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Study of Germination Characteristics of Fenugreek (*Trigonella foenum-graecum* L.) population under Salinity and Drought Stress

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Introduction: Fenugreek (*Trigonalla foenum-graecum* L.), an annual herbaceous plant belonging to the Coleoidea (Fabaceae) family, has numerous medicinal properties such as decreasing blood glucose, laxative, appetizer, mucus, antipyretic and increasing the amount of milk during lactation . Among the most important problems in arid and semi-arid regions, drought stress or water shortage will have negative effects on plant growth. Drought stress occurs mostly because of reducing water availability in the soil. This may be due to excessive water loss or absorption problems, or both of them. One of the major factors limiting germination, which occurs in more arid and semi-arid regions, is salt stress. The study was done to evaluate germination of four Iranian population of fenugreek (Amol, Tabriz, Sari and Mashhad) under drought and salinity stresses.

Materials and Methods: To investigate the effect of salinity and drought stresses on germination and seedling growth characteristics of native landrace fenugreek, two separate experiments were conducted in a Completely Randomized Design with three replications in Seed Laboratory of University of Mashhad in 2014. The experiment treatments consisted of four levels of salinity (0, 60, 120, 180 mM) that was induced by different concentrations of sodium chloride and drought stress induced by polyethylene glycol 6000 (PEG 6000) at four levels (0, -3, -6 and -9 Bar) with three replications. The drought stress levels were simulation by polyethylene glycol 6000 and using the Michel and Kaufmann formula. Distilled water was applied as control. Iranian seed population of fenugreek were purchased from the city of Amol, Tabriz, Sari and Mashhad then the seeds were washed with sodium hypochlorite (3 % v/v) for two minutes for disinfestation and washed three times with distilled water. On the twelfth day of experiment, seedling traits such as plumule and root length and weight in Petri dishes were measured.

Results and Discussion: The results of ANOVA showed that salinity and drought stress significantly ($p\leq0.01$) affect germination process. The results of the means comparison confirmed that fenugreek germination in all seed population was reduced by increasing salinity levels. The lowest germination was detected under 180 mM salt stress in "Tabriz" population (12.04%), while the highest germination (95/26%) was calculated in "Mashhad" population at control. Seeds of "Mashhad" population in comparison to other population showed higher germination at other salinity levels. Germination rate also was significantly affected by salinity ($p\leq0.01$). Decreasing of germination rate in fenugreek population of Amol, Tabriz, Sari and Mashhad under 180 mM salinity stress in comparison to control (0 mM) were 84/62, 87/80, 85/93, 82/59, respectively. Mashhad and Amol (second order) populations showed more germination rate stability after changes in salinity levels. The results of analysis of variance from this study showed that interaction effect of salinity and population significantly ($p\leq0.05$) affect root length of the fenugreek. The root length of Mashhad and Amol populations were more stable at high level of salinity. Other researcher also reported that the root length decreased after salinity treatments (10, 13). Salinity stress affect water absorption by seed and decreasing Amylase and lipase activity caused degradation of stored material in seeds and then decreasing root length (23). Salinity, population and interaction between these factors significantly ($p\leq0.01$) affected length of plumule. The results showed that Mashhad population had the highest and Tabriz revealed the lowest length of plumule. Interaction effects of treatments on seedling dry weight showed significant ($p\leq0.01$) differences. Mashhad in comparison to the other populations had the highest seedling dry weight as 9.26, 8.10, 7.22 and 3.6 mg/seedling at different salinity treatments (0, 60, 120, 180 mM), respectively.

Interaction effects of drought stress and population on germination percentage was significant ($p\leq0.01$). Mashhad and Amol (second order) populations were the best populations. At the highest level of drought stress (-9 Bar), these two populations had the lowest decrease in germination percentage. The mechanism of the results was the same as salinity which explained in above. According to the results of analysis of variance (ANOVA), all treatments and all interaction had significant effect ($p\leq0.01$) on germination rate. The Mashhad and Sari populations were more tolerant than other populations against drought stress examined as germination rate as

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concerned. Analysis of variance showed that the simple effects of drought stress and population on root length were significant at one percent but interaction effect of drought stress and population was not significant statistically. The root length was in the range of 26.78 to 50.29 mm in the tested population. Mashhad population was more tolerant against drought stress in comparison to the other tested populations. Analysis of variance showed that simple effect of drought and population were significant ($p\leq0.01$) on this trait but their interaction was not significant. Length of plumule mean comparison showed that the traite was in the range of 21.74 to 43.31 mm in Tabriz and Mashhad populations, respectively.Acoording to the length of plumule,Mashhad population in comparison to other tested populations under drought stress was tolerant . The water potential (drought stress), population and interaction between them showed significant effect ($p\leq0.01$) on seedling dry weight. Among the evaluated population the Mashhad population was tolerant to drought stress when seedling dry weight was concerned. The highest correlation coefficient ($r=0.96$) was detected between germination percentage and root length and in second order the correlation coefficient between germination percentage and seedling dry weight was 0.93. The lowest correlation coefficient (0.61) was observed between germination rates and seedling dry weight.

Conclusions: The decline in germination percentage, germination rate, root length, shoot length and dry weight of seedlings with increased water osmotic potential in Mashhad population was less than other evaluated populations. Seed germination rate was more sensitive than seed germination percentage in both salt and drought stress therefore this trait is a suitable criterion for screening of tolerant population for future breeding purpose. The order for tolerance to salinity and drought stress in evaluated population was Mashhad, Tabriz, Sari and Amol.

Keywords: Polyethylene glycol, Environmental stresses, Seed population, Sodium chloride