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# An Investigation of Seed Germination Characteristics of Twenty Medicinal Plants

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## ABSTRACT

Due to the side effects of chemical drugs, the use of medicinal plants has increased in recent years. In this study, in order to select suitable medicinal plants for planting in the soil of Fars Science and Research Branch of Islamic Azad University, the seed germination characteristics of twenty medical plants were examined. These germination parameters include germination percentage, germination rate, the mean germination time and the germination index. The results showed that in the germination stage three plants including chicory, yellow clover and chia showed better germination characteristics rather than the other ones. Considering the germination parameters, three plants which have the lowest yield among the other plants in this study are milk thistle, datura and burdock.
**KEYWORDS**: Chia, Chicory, Germination, Medicinal plants, Yellow clover.

## 1. INTRODUTION

Herbal medicines have been recognized for thousands of years and they are widely used as an important source for the treatment and prevention of various diseases. Approximately, eighty percent of drugs produced around the world have plant origin [1].The use of medicinal plants is increasingly growing in developed countries. Side effects of many synthetic drugs and high cost of chemical treatments led different groups of people to have tendency to use herbal medicines [2]. Active ingredients in herbal medicines and other materials always had a biological balance and do not accumulate in the body and have no adverse side effects [3]. The medicinal plants also play an important role in the economy of the developed countries. Iran is a source of valuable medicinal herbs that can play a significant role in public health, employment and exports. The synthesis and formation of the active ingredients of medicinal plants are largely related to the ecological conditions in the environment surrounding the plants [4]. Distribution, diversity of vegetation and active substances of plants are affected by such factors as environmental and climatic conditions, topography and the changes of ecological stress in the region [5].Therefore, finding and selecting suitable plants for growing in every region can enhance the performance and productivity of plants. The rate and high percentage of seed germination and seedling establishment are the most important stages of the growth and development in the life cycle of plants[6].The study of mentioned indicators can help the experts to increase the number of seedling, rapid and successful establishment of seedlings in the soil and it causes the plants to have suitable growth and development in the next stages of plant life cycle[7].So, investigating the germination and seedling growth indicators and having access to better conditions for the improvement of these indicators can have more effects in the cultivation of the plants. Fars Science and Research Branch of Islamic Azad University is located around the city of Marvdasht in Fars Province in Iran. This area due to climatic and soil conditions, has always been a hub of agriculture in Fars Province and Iran. Therefore, this area has high potential for cultivation and production of the medicinal plants. The aim of this study was to evaluate germination indicators of twenty medicinal plants in the soil of Fars Science and Research Branch of Islamic Azad University. Accordingly, the best medicinal plants with high germination characteristics were selected and introduced for planting in this area.

## 2. MATERIALS AND METHODS

Seeds of twenty medicinal plants used in this study including Datura (*Datura stramoninum* L.), Oats (*Avena sativa* L.), Psyllium (*Plantago psyllium* L.), Fenugreek (*Trigonella foenum* L.), Marygold(*Calendula officinalis* L.), Green basil (*Ocimum basilicum* L. ), Common Sage (*Salvia officinalis* L.), Chia (*Salvia hispanica*L.), Moldavian balm (*Dracocephalum moldavica* L.), Feverfew (*Tanacetum parthenium*Sch.Bip), Milk thistle (*Silybum marianum*

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L.), Golden cotula*(Matricaria aurea*L.), Purple basil (*Ocimum basilicum* L.), Artichoke (*Cynara scolymus* L.), Chicory (*Cichorium intybus* L.), Evening primrose(*Oenothera biennis* L.), Burdock (*Arctium lappa* L.), Yellow clover (*Melilotus officinalis* L.), Oxtonyue flower(*Echium amoneum* L.) and Borage (*Borago O*fficinalis L.). These seeds were purchased from Pakan Bazr Company in Isfahan, Iran. For testing, the seeds of medicinal plants were disinfected by 3% sodium hypochlorite disinfection solution for one minute, and then washed with distilled water, and the research was conducted as follows. The 60 pots used in this study and each pots had 70 separate houses that filled with 0.07 Kg soil of Fars Science and Research Branch of Islamic Azad University in each house. Seventy seeds were sown in each pot. Then the number of germinated seeds in every pot was counted every day. This process continued for two weeks. Then with relevant formula were calculated the germination indicators including germination percentage, germination rate, germination index and average germination time. Germination percentage (GP) and germination rate (GR) were calculated using these formulas:

Germination percentage (GP) = $S/T \times 100$

Germination rate (GR) = $(\sum Ni/Di)/S$

S: Number of germinated seeds

T: Total of number seeds

Ni: The number of germinated seeds in Di (day)

The germination index (GI) was calculated based on the following formula[8].

GI = (number of new seedlings after day n1/ n1) + (number of new seedlings after day n2/ n2) + ..... + (number of new seedlings after day ni/ ni).

The mean germination time (MGT) was calculated for each pot using the formula cited by Ellis and Roberts [9] given below:

$MGT= \Sigma (n T)/ \Sigma n$

Where,

n = number of seeds newly germinated

T = hours from the beginning of the germination test

$\Sigma$ n = final germination.

Data analysis was carried out with SPSS software, Mean comparison was performed with Duncan's test at the 5% level of significance ($P < 0.05$) and graphs were drawn using Excel software.

## 3. RESULTS

**Germination percentage:**

The analysis of variance (table 1) and the comparison of means (Fig. 1) indicated that the medicinal plants had significant difference in the germination percentage at 5% level. The results also showed that the highest germination percentage was observed in golden cotula, chicory, fenugreek, feverfew and yellow clover with 100% germination. Also according to these results, the lowest germination was found in burdock plant (30%). In this study the germination percentage of three plants in addition to burdock plant were lower than 50% that include marygold, datura and common sage with 35, 40 and 45% respectively. In other medicinal plants the germination percentage varied differently. The purple basil and chia had germination with 95% and 90%, respectively. The results also revealed that psyllium, artichoke and moldavian balm had the same germination percentage with 85%.As shown in Fig. 1, the other medicinal plants used in this study were arranged between 50% to 75% germination.

**Table 1: Analysis of variance on germination characteristics of medicinal plants**

| Source of Variance | df | Mean of Square | | | |
|---|---|---|---|---|---|
| | | Germination percentage | Germination rate | The mean germination time | Germination index |
| **Medicinal plants** | 19 | 890.241* | 155.035* | 35.817* | 2.599* |
| **error** | 40 | 390.217 | 55.031 | 1.938 | 0.355 |

***: Significant at the 0.05 level of probability**

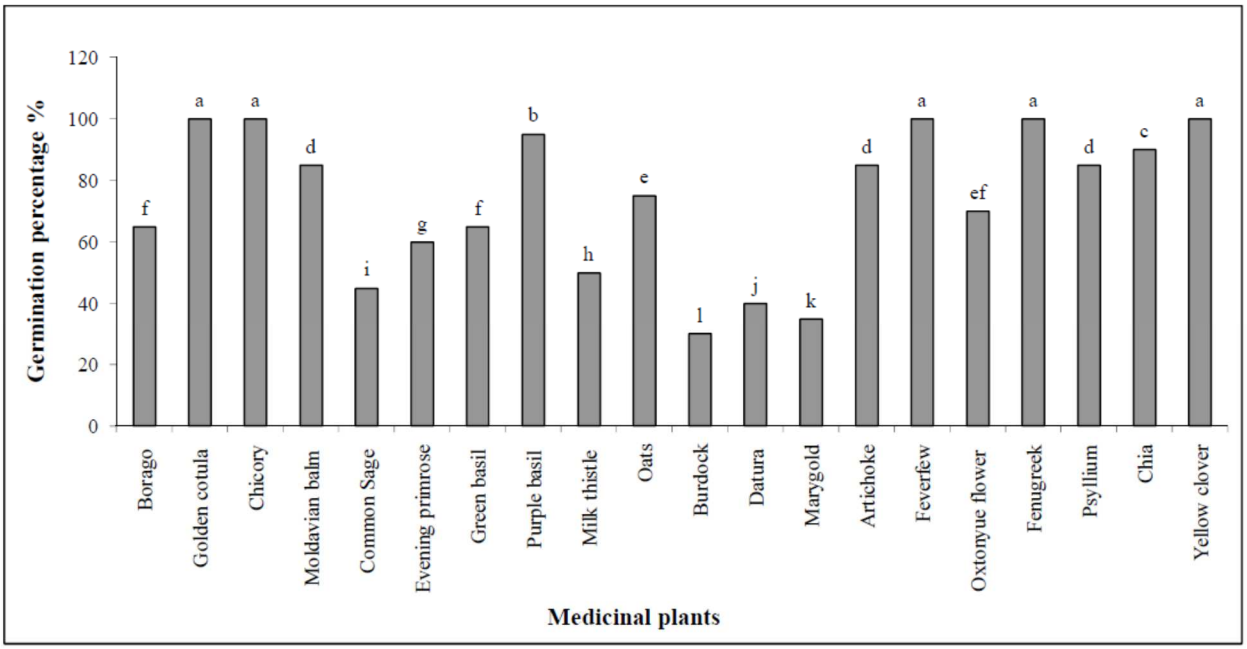


**Fig. 1**: Comparison of the mean germination percentage of twenty medicinal plants. No significant difference exist ($p < 0.05$) for the given means with the same letter.

**Germination rate:**

Due to results shown in table 1 and Fig. 2, the germination rate of various medicinal plants seeds had significant differences at 5% level. The highest germination rate was observed in chicory plant by 17.83 (n/day). The next high germination rate belongs to yellow clover and chia with 14.44 and 13.31 (n/day) respectively. In other plants, the germination rate was less than 10 germinated seed in day and burdock plant had lowest germination rate with 0.93 (n/day). Also the low germination rate of datura, common sage, green basil and marygold were cleared. These plants had the germination rate by 1.45, 2.05, 2.27 and 2.58 (n/day) respectively. The results shown in Fig. 2 demonstrated that evening primrose and borago had germination rate less than 5, so that the germination rate of Evening primrose was 3.92 and 4.67 (n/day) for borago. As seen in Fig. 2, artichoke and golden cotula have a germination rate close together. The germination rate of artichoke and golden cotula calculated as 5.58 and 5.26. The results finally indicated that other medicinal plants were arranged on the basis of germination rate according to this order; fenugreek (8.92) >purple basil (7.75)>psyllium (7.47) >feverfew (7.08) >moldavian balm (6.46) >oats (6.25) >oxtonyue flower(6.17). The highest and the lowest germination rate were observed in chicory and burdock, respectively.

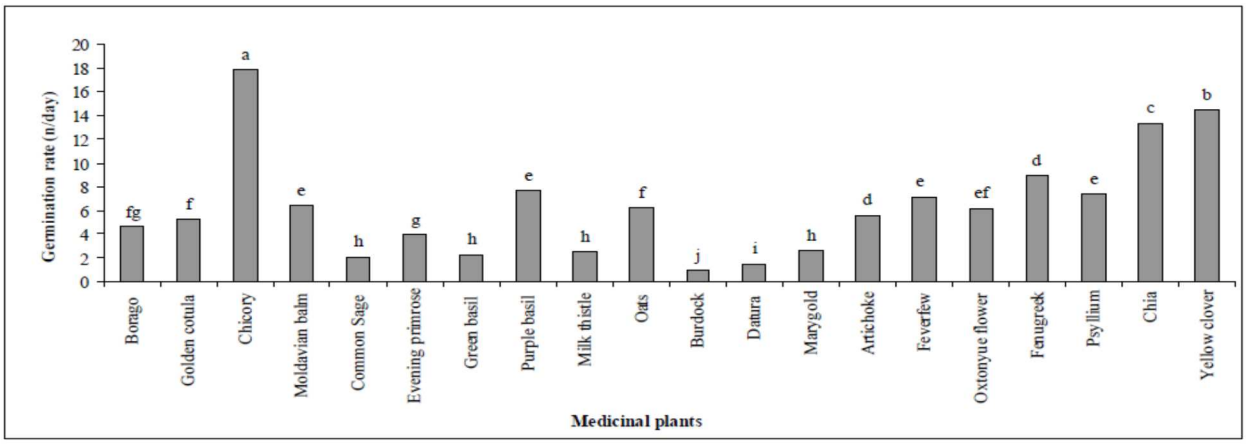


**Fig. 2**: Comparison of the mean germination rate of twenty medicinal plants. No significant difference exist ($p < 0.05$) for the given means with the same letter.

**The mean germination time:**

The mean germination time of various medicinal plants have been shown in Fig. 3. As seen in Fig. 3 and table1, the various medicinal plants have germinated in different times and had a significant difference in the mean germination time at 5% level. The results showed that the burdock plant needed more time Stan for seed germination (6.5 days). The mean of time for green basil was 6.08 days. The next plant is datura which has needed 5.88 days for seed germination. The mean germination time for the three plant (cotula, common sage and milk thistle) had been more than 4 days. They needed 4, 4.4 and 4.44 days respectively. The required time for germination of moldavian balm, artichoke and evening primrose were 3.06 days and not observed significant differences between these plants. The results of this study indicated that three plants had required less than 2 days for germination which including chia (1.92 days), yellow clover (1.73 days) and chicory (1.25 days).

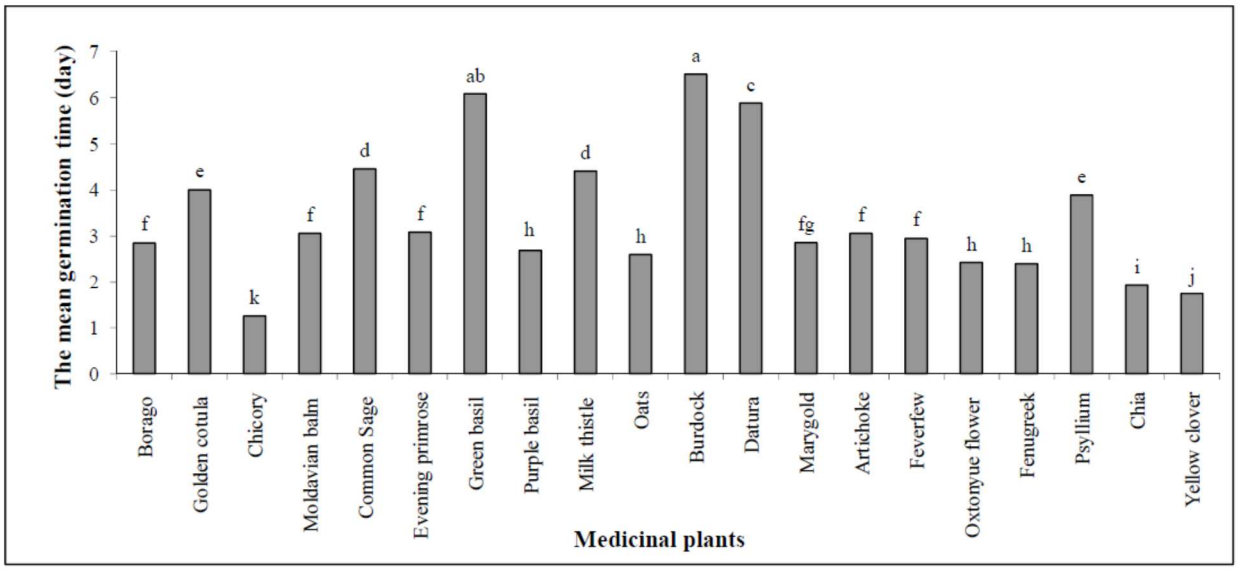


**Fig. 3**: Comparison of the mean germination time of twenty medicinal plants. No significant difference exist ($p < 0.05$) for the given means with the same letter.

**Germination index:**

The results showed that various types of medicinal plants have significant differences in the case of germination index (table 1 and Fig. 4). According to results the chicory plant had the highest germination index between twenty medicinal plants. The yellow clover was in second place by the average of germination index equal to 0.78. The next high germination index is belonging to chia plant which has the germination index by 0.67. The Fig. 4 also showed that the germination index of other medicinal plants was less than 0.5. The fenugreek plant was taken in next place (by 0.65). The average of germination index for purple basil, psyllium, golden cotula, moldavian balm, oxtonyue flower and oats were 0.39, 0.37, 0.35, 0.32, 0.31 and 0.31, respectively. The lowest germination index was observed in burdock and datura which showed the germination index equal by 0.05 and 0.07.

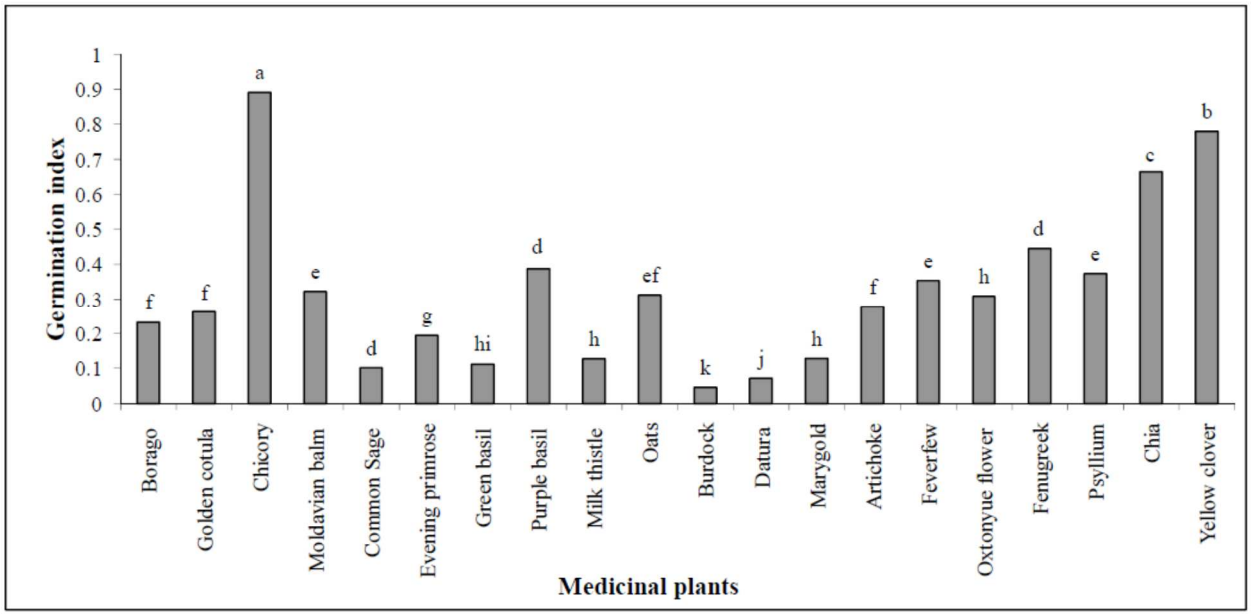


**Fig. 4**: Comparison of the mean of germination index of twenty medicinal plants. Nosignificant difference exist ($p < 0.05$) for the given means with the same letter.

## 4. DISCUSSION

Plant growth and development is largely depending on the success of germination which is largely effected by seed characteristics[6].Results of this study indicated that the germination characteristics of twenty medicinal plants are variable. The seeds of medicinal plants showed different germination percentage (Fig. 1). The different reasons can be responsible for these observations. The medicinal plants in this experiment had different sizes of seeds. It has been established that large seeds had higher germination rate, seedling emergence success and more rapid growth than small seeds. Larger seed size indicates that the higher protein synthetizing ability, which is probably attributed to more available substrate and energy (ATP), active enzymes and machinery for protein synthesis[11]. Yagmur and Kaydan (2008) reported that seedling growth of large seed size were higher than small seeds in Triticale [12]. Ozgen et al. (2007) showed that water content in large seed size was higher than small seed size [13]. Perry (1980)reported that there was a close correlation between seed size and seed nutritional resources; large seeds produced larger seedling compared with small seeds and it can cause an increase in the crop production in the field [14]. The large food reserves in seeds could allow for better photosynthetic activity, which could contribute to better growth and seedling survival. In the other hand, seedling establishment is a critical stage in plant production and considerably depends on biochemical and physiological structures of seed[10].Successful establishment of plants largely depends on successful germination. Several environmental factors such as salinity, temperature, light and soil moisture simultaneously influence germination. In order to obtain fast and good establishment of seedling, high seed germination rate is needed to provide essential nutrients for seedling until it becomes established and can photosynthesize independently[11].Successful seedling establishment depends on the frequency and the amount of precipitation as well as on the ability of the seed species to germinate. Decrease in germination rate lead to delay in seedling establishment and as a result plant resistance to unfavorable conditions will be decreased. Initial establishment of species in unfavorable conditions is related to germination response of seeds to these conditions and early establishment usually determines if a population will survive to maturity. For seed germination to occur the dry and quiescent seed must be imbibe water and become hydrated. It seems that in this study, decrease of germination percentage and germination rate in some of plants is related to reduction in water absorption into the seeds at imbibitions and seed turgescence stages[11].The seed germination rate is a standard parameter to reflect the quality of seeds.Zhang et al. (2013)reported that some nutrient elements in the soils improved seed vigor, water absorption and cytoplasmic membrane permeability of seeds of medicinal plant during the seed imbibition and germination [15].Germination of many species is light independent, and some others present higher germination percentages in darkness than in light [16].Thanos and Doussi (1995) indicated that seed germination of two *Crete sage* species is favored by darkness [17]. They showed that only germination of *S. pomifera* was slightly enhanced by light; however, germination of *S. fruticosa* was inhibited by white or red lights.The seeds of many species of

Asteraceae, Lamiaceae, Brassicaceae, Plantaginaceae and other familieshave an external mucilage layer [18, 19]. This mucilage can provide some ecological benefits in these extreme conditions [20]. Yang et al. (2010) showed that intact achenes of *Artemisia sphaerocephala* exhibited higher germination percentages than those demucilaged as osmotic stress decreases either by drought or salinity[21]. These authors concluded that mucilage presumably plays an ecologically important role in the life cycle of *A. sphaerocephala*by insuring under harsh conditions. Temperature plays a critical role in the regulation of plant vital processes, including seed germination [22].

## 5. CONCLUSION

According to the results of this study three plants including chicory, yellow clover and chia showed better results rather than the other ones. The results also showed that in all germination parameters the chicory plant with 87 percent received the best performance. The Chamomile with 85% performance is the second suitable plant for growing in the soil of Fars Science and Research Branch of Islamic Azad University. The yellow clover plants with a total yield of 83% are the third plant recommended for cultivation in this region. Considering the germination stage three plants which have the lowest yield among the other plants in this study are milk thistle, datura and burdock with yield of 57%, 53% and 50 %, respectively.

## 6. ACKNOWLEDGEMENT

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## 7. REFERENCES

[1] Silva, N. and F. Jounior, 2010. Biological properties of medicinal plants: a review of their antimicrobial activity. The Journal of Venomous Animals and Toxins including Tropical Diseases. 16(3): 402-413.

[2] Elvin-Lewis, M. 2001. Should we be concerned about herbal remedies. Journal of Ethnopharmacology. 75: 141-164.

[3] Motamed, Sh., M. Jafarinia, and B. Kholdebarin, 2015. Investigating the effect of drought stress on photosynthetic electron transport chain of two basil (*Ocimum basilicum* L.) cultivars measuring by chlorophyll a florescence. Journal of Biodivercity and Environmental Sciences. 7 (1), 564-571.

[4] Ajay, A., R. K.Sairam, and G. C. Srivatava, 2002. Oxidative stress and antioxidative system in plants. Current Science. 82: 1227-1238.

[5] Gorai, M., H. Gasmi, and M. Neffati, 2011. Factors influencing seed germination of medicinal plant. Saudi Journal of Biological Sciences, 18(3), 255–260.

[6] Jafarinia, M. and M. R. Hadi, 2015. Effect of biopriming on germination characteristics of two Turfgrass. Journal of Seed Research. 5(1): 1-12.

[7] Dobbelaere, S., A. Croonenborghs, A. Thys, D. Ptacek, J. Vanderleyden, P. Dutto, C. Labandera-Gonzalez, J. Caballero-Mellado, J. F. Aguirre, Y. Kapulnik, S. Brener, S. Burdman, and D. Kadouri Egamberdiyeva, 2007. The effect of plant growth promoting bacteria on growth and nutrient uptake of maize in two different soils. Appl. Soil Ecol., 3(6): 184-189.

[8] Association of Officinal Seed Analysis (AOSA). 1983. Seed vigor testing handbook. Contribution No.32 to the handbook on the seed testing.

[9] Ellis, R.H. and E. H. Roberts, 1980. Towards a rational basis for testing seed quality. In Seed Production, pp. 605-635.

[10] Bybordi, A., and J. Tabatabaei, 2009. Effect of Salinity Stress on Germination and Seedling Properties in Canola Cultivars (*Brassica napus* L.), Not. Bot. Hort. Agrobot. Cluj 37(1): 71–76.

[11] Akinyosoye, S. T., J. A. Adetumbi, O. D. Amusa, M. O. Olowolafe, and J. O. Olasoji, 2015. Effect of seed size on in vitro seed ermination, seedling growth, embryogenic callus induction and plantlet regeneration from embryo of maize *(Zea mays* L.) seed. Nigerian Journal of Genetics, 10(2):1-7.

[12] Yagmur, M. and D. Kaydan, 2008. Allevetion of osmotic stress of water and salt in germination and seedling growth of triticale with seed priming treatment. African Journal of Biotechnology. 7: 2156-2162.

[13] Ozgen, M., M. Yildiz, N. Koyoncu, and S. Onde, 2007. The effect of seed size on tissue culture response of callus from endosperm-supported mature embryos of barley (*Hordeum vulgare* L.). Cereal Research Communications, 35: 1415-1425.

[14] Perry, D. A. 1980. Seed vigour and seedling establishment. Advances in Research and Technology of Seeds. 5: 25-40.

[15] Zhang, C., Q. Li,M. Zhang, N. Zhang, and M. Li, 2013. Effects of rare earth elements on growth and metabolism of medicinal plants. Acta Pharmaceutica Sinica B, 3(1), 20–24.

[16] Baskin, C. C. and J. M. Baskin, 1998. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press, 331-345.

[17] Thanos, C. A. andM. A. Doussi, 1995. Ecophysiology of seed germination in endemic Labiates of Crete. Isr. J. Plant Sci. 43, 227–237.

[18] Gutterman, Y. 2002. Survival Strategies of Annual Desert Plants: Adaptations of Desert Organisms. Springer, Berlin.

[19] Huang, Z., Y. Gutterman, andD.J. Osborne, 2004. Value of the mucilaginous pellicle to seeds of the sand-stabilizing desert woody shrub *Artemisia sphaerocephala* (Asteraceae). Trees, 18: 669–676.

[20] Huang, Z., I. Boubriak, D.J. Osborne, M. Dong, andY. Gutterman, 2008. Possible role of pectin-containing mucilage and dew in repairing embryo DNA of seeds adapted to desert conditions. Ann. Bot. 101: 277–283.

[21] Yang, X., M. Dong, andZ. Huang, 2010. Role of mucilage in the germination of *Artemisia sphaerocephala* (Asteraceae) achenes exposed to osmotic stress and salinity. Plant Physiol. Biochem.48: 131–135.

[22] Parmoon, G., S. Amir, H. Akbari, and A. Ebadi, 2015. Quantifying cardinal temperatures and thermal time required for germination of *Silybum marianum* seed. The Crop Journal. 3(2): 145–151.