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EFFECT OF DIFFERENT KINDS OF SALT AND THEIR DIFFERENT LEVELS ON SEED GERMINATION OF *TRIGONELLA FOENUM-GRAECUM* L.

Ambarish Bhuyan

Abstract

Salinity is a major abiotic stress which reduces the productivity of crops. This research was carried out in order to test the effects of three different salts viz. NaCl, $BaCl_2$ and $FeCl_3$ on germination of Trigonella foenum-graecum seeds. The experiment was carried out using completely randomized design in six replications. Seeds were treated with 2.5, 5, 10, 25, 50, 100, 200 and 300mM salt concentrations. ANOVA revealed significant reduction in germination percentage, germination index and germination energy under various salt concentration. However the reduction in case of $FeCl_3$ was much more than the other two salts. The findings suggest that Trigonella can tolerate lower concentration of salt stress and therefore their cultivation can be done on marginal salted soils.

Keywords :*Salinity, Trigonella, Germination percentage, Germination index.*

Short Profile

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INTRODUCTION :

Salinity is a major cause of inhibition of plant growth. Salinity in the arid and semi-arid regions is one of the major abiotic stresses which subsequently reduce the yield of major crops by more than 50% (Bray, 2000). 7% of the worlds land area is affected by salinity (Munns, 2002). In semi-arid and arid regions, due to the extreme dryness and inappropriate irrigation, 15% of the soils in these regions face salinity problem (Hoffman et al., 1980; Jefferies, 1981). Different plants have different responses to salinity (Hasegawa et al., 2000). Salinity can affect any process in the plant's life cycle and it has direct harmful effects on a lot of plant species (Greenway and Munns, 1980; Keck et al., 1984; Cordovilla et al., 1994). But germination is regarded as the most sensitive stage in the growth cycle, because of its major role in final compression (Cuartero et al., 2006; Ali, 2011). Moreover, germination and seedling stage show predictive of plant growth responses to salinity (Cuartero et al., 2006). Enhancing salinity treatments lead to growth reduction (Younis et al., 2008). Overall salinity enhances osmotic pressure which ultimately leads to the reduction of water absorbance and disturbance in metabolic and physiological process.

Legumes are mild salt sensitive plants. Fenugreek (*Trigonella foenum-graecum* L.) is an annual flowering leguminous plant. This crop is widely cultivated in India. Fenugreek leaves are used in medicinal purposes for curing diabetics, lowering blood pressure and cholesterol level etc. It is a very useful short term rotation legume crop. Its production is highly affected by salt stress (Almansouri et al., 2001). The present investigation was undertaken to study the effects of three different salt stresses on germination and growth of *Trigonella foenum-graecum* plant.

MATERIALS AND METHOD

Healthy seeds of fenugreek (local variety)

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were surface sterilized0.1% $HgCl_2$ solution for 2-3 minutes. The seeds were washed thoroughly with distilled water. The seeds were germinated in petridishes on Whatmann No. 1 filter paper moistened initially with 5ml of distilled water (control) or with different treatment solutions 2.5, 5, 10, 25, 50, 100, 200 and 300mM NaCl. Same procedure was followed for $BaCl_2$ and $FeCl_3$. The filter papers were kept moist by adding the respective salt solutions. To determine the germinated seeds, the seed counting process was begun with the day following the day on which the seeds moistened for the first time. Germination was counted when a 5mm radical had emerged from the seed coat (Kabar, 1990; Akman, 2009). The germination was recorder at 24h interval for 6 days and in the last day traits such as root length and shoot length. The following parameters were studied:

Germination Percentage:- Germination percentage is an estimate of the viability of a population of seeds.

Germination Percentage was determined by the following formula (Li, 2008):

$$\text{Germination percentage} = \frac{\text{No. of germinated seeds}}{\text{Total no. of seeds to germinate}} \times 100$$

Germination energy:- Germination energy is a measure of the speed of germination and hence, it is assumed, of the vigor of the seed and of the seedling which it produces.

Germination Energy is determined by the following formula (Li, 2008);

$$\text{Germination Energy} = \frac{\text{Total no of germinated seed in six days}}{\text{Total no of seeds to germinate}}$$

Germination index:-

Germination index was calculated by the method of Wang et al. (2004) with the formula as following:

$$\text{Germination index} = \Sigma\ (G_i/T_t)$$

where G_i is the germination percentage at the ith day, and T_t is days of germination test.

Statistical analysis

Statistical analysis was performed using one-way ANOVA (for $P<0.05$).

RESULTS AND DISCUSSION

Germination percentage: The results showed that salinity caused a significant reduction in seed germination. The results of analysis of variance show the effect of NaCl, $BaCl_2$ and $FeCl_3$ on germination percentage in the following tables (Table 1, 2 and 3). The tables showed that there is a general trend in decline of the germination percentage of the treated seeds. The seeds treated with 100mM and higher concentration showed much less germination percentage.

Table 1: Effect of NaCl on germination percentage

Sl no	Treatments	Germination percentage					
		Day1	Day 2	Day 3	Day 4	Day 5	Day 6
1	Control	92.22 ± 1.109	92.22 ± 1.109	92.22 ± 1.109	98.88 ±1.111	98.88 ±1.111	98.88 ±1.111
2	2.5mM	92.22 ± 1.109	92.22 ± 1.109	93.33 ± 1.720	98.88 ± 1.111	98.88 ±1.111	98.88 ±1.111
3	5mM	91.11 ± 1.403	91.11 ± 1.403	91.11 ± 1.403	92.22 ± 1.109	92.22 ± 1.109	97.77 ±2.221
4	10mM	85.56 ± 1.111	85.56 ± 1.111	85.56 ± 1.111	85.56 ± 1.111	91.11 ± 1.403	92.22 ± 1.109
5	25mM	78.88 ± 1.111	78.88 ± 1.111	78.88 ± 1.111	78.88 ±1.111	78.88 ±1.111	78.88 ±1.111
6	50mM	71.11 ± 2.221	71.11 ± 2.221	71.11 ± 2.221	71.11 ± 2.221	71.11 ±2.221	78.88 ±1.111
7	100mM	0	5.56 ± 1.111	38.88 ± 1.111	45.56 ± 1.111	49.99 ±2.275	71.11 ±1.403
8	200mM	0	0	5.56 ± 1.111	18.88 ± 1.111	18.88 ±1.111	62.22 ±2.811
9	300mM	0	0	0	0	0	42.22 ±2.221

Results are the mean of six determinants.

One-way ANOVA was carried out and it was observed that F ratio for treatment as well as days was significant at 5% level of significance.

Table 2: Effect of $BaCl_2$ on germination percentage

Sl no	Treatments	Germination percentage					
		Day1	Day 2	Day 3	Day 4	Day 5	Day 6
1	Control	31.11 ± 2.221	31.11 ± 2.221	37.77 ± 1.405	78.88 ± 1.111	91.11 ± 1.403	96.66 ± 1.491
2	2.5mM	63.34 ± 3.332	71.11 ± 1.403	72.22 ± 1.109	72.22 ± 1.109	78.88 ± 2.049	89.99 ± 2.275
3	5mM	60.01 ± 4.215	63.34 ± 3.332	76.66 ± 2.276	77.77 ±1.405	78.88 ± 1.111	84.45 ± 1.405
4	10mM	71.11 ± 1.403	71.11 ± 1.403	75.55 ± 2.221	76.66 ± 1.491	78.88 ± 1.111	80 ± 1.721
5	25mM	43.33 ± 1.491	44.45 ± 1.405	74.44 ± 2.674	75.55 ± 2.221	77.77 ± 1.405	78.88 ± 1.111
6	50mM	34.44 ± 3.181	43.33 ± 2.277	58.88 ± 1.111	66.66 ± 2.980	71.10 ± 2.221	71.11 ± 2.221
7	100mM	17.78 ± 2.221	22.22 ± 2.222	32.22 ± 1.109	37.77 ± 1.405	45.56 ± 1.111	45.55 ± 1.111
8	200mM	0	0	0	5.558 ± 1.111	6.558 ± 0.111	18.88 ± 1.111
9	300mM	0	0	0	0	0	0

Results are the mean of six determinants.
One-way ANOVA was carried out and it was observed that F ratio for treatment as well as days was significant at 5% level of significance.

Table 3: Effect of $FeCl_3$ on germination percentage

Sl no	Treatments	Germination percentage					
		Day1	Day 2	Day 3	Day 4	Day 5	Day 6
1	Control	61.11 ± 2.71	62.22 ± 1.40	64.44±1.40	71.11± 1.40	79.99± 2.98	96.66± 2.27
2	2.5mM	38.88 ± 2.72	37.77 ± 1.40	38.88±1.11	46.66± 2.98	48.88± 2.80	48.88± 2.80
3	5mM	24.44 ± 3.43	31.12 ± 1.40	37.77±1.40	44.44± 2.80	57.77± 1.40	58.88± 1.11
4	10mM	17.77 ± 3.44	18.88 ± 1.11	24.44±1.40	42.22± 6.36	55.55± 5.34	55.55± 5.34
5	25mM	1.11 ± 2.72	2.22 ± 1.40	2.22±1.40	6.66± 2.43	13.33± 2.43	46.66± 2.98
6	50mM	0	0	0	0	0	11.10± 2.22
7	100mM	0	0	0	0	0	8.88± 2.80
8	200mM	0	0	0	0	0	0
9	300mM	0	0	0	0	0	0

Results are the mean of six determinants.
One-way ANOVA was carried out and it was observed that F ratio for treatment as well as days was significant at 5% level of significance.

The results revealed that the germination percentage of *Trigonella foenum-graecum* was strongly affected by all the salt treatments. Increased salt concentration caused a decrease in germination percentage. Strong reduction was observed mainly at the higher level of salt concentration compared to control. These results were in agreement with Kaymak et al.(2009) who found that lowest concentration of NaCl was not significantly affected radish seed germination. According to Huang and Redman (1995), salt induce inhibition of seed germination could be attributed to osmotic stress or specific ion toxicity. Seed germination is an essential developmental event in plants (Kim and Park, 2008). It is an important growth stage often subjected to high mortality rates (Jamil et al., 2007; Asaadi, 2009). According to Begum et al. (2010), germination of seed depends on the utilization of reserved food material of the seed. Salinity interferes with the process of water absorption by the seeds. This subsequently inhibits the hydrolysis of seed reserves which ultimately delays and decreases seed germination. With increase of salinity concentration through osmotic potential and by creation of external osmotic potential, water absorption is reduced through the negative effect of Na and Cl ions (Khajeh-Hosseini et al., 2003; Murillo-Amador et al., 2002), and germination is reduced or retarded (Todd, 2001).

Germination index: Germination index was significantly affected by all the salts. Considerable changes occurred in germination index in the treated seeds. In case of $BaCl_2$ the germination index at low concentration was found to be greater than the control. But with increasing concentration the germination index falls down. Among the three salts the germination index was highly affected by $FeCl_3$ salt. The reduction gets stronger at higher level of salinity. Similar results were corroborate from Khan et al.(2009).

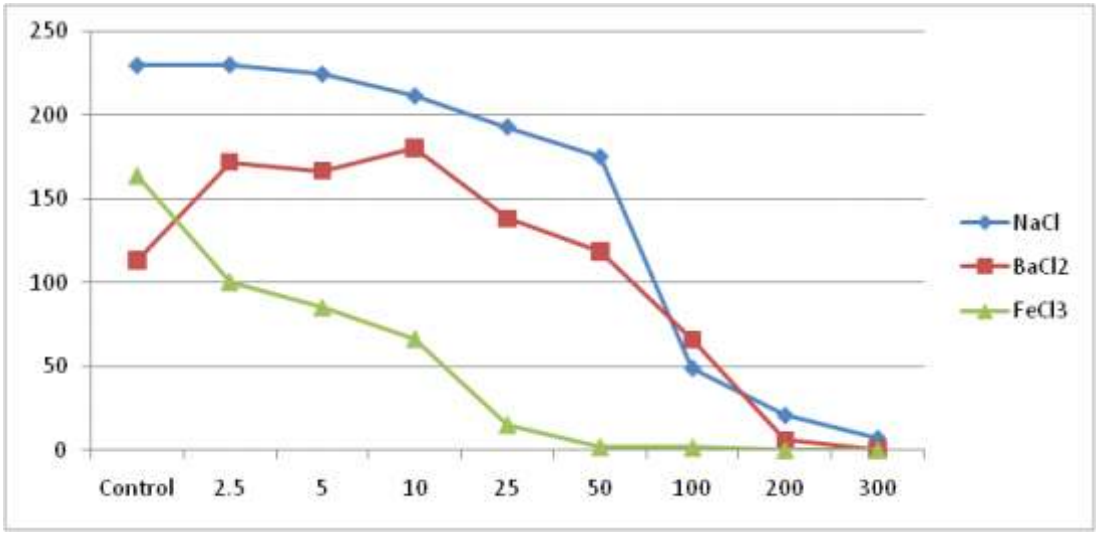

Figure 1: Effects of different salts on germination index.

Germination energy: Like germination index, germination energy also decreases with increase in salinity. Most prominent reduction was in case of $FeCl_3$ salt. The highet germination energy was obtained from control treatment. There was a small decrease in germination energy as a result of salt treatment (2.5-10mM) in case of NaCl and $BaCl_2$.

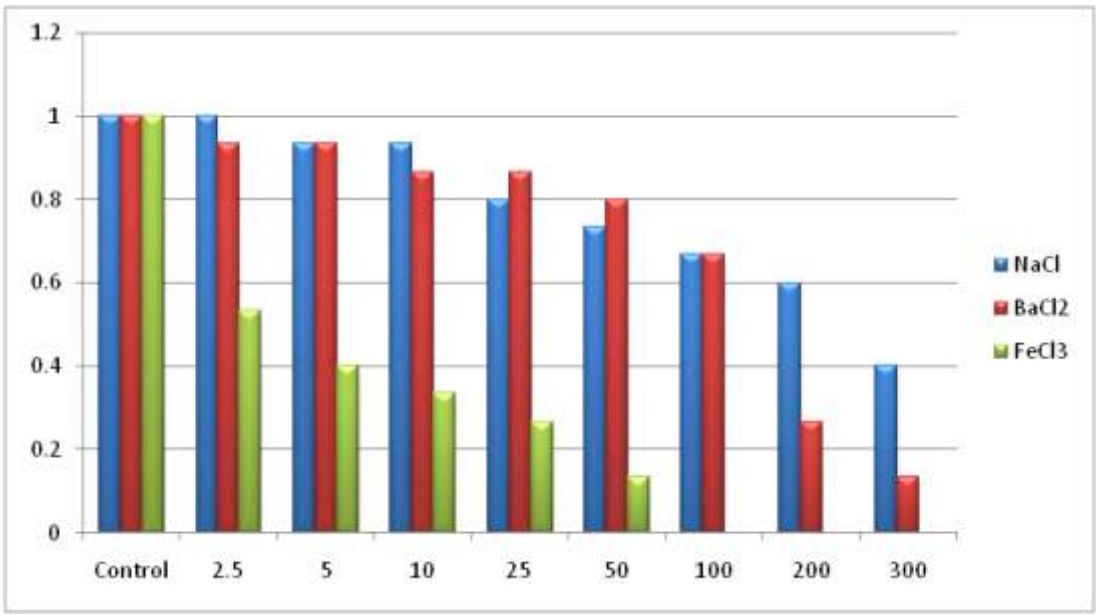

Figure 2: Effects of different salts on germination energy.

These results were in accordance with Turhan (2010) who stated that lowest germination energy values were determined at 200mM salt concentration.

CONCLUSION:

In this study, the affect of three different salts (NaCl, $BaCl_2$ and $FeCl_3$) on germination of Trigonella foenum-graecum seeds were examined. Increasing salt concentration of all the salts after 50mM caused significant reduction in germination percentage, germination index and germination energy. Among the three salts the effect of $FeCl_3$ was found to be more harmful than the other two.

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