Khulna University Studies **Volume 11 (1&2) and 12 (1&2): ??-?? : December 2013**

LIFE SCIENCE

SEED GERMINATION AND SEEDLING GROWTH OF DIFFERENT JUTE CULTIVARS UNDER DIFFERENT LEVELS OF SODIUM CHLORIDE SALINITY

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KUS: 12/03- 310112
Manuscript received: January 31, 2012 Accepted: January 20, 2013

Abstract: Six jute cultivars *viz.* CVL-1, CC-45, CVE-3, D-154, BINA-1, and BINA-2 were tested under six salt concentrations, *viz.* S_0 = deionized water (control), S_1 = 4 dS m^{-1}, S_2 = 8 dS m^{-1}, S_3 = 12 dS m^{-1}, S_4 = 16 dS m^{-1} and S_5 = 20 dS m^{-1}. Different parameters of germination and seedling growth were found variable with the varieties and also with the various concentrations to sodium chloride salts. Overall better performance of germination as well as seedling growth parameters was found with the variety D-154 followed by CC-45 although percentage of germination and seedling growth decreased with the increase in salinity level in almost all the cases.

Keywords: Jute, seeds, germination, growth, salinity

Introduction

Jute (family Tiliaceae) is a dicotyledonous fibre-yielding (bast fibre) plant. Jute fibre is produced mainly from two commercially important species, namely White Jute (*Corchours capsularis*), and Tossa Jute (*Corchorus olitorius*).

Jute was once known as the golden fibre of Bangladesh, since it was the most important cash crop for the country. Earlier Bangladesh was the highest producer of jute, but since 1980s its demand of jute had drastically fallen down due to the introduction of low cost plastic materials. Plastic is known as non-biodegradable causing enormous environmental problems. Gradually jute products have been gaining popularity worldwide. As demand of jute has increased, we need to produce more jute fiber by exploiting the available jute varieties and also by expanding the area of cultivation. The coastal fallow land (during jute growing season) thus may be the new avenue for expansion of jute cultivation. The cultivable areas in coastal districts are affected with varying degrees of soil salinity. The coastal and offshore area of Bangladesh includes tidal, estuaries and river floodplains in the south along the Bay of Bengal. Agricultural land use in these areas is very poor, which is roughly 50% of the country's average (Petersen and Shireen, 2001). If it is possible to identify and to introduce salt tolerant jute varieties for this region, the productivity of these lands as well as the crop intensity will be increased.

Thus the major objective of this study is to observe the effect of different levels of NaCl salinity on seed germination, seedling growth and dry matter production of jute cultivars under laboratory condition.

DOI: https://doi.org/10.53808/KUS.2013.11and12.1203-L

Ratna M.N.S; Jahan M.S.; Islam M.M. and Haque M.M. (2013). Seed germination and seedling growth of different jute cultivars under different levels of sodium chloride salinity. *Khulna University Studies* Volume 11 (1&2) and 12(1&2): ??-??

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Materials and methods

The experiment was laid out in a Completely Randomized Design (CRD) with five replications. Two factors were considered in this experiment. Factor A: six jute varieties *viz.* CVL-1, CC-45, CVE-3, D-154, BINA-1, and BINA-2 and factor B: six salinity (NaCl) levels *viz.* S_0 = 0 dS m^{-1}, S_1 = 4 dS m^{-1}, S_2 = 8 dS m^{-1}, S_3 = 12 dS m^{-1}, S_4 = 16 dS m^{-1} and S_5 = 20 dS m^{-1}. Twenty five seeds for each variety were placed in each petridish. The experiment was kept at 25^0C for 14 days under laboratory condition.

Germination parameters: The experiment was observed every day and the numbers of germinated seeds were recorded. Maximum numbers of seed were germinated within 7 days. Germination count was expressed in percentage. The germination parameters were calculated using the formula as suggested by Krishnaswamy and Seshu (1990).

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds placed in petridish}} \times 100$$

Germination energy = Percentage of seeds germinated at 72 h
Germination capacity = Percentage of seeds germinated at 168 h

$$\text{Speed of germination (\%)} = \frac{\text{Number of seeds germinated at 72 h}}{\text{Number of seeds germinated at 168 h}} \times 100$$

Growth parameters: Data were collected from each replicated petridish after 14 days of experiment. Five samples were collected from each petridish and the mean were calculated for shoot and root length. The dry weight of shoot and root were collected after oven drying at 70° C for 48 hours.

The collected data were analyzed for variance (ANOVA) with MSTAT-C programme. Differences between the treatment means were compared according to Duncan's Multiple Range Test (DMRT).

Results and Discussion

Germination parameters: Seed germination percentage, germination energy, germination capacity and germination speed differed significantly due to interaction of different jute varieties with different levels of salinity (Table 1). Germination percentage ranged between 0.00 and 90.40%. The highest germination percentage was found with CC-45 (90.40%) which was statistically similar to CVL-1 and CVE-3 with 0 dS m^{-1}, CVL-1 and CC-45 at 4 dS $m^{-1,}$ and D-154 at 8 dS m^{-1} and 12 dS m^{-1} salinity level. However, CVE-3 did not germinate at 20 dS m^{-1} salinity and the other parameters like germination energy, germination capacity and germination speed were also found zero at this salinity.

The treatment combination S_1V_3 (control × CVE-3) was found superior regarding germination energy, germination capacity and germination speed while the S_6V_3 (20 dS m^{-1} × CVE-3) combination was found inferior and that variety CC-45 was found tolerant to salinity while CVE-3 had low salt tolerant capacity in comparison to other varieties. This result also showed that up to 4 dS m^{-1} all varieties showed more or less same tolerance which decreased with increasing salt concentration from this level. The result was similar with Emam and Helal (2008). Salinity stress consistently decreased the rate of germination of wheat (Begum *et al.*, 1992). Salinity delays germination, higher salt concentrations eventually reduced the percentage of seed germination (Mauromicle and Licandro, 2002). Abbas and Latif (2005) stated that salinity plays a remarkable change in germination and subsequent growth on different genotypes of jute varieties

and seed germination dropped below the controlled level, at high concentration of NaCl (5000 ppm).

Table 1: Effect of salinity on germination parameters of six jute varieties

EC (dS m^{-1})	Variety	Germination (%)	Germination energy (%)	Germination capacity (%)	Germination speed (%)
0	CVL-1	88.00 a	81.60 ab	88.00 a	92.55 abc
	CC-45	90.40 a	87.20 a	90.40 a	96.59 ab
	CVE-3	88.00 a	88.00 a	88.00 a	100.0 a
	D-154	83.20 ab	77.60 abcd	83.20 ab	94.19 ab
	BINA-1	65.60 bcde	65.60 cdefgh	65.60 bcde	100.0 a
	BINA-2	77.60 abc	68.00 bcdefg	77.60 abc	87.98 abc
4	CVL-1	87.20 a	80.80 ab	87.20 a	92.78 abc
	CC-45	86.40 a	75.20 abcde	86.40 a	87.25 abc
	CVE-3	83.20 ab	80.00 abc	83.20 ab	96.34 ab
	D-154	80.80 ab	76.80 abcd	80.80 ab	95.19 ab
	BINA-1	66.40 bcde	60.00 fghi	66.40 bcde	90.19 abc
	BINA-2	83.20 ab	75.20 abcde	83.20 ab	90.23 abc
8	CVL-1	79.20 ab	60.00 fghi	79.20 ab	75.56 bcd
	CC-45	81.60 ab	61.20 efghi	81.60 ab	75.59 bcd
	CVE-3	75.20 abc	64.40 defghi	75.20 abc	86.90 abc
	D-154	87.20 a	68.80 bcdef	87.20 a	78.64 abc
	BINA-1	56.00 defg	53.60 ghij	56.00 defg	95.90 ab
	BINA-2	73.60 abcd	51.20 hij	73.60 abcd	70.09 cde
12	CVL-1	73.60 abcd	57.60 fghi	73.60 abcd	78.25 abcd
	CC-45	76.00 abc	43.20 j	76.00 abc	56.69 de
	CVE-3	32.00 ijk	22.40 klm	32.00 ijk	74.89 bcd
	D-154	85.60 a	80.00 abc	85.60 a	93.18 ab
	BINA-1	64.80 bcde	50.40 ij	64.80 bcde	77.61 abcd
	BINA-2	34.40 hijk	28.00 k	34.40 hijk	85.62 abc
16	CVL-1	49.60 efgh	18.40 klmn	49.60 efgh	32.88 fg
	CC-45	60.00 cdef	14.40 klmno	60.00 cdef	24.45 gh
	CVE-3	23.20 jkl	9.600 mno	23.20 jkl	26.25 g
	D-154	72.80 abcd	24.80 kl	72.80 abcd	34.56 fg
	BINA-1	35.20 hij	0.0000	35.20 hij	0.0000 i
	BINA-2	17.60 klm	7.200 no	17.60 klm	51.19 ef
20	CVL-1	12.00 lmn	0.0000	12.00 lmn	0.0000 i
	CC-45	47.20 fghi	12.00 lmno	47.20 fghi	24.56 gh
	CVE-3	0.0000 n	0.0000 o	0.0000 n	0.0000 i
	D-154	40.80 ghi	0.0000 o	40.80 ghi	0.0000 i
	BINA-1	11.20 lmn	0.0000 o	11.20 lmn	0.0000 i
	BINA-2	3.200 mn	0.8000 o	3.200 mn	5.000 hi
CV (%)		15.93	16.94	15.93	18.50
Level of significance		0.01	0.01	0.01	0.01

Growth parameter: Interaction between salt levels and varieties had significant effect on growth parameters (Table 2). All the varieties performed better in case of shoot length up to 8 dS m^{-1} and the variety D-154 showed statistically similar result at 12 dS m^{-1}. The longest shoot length (3.44 cm) was found with CVE-3 at 4 dS m^{-1} and shortest length was also found with CVE-3 at 20 dS m^{-1}. The longest root length (5.70 cm) was found with the variety BINA-2 at control treatment and was found statistically similar with all the varieties at this level of salinity. Again at 4 dS m^{-1} all the varieties showed statistically similar result except CVL-1 and CC-45. The shortest root length was obtained at 20 dS m^{-1} with CVE-3. The dry weight of shoot varied from 0.000 to 0.102 mg and the maximum dry weight of shoot (0.102 mg) was estimated with the variety CVL-1 at 16 dS m^{-1} which was statistically similar with all the varieties in all the salinity levels except CVL-3 at 16 dS m^{-1} and 20 dS m^{-1} and D-154 and BINA-2 at 20 dS m^{-1}. The minimum shoot dry weight was found with the variety CVE-3 at 20 dS m^{-1}. The maximum dry weight of root was obtained with the variety D-154 at 20 dS m^{-1} and the lowest value was found with the variety CVE-3 at 20 dS m^{-1}. Delgado *et al.* (1994) reported that seed germination and growth of plants are commonly adversely affected in a negatively correlated manner with salinity level. Ahmad and Jabeen (2005) said that salinity is an environmental stress that limits growth and development of plants.

Table 2: Effects of salinity on growth parameters of seedlings of six jute varieties

EC (dS m^{-1})	Variety	Shoot length seedling^{-1} (cm)	Root length seedling^{-1} (cm)	Dry weight of shoot seedling^{-1} (mg)	Dry weight of root seedling^{-1} (mg)
0	CVL-1	3.160 abcd	4.520 bcde	0.8698 abc	0.3343 efghijk
	CC-45	2.720 abcdef	4.640 abcde	0.8677 abc	0.3556 efghijk
	CVE-3	3.160 abcd	5.100 abc	1.031 ab	0.4088 bcdefg
	D-154	3.140 abcd	5.100 abc	0.8995 abc	0.3949 bcdefgh
	BINA-1	3.060 abcd	5.040 abc	0.9416 ab	0.3941 bcdefgh
	BINA-2	3.160 abcd	5.700 a	1.083 a	0.4305 bcdef
4	CVL-1	2.840 abcd	3.960 cdefg	0.7890 abc	0.3424 efghijk
	CC-45	3.140 abcd	3.640 defgh	0.8439 abc	0.3603 efghijk
	CVE-3	3.440 a	5.440 ab	1.004 ab	0.4106 bcdefg
	D-154	3.060 abcd	5.200 ab	0.8895 abc	0.4339 bcde
	BINA-1	3.360 a	4.900 abc	1.058 ab	0.3989 bcdefg
	BINA-2	3.280 ab	4.640 abcde	1.001 ab	0.4853 b
8	CVL-1	2.720 abcdef	4.020 cdef	0.8454 abc	0.3648defghijk
	CC-45	2.620 abcdefg	3.940 cdefg	1.055 ab	0.3592 efghijk
	CVE-3	3.220 abc	4.660 abcd	0.9689 ab	0.4709 bcd
	D-154	2.520 bcdefg	3.980 cdefg	0.8836 abc	0.4044 bcdefg
	BINA-1	3.000 abcd	4.380 bcde	0.9998 ab	0.3775cdefghij
	BINA-2	2.740 abcde	3.980 cdefg	1.030 ab	0.3882 bcdefghi
12	CVL-1	2.380 defgh	3.620 defgh	0.9381 ab	0.3180 ghijk
	CC-45	2.340 defgh	3.180 fghij	1.029 ab	0.3301 efghijk
	CVE-3	2.480 bcdefg	3.560 defgh	0.8246 abc	0.4813 bc
	D-154	2.960 abcd	3.980 cdefg	0.8534 abc	0.3594 efghijk
	BINA-1	2.360 defgh	3.960 cdefg	0.8590 abc	0.3603 efghijk
	BINA-2	2.440 cdefg	3.480 efghi	0.9763 ab	0.3712 defghij

16	CVL-1	1.600 hij	2.600 hij	1.102 a	0.3234 fghijk
	CC-45	2.360 defgh	3.140 fghij	1.045 ab	0.2876 hijk
	CVE-3	1.920 fghi	3.060 ghij	0.5804 c	0.2617 k
	D-154	2.020 efghi	2.840 ghij	0.8120 abc	0.3653defghijk
	BINA-1	1.820 ghij	2.840 ghij	0.7937 abc	0.3580 efghijk
	BINA-2	1.880 ghij	2.680 hij	1.050 ab	0.3750 defghij
20	CVL-1	1.120 j	2.100 j	1.093 a	0.2767 jk
	CC-45	1.500 ij	2.320 j	0.8426 abc	0.3222 fghijk
	CVE-3	0.0000 k	0.0000 k	0.0000 d	0.0000 l
	D-154	1.440 ij	2.400 ij	0.7439 bc	0.5771 a
	BINA-1	1.360 ij	2.360 ij	0.8567 abc	0.2839 ijk
	BINA-2	0.3000 k	0.6800 k	0.1450 d	0.04500 l
CV (%)		17.28	16.44	18.57	16.34
Level of significance		0.01	0.01	0.01	0.01

Conclusion

Germination parameters are negatively affected with increasing salinity. D-154 and CC-45 were the best varieties among six jute cultivars for germination parameters. Among the jute cultivars CVL-1 and D-154 showed the best performance in growth parameters. Considering all the parameters observed in the experiment D-154 could be considered the best salt tolerant variety.

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