

Germination of *Salsola Richteri* (Moq.) Karel ex Litv. in the Conditions of Karakalpakstan

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Abstract The literature provides information on the conduct of phytomelioration works aimed at improving natural pastures and fodder bases in desert conditions, using local plant resources, studying the germination of their seeds, and cultivating plant species. In the deserts of Kyzylkum, Uzbekistan, two species of the genus *Salsola*, *Salsola richteri* (Moq.) Karel ex Litv. and *Salsola paletzkiana* Litv., are widely distributed. In the flora of Karakalpakstan, two species of the genus *Salsola*, *Salsola richteri* (Moq.) Karel ex Litv. and *Salsola paletzkiana* Litv., belonging to the *Chenopodiaceae* family of weeds, are prevalent. The growth of *Salsola richteri* (Moq.) Karel ex Litv. in open sands, its abundant fruiting, seed reproduction, and propagation by cuttings, salt tolerance, strong root system development, and the emergence of root suckers contribute to its role as the principal plant in stabilizing sands.

Keywords Seed germination, Seed sprouting, Embryo, Cotyledons, Radicle, Sprouts, Fruitlet, Seeds, Scarification, Seed stratification, Growth and development, Sowing, Wild plants, Ovary, Seed viability, Storage life, At room temperature, Germination percentage, Seed survival, Soil germination, Sowing period

1. Introduction

Salsola richteri (Moq.) Karel ex Litv., also known as white *Salsola*, is a large-stemmed plant that can reach up to 3 meters in height. This sandy desert endemic plant of Central Asia features white, feather-like membranous and thin milky-white membranous branches that grow close to the ground. The leaves of *Salsola richteri* are arranged alternately, are roll-like, and cylindrical in shape, with small flowers (Table 1).

Table 1. Morphological and Biological Characteristics of *Salsola richteri* (Moq.) Karel ex Litv.

Characteristics	<i>Salsola richteri</i> (Moq.) Karel ex Litv.
Leaves	Very light, grey-green, length reaching up to 6-8 cm (3-7 cm), drooping, rough
Crown shape	Soft, 2-3 m, branch length 60-90 cm
Epidermis	Easily separates from the mesophyll
Branches	Upright
Fruits	Grey
Wings	Reddish, smoky, or transparent (colorless)
Petals	Round or heart-shaped
Cell sap	White cottony fibrous tissue is colored black-green

The fruits are gray, red, or reddish-smoky, and the plant is single-seeded. Flowering begins in June and continues until the cold weather sets in. Fruits start to mature in September, and seeds are collected in October-November.

The leaf length of *Salsola richteri* (Moq.) Karel ex Litv. is 3.0 cm, with a light gray color [2]. Leaves start to appear in March-April, begin to fall in August-September, and completely drop off by October. The leaves on the young branches of white *Salsola* are greener, but turn black as they mature; the roots are well-developed [1]. According to A. Bakhiev [3] and S. Dauletmuratov [4], the natural density of *Salsola* in the sands widespread in the Republic of Karakalpakstan is 68 thousand hectares.

Habitat: Ustyurt, Northwest Kyzylkum, and the lower elevations of Northeast Kyzylkum. This plant is widely used in phytomeliorative practices. It has high nutritional characteristics, being considered the best fodder plant, with its small branches and flowers serving as the main food source for sheep, goats, and cattle throughout the year.

2. Materials and Methods

The growth and germination of seeds in laboratory conditions were studied based on the methodological guidelines of M.G. Nikolaeva [7], M.K. Firsova [8], and others. Seeds were grown in Petri dishes at various temperatures. Observational studies were conducted on the width of the hypocotyl, length

growth, and leaf formation during plant growth. Seed germination in soil conditions was studied by planting at different times and at various depths.

To improve natural pastures and fodder bases in desert conditions, phytomeliorative work should be conducted, using resources from local plants and cultivating new plant species. Temperature is a primary factor in seed germination, closely related to biological and ecological characteristics and plays a significant role in forming life forms. When increasing the fodder base, the quality of the seeding materials plays a significant role. The quality of the seeding materials is primarily determined by the purity of the seeds, their germination, and classes.

Laboratory germination is an indicator expressed as a percentage of the number of normally developing test seeds. The uniform growth of seeds is greatly influenced by the species density in the field, growth rate, and seed energy. All these indicators determine seed viability. Seed formation and survival depend on several factors, particularly meteorological conditions. In dry years, regeneration is observed in shrubby plants. Furthermore, *Salsola richteri* (Moq.) Karel ex Litv. is included in the national pharmacopoeia. The fruits and shoots contain alkaloids—salsolidine and salsoline, which are used for hypertension and severe neurological disorders [4].

When comparing the laboratory germination of seeds collected on November 28, 2023, from the Northwest Kyzylkum with aridity (average annual temperature 14.9°C, relative humidity 51.2%, and annual precipitation norm of 95.2 mm), the germination rate was 7-21%. Meanwhile, seeds collected on November 20, 2021 (average annual temperature 12.5°C, relative humidity 31.9%, and annual precipitation norm of 103.6 mm) showed a germination rate of 16-32.2%. The slight difference in precipitation volumes demonstrates that meteorological conditions significantly impact seed germination. U. Japakova notes that the germination rate of *Salsola richteri* seeds under Kyzylkum conditions ranges from 8-12%, and that of *Salsola paletziana* is 3-16%, which is close to our figures [6].

The germination rate of *Salsola richteri* seeds after 12 months is 9.6%, after 8 months it is 11%, and after 4 months it reaches 28.2% (Table 2). The germination of Richter's saltwort seeds drops sharply after 5 months of storage, so it is advisable to use recently collected seeds for sowing. It is practical to sow *Salsola richteri* (Moq.) Karel ex Litv. seeds in November and December.

Thus, field germination directly depends on spring climatic conditions, soil fertility features, agronomic practices, and the physical-mechanical properties of the soil.

3. Results and Discussion

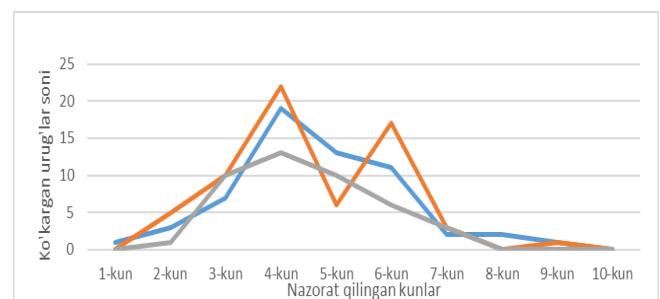
Seed germination. To determine the laboratory germination of *Salsola richteri* seeds, we collected seeds in the fall of 2023 from *Salsola richteri* growing around the city of Nukus in the Northwest Kyzylkum (from the place where it grew in roadside sand). We placed 100 seeds in a Petri dish and

repeated the experiment three times at temperatures of 18-23°C, achieving a seed germination rate of 32.2%. In laboratory experiments, *Salsola richteri* seeds germinate within 3-6 days.

In laboratory conditions, we took seed wings of *Salsola richteri* and conducted an experiment. Seeds germinated over 1-9 days, with high germination observed on days 3-4 (Table 2).

The seed germination rate was 55.3%. The uniform growth of seeds is greatly influenced by species density, growth rate, and seed energy. All these indicators determine seed survival. Germination and seed survival depend on meteorological conditions.

Table 2. Germination of Wingless Seeds of *Salsola richteri*



The germination rate of *Salsola richteri* seeds collected in 2023 ranges from 6-13%, and 3-5% for spring planting. By evaluating the germination rate of seeds in the soil, we can determine the standard rate, the number of seeds sown, and the yield per unit area. We studied the effect of storage duration on the germination of *Salsola richteri* seeds in February 2023, observing that the germination rates decrease as the storage period lengthens. For the *Salsola* species, the germination of *Salsola richteri* is 9.6% after 12 months and 28.2% after 4 months (Table 3).

Table 3. Effect of Storage Duration on the Germination of *Salsola richteri* Seeds

Name of plants	Date of experiment	Storage duration	Germination rate in %
<i>Salsola richteri</i>	2-II-2023	12	9,6
<i>Salsola richteri</i>	2-II-2023	8	11,0
<i>Salsola richteri</i>	2-II-2023	4	28,2

The germination of *Salsola richteri* seeds drops sharply after five months of storage; however, the seeds maintain good germination within a month after collection.

Field Germination. The germination of *Salsola richteri* in field conditions was determined at special plots of the Berdakh farmers' association in the Amudarya district. For this purpose, in the fall, the field was plowed to a depth of 25-30 cm, then raked, the surface leveled, and prepared.

On November 9, 2023, seeds were sown over an area of 5-15 m². These seeds were collected in the Northwest Kyzylkum area along the Nukus-Tashkent highway. To determine the optimal sowing time, seeds were sown on two different dates (Table 4).

Table 4. The field germination of *Salsola richteri* in 2023

Time of sowing	Seed germination	
	Number of seeds sown	Number of seedlings per 1 m².
	<i>Salsola richteri</i>	
9.XI.2023	100	6-13
2.III.2024	100	3-5

As shown in the table, seeds sown in November exhibit good germination. However, seeds sown in the spring germinate less effectively because the seeds need to undergo stratification in the soil.

4. Conclusions

Therefore, it is advisable to sow *Salsola richteri* in November and December. In field conditions, germination rates can vary depending on the sowing rate. With an increase in sowing rates, germination in field conditions also increases.

The reason that seed germination in field conditions is lower compared to laboratory germination is due to the drastic change in growth conditions for the seeds. In the laboratory, conditions are optimized for germination. When seeds grow in the field, the circumstances are quite different; in this case, the temperature, moisture regimes, and lighting differ from laboratory conditions. In field conditions, seeds must not only grow but also emerge through the soil surface.

Thus, field germination directly depends on spring weather conditions, soil fertility, agricultural techniques, and the physical-mechanical properties of the soil.

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