# Germination Behavior of Selected Improved Rice Varieties under Salt Stress

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**Abstract**
Soil salinity especially in coastal area after tsunami disaster is a major factor that reduces the germination, plant vigour and yield of agricultural crops. Rice is one of the most sensitive crops to salinity and the effects of salinity vary in different growth stages. The knowledge of the effects of salt stress on plants at the early stage is necessary to improve crop production under saline environment. Therefore this study was carried out to determine the salt tolerance of nine *indica* rice varieties at germination stage using a simple laboratory technique. The response of nine rice verities (At 362, At 354, At 308; Bw351, Bw361, Bw364; Bg 379/2, Bg 358, Bg 359) against five salinity (0, 4, 8, 12 and 16 dS m-1) levels was tested. Twenty seeds from each cultivar in each treatment with four replicates were allowed to germinate on a sterilized filter paper moistened with salt solutions on sterilized petri plates, arranged in completely randomized design (CRD). The results revealed that the germination percentages were inversely related to level of salt concentration. The salinity level 16 dS $m^{-1}$ shows complete impairment of germination in all varieties tested. The rice varieties, At 308, At 362, At 354, Bw 351, Bg 379/2 and Bg 358 can tolerate salinity up to 12dS $m^{-1}$ with varying degree of germination percentages. In general, 'At' cultivars withstand salinity than 'Bw' and 'Bg' and the results conclude that At 354 is the best variety for saline environment.

***Keywords:*** Germination, Rice, Salinity stress
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## Introduction

Rice (*Oryza sativa* L.) is one of the most important world's cereal crops, particularly in Asia where approximately 90% of world's rice is produced and consumed (Zeigler and Barclay, 2008). In Sri Lanka, rice is the most important crop occupying 34 percent (0.77 /million ha) of the total cultivated area. Abiotic stress is the major threat to crop production worldwide, reducing average yields of major crops by more than 50%. Salinity is one of the most serious factors limiting the productivity of agricultural crops, with adverse effects on germination, plant vigour and crop yield (Munns and Tester, 2008). High salinity affects plants in several ways: water stress, ion toxicity, nutritional disorders, oxidative stress, alteration of metabolic processes, membrane disorganization, reduction of cell division and expansion (Zhu, 2007).

Salt concentration in a soil is measured in terms of its electrical conductivity (EC); the SI unit of electrical conductivity is $dSm^{-1}$(Anbumalarmathi and Mehta, 2013). According to the classification of crop tolerance to salinity, the rice crop is within the sensitive division from $0dSm^{-1}$ to $8dSm^{-1}$(Maas, 1986). A fundamental biological understanding and knowledge of the effects of salt stress on plants at the early stage is necessary to successful crop production in a saline environment. Therefore, the objective of this study was to find out the salt tolerance of nine *indica* rice varieties at germination stage using a simple laboratory technique.

## Materials and Methods

Nine different rice varieties collected from 3 rice research stations (Ambalantota; At 362, At 354, At 308; Bombuwala; BW351, BW361, BW364; Batalagoda; BG379/2, BG 358, BG 359) were used for this experiment.

Healthy, uniform seeds of all varieties were surface sterilized with 0.3% Chlorox and distilled water. Four different salt concentrations, 0 (distilled water) as a control, 4, 8, 12 dS $m^{-1}$ were tested as treatments and twenty seeds for each cultivar in each treatment were allowed to germinate on a sterilized filter paper which moistened with salt solutions on sterilized Petri dishes. Sodium chloride was used to prepare the salt solution and 15 ml of appropriate solution was applied for each Petri dish. Petri plates were arranged in completely randomized design (CRD) with two replicates and periodically monitored. The number of germinated seeds was counted daily and final germination percentage was measured at the time of harvesting (9 days after treatment application).The data were analyzed using Analysis of Variance (ANOVA).

## Results and Discussion

The results revealed that the germination percentages were inversely related to level of salt concentration. At 16 $dSm^{-1}$ salinity, seed

germination of nine varieties was completely

**Table 1:** Germination percentages of selected rice varieties with 4 different salinity levels ($dsm^{-1}$)

| Variety | Salinity level ($dsm^{-1}$) | | | |
|---|---|---|---|---|
| | 0 | 4 | 8 | 12 |
| At 308 | 97.50 $^{a}$± 3.53 | 90.00 $^{ab}$ ± 7.07 | 45.00 $^{bc}$±7.07 | 40.00$^{a}$±0 |
| At 362 | 100.00 $^{a}$ ± 0 | 100.00 $^{a}$± 0 | 85.00 $^{a}$± 7.07 | 27.50$^{ab}$± 17.67 |
| At 354 | 97.50 $^{a}$± 3.53 | 95.00 $^{ab}$ ± 7.07 | 55.00 $^{abc}$±7.07 | 45.00 $^{a}$±28.28 |
| BW351 | 95.00 $^{a}$± 0 | 82.50 $^{b}$± 10.60 | 82.50 $^{a}$ ± 3.53 | 30.00 $^{ab}$±14.14 |
| BW361 | 90.00 $^{a}$± 14.14 | 10.00 $^{d}$± 0 | 7.50 $^{d}$ ± 3.53 | 0$^{d}$±0 |
| BW364 | 35.00 $^{c}$± 7.07 | 12.50 $^{d}$ ± 3.53 | 10.00 $^{d}$± 0 | 5.00 $^{b}$ ±0 |
| BG379/2 | 72.50 $^{b}$± 3.53 | 67.50 $^{c}$± 3.53 | 32.50 $^{cd}$± 3.53 | 30.00$^{ab}$±0 |
| BG 359 | 35.00 $^{c}$ ± 7.07 | 15.00 $^{d}$ ± 7.07 | 10.00 $^{d}$±7.07 | 0$^{d}$±0 |
| BG 358 | 95.00 $^{a}$ ± 7.07 | 97.50 $^{a}$± 3.53 | 67.50 $^{ab}$± 38.89 | 37.50$^{a}$±10.60 |

Different letters behind the mean value indicate significant differences between rice varieties based on Duncan's Multiple Range Test.

inhibited. Significant differences ($p<0.05$) found in seed germination at all salinity levels. The highest seed germination ability was observed at 0 (control) stages in all varieties. At 4$dSm^{-1}$and 8 $dSm^{-1}$salinity, the highest germination showed At 362 while lowest observed in Bw 361.At 12 $dSm^{-1}$salinity, the significantly highest germination was observed in At 354 and no differences among At 308, At 362, Bw 351, Bg 379/2 and Bg 358. The germination was completely inhibited in Bw 361 and Bg 359at 12 $dSm^{-1}$. The variability has also been reported in salinity tolerance among rice varieties at germination. Salinity results in poor crop stand due to decreased seed germination.

## Conclusion

The percentage of germination significantly decreased in all varieties due to increasing salinity level. However, the varieties At 308, At362, At 354, Bw 351, Bg 379/2 and Bg358 can tolerate salinity upto12 $dSm^{-1}$. Study found that At 354 was the best variety for saline environment.

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