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Germination and seedling growth of indigenous *Aman* rice under NaCl salinity

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Abstract
Salinity is considered as one of the most important abiotic stresses limiting crop production. Among crop indigenous rice are known to survive under this stress. In this content, the present study was carried out to analyze genotypic variations in different salt tolerance of indigenous rice at germination and early seedling growth. The seeds of eleven indigenous (aman) rice genotypes and four salt concentrations (distilled water, 5, 10, 15dSm^{-1}) were used as salt treatments. The experiment was laid out in Completely Randomized Design (CRD) with three replications. Results showed that with the increase in salinity levels, germination parameters (germination percentage, germination energy, germination capacity, germination speed and seedling vigor index) and seedling growth parameters (seedling growth rate, shoot length, root length, dry weight) were decreased. The seedling growth parameters are relatively more sensitive to salinity than the germination parameters. Among the genotypes, Nara Jamai naru was superior to others considering germination parameters and growth parameters. In case of 5, 10dSm^{-1} Nara Jamai naru should comparatively better performance than other genotypes.

Keywords: Indigenous rice, salinity, germination parameter, growth parameter

1. Introduction
The abiotic stresses such as salinity (soil or water) are serious obstacles for field crops especially in the arid and semi-arid zones of the world. According to salinity survey findings and salinity monitoring information, in Bangladesh about 1.02 million ha (about 70%) of the cultivated lands are affected by varying degrees of soil salinity (very slight, slight, moderate strong and very strong salinity) [11]. In Bangladesh about 53% of the coastal areas of Bangladesh are affected by salinity [19]. Salinity has an adverse effect on seed germination of several vegetables and field crops, by creating an osmotic potential outside the seed inhibiting the absorption of water, or by the toxic effect of Na^+ and Cl^- [18]. Osmotic and saline stresses are responsible of the inhibition and delay of germination and plant growth [2]. Several physiological pathways, i.e., photosynthesis, respiration, nitrogen fixation and carbohydrate metabolism have been observed to be affected by high salinity [6].

Rice (*Oryza sativa* L.) is rated as one of the major food crops in the world. Bangladesh was a treasury of rice diversity. In Bangladesh nearly 10,000 land races of rice are considered to exist [22]. They are usually poor yielder but have the capability to tolerate various ranges of salinity. Some of these varieties have high yield potentiality and higher consumer demand due to their grain quality compared to modern varieties. Study on the response of rice to salinity stress may be helpful in breeding salt tolerant cultivars by identifying physiological features. Works on salt tolerance on indigenous *aman* rice of southwestern region of Bangladesh are scanty [21]. The aim of the present investigation was to analyze genotypic variations in salt tolerance of rice at germination and early seedling stage of growth.

2. Materials and Methods
2.1 Experimental site: The experiment was conducted at Agronomy Laboratory of Agrotechnology Discipline, Khulna University, Khulna, during June, 2014.

2.2 Experimental treatments:
The factorial experiment consists of two factors –
Factor A- Different levels of salt solution. The salinity was expressed in electrical conductivity (EC) expressed in dSm^{-1}. S_0 = Water (Control), S_1 = 5, S_2 = 10, S_3 = 15. Factor B – Rice genotypes (11 indigenous *aman* rice genotypes). V_1 = Kumro gour, V_2 = Kachra, V_3 = Chap shail, V_4 = Kashful balam, V_5 = Nara jamai naru, V_6 = Sylhet balam, V_7 = Durga vog, V_8 = Patnai balam, V_9 = Kalo mona, V_{10} = Dudh kamol, V_{11} = Mohinee chalut. Rice seeds were collected from the rice germplasm collections of Agrotechnology Discipline and local farmers.

2.3 Experimental design: The experimental design was laid out in a Completely Randomized Design (CRD) with three replications. Total number of petridishes = 4 (salinity levels) × 3 (replications) ×5 genotypes = 60

2.4 Preparation of the solutions: Required amount of salt (NaCl) was estimated and added to distilled water to make the required solution of NaCl following USDA (1996) which is given bellow:
Percent of salt= 0.064 x EC (dSm^{-1})

2.5 Germination test: Germination is the emergence of seedling which was conducted using petridish method. Germination paper or blotting paper in the size of petridish and were used in each petridish as substrate. 25 seeds of rice were placed in each petridish. Different salt solutions with different EC were used for respective treatment of seeds and distilled water was used in control. For immergence, the petridishes were kept at 25°C for 7 days in laboratory condition.
The petridishes were observed everyday and watering was done by respective solutions whenever required.

2.6 Data collection: Data were collected and calculated on germination percentage (%), germination energy (%), germination capacity (%), germination speed (%), seedling vigor index, seedling growth rate ($mgday^{-1}$), shoot length (cm), root length (cm) and root and shoot dry weight (mg/20 seedlings).

2.7 Germination parameters: For germination the petridishes were observed every day and the numbers of germinated seeds were recorded. After one day of seed setting in petridishes, few of the seeds were germinated. Within 7 days of seed setting in petridishes maximum number of seeds were germinated. A seed was considered to be germinated as seed coat ruptured, plumule and radicle came out and were >2mm long.

Germination percentage: The germination percentage was calculated using the following formula-

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds set for test}} \times 100$$

Germination energy: Percentage of seeds germinated at 72 h [5].

Germination capacity: Percentage of seeds germinated at 168 h [5].

Speed of Germination:
The rate/speed of germination was calculated using the following formula

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

Seedling vigor index (SVI): Seedling vigor index can be expressed by the following equation [1]
Seedling vigor index **= (**Average shoot length + average root length) × germination percentage

2.8 Growth parameters:
Seedling growth rate: Amount of dry matter production per unit time is known as seedling growth rate. It indicates at what rate the crop is growing that is whether the crop is growing at a faster rate or slower rate than that of normal. It is expressed as milligram (mg) of dry matter produced per day and can be expressed by following equation

$$\text{Seedling growth rate} = \frac{W_2 - W_1}{T_2 - T_1}$$

Where, W_1 and W_2 are initial and final weight of plant sample at initial (T_1) and final time (T_2) respectively.

Root and shoot length measurement: Randomly selected five seedlings were taken from each petridish to measure root and shoot length. Root lengths of seedlings were measured manually after 7 days of seed setting.

Dry weight of root and shoot measurement: After 7 days of seed setting the roots and shoots of the seedlings of each petridish were dried in oven at 70°C for 48 hours and weighed.

2.9 Statistical analysis: All the collected data were analyzed by using analysis of variance (ANOVA) technique. Data analysis was carried out according to the statistical procedure described by Gomez and Gomez (1984) [9] and the computer package MSTAT-C. Means were separated by using the Duncan's Multiple Range Test (DMRT) and Least Significant Differences (LSD) at 5% level of significance.

3. Results and Discussion
3.1 Germination parameters
3.1.1 Effect of genotypes on germination parameters
All the studied parameters viz, germination percentage, germination energy, germination capacity, germination speed in the tested genotypes differed significantly (Table 2). The highest germination percentage (98.50%), germination energy (93.50%), germination capacity (98.50%), germination speed (94.96%) were observed in Nara jamai naru. In case of seedling vigor index the highest value was recorded in Patnai balam (1332.66) which was statistically similar to Nara jamai naru (1291.50). The variation in germination parameters among different genotypes may be due to genetic differences. The variability has also been reported in germination parameters among different genotypes [4, 10, 24]. Hasegawa *et al.* (2000) [12] stated that salt stress tolerance in several species including rice might include the expression of specific genes and repress or completely suppress the expression of others.

Table 2: Differences of genotypes on germination parameters under salinity levels

Genotype	Germination Percentage (%)	Germination Energy (%)	Germination Capacity (%)	Germination Speed (%)	Seedling Vigor Index
Kumro gour	93.83 b	65.17 c	93.83 b	68.95 cd	700.38 bc
Kachra	96.00 ab	50.50 d	96.00 ab	52.61 e	904.39 ab
Chap shail	95.00 ab	60.67 c	95.00 ab	63.36 d	797.82 b

Kashful balam	86.00 c	62.83 c	86.00 c	70.75 c	971.63 ab
Nara jamai naru	98.50 a	93.50 a	98.50 a	94.97 a	1291.50 a
Sylhet balam	94.17 b	81.17 b	94.17 b	86.17 b	768.33 bc
Durga vog	98.33 a	84.67 b	98.33 a	86.07 b	932.63 ab
Patnai balam	65.33 d	42.50 e	65.33 d	63.00 d	1332.66 a
Kalo mona	30.83 e	26.33 f	30.83 e	84.89 b	293.98 c
Dudh kamol	96.00 ab	80.83 b	96.00 ab	83.85 b	1166.87 ab
Mohinee chalut	92.33 b	52.50 d	92.33 b	55.40 e	887.77 ab
Level of Significance	0.01	0.01	0.01	0.01	0.01
CV (%)	4.62	9.40	4.62	10.19	57.60

3.1.2 Effect of different salinity levels on germination parameters

There was decreasing tendency of germination percentage with increasing salinity levels (Table 3). The highest germination percentage (88.36%), germination energy (78.61%), germination capacity (88.36%) and germination speed (88.86%) were found at control level (0dSm^{-1}) which was statistically similar to those at 5dSm^{-1} and some parameters at 10 dSm^{-1} (86.42 % germination percentage, 86.42 % germination capacity, 943.69 seedling vigor index). At 15dSm^{-1} the measured parameters were found lowest (Table 3).

In some studies germination parameters (germination percentage, germination energy, germination capacity, germination speed and seedling vigor index) was reduced by soil salinity due to the enzyme inhibition. [10, 13, 20, 25, 26]. Flowers (1972) [8] reported that malic dehydrogenase and glucose-6-phosphate dehydrogenase were inhibited by elevated NaCl levels. High ion content in plant cells can induce changes in protein hydration and their precipitation, causing an inhibition of enzyme activity.

Table 2: Effect of levels of salinity on germination parameters

EC (dSm^{-1})	Germination percentage (%)	Germination Energy (%)	Germination Capacity (%)	Germination Speed (%)	Seedling Vigor Index
0	88.36 a	78.61 a	88.36 a	88.86 a	1181.88 a
5	87.70 a	74.36 a	87.70 a	85.05 a	937.70 ab
10	86.42 a	63.94 b	86.42 a	74.74 b	943.69 ab
15	81.64 b	37.88 c	81.64 b	45.90 c	590.54 b
Level of Significance	0.01	0.01	0.01	0.01	0.01
CV (%)	4.62	9.40	4.62	10.19	57.60

3.1.3 Interaction effect of genotypes and different salinity levels on germination parameters

In the experiment control × Nara jamai naru was found superior regarding germination percentage (100.00%), germination energy (98.667%), germination capacity (100.00%), germination speed (98.33%). The 5dSm^{-1} × Nara jamai naru also found superior regarding germination percentage (100.00%), germination energy (98.00%), germination capacity (100.00%), germination speed (98.67%). At 10dSm^{-1} × Nara jamai naru and 15dSm^{-1} × Nara jamai naru also showed relatively better performance than other genotypes. It was noticed that both genotypes and salinity level significantly affect germination parameters. Several studies indicate that the response of plant cells to high salt is controlled by multiple genes [12,27,1]. Hasegawa *et al.* (2000) [12] reported salt stress tolerance in several species including rice might include the expression of specific genes and repress or completely suppress the expression of others. Again salt-induced oxidative stress might disrupt membrane structure because overproduction of reactive oxygen species triggers lipid and protein peroxidation [27] for this in higher level of salt stress plant show lower tolerance.

Table 4: Interaction effect of genotypes and different salinity levels on germination parameters

EC (dS m^{-1}	Genotype	Germination percentage (%)	Germination Energy (%)	Germination Capacity (%)	Germination Speed (%)	Seedling Vigor Index
	Kumro gour	96.00 a-d	85.33 b-h	96.00 a-d	88.86 a-g	823.00
	Kachra	97.33 a-c	74.67 h-k	97.33 a-c	76.67 g-l	999.67
	Chap shail	96.00 a-d	82.67 d-i	96.00 a-d	86.18 a-g	850.07
	Kashful balam	88.00 ef	76.00 g-k	88.00 ef	86.27 a-g	1278.13
	Nara jamai naru	100.00 a	98.67 a	100.00 a	99.33 a	1254.17
0	Sylhet balam	94.67 a-e	88.00 a-f	94.67 a-e	92.98 a-e	932.15
	Durga vog	98.67 ab	95.33 ab	98.67 ab	96.63 ab	1284.83
	Patnai balam	72.00 g	60.00 lm	72.00 g	83.12 b-h	2884.83
	Kalo mona	34.67 i	31.33 pq	34.67 i	90.60 a-g	378.00
	Dudh kamol	98.67 ab	90.67 a-d	98.67 ab	91.86 a-f	1213.33
	Mohinee chalut	97.33 a-c	82.67 d-i	97.33 a-c	84.97 a-g	1102.50
	Kumro gour	96.67 a-d	80.67 d-i	96.67 a-d	83.49 b-h	1004.95
	Kachra	96.00 a-d	66.67 j-l	96.00 a-d	69.51 h-m	944.73
	Chap shail	96.67 a-d	77.33 f-j	96.67 a-d	80.00 d-j	751.40

	Kashful balam	92.00 b-e	83.33 c-i	92.00 b-e	90.64 a-g	1187.83
	Nara jamai naru	100.00 a	98.00 a	100.00 a	98.67 a	1020.33
5	Sylhet balam	94.00 a	85.33 b-h	94.00 a	90.78 a-g	950.43
	Durga vog	98.67 ab	94.67 a-c	98.67 ab	95.95 a-c	945.33
	Patnai balam	67.33 g	52.67 mn	67.33 g	78.18 e-j	945.33
	Kalo mona	28.67 ij	25.33 qr	28.67 ij	90.77 a-g	371.07
	Dudh kamol	97.33 a-c	87.33 a-g	97.33 a-c	89.70 a-g	1188.08
	Mohinee chalut	97.33 a-c	66.00 j-l	97.33 a-c	67.83 i-m	1005.17
	Kumro gour	92.00 b-e	60.67 lm	92.00 b-e	65.94 j-m	466.87
	Kachra	94.00 a-e	48.00 no	94.00 a-e	51.02 n	961.25
	Chap shail	98.00 a-c	56.67 l-n	98.00 a-c	57.82 mn	951.40
	Kashful balam	90.67 c-f	74.00 h-k	90.67 c-f	81.54 c-i	971.23
	Nara jamai naru	95.33 a-e	90.00 a-e	95.33 a-e	94.54 a-d	1966.50
10	Sylhet balam	94.67 a-e	78.67 e-i	94.67 a-e	83.09 b-h	635.00
	Durga vog	98.00 a-c	84.00 b-i	98.00 a-c	85.71 a-g	867.42
	Patnai balam	67.33 g	41.33 op	67.33 g	61.32 mn	867.57
	Kalo mona	33.33 ij	31.33 pq	33.33 ij	94.44 a-d	264.67
	Dudh kamol	96.67 a-d	88.00 a-f	96.67 a-d	91.03 a-g	1486.07
	Mohinee chalut	90.67 c-f	50.67 m-o	90.67 c-f	55.68 mn	942.57
	Kumro gour	90.67 c-f	34.00 pq	90.67 c-f	37.50 o	506.70
	Kachra	96.67 a-d	12.67 s	96.67 a-d	13.26 p	711.90
	Chap shail	89.33 d-f	26.00 qr	89.33 d-f	29.42 o	638.42
	Kashful balam	73.33 g	18.00 rs	73.33 g	24.56 op	449.33
	Nara jamai naru	98.67 ab	87.33 a-g	98.67 ab	87.33 a-g	925.00
15	Sylhet balam	93.33 a-e	72.67 i-k	93.33 a-e	77.84 f-k	555.73
	Durga vog	98.00 a-c	64.67 kl	98.00 a-c	65.99 j-m	632.92
	Patnai balam	54.67 h	16.00 rs	54.67 h	29.38 o	632.90
	Kalo mona	26.67 j	17.33 rs	26.67 j	63.72 k-n	162.17
	Dudh kamol	91.33 b-f	57.33 l-n	91.33 b-f	62.78 l-n	780.00
	Mohinee chalut	84.00 f	10.67 s	84.00 f	13.14 p	500.83
	Level of Significance	0.01	0.01	0.01	0.01	NS
	CV (%)	4.62	9.40	4.62	10.19	57.60

3.2 Growth parameters

3.2.1 Differences of genotypes on growth parameters

Seedling growth rate, shoot and root length and dry weight of shoot and root of different rice varieties were significantly affected by different salinity levels. The highest seedling growth rate (30.28 mgday^{-1}), dry weight (123.98 mg/20 seedlings) were recorded in Nara jamai naru.

Rice genotypes significantly differed in shoot and root length. Shoot length varied from 3.84 cm to 5.42 cm. The highest shoot length was observed in Kalo mona (5.42cm); and lowest shoot length was in Chap shail (3.84cm).

The root length varied from 3.97cm to 7.27cm. The highest root length was recorded in Dudh kamol (7.27cm) which was statistically identical to Nara jamai naru (6.34cm) and Kashful balam (6.32cm).The lowest root length was noticed in Sylhet balam (3.97cm). These results are inline with the work of [10, 14, 15, 16] who described that growth parameters varied with genotypic differences. Salt tolerance of plant cell is controlled by multiple genes [12] that produce various osmotic regulation materials, such as proline, sugars and proteins which stabilize cellular constituents.

Table 5: Differences of genotypes on growth parameters

Genotype	Seedling Growth Rate (mgday^{-1})	Shoot Length (cm)	Root Length (cm)	Dry Weight (mg/20 seedlings)
Kumro gour	22.86 d	3.92 c	5.12 b	96.68 cd
Kachra	26.14 bc	4.63 bc	4.81 bc	109.63 bc
Chap shail	22.72 d	3.84 c	4.56 bc	97.97 cd
Kashful balam	16.43 e	4.47 bc	6.32 a	75.39 f
Nara jamai naru	30.28 a	4.49 bc	6.58 a	123.98 a
Sylhet balam	22.30 d	4.20 bc	3.97 c	95.39 de
Durga vog	23.68 cd	4.40 bc	5.06 b	97.11 cd
Patnai balam	13.76 e	4.31 bc	5.06 b	82.59 ef
Kalo mona	9.20 f	5.42 a	4.31 bc	123.17 a
Dudh kamol	27.02 b	4.83 ab	7.27 a	111.95 ab
Mohinee chalut	22.07 d	4.34 bc	5.12 b	95.37 de
Level of Significance	0.01	0.01	0.01	0.01
CV (%)	14.76	19.46	20.80	14.23

3.2.2 Effect of different levels of salinity on growth parameters

The highest seedling growth rate (26.59mgday^{-1}), Shoot length (5.53cm), root length (6.38cm) dry weight (124.66mg/20 seedlings) were found at control level (0dSm^{-1}) which was statistically similar to those at 5dSm^{-1} while 15dSm^{-1} treatment level gave the lowest value of those parameters (Table 6). Similarly, [28, 29, 30] observed that shoot length, root lengths and dry weight were decreased with increasing salt stress.

Table 6: Effect of levels of salinity on growth parameters

EC (dSm^{-1})	Seedling Growth Rate (mgday^{-1})	Shoot Length (cm)	Root Length (cm)	Dry Weight (mg/20 seedlings)
0	26.59 a	5.53 a	6.38 a	124.66 a
5	25.74 a	5.11 a	5.27 b	117.91 a
10	20.02 b	4.19 b	5.58 ab	94.39 b
15	13.63 c	2.93 c	3.94 c	66.39 c
Level of Significance	0.01	0.01	0.01	0.01
CV (%)	14.76	19.46	20.80	14.23

3.2.3 Interaction effect of genotypes and salinity levels on growth parameters

Control × Nara jamai naru produced highest results than other genotypes. The 5dSm^{-1} × Nara jamai naru also found superior regarding seedling growth rate (31.13mgday^{-1}), dry weight (130.64mg/20 seedlings). At 10dSm^{-1} × Nara jamai naru and 15dSm^{-1} × Nara jamai naru also produced relatively higher results than other genotypes. The lowest seedling growth rate (3.83mgday^{-1}) and dry weight (28.10mg/20seedlings) was found in Patnai balam. The lowest shoot length (2.17cm) in Kumro gour and root length (3.08cm) was found in Sylhet balam. These results are inline with the work of [7, 10, 17, 23]. [17] observed that shoot length, root length and dry weight were decreased with increasing salt stress. The reduction in root and shoot development may be due to toxic effects of the NaCl as well as unbalanced nutrient uptake by the seedlings. Salinity can rapidly inhibit the root growth and its capacity to water uptake and essential mineral nutrition from soil [10]. [16] found that total chlorophyll content was reduced with increased levels of salinity. [15, 27, 18] also found that seedling height and dry weight of different rice genotypes showed a declining trend with the increase of salinity level.

Table 7: Interaction effect of genotypes and different salinity levels on growth parameters among eleven local *aman* rice genotypes

EC (dSm^{-1}	Genotype	Seedling Growth Rate (mgday^{-1})	Shoot Length (cm)	Root Length (cm)	Dry Weight (mg/20 seedlings)
	Kumro gour	28.53 b-f	5.71	6.79 b-f	118.03 c-i
	Kachra	29.17 b-f	4.58	5.83 d-j	121.47 b-g
	Chap shail	25.67 c-h	4.04	4.75 f-m	107.76 e-l
	Kashful balam	24.80 d-h	5.63	8.29 b	108.04 d-l
	Nara jamai naru	36.57 a	4.83	7.71 b-d	148.07 ab
0	Sylhet balam	27.97 b-g	5.71	4.21 i-m	119.01 c-h
	Durga vog	30.67 b-d	6.00	7.00 b-e	124.36 b-f
	Patnai balam	17.57 j-o	5.67	7.00 b-e	106.47 e-m
	Kalo mona	10.97 p-r	7.38	6.17 b-i	167.50 a
	Dudh kamol	33.23 ab	5.83	6.63 b-g	136.52 b-d
	Mohinee chalut	27.37 b-g	5.50	5.83 d-j	114.01 c-j
	Kumro gour	28.40 b-f	4.46	6.00 c-i	118.13 c-i
	Kachra	29.93 b-e	5.42	4.29 h-m	123.13 b-f
	Chap shail	24.13 e-i	4.17	3.67 j-m	105.21 e-m
	Kashful balam	19.67 h-m	5.29	8.17 bc	90.18 i-o
	Nara jamai naru	32.13 ab	4.83	5.50 e-k	130.64 b-e
5	Sylhet balam	29.17 b-f	4.63	5.33 e-l	125.76 b-f
	Durga vog	30.47 b-d	5.00	4.58 g-m	125.27 b-f
	Patnai balam	18.40 i-n	5.00	4.58 f-m	103.03 e-m
	Kalo mona	11.80 o-q	6.63	4.29 h-m	138.37 bc
	Dudh kamol	31.73 a-c	5.67	6.38 b-i	129.15 b-e
	Mohinee chalut	27.30 b-g	5.17	5.13 e-m	112.14 c-k
	Kumro gour	21.10 h	3.33	4.21 i-m	91.47 h
	Kachra	23.43 f	4.79	5.46 e-l	100.88 e
	Chap shail	23.20 f	4.08	5.63 d-k	97.32 f
	Kashful balam	15.63 k	4.33	6.38 b-i	71.73 n
	Nara jamai naru	27.30 b	4.67	6.46 b-h	116.06 c
10	Sylhet balam	18.50 i	3.63	3.08 m	78.22 m
	Durga vog	20.13 h	3.79	5.00 e-m	83.86 k
	Patnai balam	15.23 k	3.79	5.00 e-m	92.76 h
	Kalo mona	8.63 q	4.58	3.54 k-m	103.97 e
	Dudh kamol	27.33 b	4.88	10.50 a	113.12 c
	Mohinee chalut	19.77 h	4.17	6.08 c-i	88.93 j
	Kumro gour	13.40 n-q	2.17	3.46 k-m	59.08 pq

	Kachra	22.03 g-j	3.71	3.67 j-m	93.02 g-o
	Chap shail	17.87 j-o	3.08	4.21 i-m	81.61 l-q
	Kashful balam	5.63 rs	2.63	3.50 k-m	31.58 rs
	Nara jamai naru	25.10 d-h	3.63	5.63 d-k	105.16 e-m
15	Sylhet balam	13.57 l-q	2.83	3.25 lm	58.56 pq
	Durga vog	13.47 m-q	2.79	3.67 j-m	54.97 qr
	Patnai balam	3.83 s	2.79	3.67 j-m	28.10 s
	Kalo mona	5.40 rs	3.08	3.25 lm	82.83 l-p
	Dudh kamol	15.77 k-p	2.96	5.58 d-k	68.99 o-q
	Mohinee chalut	13.83 l-q	2.54	3.42 k-m	66.41 o-q
	Level of Significance	0.05	NS	0.01	0.05
	CV (%)	14.76	19.46	20.80	14.23

4. Conclusion
Germination and seedling growth parameters are affected by salinity but seedling growth parameters are relatively more affected than germination parameters. Nara jamai naru is superior to others considering germination parameters and growth parameters.

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