Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 3, Issue, 11, pp.053-056, October, 2011

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EVALUATING TOMATO RESPONSES: A MEANS OF SCREENING VARIETIES TO SALINE SOIL

Girma Kebede[1], Kassaye Tolessa[2] and Adugna Debela[2]

[1] Melkassa Agricultural Research Center, Department of Horticulture. Adama, Ethiopia
[2] Jimma University Colleges of Agriculture and Veterinary Medicine, Department of Horticulture and Plant Sciences. Jimma, Ethiopia.

ARTICLE INFO

Article History:
Received 25th July, 2011
Received in revised form
28th August, 2011
Accepted 27th September, 2011
Published online 15th October, 2011

Key words:
Bishola,
Germination percentage,
Jimma, Miya, Salinity,
Tomato.

ABSTRACT

Salinity effects were evaluated on seed germination rate and percentage of six different tomato (*Lycoperscum esculentum* Mil.L) varieties nationally released form Melkassa Agricultural Research Center. The seeds were grown in petri dish being subjected to six different levels (0.0, 0.1, 0.2, 0.3, 0.4 and 0.5%) of NaCl concentrations in Jimma University College of Agriculture and Veterinary Medicine postharvest laboratory. The experiment was arranged in a randomized complete block design for all levels of NaCl concentrations with four replications. From the result, increasing NaCl concentration reduced seed germination percentage and rate in all cultivars. At the highest NaCl concentrations, highest germination percentages were observed in Bishola and Miya varieties. In addition, Bishola and Miya reached their final germination percentage earlier than the others indicating optimum performance as compared to the other varieties. It was therefore concluded that Bishola and Miya varieties can tolerate salinity and can successfully be grown in the rift valley areas of the country, Ethiopia. In addition, can be used for further breeding processes.

INTRODUCTION

Tomato (*Lycoperscum esculentum* Mil.L) is native to Indes Mountains of South America, where it was used long before Columbus. Tomato belongs to the Solanaceae family and the genus Lycopersicon. It is one of the most important widely grown and consumed vegetable crops next to potato with the total area and production of 5 million ha and 129 million tons, respectively in the year 2008 (FAO, 2009). It is the most frequently consumed vegetable in many countries, becoming the main supplier of several plant nutrients and providing an important nutritional value to human diet (high vitamin A, C and E as well lycopene content). In Ethiopia, it is also an important cash crop widely produced by small farmers and commercial growers under irrigated conditions. It is extensively produced in the mid rift valley areas of the country both for fresh market and processing industries (Selamawit and Lemma, 2006). Recently the crop has expanded to commercial production for home use, export, and processing industries. In the year 2008 the total cultivated crop land and the production were, respectively 3542 ha with 41.8 ton (FAO, 2009). Even though there is high potential for expansion, the productivity under farmer's condition is still 9 ton ha^{-1}, which is very low as compared to 25 ton ha^{-1} and 40 ton ha^{-1} in demonstration and research plots, respectively (Lemma, 2002). A number of constraints have been contributing to such lower yield and poor quality of tomatoes under farmers' conditions. Among them soil salinity is one as it affects seed germination and seedling establishment which in turn affect the final yield and quality of the crop. Salinity is one of the most severe environmental factors limiting the productivity of agricultural crops (Lauchli and Grattan, 2007). It is a predominant problem due to poor irrigation water management, poor soil conditions and poor cultivation practices by small farmers and large – scale commercial growers.

Crops tolerate salinity up to a certain threshold level without any yield reduction. After which, an increase in salinity level significantly reduces yield (Ahmet *et al*., 2004). Seed germination is the most sensitive to salinity effect compared to other growth stages (flowering, fruiting). At this stage tomato exhibits sensitivity even to low concentration of salts to about 75 mM NaCl (Foolad and Lin, 1997). Salinity impairs seed germination and reduces nodule formation (Jamil *et al*., 2006). At later stages, plant growth and economic yield are substantially reduced and plant survival is jeopardized. Salinity stress can affect seed germination through osmotic effects or by ionic toxicity (Karajol and Naik, 2011)

***Corresponding author:** kasech_tolassa@yahoo.com

One approach to solve such salinity threat is selecting salt tolerant varieties that perform well under stressful conditions. Therefore, this research was initiated to evaluate fresh market and processing tomato varieties for their salt tolerance (using NaCl) and to study the effect of different salt concentrations on tomato seed germination.

MATERIALS AND METHODS

The experiment was conducted in post harvest physiology of JUCAVM laboratory, Jimma, Ethiopia. Six different varieties (Bishola, Chali, Cochoro, Eshet, Melkashola and Miya), which were nationally released by Melkassa Agricultural Research Center, were subjected to different salt (NaCl) concentrations (0, 0.1, 0.2, 0.3, 0.4 and 0.5%). Germination ability was tested in samples of 30 seeds placed in 9 cm diameter petri dishes with four replications on double layer filter paper moistened with 15 ml distilled water or with the desired NaCl solution. The experiment was arranged in room temperature with a complete randomized block design for all levels of NaCl concentrations. A seed was regarded as germinated when the radicle protruded (2 mm) through the seed coat. Germination counts were made daily up to 10 days. Results were expressed as the final germination percentage and the time to reach 50% germination. The collected data were subjected to a two way analysis of variance using GeneStat statistical software (11^{th} ed.) and mean values were compared using LSD values at $P< 0.05$.

RESULT

Analysis of variance indicated that both salt concentration and varieties have significant effects on the final percent of germination and seed germination rate (table 1). In addition their interaction effects have also showed highly significant difference (P< 0.01) with respect to these parameters. As salt concentration increased form control to 0.5, germination percentage and germination rate were decreased for all varieties. From the result obtained in this experiment (Table 2), germination was observed in all salt concentrations used for all varieties. At the lowest levels of salinity, there were no notable differences among all varieties. But, with increasing level of salinity form 0.1 to 0.3% the germination percentage of Cohoro, Eshet and Melkashola was reduced form 91.25, 94.5 and 94.75% to 70.5, 85.5 and 88.75, respectively. When the concentration was increased to 0.4 and 0.5% the percentage was significantly reduced including that of Bishola and Miya. But, the germination percentages of Bishola and Miya were still greater than 80% even at 0.4% of NaCl solution.

All the varieties tested reached 50% of their final germination percentage before 72 hr in distilled water (0.0%) (Fig.1-6).Though the varieties responded differently to the salt concentrations, their germination was delayed in response to the different sodium chloride concentrations used. For Bishola variety, there was no difference in germination rate between 0.0 and 0.1% NaCl concentration (Fig 1). At the concentration level of 0.4 and 0.5% germination was started after 72 hrs of seed sowing and the rate was significantly reduced in all varieties with considerable reduction observed in Chali and Cochore. When varieties were compared, Bishola and Miya showed good germination responses and reached their final germination percentage before 192 hrs at 0.2 and 0.3%. The other varieties on other hand took relatively more time to complete their germination at these NaCl concentrations.

Table 1: Analysis of variance of the treatments under study

	Means of Squares of Germination	
Treatments	Percentage (%)	Rate (per hr)
Concentration	703.34**	17129.11**
Variety	248.99**	1265.28**
Concentration* Variety	43.42**	45.148**
Error	14.83	2.26

**: Significant at P < 0.01

Table 2: Germination percentage of Tomato varieties as affected by different concentration of NaCl

Concentration (%)	Variety					
	Bishola	Chali	Cohoro	Eshet	Melkashola	Miya
0.0	98.50a	98.00a	96.50a	98.0a	97.0a	98.0a
0.1	98.25a	95.25ab	91.25a	94.5a	94.75a	96.75a
0.2	95.25a	92.0b	82.25b	88.5b	89.75b	93.25ab
0.3	94.50a	85.5c	70.50c	85.5b	88.75b	89.75b
0.4	86.3b	78.6d	63.3d	75.18c	73.7c	82.4c
0.5	78.4c	70.2e	54.1e	70c	71.8c	77.6d
LSD (5%)	*5.432*					

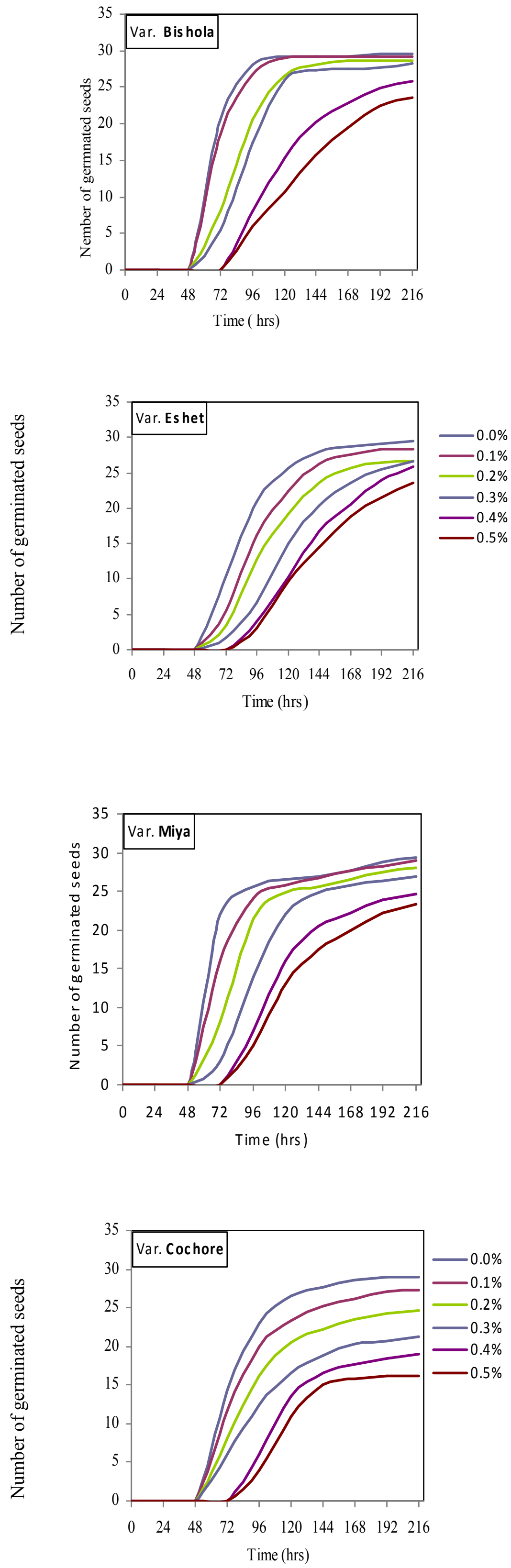
Means followed by the same letter in each column are not significantly different from each other at P< 0.05.

DISCUSSION

Salt stress affect seed germination percentage and rate through osmotic effects (Welbaum *et al*, 1990) and/or by specific toxicity effect (Haung and Reddman, 1995).

Higher concentration of salt reduces the water potential in medium which hinders water absorption and thus reduce seed germination (Shahba *et al*., 2010). The speed of germination and the final germination percentage determine the ability of the seed to tolerate stresses like salt stress (Foold and Jones, 1991). In this experiment it was observed that tomato seed germination rate and percentage were decreased as the level of salinity increases. Similar results were observed in cabbage, sugar beet and cauliflower (Jamil and Rha, 2004; Jamil *et al*. 2005).

Seeds from salt resistant varieties that germinate rapidly under non- stress conditions germinate rapidly under salt stress conditions (Karajol and Naik, 2011). Variety Bishola and Miya showed rapid germination rate at lower NaCl



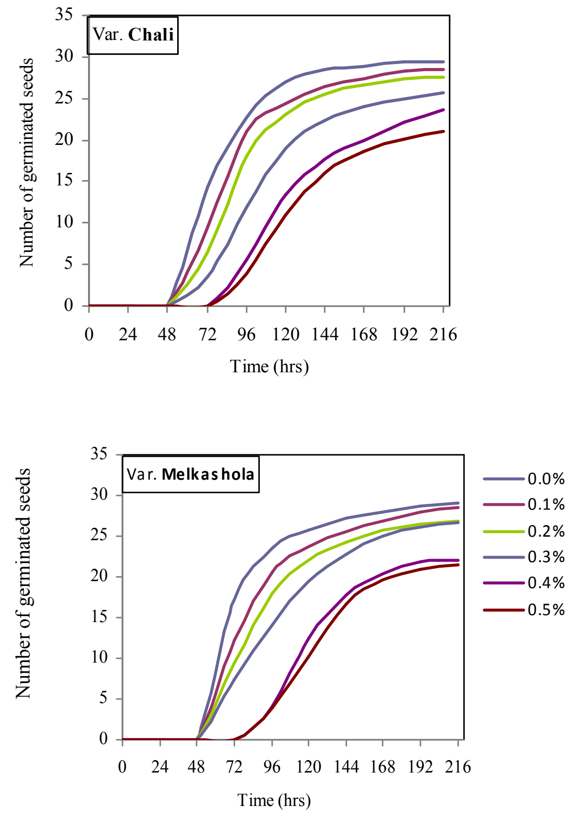


Fig. 1-6 Effect of NaCl concentration on germination rate of different tomato varieties: Bishola, Eshet, Miya, Cochore, Chali and Melkashola, respectively

concentration but their rate decreased at 0.4 and 0.5%. How ever, their final germination percentages at 0.4% were greater than 80% indicating optimum performance as compared to the other varieties. This indicated that the varieties are relatively tolerant to salt stress as compared to Chali, Cohoro, Eshet and Melkashola.

Conclusion

The result of this study demonstrated that salinity at higher concentration affects both seed germination rate and final germination percentage of tomato seeds grown here in Ethiopia. But, the varieties tested responded differently to the different concentrations of NaCl used in the experiment. Considering the percent of final germination and the rate at which the varieties germinated, both Bishola and Miya varieties are screened as the promising varieties to be successfully grown under salt affected parts of the country, Ethiopia. Therefore, small scale farmers and large scale commercial producers can use these varieties for expansion and production in the rift valleys of the country. In addition, the varieties can be used for further breeding purposes.

Acknowledgements

The Authors would like to thank Jimma University College of Agriculture for funding the research and Melkassa Agricultural Research Center for providing us the six varieties used in this experiment.

REFERENCES

Ahmet O., A. Unlukara, A. Ipek and G. Bilal, 2004. Effects of Salt Stress and Water Deficit on Plant Growth and Essential oil content of Lemon Balm (*Melissa officinalis* L.). *Pak. J. Bot.,* 36(4): 787-792.

FAO, 2009 – Statistical Bulletin, Rome, Italy. 150: 1-2.

Foolad M.R, and R.A. Jones, 1991. Genetic analysis of salt tolerance during germination in Lycopersicon. *Theor. Appl. Genet.,* 81:321–326.

Foolad M.R., G.Y. Lin, 1997. Absence of a relationship between salt tolerance during germination and vegetative growth in tomato. *Plant Breed.,* 116: 363-367.

Huang, J. and R. E. Reddman, 1995. Salt tolerance of Hordeum and Brassica species during germination and early seedling growth. *Can. J. Plant Sci.,* 75:815–819.

Jamil M, E.S. Rha, 2004. The effect of salinity (NaCl) on the germination and seedling of sugar beet (*Beta vulgaris* L.) and cabbage (*Brassica oleracea* L.). *Korean J. Plant Res.*, **7:** 226-232.

Jamil M., C.L. Cheong, U.R. Shafiq B.L. Deok, A. Muhammad and S.R. Eui, 2005.Salinity (NaCl) Tolerance of Brassica Species at Germination and Early Seedling Growth. *EJEAFChe.,* 4(4): 970-976.

Jamil M., B.L., Deog, Y.J. Kwang, A. Muhammad, C. L.Sheong and S. R. Eui, 2006. Effect of Salt (NaCl) Stress on Germination and Early Seedling Growth of Four Vegetables Species. *J. of Central European Agriculture*. 7 (2): 273-282.

Karajol K. and G.R. Naik, 2011. Seed Germination Rate as a Phenotypical Marker for the Selection of NaCl Tolerant Cultivars in Pigeon Pea (Cajanus cajan (L.) Millsp.) *World Journal of Science and Technology,* 1(2): 2231 – 2587

Lauchli A. and S.R. Grattan, 2007. Plant Growth and Development under Salinity Stress. In: M.A. Jenks et al. (eds.), Advances in Molecular Breeding toward Drought and Salt Tolerant Crops, Pp. 1–32.

Lemma D., 2002. Research experience and production prospects, Ethiopia Agricultural Research Organization (EARO), Research Report No. 43, pp: 20-28 Addis Ababa, Ethiopia.

Selamawit K. and Lemma D., 2006. Evaluation Tomato Genotype for salt Tolerance at seed germination. In: Proceedings of the Inaugural and First Ethiopian Horticultural Science Society Conference. Addis Ababa, Ethiopia, pp. 98-102.

Shahba Z., A. Baghizadeh, M. Yosefi, 2010. The salicylic acid effect on the tomato (*Lycopersicum esculentum* Mill.) germination, growth and photosynthetic pigment under salinity stress (NaCl). *J. of Stress Physiology and Biochemistry,* 6 (3): 4-16. ISSN: 1997-0838.

Welbaum, G. E., T. Tissaoui and K. .J. Bradford, 1990. Water relations of seed development and germination in muskmelon (Cucumis melo L.) III. Sensitivity of germination to water potential and abscisic acid during development. *Plant Physiol.,* 92: 1029–1037.

****