

Planting Methods and Seedling Establishment of *Artemisia sieberi* Besser: Seeds Collected from Isfahan Kolah Ghazi Sagebrush Vegetations

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Abstract. Wormwood sagebrush (*Artemisia sieberi* Besser) is one of the most widely distributed shrub species in Iran and Turkistan steppes, its establishment on dry lands has generally been proven difficult because of low seedling vigor, inability to compete with herbaceous species, poor seed quality, and altered edaphic conditions. In order to evaluation of planting methods and seedling establishment, seed of *A. sieberi* was collected at Isfahan Kolah Ghazi National Park situated at 51°45' Eas longitude and 35°15' Nort latitude. To overcome dormancy effects, seeds were pre-chilled for 9 days at 0 to 5°C. To determine the establishment of the seedlings, the seeds were sown in Petri dishes. The germination percentage was recorded after three weeks. After 5 months, 40 seedlings were transferred into plastic pots. Two months later, 16 seedlings were transferred to the field. The result of plate experiment showed that the percentage of germination was 63%, survival of the sprouted seedlings was 23%, the percentage of the establishment of the seedlings in plastic pots was 70%, and the percentage of the establishment of the seedlings in the field was 75%. On the whole, 7.61% of the cultivated seeds produced seedlings that were successfully established in the field ($0.63 \times 0.23 \times 0.70 \times 0.75 \times 100 = 7.61$).

Keywords. *Artemisia sieberi*, Germination, Vigor, Sagebrush, Kolah Ghazi, Iran.

Introduction

Preservation and development of plant cover are major parameters in the management of range ecosystems. One of the native species of Iran and Turkistan steppes is *Artemisia sieberi* that is not much used in rehabilitation of desert vegetations. The most suitable species for the reclamation of these ranges are the native species.

Early stages of seedling development, resistance to drought in the first year, and intra- and extra-specific competition are important issues for plant establishment in natural habitats, of the native and most adaptable species to our country's harsh desert conditions are critical in seed development in species of *Artemisia* genus from *Asteraceae* family. Sagebrushes are of genetically important species in Iran propagated by seeds and by resisting against heat, drought, and pests they prevent water and wind erosion besides providing forage in fall and winter which also have medicinal properties (Mozafarian 1999).

Mechanisms which help *A. sieberi* to survive in severe conditions are germination of a large number of seeds, with high viability and resistance to wetting and thawing (Moghimi 2005), *Artemisia* seeds generate transparent gelatin cover around the seeds while contacting to moisture which helps the seeds to store water in order to prevent germination in unfavorable conditions (Mozafarian 1999). With a view to the small number of the present studies conducted on its cultivation and establishment, this species has not been in wide use to combat against desertification and reclaim the arid regions.

The fruit of *A. sieberi* is nutlet and ovoid weighing 0.25 to 0.35 g (Moghimi 2005). The *A. sieberi* is an after-ripening seed with a short dormant period that satisfies by being exposed to cold weather (Meyer and Monsen 1992; Booth *et al.* 1997)

studied two commercial seed lots and found that germination percentage increased by 15 to 20% after 4.5 months period of storage, indicating an after ripening effect. After ripening is post-harvest embryo maturation measured as the time required for seeds to be germinated.

Herbaceous species competition may also contribute to the variable success rate of direct seeded sagebrush. Blaisdell (1949) reported that grasses were more competitive than sagebrush when seeded from 2 years before to 1 year after seeding sagebrush. Jones (1991) was able to show increased survival of big sagebrush by removing vegetative competition. Cook and Lewis (1963) and Sturges (1977) noted that competition effects were probably related to the sagebrush seedlings' inability to compete for water. Recruitment of sagebrush seedlings is strongly limited by abiotic and biotic factors. Newly emerged seedlings are susceptible to frost damage, drought, and damping off disease. Some factors such as snow cover can effectively increase establishment success. In a study seedling emergence was increased substantially than those controls with placement of a snow fence to capture moisture (Meyer 1994). In addition, companion plants have been demonstrated to ameliorate site conditions and allow for greater survival of seedlings and establishment (McArthur *et al.* 1995).

The objective of this research was to evaluate planting methods and seedling establishment of *Artemisia sieberi* Seeds collected from Isfahan Kolah Ghazi Sagebrush vegetations.

Materials and methods

Seed collection

The seeds of *Artemisia sieberi* were collected from Isfahan Kolah Ghazi National Park situated at 51°45' East longitudes and 35°15' North latitude, 36 km south of Isfahan city. The climate of this region is dry with very hot and dry

summer according to Kop pen's Method. Minimum and maximum rainfall of the region is 111 and 144.6 millimeters with minimum and maximum temperatures of -16° to 42°C , respectively. Elevation of study area varied from 1650 to 2534 m from plains to mountain peak (Khajedin and Soltani Kupae 1998). The vegetation cover was very little and varied from zero to at most 5% (Khajedin 2000).

From the collect seeds, 20 individual plants of *A. sieberi* with different crown cover and heights were selected along a 6-

kilometer transect in November 2006. Seeds of them were collected separately in transparent cloth bag. The cloth bags were pulled over each plant and the opening of the bag was firmly closed under the stem, so that all the seeds can be collected in the bags. The seeds were collected in January 2007 and air-dried. The seeds from the ripened inflorescences were separated from other organs by a sieve and wind current. Weights of 1000 seeds were determined by ISTA (1985).

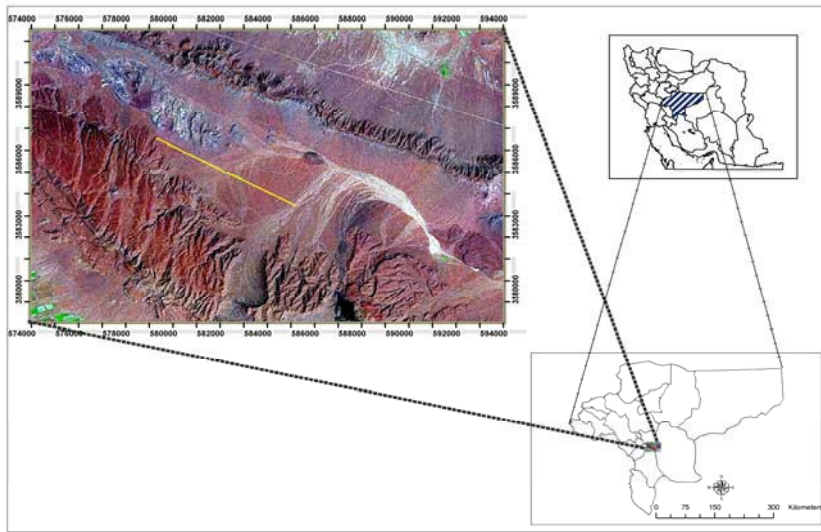


Fig. 1. Geographical Position of Kolah Ghazi National Park Seedling Establishment

Cultivation dishes had 216 cells (dimples) having a hole for drainage were used to plant seeds of *A. sieberi*. Each cell was filled with a mixture of agricultural soil, fertilizer (litter), and sand in ratio of 1:1:1 in 23 Oct 2007. Selected seeds were pre-chilled at 0 to 5°C for about 9 days before experiment (Modares Hashemi 2003).

Three seeds were sown in each cell. Seeds were covered with a 0.5 centimeter of the above mixture and peat moss. Watering was done through a piece of cloth spread over the dishes. The weak seedlings had to be removed so that each cell contained only one strong and healthy seedling for transfer. The percentage of germination was calculated after 21 days. During the whole period of the plant growth in the dishes, soil moisture

remained at field capacity. After 5 months of cultivation i.e. in Feb. 2008, the remaining healthy seedlings capable of being transferred were also counted.

After 5 month, when plants were relatively resistant to against new stresses during transfer, 40 seedlings were transferred to plastic pot with 20 and 10 centimeters length and diameter respectively. The pots were filled with a sandy loam soil and placed in field.

After seedling establishment, the plant in the pots, the frequency of watering was reduced to 2-week interval. The establishment seedlings were counted and the percentage of the establishment was calculated.



Fig. 2. Cultivation Dishes Cells (dimples) Used to Plant Seeds of *A. sieberi*

Two months after growing in pots, 16 plants were selected and transferred to field. University field soil and climate were similar to the habitat of seed collection site. Two months later, 16 seedlings were transferred to field soil. The sides of the pots were cut and the passage of water into the bags was open. Watering was done every 40 days. The number of the seedlings established in the field was counted and the percentage of the establishment was calculated.

Result and Discussion

Seed size and weight

The weight of 1000 seeds of *A. sieberi* seedlings was 0.19 g according to the results of this research. The mean length and the width of the seeds were 1.7 and 0.6 mm, respectively (Fig. 3).

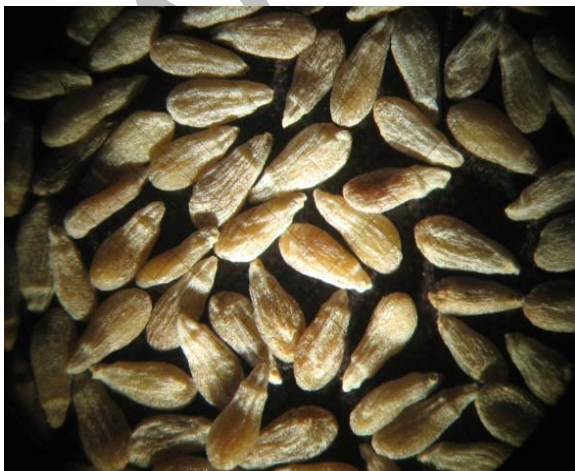


Fig. 3. Morphology of Seeds of *A. sieberi* from Kolah Ghazi National Park, Bar in Each Graph Indicates 1.7 mm.

Study of *A. sieberi* Seedling Survival and Establishment

Seeds were placed in plates in 23 Oct 2007 and after 3 weeks 63% of the seeds were germinated. After 5 months from the date of cultivation, only 23% of the seedlings remained healthy and were capable of being transferred to flower pots. This reduction was due to the fact that a number of the weak seedlings died during 5 months after cultivation. In 18 Mar 2008, 40 seedlings selected from the remaining healthy seedlings were transferred to plastic pots. After 2 months from the date of their transfer to the pots, 70% of the seedlings were properly established and the rest withered. The seedlings were transferred from the plastic pots to field in 27 May 2008. After 4.5 months from the date of transferring to the field and at the end of summer, 75% of the transferred seedlings were vigorously established. Therefore 7.6% of the initial seeds were finally established in the farm (Fig. 4).

Due to time limitation in this research and the study of the transfer to the farm, the seedlings remained in the plastic pots for only 2 months and the time of the transfer to the site coincided with drought and heat of summer. In practice, it is recommended that germination should be done in time so that germinated seeds grow good enough to be transfer to the pots at the beginning of the growing season. To transfer seedlings from pots to the field,

seedlings should have enough strength and reserves to survive the unfavorable conditions of new habitat.



Fig. 4. Seedlings of Established in Experimental Site at the University Field

The plants were irrigated every 40 days in this study, but they only reserved precipitation after Oct. 2008. From the beginning of the seed germination to its complete establishment in the flower pots and also at the beginning of their transfer to the site, the need for water is very high in *A. sieberi* species and only if this need is met, the establishment percentage will also be increased. At the time of growing in the cultivation plate, it needs suitable light, neither too strong nor too weak. The percentage of germination and survival of the plant was low in this study, because the plant was exposed to the fall sun for only 2 to 3 hours in the morning. This resulted in a very high mortality of the seedlings in the plate and only 23% of the seedlings survived after 5 months. In a study, Cawker (1980) pointed that drought could have an effect on the age structure of *Artemisia* seedlings and make the establishment of the seedlings difficult. The results showed that the best time for the seedling cultivation was in March, because it was less exposed to drought and also the high rate of raining in the winter satisfied a part of the plant's need for water. Giner *et al.* (1999) stated that germination of species of *Artemisia* genus

was significantly related to the high rate of raining in the winter.

For the reclamation of weathered sagebrush vegetations, Scott (2005) studied the subspecies of *A. tridentata*. He cultivated the seedlings at the beginning of the spring and the seedlings were successfully established. He stated that greenhouse cultivation of the seedlings might prepare them within 6 to 8 months. But for more protection of the bare roots and reduction of damage during transfer to the site, the time was extended to 2 years. He also suggested that randomized inter-seeding be done in weathered regions for better establishment. After some time, the established *A. tridentata* seedlings generated fertile spots of sagebrush which also helped to improve the nearby plant cover.

In this research, after one year from their germination, bushes flowered in the spring of 2009 and fruited. It demonstrated successful establishment of the remaining bushes. With regard to the fact that the seedlings transferred to the farm had suitable growth and successful establishment, this method can be applied to inter-seeding in weathered sagebrush vegetations. Since bush planting was not studied extensively in this research, a thorough study of the plan for its cost and efficiency compared to other species is recommended before taking action. Of course, if its planting is expensive, it will again be recommended that the cultivation of *A. sieberi* should be more comprehensively studied since it is a native plant with high quality establishment.

Conclusions

In the beginning of experiment, the germination percent was 63%; the survived germinated seedlings were 23%; established seedlings in the plastic pots were 70%, and establishment of the seedlings in the farm was 75%. In the other word only $(0.63 \times 0.23 \times 0.70 \times 0.75 \times 100 = 7.61)$, of the total seeds that sown in the plates were properly established in the

farm. To obtain higher values of the seedling number and with a view to the results, it is suggested to cultivate the seeds in the plates at the beginning of the fall to protect them from heat. The transfer of the seedlings to the flower pots should be done at the beginning of the growth season and at the end of the winter or at the beginning of the spring before facing with drought or/and high temperature of summer. The seedlings should be 1 year old at the time of transfer to the site (according to the results of the transfer of the seedlings from the flower pots to the farm) *i.e.*, the transfer should be done at the end of the next year's fall to be less under the effect of drought and at the same time it can benefit from the winter rainfall. From the beginning of germination until complete establishment in the pots and at the beginning of transfer *A. sieberi* seedlings need sufficient moisture.

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