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Effect of Different Level of Salinity on Tomato (*Solanum Lycopersicum* L.) Plant Germination of Two Different Cultivars

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***Abstract*: Tomato is a highly economically and valuable vegetable crop which grown in many country worldwide. The market value of this vegetable is also high and their great importance in agriculture sector. In agriculture sector many farmer grow this vegetable but due to some abiotic condition like high concentration of salt, pH in soil reduce the production of tomato vegetable. So it is great challenges to the framer to grown the vegetable in adversely condition especially in salinized water irrigation. The main objective of study was to find out the effect of salinity on tomato plant growth and their production in different salt level.**

The effect of salt concentration [variety1 TM-7328 and variety2 NP-5005] against four concentrations was 50, 100, 150 and 200 mili mole and distilled water as a control. Different data was examined like rate of germination, root length and fresh root weight was recorded and percentage of germination of plant after 12 days was measured. Results found in this study indicated that interaction of salt and plant had significant effect on the all parameters. It is seen a great difference in germination percentage, of two different cultivar i.e. TM-7328 and NP-5005, however, in the salt level of 100 mM the two cultivars TM-7328 and NP-500 have different response.

In the salt level of 100 mM concentration cultivar TM-7328 showed 41.39% germination whereas the germination percentage of NP-5005 was 39.7. At concentration 150mM of NaCl only variety TM-7328 shows the germination but in variety NP-5005 there was no germination was found. So the correlation between increase salt concentration and two cultivar of plant show great reduction in their radical length and fresh weight. However, on 200 mM concentration of NaCl there was no growth recorded on both cultivars.

***Keywords*: Cultivar, Salinity stress, NP-5005, NaCl, Tomato, TM-7328.**

1. Introduction

Tomato (*Solanum lycopersicum* L.) belonging to the family *Solanaceae*, is one of the most important vegetable grown in Indian as well as other parts of country [1]. Its fruit contain rich source of vitamin and other nutrition like oxalic acid, amino acid and carotenoids [2]. In India, tomato has a great demand all over the year, but its production is moderate in winter and highly in summer. The production tomato was 69.41 tones ha^{-1} in USA and 59.26 tones ha^{-1}Japan [3]. In many countries and regions, fresh water is relatively scarce, but there are considerable resources of saline water, which could be utilized for irrigation if proper crops, soil and water management practices were established [4], [5]. In India, mainly north plain, fresh water irrigation is affected by the salinity by anthropogenic activity.

Abiotic stresses are major problem for global crop production. Among various abiotic stresses, salinity has become a severe threat to food production by affecting about one-third of the irrigated land on earth [6]. The effect of soil salinity in tomato and other crop plant are sensitive and cannot survive or can survive only with decreased yields. To avoid the lethal effects of salinity, the measures such as the recovery of salinized lands, the improvement of irrigation with saline water and the cultivation of salt-tolerant variety have been applied [7]. Salt stress affects some major physiology of the plant like seed germination, speed of germination, root/shoot dry weight and Na+/K+ ratio in root and shoot [8]. Many seed developing company have developed the salt tolerance variety of tomato plant but it is very difficult to identify the wild varieties of plant due to large number of genotype, it is also most important to identify the salt tolerance variety of plant by farmer and planting the correct variety. One approach to reduce the effect of salinity on plant to supply the main macronutrient is (N, P, K, Mg and Ca) [9, 10]. High salinity also induce the oxidative stress in plant, production of ROS also damage the cellular enzyme and nucleic acid of the cell. Plants have many enzymes to reduce the effect of ROS like catalase (CAT), superoxide dismutase (SOD) and peroxidase [11], [12].

The objective of the present work was to find out the germination percentage, fresh dry weight of root and number of fruit production in two different varieties of tomato plant. The plant was treated with salanized water with different concentration of sodium chloride in lab as well as in field condition. It has been shown that among two varieties which one is salt tolerance in adult stage [13].

2. Material and Methods

The two variety of tomato Tm-7328 and NP-5005 were germinated in control laboratory condition with maintain to relative humidity and 25ºC temperature in plant growth chamber. Firstly, seed was wash to distilled water followed by sterilized by 5% solution of mercuric chloride. After sterilization 10 seed of each variety were placed in petri plate on the surface of 8cm diameter of blotting paper. There are five petri plates on them one as a control and other four was salinized to four different concentration of sodium chloride (50, 100, 150 and 200 mM). After 24 hours seed germination was recorded daily. Same experiment was carry out in the field condition, in which five pots are filled with soil, one pots as a control and other four pots were irrigated with four different concentration of sodium chloride. As the same concentration is maintain also in pot as in laboratory condition. After flowering and fruiting the number of tomato fruit was recorded to each pot with different concentration of salinized water. The germination of seed in laboratory condition are shown in figure 1 and the growth of plant are show in figure 2. Whole experiment was done in the laboratory of Biotechnology, University Department of Botany, Ranchi. Rate of seed germination and germination percentage were calculated using following formulas [14].

$$GP = SNG/SNO \times 100\%$$

Where: GP is germination percentage, SNG is the number of germinated seeds, and SNO is the number of experimental seeds with viability.

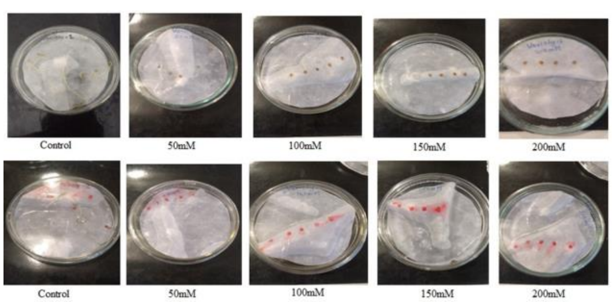

Fig. 1. The germination of seed in petri plate. The top one is variety TM-7328 and bottom one is NP-5005

Fig. 2. shows the flowering stage of two different varieties

3. Result and Discussion

A. *Effect of salinity on cultivar*

As show in table 1 the data of germination percentage and other parameter of two cultivars were recorded. The relative germination percentage of TM-7328 is 84.3% and NP-5005 is 79.41% in controlled condition, were as they percentage of germination up to 150mM the TM-7328 is 11.5% and NP-5005 is 22.5%. In both cultivar concentration up to 200mM there was no growth is recorded. The cultivar TM-7328 shows the highest tolerance level then the NP-5005. The effect of salinity on seed germination is affected by osmotic toxicity, which can alter the physiological process of many cellular enzymatic actions [15, 16]. Low level of gibberellic acid inside the seed in salanized water supplement was unable to break the seed coat due to mechanical resistance of endosperm reduce the speed of germination [17].

Table 1
Germination percentage, root length and root fresh weight

cultivar	Salinity level (mM)	Germination percentage (%)	Root length (cm)	Root fresh weight (g)
TM-7328	0	84.3	7.4	0.06
	50	68.7	5.2	0.04
	100	41.19	4.8	0.03
	150	22.5	1.7	0.02
	200	0	0	0
NP-5005	0	79.41	7.3	0.04
	50	58.2	5	0.04
	100	39.7	4.1	0.02
	150	12.7	2.7	0.01
	200	0	0	0

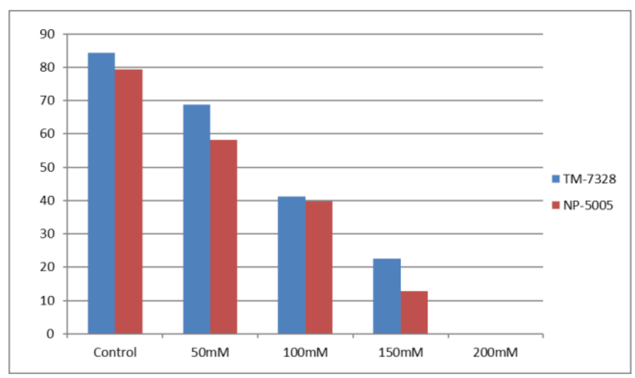

Fig. 3. Chart show the germination percentage of two varieties

B. *Salt and cultivar interaction*

Results obtained in this study indicated that interaction of salt × cultivar had significant effect on growth. With increase in salinity level, germination percentage was significantly decreased [table 1], however, in the salt level of 50 mM the two cultivars were significantly different from TM-7328 and NP-5005. In the salt level of 50 mM cultivar TM-7328 showed 68.7% germination whereas the germination percentage of NP-5005 was 58.2%. Regarding interaction of salt × cultivar, it can be seen that TM-7328 had higher germination percentage compared to other cultivars. By increasing salt concentration from 50 to 100 mM, germination percentage was reduced, which accords with the results reported by Dudeck and Peacock [7]. According to Foolad and Jones [8] and Mortezai nejad and Rezai [9] salt stress in germination stage results in reduction and delay of germination, reduced vegetative growth and yield which is in agreement with the results obtained in the present study. Foolad and Jones [10] reported that ability of tomato cultivars for fast germination is independent from further growth in vegetative stage. It was also observed in other studies that salt tolerance in a given growth stage is not related to other stages. In all the salt levels, TM-7328 had the highest germination rate. According to table 1, radical length is reduced as a result of increase in salinity. Results showed that salt tolerant cultivars possessing longer roots can absorb water more efficiently. The salt tolerant cultivar use salt dilution strategies and its accumulation in vacuoles to get protected against harmful effects of salt [1]. According to the results obtained in the present study, it can be concluded that indices of root and shoot growth are those plant growth indices quickly affected by salt stress. That is, by increase in salt concentration these indices are quickly reduced. Based on this, a tolerant genotype is that exhibits higher shoot length and fresh weight in high concentrations of salt. Concerning identical growing condition provide for all the tested cultivars, TM-7328, possessing higher growth indices across different salinity levels, is considered as the tolerant genotypes, whereas the other cultivars exhibited lower tolerance to salt.

4. Guidelines

The method discussed in this paper provides information about the effect of salt on cultivar. So before farming the plant it is very important to know that which cultivar show highest level of stress tolerant. The seed developing company provided the better tolerant plant to the farmer. It is also finding in study the number of flower, fruiting time and yield of fruit is highly affected by increasing the salt level.

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