Research Journal of

Environmental Sciences

ISSN 1819-3412

Academic Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 9 (7): 349-354, 2015
ISSN 1819-3412 / DOI: 10.3923/rjes.2015.349.354

Evaluation of Soybean Genotypes (Glycin Max L) to Drought Tolerance at Germination Stage

Sarkaut Salimi
Islamic Azad University, Mariwan Branch, Mariwan, Iran

ABSTRACT

Drought is one of the limiting factors for better and higher yield of plants. New variety selection is difficult due to the complex mechanism of drought resistance. Soybean is an important legume crop, known for its high quality protein and oil content, which selecting the varieties resistant to drought stress will increase the number of green seedlings and yield. For this purpose, the plants were grown in a completely randomized design with three replications as a factorial with two factors of drought stress and genotype. The genotype factor had 3 levels (Hamilton, M7 and L17) and the drought stress factor had 4 levels (0, -3, -6 and -9 bar). The experiment was done in Laboratory of Agronomy, Faculty of Agriculture Science, Guilan University in 2009 and traits were measured too. Analysis of variance showed that there were significant differences among genotypes for percent of germination. The different levels of drought stress showed significant differences for all studied traits. Genotype×drought interactions were significant for traits germination rate, shoot height and root height. At all levels of drought stress, growth parameters were reduced and the decreasing trend was observed in them but this reduction in the cultivars and traits were different. Out of these three genotypes, M7 genotype showed better response to drought stress in the germination stage and germination index had higher values than the other two genotypes. Here, the sensitive cultivars of all germination indexes were Hamilton. Also, results showed that there is a probability of drought conditions in the germination stage and non use of the stress-sensitive seeds is better and also Seeding quality in stress conditions must be considered.

Key words: Drought stress, genotypes, germination, glycin max, soybean

INTRODUCTION

The plants during the growth stages are exposed to the some biological and non-biological stresses that can affect undesirably their growth, metabolism and yield. Between them, drought stress is one of the most important factors effective in the reduction and impairment in different stages of growth of the plant specially germination in the arid and semi-arid regions (Machado Neto *et al*., 2004). Drought or generally the limitation in the water availability is the main factor which can reduce the yield in agricultural plants. Breeding of cultivars which can have a desirable yield in the arid conditions, will be a significant development (Bradford *et al*., 1992). Germination is an important stage of the plants life cycle in the arid regions, because the germination regarding the number of germinated plants per area, is important and determinative in the production level. Since the creation and maintaining the potential of pure water in the soil environment, is an impossible action, regarding to this establishing the arid condition using the osmotic materials to create the osmotic potentials, is considered as one of the important ways in the study of drought stress effect on the germination. Among these materials, poly ethylene glycol, due to produce some conditions similar with the natural environment, is more effective and efficient and then in-vitro conditions can be utilized widely (Khan, 1980; Lichtenthaler, 1996). This weight (PEG-6000) to create the drought stress compared with little molecules, such as; PEG-4000 is more desirable, because the seed germination percent in the solution of Polyethylene glycol-6000 and in a soil with the same potential of water is approximately equal (Okcu *et al*., 2005). Okcu *et al*. (2005) concluded with their experiment on chickpea (*Pisumsativum*) that the whole germination indices can be reduced by the effect of drought stress. material due to having high molecular weight cannot pass from the cellular membrane and regarding to this can be used as a regulator in improving the water potential in test of germination. Polyethylene glycol with an high molecular Because that the primary uptake rate of water will be reduced by the seed and there is more difference in the minimum required moisture for germination between the different cultivars of soybean and the seeds in which have an appropriate and acceptable germination in the stress conditions, will have a great value and importance in the arid and semi-arid regions. Whole germination indices will be generally reduced by increasing the osmotic potential. Duman (2006) has reported that the drought stress will reduce the germination percent and the length of rootlet and stemlet (Emmerich and Hardegree, 1990). The same results have been reported by Rahimi *et al*. (2006). Soybean is of the valuable agricultural plants due to their oil and protein and then finding the cultivars which are tolerant against the drought in germination stage, can be effective on increasing the number of germinated plantlets and their yield.

The aim of this research is to study the traits and indices related to the germination of soybean cultivars under the drought stress and identifying the most tolerant cultivars.

MATERIALS AND METHODS

This study was done in autumn of 2009 at the breeding and agronomy laboratory of agriculture faculty in Guilan University to study the resistance to dryness and also identifying the resistance mechanism of different soybean varieties. Our considered factors include three soybean varieties titled as M7, L17 and Hamilton (distilled water as control) with osmotic levels, respectively -3, -6, -9 that here we used of PEG to produce the Drought stress. Petri dishes, forceps, pipette and filter papers were heated and sterilized during 2 h in autoclave. In each treatment, 50 seeds of soybean were counted and sterilized during 10 min in Mancozeb 5 ppm and then seeds were washed with distilled water and poured in the sterile 12 cm petri dishes and for each petri dish from produced solution about 10 mL with certain osmotic potential was added. Petri dishes previously were covered with Whatman ashless filters. Also for minimizing the vaporization error, the petri dishes were covered with cellophane cover (plastic cover) and placed at incubator (temperature was 23±1 and relative moisture was 70%). Seeds germination criterion was considered as exit of rootlet in 3 mm. In each 24 h, germination rate and after spending 7 days, germination percent traits, rootlet and stemlet length and also stemlet length ratio to the rootlet were measured. To estimate the Germination Percent (GP), was used of dividing the number of germinated seeds by the number of cultivated seeds and multiplying the percent and GR in terms of the germinated seeds ratio per day via the presented:

$$GR = \sum \frac{X_n}{Y_n (X_n - X_{n-1})}$$

where, X_n is the germination percent in n-the day and Y_n is the days from beginning of cultivation to the nth day. To analyze the data and comparing the averages was used of SAS program in Duncan's multiple range test.

RESULTS AND DISCUSSION

The results of variance analysis (Table 1), shows the very significant effect of drought stress on the germination indices. A significant difference was observed between the different drought concentrations regarding the germination percent traits and ratio of stemlet length to the rootlet according to the obtained results he variance analysis table. Our supposed cultivars have a significant difference regarding the germination percent trait in the probability level of 1%. Cultivar interactions×drought was significant regarding the germination rate traits, rootlet and stemlet lengths. This shows that among our studied cultivars regarding the listed traits in different drought concentrations is a significant differences.

Among the studied cultivars, L17 with 68% has the maximum germination percent and Hamilton cultivar with 50% has the minimum germination percent (Fig. 1). Comparing the averages showed that by increasing the osmotic potential, germination percent significantly will be reduced (Fig. 2). Namely, the 88% of control treatment will be reached to 18% in -9 bar of osmotic potential. Meanwhile, we observed no significant difference between M7 and Hamilton

Table 1: Result of variance analysis of germination features of soybean different cultivars in various levels of drought stress

Source of changes	DF	Germination percent	Germination rate	Stemlet length	Rootlet length	Stemlet length ratio to the rootlet
Cultivar	2	0.10**	27.55**	159.02**	112.64^{ns}	0.15^{ns}
Drought	3	0.80**	21.24**	6051.37**	1005.90**	2.71**
Drought ×cultivar	6	0.005^{ns}	2.90**	163.13**	118.06*	0.77^{ns}
Error	24	0.006	0.31	24.04	42.75	0.42
Coefficient of variation (%)		13.66	23.19	12.47	31.86	34.94

ns: Non-significant, *,**Respectively are the significant in the possibility levels of 5 and 1%, DF: Degree of freedom

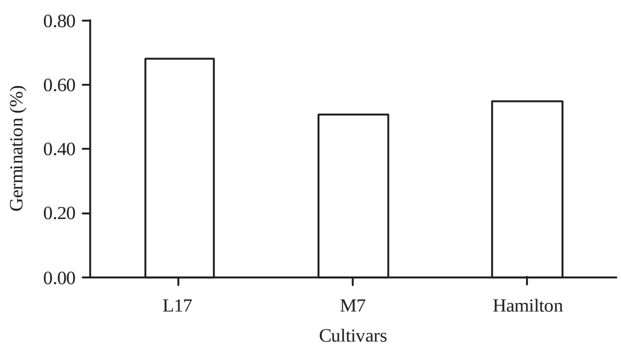

Fig. 1: Comparing the average percentage of germination in various cultivars

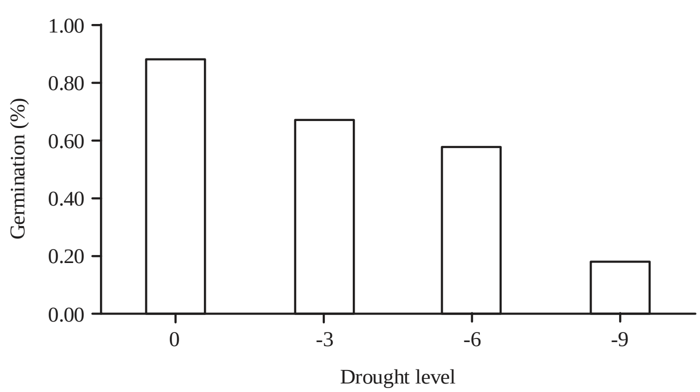

Fig. 2: Comparing the average percentage of germination in the various levels of drought

cultivars regarding the germination percent. De and Kar (1995) about mung bean varieties and Okcu *et al*. (2005) about chickpea have reported that by increasing the drought levels, the germination percent will be significantly increased, although we observed some differences between cultivars. By increase of osmotic potential, germination rate will be reduced. The highest germination rate in the various osmotic potentials is related to the L17 cultivar and lowest germination rate is related to the Hamilton cultivar (Fig. 3). Prisco *et al*. (1992) have reported that by increasing the drought stress, the germination rate will be decreased. Similar results have been reported by Bradford *et al*. (1992) too. Sarmadnia and Azizi (1995) believed that, the germination rate is one of the drought tolerance evaluation indices such that the cultivars having the highest germination rate under the drought stress have more maximum chance for emergence. The length of rootlet and stemlet was decreased by increase of the osmotic potential (Fig. 4, 5) such that the stemlet length reduction was more than the rootlet. Prisco *et al*. (1992) believe that under the stress, aggregation of dry matter in tissues of rootlet and stemlet of tolerant cultivars is more that the sensitive cultivars (16). Between the studied cultivars, highest length of stemlet and rootlet is related to L7 and lowest case is related to Hamilton. There is not a significant difference between the studied cultivars regarding the length of rootlet and stemlet in the various osmotic potentials

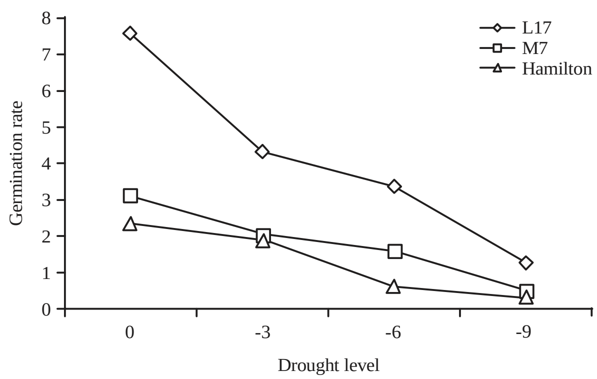

Fig. 3: Interactions of cultivar drought for the trait of germination

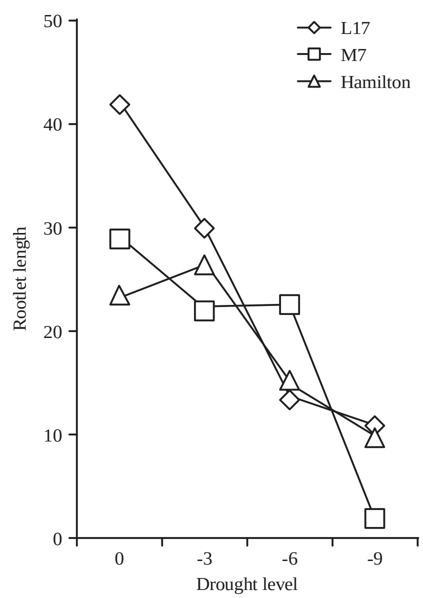

Fig. 4: Interactions of cultivar drought for trait of rootlet length

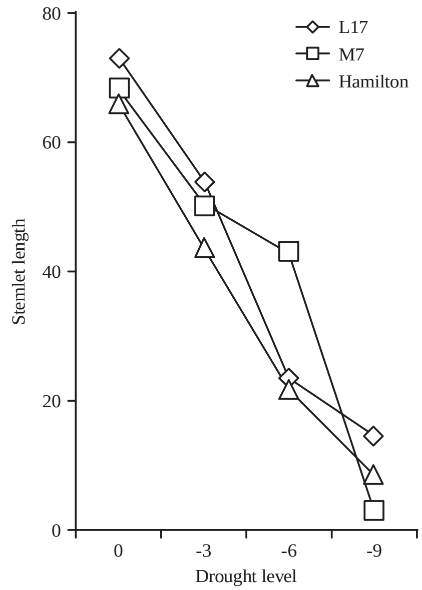

Fig. 5: Interactions of cultivar×drought for trait of stemlet length

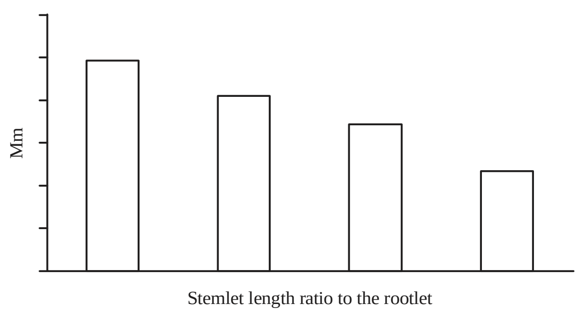

Fig. 6: Simple effect of drought different levels on trait of stemlet length ratio to the rootlet

and also between L17 and M7 was not a significant difference regarding the stemlet length. Duman (2006) also reported that drought stress reduces the length of rootlet and stemlet (5). Stemlet ratio to the rootlet by the increase of osmotic potential was reduce (Fig. 6). The highest of this ratio is related to the control treatment and lowest of it is related to the osmotic potential of -9. We did not observe a significant difference for this trait between the studied cultivars.

Result of this experiment showed that under the drought conditions, germination rate will show more reduction in itself compared to other traits and according to this that germination rate can affect the grain quality and uniformity of germination, therefore, we must consider and pay more attention to the breeding of soybean cultivars in order to create the more tolerant cultivars. Also, due to this that the grain quality in the interaction of grain with drought stress will be effective, we must also take into account this case in selection of the tolerant and resistant cultivars compared to the others.

REFERENCES

Bradford, K.J., P. Dahal and B.R. Ni, 1992. Quantitive models scribing germination responses to temperature, water potential and growth regulators. Proceedings of the 4th International Workshop on Seeds: Basic and Applied Aspects of Seed Biology, July 20-24, 1992, Angers, France.

De, R. and R.K. Kar, 1995. Seed germination and seedling growth of mung bean (*Vigna radiata*) under water stress induced by PEG-6000. Seed Sci. Technol., 23: 301-308.

Duman, I., 2006. Effects of seed priming with PEG or K_3PO_4 on germination and seedling growth in lettuce. Pak. J. Biol. Sci., 9: 923-928.

Emmerich, W.E. and S.P. Hardegree, 1990. Polyethylene glycol solution contact effects on seed germination. Agron. J., 82: 1103-1107.

Khan, A.A., 1980. The Physiology and Biochemistry of Seed Dormancy and Germination. North Holland Publishing Co., New York.

Lichtenthaler, H.K., 1996. Vegetation stress: An introduction to the stress concept in plants. J. Plant Physiol., 148: 4-14.

Machado Neto, N.B., S.M. Saturnino, D.C. Bomfim and C.C. Custodio, 2004. Water stress induced by mannitol and sodium chloride in soybean cultivars. Braz. Arch. Biol. Technol., 47: 521-529.

Okcu, G., M.D. Kaya and M. Atak, 2005. Effects of salt and drought stresses on germination and seedling growth of pea (*Pisum sativum* L.). Turk. J. Agric. For., 20: 237-242.

Prisco, J.T., C.R. Haddad and J.L.P. Bastos, 1992. Hydration-dehydration seed pre-treatment and its effects on seed germination under water stress conditions. Revista Brasileira Botanica, 15: 31-35.

Rahimi, A., M.R. Jahansoz, H.R.R. Mashhadi, K. Postini and F. Sharifzade, 2006. Effect of iso-osmotic salt and water stress on germination and seedling growth of two *Plantago* species. Pak. J. Biol. Sci., 9: 2812-2817.

Sarmadnia, A. and M. Azizi, 1995. Study of the effects of long-term storage of on the quality indices of soybean seeds. J. Agric. Sci. Technol., 9: 79-91.