The Effect of Salinity on Seed Germination and Early Seedling Growth of Three Finger Millet (*Eleusine coracana* L. Gaerth) Varieties

DL Wathugala, ID Nagahawatta and HMS Kumarasinghe
Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kambutupitiya, Sri Lanka

Abstract

Salinity is one of the major environmental factors that limit plant growth and development. The salt affected areas around the world also in rapid expansion. Therefore, it is important to determine effect of salt on plant growth and development. Germination is the first stage of plant life cycle confronted with soil salinity. Therefore a laboratory experiment was carried out to test the effects of different salinity levels on germination and early seedling growth of three finger millet varieties (Ravi, Ravana, Oshada). The experiment was conducted using completely randomized design with three replicates per treatment. Experimental treatment included 7 levels of salt concentration (0, 2, 4, 6, 8, 10, 12 mS/cm). Results showed that the salinity stress levels and varieties have significant effect on germination, shoot length, root length and seed vigor ($P<0.01$). Moreover interaction of variety and salinity on shoot length, root length and seed vigor were also significant ($P<0.01$). Highest germination percentage was observed in 6 mS/cm salt concentration showing moderate salt tolerance. Moreover, highest shoot lengths were observed in 2 mS/cm salinity level. However, root lengths were decreased with increasing salt concentrations. In 2 mS/cm salt level highest vigor index was observed. Variety Ravana showed highest performances than other two varieties in all salinity levels. These results show that these three finger millet verities are moderately tolerant to salt but further studies on growth and development of finger millet under saline conditions need to be tested.

Key words: Finger millet, Salinity, Tolerance, Germination, Early Seedling Growth

Introduction

Soil salinity is a critical environmental problem in many countries around the world. This problem has a great impact on soil fertility which in turns has a great impact on crop productivity. Seed germination is an important and vulnerable stage in the life cycle of plants as it determines seedling establishment and plant growth. Therefore, investigating salt effect on seed germination of different crops is important.

Finger millet is grown as an important food crop in many developing countries of the tropical region; mainly in Africa and Asia. There is a surge in demand for millets for both food and non-food uses. Finger millet contains more fiber, minerals and vitamins, and has eight times more calcium than other cereals (Krishania and Agarwal, 2012). The high calcium, high soluble fiber, low fat and low glycemic index of malted grains is effective in controlling the blood glucose levels of diabetics. This can be stored for many years under normal room temperature. India is the largest producer of millet grains, producing about 33-37% of a total of 28 million tones of the world produce (Pradhan et al, 2010). In Sri Lanka finger millet is grown as a direct seeded crop in dry zone. It has been reported that the soil salinity levels are increasing year by year in most of cultivating lands in the dry zone due to sea water intrusion into the country. Therefore, in this study the effect of different salinity levels on germination and early seedling growth of three finger millet varieties were studied.

Materials and Methods

Seeds of three finger millet varieties (Oshada, Ravi and Ravana) were used for this experiment and these seeds were collected from Angunakolapalassa Research Station of the Department of Agriculture. Different salinity levels were prepared by diluting sea water. Germination was preceded in petri dishes on filter papers moistened with different concentrations of salt water (0, 2, 4, 6, 8, 10, 12 mS/cm). The petri dishes were kept in room temperature. After 7 days germinated seeds were counted and recorded. The shoot length and root length of seedlings were also

Corresponding author: wgdlakmini@crop.ruh.ac.lk

measured. Completely randomized design with three replicates for each treatment was used and 50 seeds from each variety were used for one replicate. The means and standard errors for all treatments were compared using analysis of variance in order to define whether the differences were significant. When significant main effects existed, differences were tested by Duncan test at $P \leq 0.05$. Germination percentage and seedling vigor was calculated as follows,

Germination percentage (GP)-GP: Ni / N × 100
(Ni= number of germinated seed, N= total number of seeds)

Seed vigor (SV)- Seed vigor was calculated according to the formula developed by Abdul-baki and Anderson (1970).
SV = {germination percentage × means of seedling length (radicle + plumule)}/ 100

Results and discussion

Seeds of three finger millet varieties responded similarly to salinity treatments. According to results of analysis of variance salinity and varietal effects were significant on germination, shoot length, root length and seed vigor ($P<0.01$) (Fig 1). Moreover, interaction of variety and salinity on shoot length, root length and seed vigor were significant ($P<0.01$). Germination percentages of all three varieties showed significant increment with increasing salinity levels up to 4 mS/cm and then decreased. The highest germination percentage was observed in variety Ravana at 4 mS/cm salt concentration. However, all three varieties showed even more than 80% seed germination at 12 mS/cm salt concentration. Out of these three varieties, var. Ravi showed significantly low percentage of seed germination than other two varieties.

The highest shoot length was observed in 2 mS/cm salinity level in all varieties. However, root lengths were decreased with increasing salinity. The highest shoot length, root length and seed vigor were observed in var. Ravana than other two varieties. Seed vigor index also showed significantly higher value in 2mS/cm salinity level.

Plant growth inhibition is a common response to salinity and plant growth is one of the most important agricultural indices of salt stress tolerance but results of this test shows that finger millet seeds are able to tolerate salinity and germinate on highly saline soils. Shoot growth of seedlings also increase in slightly saline condition. Francoise et al. (1986) found that soil salinity up to 0.5% did not significantly inhibit germination of Sorghum bicolor seeds but salt levels greater than 0.5% delayed germination. Even though finger millet varieties could germinate in higher salt concentrations, seedling survival in different soil salinity levels should also be evaluated as seedling growth stage is more sensitive to the stress of salinity than the germination stage (Rahman and Ungar, 1990). As an example *Sorghum bicolor* and *E. cruss-galli* seeds germinate fairly higher levels of NaCl but those seedlings survived for only few weeks at salinities above 1% NaCl (Rahman and Ungar, 1990). Dan and Brix (2007) also reported that *Sesbania sesban* seeds also shows higher germination % in slightly saline soils. In conclusion, based on the obtained results it seems that finger millet is able to tolerate some salinity and for better performances of

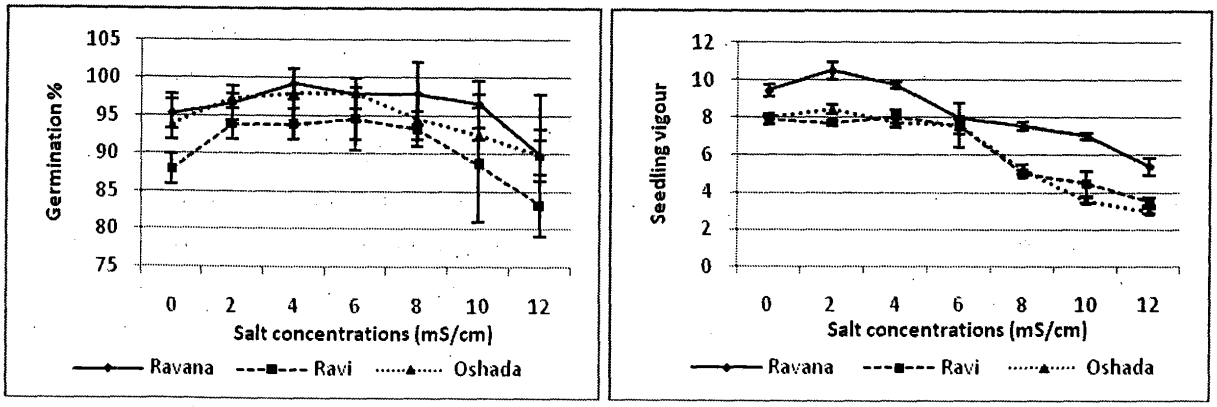

Figure 1: Effect of salt concentration on germination percentage and seedling vigour of three finger millet varieties.

Weevil damage was not recorded due to pre treatment was adopted before planting and field management condition were well. Ranking was performed by using an in house consumer panel of 20 and the overall acceptability is ranked as shown in table 2. Fruit size, taste, flesh color and external appearance were considered as main characteristics for consumer preference. It is seen from the Table 2 a first rank was received to HoSu 3 Suwandel accession and it was followed by the accession HoSu9.

Daniells (2000) has argued that there is no perfect variety, that each has its own set of advantages and disadvantages. Growers must find out what is best from them. Among the evaluated accessions, two Suwandel accessions namely HoSu3 and Hosu 9 were identified as high yielding and good quality accessions with which are adaptable to prevailing climatic conditions of Low Country Wet Zone in Sri Lanka. They produced reasonably high yield of acceptable fruits. According to the performances of HoSu 3 and HoSu 9 were selected to evaluate in the farmer field.

References

Anonymous 2011 Agstat vol III , pocket book of Agricultural Statistics, Socio Economics and Planning Centre, Department of Agriculture, Peradeniya

Danilles JW 2000 Which banana variety should I grow? Infomusa 9 (1): 31-33

FAO 2012 FAOStat agricultural data, Internet. http:// apps.fao.org

Weerasinghe SS 2000 Germplasm evaluation and virus management programme of banana(Musa) in Sri Lanka, Advancing banana and plantain R & D in Asia and pacific, Vol 10- ed Molina AB, Roa VN and Maghuyop MAG, Proceedings of the 10th INIBAP-ASPNET Regional Advisory Committee meeting at Bangkok 2000/11/10-11.