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# SCREENING OF JUTE MUTANTS FOR SALINITY TOLERANCE

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**ABSTRACT**

Islam MT, Begum MB, Islam MO (2011) Screening of jute mutants for salinity tolerance. *Int. J. Sustain. Crop prod.* 6(2), 6-11.

A pot culture experiment was conducted at the pot yard of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from February to May 2007 to screen jute mutants at different levels of salinity. The experiment was laid out in complete randomized design with three replications. In germination test, 20 jute genotypes were treated with 8, 6 $dSm^{-1}$ and control where no salt was applied. Among these genotypes, only five were germinated at 6 $dSm^{-1}$ salinity level. These five selected jute mutants *viz.* 0-9897 400 Gy P-26(1), 0-9897 500 Gy P-58(2), 0-9897 500 Gy P-65(3), 0-9897 900 Gy P-72(1), 0-9897 900 Gy P-86(3) were then treated with control, 4, 6 $dSm^{-1}$ salinity levels for growth and yield studies. The results revealed that plant height both at 85 DAS and maturity stage, number of leaves, leaf area, dry weight of roots, stem and leaves, total dry matter $plant^{-1}$ at 85 DAS, base diameter, fibre and stick yields at maturity were gradually decreased with the increase in salinity levels. The highest plant height was recorded in 0-9897 900 Gy P-86(3) and 0-9897 500 Gy P-65(3). The mutant 0-9897 400 Gy P-26(1) produced the maximum number of leaves, dry weight of stem, leaves, total dry matter, fibre yield and stick yields. The maximum leaf areas, dry weight of roots were produced by 0-9897 500 Gy P-65(3). Under the inducing salinity condition 0-9897 400 Gy P-26(1), 0-9897 500 Gy P-65(3) and 0-9897 900 Gy P-86(3) performed better than other mutants with respect of morphological and yield attributing characters.

***Key words:*** *jute mutants, germination, salt tolerance, dry matter and fibre yield*

## INTRODUCTION

Jute is an important cash and fibre crop which belongs to the family Tiliaceae and genus *Corchorus*. Two cultivated species of jute were *Corchorus capsularis* (Deshi jute) and *Corchorus olitorius* (Tossa jute). The commercial product of the fibre derived from these two species of genus *Corchorus*, among 40 species distributed throughout the tropics (Alim 1978). Jute is the second important fibre crop of the world (Saha 1996) and it is generally known as golden fibre of Bangladesh as it contributed as lion share to the economy. Jute fibre is used for making gunny bags, sacking, carpet backing cloths, mats blankets, furnishing fabrics and packing materials as an alternative to polyethyline bags. It is also used as micro-crystal cellulose in pharmaceutical laboratories and jute Zeo-Textice for the constructions.

Salinity is one of the major widespread environmental stresses that can limit growth and development of salt sensitive plant (Greenway and Munns, 1980). The salinity developed in soil adversely affects the growth and yield of different crop plants. Morphological characters namely plant height, total tillers, root, shoot, panicle length, grain weight $panicle^{-1}$, grain size and quality and quantity of grains decrease progressively with increase in salinity level (Abdullah *et al*. 2001). Seed germination is affected by the increase in salinity (Purhpan and Rangasamy, 2002). Crop plants show reduction in dry matter accumulation and grain yield under salt stress which is invariably accompanied with pronounced changes in their ionic composition. The salinity damage manifests most prominently in the dry season when is caused by evaporation. There adverse physiological effects of salinity may be attributed to non availability of water (Singh *et al*. 2001), reduction in photosynthesis through loss of turgidity (Gufran 1994), impeded nutrient uptake causing deficiency and ion toxicity to plant (Varshney *et al.* 1998). Selective uptake of non-toxic ions into the vascular saps and compartmentalization of toxic ions into the older plant parts is considered to be important basis of tolerance to salinity. Over $4/5^{th}$ of the surface of our earth is covered with a salt solution containing among many other constituents approximately 0.5M NaCl (Abrol 1986). Millions of hectares of land throughout the world are too saline to produce economic crops and more land becoming nonproductive each year because of salt accumulation. Common salts like carbonates, bicarbonates, and sulphates of Na, K, Ca, and Mg are the major problems in saline soil (Waisel 1972). Islam (2005) evaluated jute mutants CM-107, P-26(5), CM-61, CM-67, CM-652, BINA deshi pat-2, CM-443 and P-81(2) under at three salinity levels *viz* control, 3 and 6 $dSm^{-1}$ salinity levels and observed that plant height, number of leaves, leaf area, root, stem, and leaf dry weight, total dry matter decreased with the increase in salinity levels compared to control. The mutants of CM-443 and P-26(5) were proved to be moderately salt tolerant. In Bangladesh about 2.8 million hectares constitute coastal and offshore areas (Karim *et al*. 1982). There areas are affected by different degrees of salinity (Karim *et al*. 1990). For increasing jute production it is urgently needed to extent cultivation of jute to all possible areas of Bangladesh. But the cultivation of jute crop in that area is not easy because of the lack of salinity tolerant varieties. In order to develop saline tolerant variety of jute proper morphological and yield attributes of salt tolerance must be assessed.

Considering those points, the present work was undertaken to study the salt tolerance level of jute mutants. The characters of mutants associated to the salt tolerance of different levels are investigated. The objectives of the

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work were to assess the effect of salinity on morphological and yield attributes of jute mutants; and to find out salt tolerant jute mutants, if any.

## MATERIALS AND METHODS

A pot experiment was conducted at the pot yard of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during February to May, 2007 to investigate the effect of salinity on growth and yield of jute mutants. Two tests were conducted in this experiment; one of them was germination test which had control, 6, 8 $dSm^{-1}$ salinity level and 20 jute genotypes. Another for growth and yield studies which had control, 4, 6 $dSm^{-1}$ salinity levels with 5 selected mutants from germination test. The above mentioned five mutants of jute (*Corchorus oletorius* L.) were O-9897 400 Gy P-26(1), O-9897 500 Gy P-58(2), O-9897 500 Gy P-65(3), O-9897 900 Gy P-72(1) and O-9897 900 Gy P-86(3). Both the tests were laid out in a complete randomized design with three replications. The seeds were sown directly in the pots containing 8 kg of soils (Silty loam, organic matter 1.05%, total N 0.07%, available P 14.3 ppm, exchangeable K 0.25 meq.per 100g soil, available S 13.2 and soil pH 6.67). Recommended doses of fertilizers were applied and other cultural practices were followed as and when required. Data were recorded on plant height, number of leaves $plant^{-1}$, leaf area $plant^{-1}$, dry weight of roots, stem, leaves, total dry matter $plant^{-1}$, base diameter, fibre and stick yield.

## RESULTS AND DISCUSSION

The percentage of germination, plant height, number of leaves $plant^{-1}$, leaf area, dry weight of roots, stem and leaves and total dry matter decreased with increasing salinity levels compared to those at control. Yield and yield contributing attributes like plant height, fibre and stick yield were also decreased with increasing salinity compared to the control. At both stages (at 85 DAS and mature stage) the highest plant height was recorded in O-9897 900 Gy P- 86 (3), 0-9897 500 Gy P-65(3) and the lowest in mutant O-9897 500 Gy P-58(2), moderate in O-9897 400 Gy P-26(1). O-9897 400 Gy P-26(1) produced the maximum number of leaves $plant^{-1}$, dry weight of stem, leaves, total dry matter, fibre and stick yield. O-9897 500 Gy P-65(3) produced the maximum leaf area, dry weight of roots and moderate performance in number of leaves $plant^{-1}$, leaf weight, total dry matter $plant^{-1}$, fibre and stick yield. O-9897 500 Gy P-72(1) showed the lowest number of leaves, leaf area, leaf dry weight, total dry matter and fibre yield. The lowest plant height, dry weight of roots, stem and stick yield were recorded in O-9897 500 Gy P-58(2). Interaction effects of salinity levels and jute mutants on all the studied parameters were significant. Declined percentage of germination was in conformity with the result of Nasreen *et al*. (2002). Khandker and Alim (2004) reported that plant height of jute mutants was decreased with the increase in salinity levels. The gradual decrease in plant height might be due to inhibition of cell division or cell enlargement under salinity stress. Similar results were also obtained by Oliveira *et al*. (1998); Murillo and Tryo (2000). Islam *et al*. (2006) reported that number of leaves $plant^{-1}$ and root dry weight in jute were reduced by salinity. Reduced leaf area under salinity was obtained by Chakrabarti and Mukherjii (2002). Singh *et al*. (2001) recorded lower stem dry weight under salinity. Decreased stem dry weight under salinity stress might be due to the inhibition of hydrolysis of reserve food or its translocation to the growing axis. Leaf dry weight depends on leaf size. Decreased leaf dry weight might be due to inhibition of photosynthesis under salinity stress. The decrease in total dry matter accumulation due to salinity might be the result of poorly developed root, stem and leaf and decrease in other metabolites. The findings of Islam *et al*. (2006) were in consistence with the present findings. They reported that dry matter production reduced with the increasing salinity. The variation among different mutants might be due to different genetic make up of the mutants.

Table 1. Germination percentage of jute genotypes under different salinity levels

| Sl. No. | Genotypes | Germination percentage | | |
|---|---|---|---|---|
| | | Control (0.42 $dSm^{-1}$) | 6 $dSm^{-1}$ | 8 $dSm^{-1}$ |
| 1 | O-9897 Control | 66 | 0 | 0 |
| 2 | O-9897 400 Gy P -15 (2) | 88 | 0 | 0 |
| 3 | O-9897 400 Gy P -18 (3) | 88 | 0 | 0 |
| 4 | O-9897 400 Gy P -25 (1) | 88 | 0 | 0 |
| 5 | O-9897 400 Gy P -25 (2) | 88 | 0 | 0 |
| 6 | O-9897 400 Gy P -25 (3) | 77 | 0 | 0 |
| 7 | O-9897 400 Gy P -26 (1) | 88 | 44 | 0 |
| 8 | O-9897 500 Gy P -58 (2) | 100 | 44 | 0 |
| 9 | O-9897 500 Gy P -65 (2) | 77 | 0 | 0 |
| 10 | O-9897 500 Gy P -65 (3) | 88 | 33 | 0 |
| 11 | O-9897 500 Gy P -188 (1) | 88 | 0 | 0 |
| 12 | O-9897 800 Gy P -200 (2) | 100 | 0 | 0 |
| 13 | O-9897 800 Gy P -200 (3) | 88 | 0 | 0 |
| 14 | O-9897 900 Gy P -72 (1) | 100 | 22 | 0 |
| 15 | O-9897 900 Gy P -72 (2) | 77 | 0 | 0 |
| 16 | O-9897 900 Gy P -86 (1) | 77 | 0 | 0 |
| 17 | O-9897 900 Gy P -86 (3) | 88 | 33 | 0 |
| 18 | O-9897 900 Gy P -198 (1) | 77 | 0 | 0 |
| 19 | O-9897 900 Gy P -198 (2) | 100 | 0 | 0 |
| 20 | O-9897 900 Gy P -198 (3) | 100 | 0 | 0 |

Table 2. Effect of salinity on plant height, number of leaves and leaf area of jute mutants

| Treatments | Plant height (cm) at 85 DAS | Plant height (cm) at maturity | Number of leaves $plant^{-1}$ at 85 DAS | Leaf area ($cm^2$) $plant^{-1}$ at 85 DAS |
|---|---|---|---|---|
| **Salinity level** | | | | |
| Control (0.42 $dSm^{-1}$) | 135.67a | 269a | 27.53ab | 1194 a |
| 4 $dSm^{-1}$ | 106.07b | 226b | 22.67b | 879b |
| 6 $dSm^{-1}$ | 91.73c | 202c | 19.00c | 655c |
| $LSD_{0.05}$ | 3.25 | 5.971 | 1.15 | 58 |
| **Mutants** | | | | |
| O-9897 400 Gy P-26(1) | 116.00b | 241b | 25.11a | 995a |
| O-9897 500 Gy P-58(2) | 96.67d | 211c | 22.56b | 875b |
| O-9897 500 Gy P-65(3) | 117.44ab | 252a | 23.89ab | 1014a |
| O-9897 900 Gy P-72(1) | 104.89c | 211c | 20.56c | 718c |
| O-9897 900 Gy P-86(3) | 120.78a | 247ab | 23.22b | 944ab |

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 3. Interaction effects between salinity and mutants on plant height, number of leaves and leaf area of jute mutants

| Mutants | Salinity ($dSm^{-1}$) | Plant height (cm) at 85 DAS | Plant height (cm) at maturity | Number of leaves $plant^{-1}$ at 85 DAS | Leaf area ($cm^2$) $plant^{-1}$ at 85 DAS |
|---|---|---|---|---|---|
| O-9897 400 Gy P-26(1) | Control (0.42) | 131.00c | 264b | 27.67ab | 1420a |
| | 4 | 109.00ef | 240c | 22.67d | 762d |
| | 6 | 108.00cf | 221d | 25.00bcd | 804d |
| O-9897 500 Gy P-58(2) | Control (0.42) | 117.67d | 263b | 26.67ab | 980c |
| | 4 | 97.00gh | 197e | 23.33cd | 892cd |
| | 6 | 75.33i | 172f | 17.67ef | 753d |
| O-9897 500 Gy P-65(3) | Control (0.42) | 143.00ab | 264b | 29.00a | 1214b |
| | 4 | 115.33de | 270b | 25.67bc | 1004c |
| | 6 | 94.00h | 222d | 17.00ef | 824d |
| O-9897 900 Gy P-72(1) | Control (0.42) | 149.67a | 289a | 26.67ab | 1206b |
| | 4 | 105.00f | 197f | 19.00e | 573e |
| | 6 | 60.00i | 166f | 16.00f | 374f |
| O-9897 900 Gy P-86(3) | Control (0.42) | 137.00bc | 267b | 27.67ab | 1149b |
| | 4 | 104.00fg | 242c | 22.67d | 1165b |
| | 6 | 121.33d | 232cd | 19.33e | 517e |

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 4. Effect of salinity on root, stem, leaf dry weight and total dry matter plant$^{-1}$ of jute mutants at 85 DAS

| **Treatment** | **Root dry wt. (g)** | **Stem dry wt. (g)** | **Leaf dry wt. (g)** | **Total dry matter plant$^{-1}$ (g)** |
|---|---|---|---|---|
| **Salinity level** | | | | |
| Control (0.42 dSm$^{-1}$) | 3.76a | 16.69a | 5.13a | 25.64a |
| 4 dSm$^{-1}$ | 2.48b | 14.41b | 3.79b | 20.63b |
| 6 dSm$^{-1}$ | 2.57b | 13.02c | 2.92c | 18.69c |
| $LSD_{0.05}$ | 0.3260 | 0.9538 | 0.4707 | 1.193 |
| **Mutants** | | | | |
| 0-9897 400 Gy p-26(1) | 3.07ab | 17.41a | 4.66a | 25.14a |
| 0-9897 500 Gy p-58(2) | 2.64b | 12.94d | 3.58bc | 18.95d |
| 0-9897 500 Gy p-65(3) | 3.38a | 14.33bc | 4.23a | 22.03b |
| 0-9897 900 Gy p-72(1) | 2.89b | 13.96c | 3.12c | 20.08c |
| 0-9897 900 Gy p-86(3) | 2.70b | 15.33b | 4.13ab | 22.07b |

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 5. Interaction effects between salinity and mutants on root, stem, leaf dry weight and total dry matter plant$^{-1}$ of jute mutants at 85 DAS

| **Mutants** | **Salinity (dSm$^{-1}$)** | **Root dry wt. (g)** | **Stem dry wt. (g)** | **Leaf dry wt. (g)** | **Total dry matter plant$^{-1}$ (g)** |
|---|---|---|---|---|---|
| 0-9897 400 Gy p-26(1) | Control (0.42) | 3.75b | 19.22a | 6.65a | 29.62a |
| | 4 | 2.52d-g | 17.50ab | 3.57d | 23.59d |
| | 6 | 2.94b-e | 15.50bcd | 3.77cd | 22.21de |
| 0-9897 500 Gy p-58(2) | Control (0.42) | 3.46bc | 14.40def | 4.66bcd | 22.53de |
| | 4 | 2.04fg | 12.267fg | 4.25bcd | 18.55gh |
| | 6 | 2.43d-g | 10.81g | 1.84e | 15.76i |
| 0-9897 500 Gy p-65(3) | Control (0.42) | 3.547bc | 16.96abc | 4.92bc | 25.72bc |
| | 4 | 3.17bcd | 13.65def | 4.28bcd | 21.09ef |
| | 6 | 3.42bc | 12.37fg | 3.49d | 19.29fg |
| 0-9897 900 Gy p-72(1) | Control (0.42) | 4.90a | 14.15def | 5.00b | 24.12cd |
| | 4 | 1.85g | 15.00cde | 2.80e | 19.23fg |
| | 6 | 1.92g | 12.74efg | 1.97e | 16.88hi |
| 0-9897 900 Gy p-86(3) | Control (0.42) | 3.12bcd | 18.69a | 4.39bcd | 26.20b |
| | 4 | 2.84c-f | 13.65def | 4.45bcd | 20.70ef |
| | 6 | 2.15efg | 13.65def | 3.54d | 19.31fg |

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 6. Yield and yield attributes of jute mutants under different salinity levels

| **Treatment** | **Base diameter (cm)** | **Fibre yield plant$^{-1}$ (g)** | **Stick yield plant$^{-1}$ (g)** |
|---|---|---|---|
| Salinity level | | | |
| Control (0.42 dSm-1) | 1.80a | 17.57a | 46.93a |
| 4dSm-1 | 1.61b | 9.64b | 28.49b |
| 6dSm-1 | 1.46c | 6.47c | 21.12c |
| LSD0.05 | .1109 | 1.279 | 2.423 |
| **Mutants** | | | |
| 0-9897 400 Gy p-26(1) | 1.68 | 12.49a | 37.32a |
| 0-9897 500 Gy p-58(2) | 1.54 | 9.66b | 26.00c |
| 0-9897 500 Gy p-65(3) | 1.67 | 12.47a | 31.99b |
| 0-9897 900 Gy p-72(1) | 1.57 | 9.48b | 30.04b |
| 0-9897 900 Gy p-86(3) | 1.64 | 12.06a | 35.04a |

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 7. Interaction effect of salinity levels and jute mutants on yield and yield attributes

| **Mutants** | **Salinity ($dSm^{-1}$)** | **Base diameter (cm)** | **Fibre yield plant$^{-1}$ (g)** | **Stick yield plant$^{-1}$ (g)** |
|---|---|---|---|---|
| 0-9897 400 Gy p-26(1) | Control (0.42) | 1.86ab | 18.07a | 54.91a |
| | 4 | 1.66bcd | 10.11cd | 30.68e |
| | 6 | 1.53cde | 9.28de | 26.38ef |
| 0-9897 500 Gy p-58(2) | Control (0.42) | 1.70a-d | 14.33b | 36.87cd |
| | 4 | 1.60b-e | 9.32de | 26.91ef |
| | 6 | 1.33ef | 5.33f | 14.24g |
| 0-9897 500 Gy p-65(3) | Control (0.42) | 1.76abc | 18.44a | 40.68c |
| | 4 | 1.73abc | 12.70bc | 31.86de |
| | 6 | 1.53cde | 6.26ef | 23.43f |
| 0-9897 900 Gy p-72(1) | Control (0.42) | 1.96a | 17.83a | 53.67ab |
| | 4 | 1.63bcd | 6.12f | 22.49f |
| | 6 | 1.13f | 4.48f | 13.95g |
| 0-9897 900 Gy p-86(3) | Control (0.42) | 1.70a-d | 19.20a | 48.51b |
| | 4 | 1.43de | 9.96cd | 30.51e |
| | 6 | 1.80abc | 7.02def | 27.64ef |

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

## CONCLUSION

The increase in soil salinity significantly reduced almost all the morphological attributes and yield of jute mutants. Considering the performance of jute mutants under salt stress, O-9897 400 Gy P-26(1), O-9897 500 Gy 65(3), and O-9897 900 Gy P-86(3), showed better performance than others.

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