0.2366 m/ha). The highest plant height (3.29 m) was recorded by the line C-5018 and the lowest (3.16 m) was recorded by the check CVE-3. All seven progenies (C-5018, C-5030, C-5036, C-5044, C-5133, C-5136 and C-5149) was shown higher plant height by both the check varieties CVL-1 (0.2282 m) and CVE-3 (0.2366m). In general, plant height is the most efficient morphological character which is directly related to greater fibre yield of Jute or Kenaf as well as the tallest plant maximizing the fibre yield of Jute or Kenaf. Similar findings were also obtained by (Pervin *et al.,* 2012). Who observed that the analysis of variance significant differences among the genotypes for plant height. The variation was also found due to its genetic makeup. The highest base diameter was recorded by the line C-5030 (21.79 mm) and the lowest was recorded by the line C-5044 (21.05mm). The progenies C-5018, C-5030, C-5133, C-5136 was shown higher base diameter by both the check varieties CVL-1 (21.27 mm) and CVE-3 (21.17 mm). Significant varietals performance on base diameter were also obtained in jute (Pervin *et al.,*2012; Islam *et al.,*2007; Islam *et al.,* 2004; Prodhan *et al.,*2001) and kenaf (Hossain *et al.,*2012; Hossain *et al.*, 2011)

The highest Green weight with leaves was observed by the line C-5133 (43.12 t/ha) and the lowest was recorded by the line C-5018 (35.30 t/ha). The progenies C-5030, C-5036, C-5133, and C-5149 was shown greater Green weight with leaves by both the check varieties CVL-1 (37.83t/ha) and CVE-3 (40.84 t/ha). This variation was found due to its genetic makeup and also the variation of plant height, base diameter, leaf production and branch production. Pervin and Haque (2012); Islam (2007) reported that the green weight data were statistically similar among the Jute varieties. The highest Green weight without leaves (34.97 t/ha) was observed by the line C-5030 and the lowest (30.34t/ha) was recorded by the line C-5018. The progenies C-5030, C-5044, C-5133, C-5136 and C-5149 was shown greater Green weight without leaves by both the check varieties CVL-1 (32.11t/ha) and CVE-3 (32.38 t/ha). The highest fibre weight was observed by the line C-5149 (2.83 t/ha) and the check CVL-1 (2.83 t/ha) whereas lowest (2.33 t/ha) was recorded by both the line C-5018.

Pooled mean over stations revealed that no progenies, C-5018, C-5030, C-5036, C-5044, C-5133, C-5136, C-5149 out-yielded both the check varieties CVL-1 (2.83 t/ha) and CVE-3 (2.54t/ha). However, C-5149(2.83t/ha) shows equivalent result as CVL-1 and C-5030(2.61t/ha), C-5136(2.70t/ha) and C-5149(2.83t/ha) out yielded check variety CVE-3 (2.54t/ha). These were also found due to its genetic makeup and higher regional adaptability with the climatic condition and soil properties of the experimental field of the present study. These were also found due to its genetic makeup and higher regional adaptability with the climatic condition and soil properties of the experimental field of the present study. Significant varietals performance on fibre yield

were also obtained by (Sanjoy *et al.,* 2018; Hassan *et al.,* 2018; Mollah*et al.,* 2017; Islam *et al.,* 2017; Hossain*et al.,* 2015).

The highest Stick weight (6.01 t/ha) was recorded by the line C-5149 and the lowest (5.29 t/ha) was recorded by the line C-5018. All progenies C-5018, C-5030, C-5036, C-5044, C-5133, C-5136 and C-5149 except C-5149 was shown lower Stick weight by both the check varieties CVL-1 (5.97t/ha) and CVE-3 (5.72 t/ha). This variation was found due to its genetic make-up and also the variation of plant height.

Table 2. Pooled mean of seven breeding lines and two check varieties of white jute at different regional stations.

Varieties/ strains	Parentage	Pedigree number	Plant population (m/ha)	Plant height (m)	Base diameter (mm)	Green weight with leaves (t/ha)	Green weight without leaves (t/ha)	Fibre weight (t/ha)	Stick weight (t/ha)
C-5018	Accs. 1831 x 1832	9911-1-5018	0.201	3.29	21.28	35.30	30.34	2.33	5.29
C-5030	Acc. 1831 x CC-45	9936-3-5030	0.241	3.28	21.79	42.28	34.97	2.61	5.89
C-5036	Var.CC-45x Acc.1832	9986-1-5036	0.223	3.22	21.37	39.63	31.98	2.45	5.63
C-5044	Var.CC-45x Acc.1833	9987-1-5044	0.2094	3.21	21.05	40.23	33.04	2.44	5.62
C-5133	Accs. 1831 x 1832	9931-2-5133	0.2234	3.28	21.54	43.12	34.37	2.50	5.61
C-5136	Accs. 2146 x 4087	9961-1-5136	0.2192	3.23	21.18	40.47	33.30	2.70	5.60
C-5149	Accs. 2146 x 4087	9961-3-5149	0.2166	3.27	20.78	42.39	35.02	2.83	6.01
CVL-1	-		**0.2282**	**3.18**	**21.27**	**37.83**	**32.11**	**2.83**	**5.97**
CVE-3	-		**0.2366**	**3.16**	**21.17**	**40.84**	**32.38**	**2.56**	**5.72**

Conclusion

It could be concluded that the line C-5149 more efficient on the whole growth, fibre yield and yield attributing traits line C-5149 showed the best performance for fibre yield, stick production and greater performance on other yield attributes. So, I strongly recommend that line C-5149 of white Jute would be more successful productive variety in the regional condition in Bangladesh.

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