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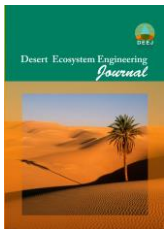

The Effect of storage conditions and storage periods on germination rates of *Kochia prostrata (L.) Schrad*

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Abstract

Storing the seeds of rangeland plant species especially key and palatable species is inevitable for improvement and development of rangelands. One of the successful projects in improvement and development of rangelands is applying seed planting methods. Having technologic knowledge in relation with temperature and appropriate time of storage in barn and its relation with germination potential preservation is of great research importance. After gathering seeds within the site Shahkooh (is located in southern slops of Golestan province) and separating litters and defected seeds, they are kept in oven at a temperature 30°C and when their humidity reached to 10 percent, they were taken out. 44 capped containers are chosen an 150 seeds are randomly put in them and are kept in the following four treatments: 0-5, 5-10, 15 and 20 °C. We put each of the eleven containers in separate storage areas and used a germination machine to measure the germination capacity in the laboratory of ecology (Gonbad-Kavous University). The Results indicated that all the temperatures have a significant effect on the germination. The maximum ratio of germination was achieved at 0-5 °C in a 6 months period. The obtained correlation between storage conditions and storage periods indicated that germination percentage increased to 9 months at 0-5 and 5-10°C temperatures, and then decreased. However, by increasing the time of storage at 15 and 20 °C, the germination of K. *prostrata* will decrease. It seems that increasing the storage temperature decreases the after-ripening period but this factor has a severe effect on the germination capacity of K. prostrata for a short time K. *prostrata* seeds can sustain more than 50% of their germination capacity at 0-5 and 5-10 °C temperatures during 24 months.

Keywords: *Kochia prostrata*, germination, storage conditions, storage periods.

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Introduction

It is unavoidable for projects of rangeland improvement and development to use palatable, compatible, local, and key species. That's why it has made the percentage of success in executive programs and it will be more economical in costs. One of the successful projects for rangeland improvement and development is to use seeding with technical knowledge, in order to have complex success in poor rangelands that are located in arid and semi-arid regions (Alimaev and Pryanishnikov, 1989; Baghestani et al., 2015). Gaining Succeess with rangeland seeding needs to regard the important matters such as the selection of healthy and wholesome seed, the degree of resistance against drought and salinity, high palatability, considerable forage production, and also the use of seeds including proper germination power. One of the most important cases in study is having proper technical and scientific knowledge for keeping seeds in the way that they would have the least decrease in their germination power during the time, because changes in precipitation in arid regions has significant influences on the production of seeds rangelands plant seeds (Agrwal, R. L., 2005). Thus gathering seeds in good weather years and preserving them in proper temperature would play a basic role in preserving the germination power of seeds and if necessary using them for rangeland improvement and development. *K. prostrata* is one of the local species of steppeic and semi-steppeic rangeland plants and has a vast distribution in Iran (Lotfi, 1996). According to the experiments, the best method for improvement of deserts and semi-desert rangelands is planting perennial plants such as *K. prostrata*. Production and chemical content of *K. prostrata* indicated an excellent potential for forage production on semi-steppeic rangeland (Kitchen and Monsen. 2001). the most important factors affecting the seed life time are seed moisture and temperature of the environment. The relative moisture can affect the seed moisture and temperature of the barn. Both of these factors are closely related to each other, many of the agricultural seeds get defected at relative moisture 80 °C and temperature 25-35 °C. If these seeds are preserved at relative 50% moisture and 5°C temperature, they can remain healthy for ten years and more (Agrwal, R.L., 2003). The best temperature for in vitro determination of the seed germination of *K. prostrata* is performed with treatments 0, 5, 10, 15, 20, 25, 30, 35 °C in four random designs and repeating that for four times and eight treatments (Lotfi, 1996). The result shows that temperatures 25, 30, 35°C during 4, 5.25 and 8.25 days were the best temperatures in *Kochia prostrata* germination (Lotfi, 1996). after-ripping was observed in seeds after 4-6 weeks after harvesting them, which makes germination possible (Lotfi, 1996). The effects of salinity on seed germination of *K. prostrata* were studied and the results indicated that *K. prostrata* had shown only a partial recovery (Orlovsky et al. 2011).

Kochia species exhibit a wide variability in both inter- and intraspecific salt tolerance (Al-Ahmadi and Kafi, 2007). We attempt to test the hypothesis that storage conditions on temperature of 0-5 °C can keep the germination of the seeds until 50% during two years. The main objectives of this study were to determine the germination capacity of storage conditions and storage periods on seed germination of *Kochia prostrata*.

Material and Methods

The seeds were collected from Shahkooh – on of the natural rangelands - which are located in southern slops of Golestan province. The seeds were sent to laboratory of ecology (Latitude and Longitude; 36° 34' North and 54° 25' East) during July and August 2014. The seeds were sent to laboratory of ecology (Gonbad-Kavous University) and after separating scratches and deformed or defective seeds, we measured the moisture of them at this stage. The moisture of the seeds were about 25% and for drying the seeds, we put them under the temperature of 13°C in two stages into the vessel and when the moisture of the seeds got to 10 present. The seeds were brought out of the vessel. In order for the ratio moisture of the maintaining circumstances to have less impact (influence) on the seeds and approximately does the same for whole maintaining treatments. About 44 same rubber covered vessels were selected and safe seeds randomly were put after anticipating in which of these vessels in order to know that which of these temperatures can keep the growth power of seeds for treatments of protections temperature of seeds 0-5, 5-10, 15 and 20°C. The treatments of storage periods were selected (3, 6, 9, 12, 15, 18, 21, 24, 27, 30 months). The 11 vessels of seeds were put in every care of protection time and every 3-month

one of the vessels were brought out and the seed germination was measured, this examination lasted for 30 months and the germination seed was selected. The germinator machine was used for defining the seed germination in 30°C. The 150 seeds were divided into 3 Petri dish and the number of germinated and ungerminated seeds in each Petri dish were counted. The averages of every different treatment were examined. This project randomly was analyzed with the of 4 * 11 factorial method using SAS statistic software.

Figure 1- *K. prostrate* on the natural rangelands of Shahkooh – Golestan province

Results

Analyzing the variance showed a significant different of storage conditions, storage periods and their interaction on seed germination percentage of K. *prostrata* (table. 1).

Table 1- Analyzing the variance of storage conditions and storage periods on seed germination of K. *prostrata*

Source	DF	SS	MS	F
Total	131	5347	-	-
Temperature	3	2214	6613	451.18**
Time	10	3104	2130	310**
Time*Temperature	30	5558	187	126.33**
Error	88	128	1.33	-
	CV =2.22			

Results showed that K. *prostrata* seeds at 0.05% on storage conditions have significant different.
The highest percentage of germination were obtained for storage conditions at 0-5°C with an average of 60. The storage conditions 5 -10, 15 and 20°C have orderly one different with the average of 55, 40 and 30 percent of seed germination (table. 2).

Table 2- The average of seed germination of K. *prostrata* on storage conditions

Temperatures (°C)	Germination%
0-5	60[a]
5-10	55[b]
15	40[c]
20	30[d]

Results showed that the best storage periods were during 6, 9 and 3 months with the average of seed germination 58%, 57% and 56% (table. 3)

Table 3- The average of seed germination of K. *prostrata* on storage periods

Time (month)	Germination%
6	58[a]
9	57[a]
3	56[ab]
12	54[b]
15	50[c]
18	49[c]
21	40[d]
24	38[e]
27	36[f]
30	25[g]
0	2[h]

For the seeds stored at 0-5°C and 5-10°C recorded over 74% seed germination after 9 months (table. 4). This level of storage conditions and storage periods recorded maximum seed germination and significant difference compared to other times and storage conditions (table. 4).

Table 4- The average interaction of storage periods * storage conditions on seed germination of K. *prostrata*

Temperatures(°C)	Time (month)	Germination%	Temperatures(°C)	Time (month)	Germination%
0-5	6	77[a]	20	3	45[m]
0-5	3	75[a]	5-10	30	44[m]
5-10	9	74[a]	15	12	41[n]
0-5	12	70[b]	15	15	40[n]
5-10	9	70[b]	20	6	40[n]
0-5	15	71[b]	15	18	39[o]
5-10	15	65[c]	15	21	38[o]
0-5	21	63[d]	20	12	30[p]
5-10	6	63[d]	15	24	30[p]
0-5	6	62[d]	15	27	30[p]
15	3	60[e]	20	9	29[p]
5-10	18	60[e]	20	15	28[q]
0-5	24	60[e]	20	18	26[r]
5-10	3	58[f]	20	21	18[s]
15	6	55[f]	20	24	17[s]
0-5	3	54[g]	20	27	18[s]
0-5	21	50[h]	15	30	18[s]
0-5	27	50[h]	20	30	12[t]
5-10	24	50[h]	0-5	0	0[u]
5-10	27	48[i]	5-10	0	0[u]
0-5	30	47[j]	15	0	0[u]
15	9	46[k]	20	0	0[u]

Discussion and Conclusion.

In our present study, nine-month storage did not show much variation in germination percentage among the storage conditions 0-5 and 5-10°C suggesting the suitability of two conditions for short-term storage, which is often practiced in several Himalayan herbs (Butola and Badola, 2004., 2006). The present study indicated that storage conditions and storage periods significantly affect the seed germination capacity as indicated by Tavili *et al* (2014). Our study indicates that the seed deterioration rates may vary depending on the storage conditions and the germination percentage declines with an increase in storage period as reported by Baghestani Maybodi *et al* (2015). The maximum ratio of germination in storage conditions of 0-5°C in storage periods of 6 month. In the period of 12 months of storage, 70% of germination remained. Many studies reported that the seed storage at 4°C was effective for germination after 12 months (Chen *et al*, 2007., Pradhan and Badola, 2008). The maximum of germination in storage conditions of 5-10°C is during a 9 months period, and maximum of germination in temperature of 15-20°C is during a 3 months period, as a result high storage conditions decrease the reduction of germination of the seeds. Tavili *et al* (2015) mentioned, but high storage conditions of seeds have a significant effect on the reduction of and 20°C is of germination in short time period and also no scientific explanation. We observed that low germination is for recently harvested seed and that germination rate increased dramatically with after-ripening. This result demonstrated that seesd plantation of K. prostrata should not been after immediate harvesting. Storage conditions on temperature of 0-5 °C can keep the germination of the seeds until 50% during two years. It is better to use the K. prostrata seeds, which can be up to two years old, to run pasture projects.

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