

Original Research

GERMINATION OF *Artemisia diffusa* Krasch. ex. Poljakov SEEDS ORIGINATED FROM RANGELAND SITES OF DIFFERENT GRAZING INTENSITIES

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Abstract

Successful germination is key stage for population renewal, particularly important for insight into the regenerative capacity of the key species influenced by rangeland degradation. Germination responses of *A. diffusa* seeds collected from rangeland sites exposed to low, medium, and high grazing intensities under controlled laboratory conditions was accessed. Seeds originating from highly grazed sites exhibited significantly higher germination percentage, faster germination (lower mean germination time), and increased dry matter content compared to those from low grazing intensity sites, while seeds from medium grazing intensity sites showed intermediate responses. These results indicate improved early establishment capacity under increased grazing pressure. The observed patterns likely reflect maternal environmental effects and adaptive responses to grazing stress conditions. Further studies across a broader range of rangeland localities are needed to elucidate underlying mechanisms. The results may contribute to the improvement of seed sourcing strategies for rangeland restoration and management.

Keywords: rangeland, germination, grazing intensity, Karnabchul.

INTRODUCTION

Successful germination is a key stage in population renewal and is particularly important for understanding the regenerative capacity of key plant species affected by degradation processes. This is particularly important in the rangelands of Central Asia, where ecosystems are increasingly affected by grazing-induced degradation. *Artemisia diffusa* Krasch. ex. Poljakov is perennial chamaephyte shrub up to 50 cm tall. It is endemic species of Central Asia, often found in desert and semi-desert areas, including plain foothills and rangelands. More than 50 associations, which have so far been described in the territory of Uzbekistan, containing around 140 plant species [1]. Species is resistant to drought and serves as a valuable fodder food for livestock, especially during the autumn and winter time. Viable

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seeds are produced in November, characterized by B1–B3 dormancy [2]. Many habitats of *A. diffusa* in Uzbekistan are subjected to grazing of various intensity, where species projective cover was recognized as one of the indicators of rangeland degradation [3]. Species physiological traits, particularly photosynthesis and pigment content, but also biochemical traits such as content of carbohydrates and proteins, are adapted to varying grazing pressures, showing increased values under high grazing pressure [3]. On contrary, biochemical traits such as content of carbohydrates and proteins, showed decreased values under high intensity grazing stress [4]. Despite the recognized influence of grazing on plant physiological traits, its effects on seed quality and early establishment remain insufficiently understood.

Changes in environmental conditions, as well as maternal plant responses, are known to influence germination behaviour [5]. Successful germination represents a key stage for population renewal, so assessing germination traits of *A. diffusa* seeds originating from habitats with low, medium and high grazing intensities provides insight into the regenerative capacity of the species under rangeland degradation. Therefore, this study aims to access early germination responses of *A. diffusa* seeds collected from sites with different grazing pressures under laboratory conditions.

MATERIALS AND METHODS

Seeds were collected from the Karnabchul rangeland area in south-western Uzbekistan (39°51'32.2"N, 65°36'10.6"E) on gypseous soil sites with low, medium and high grazing intensities. Analysis of inorganic N and soil organic carbon content were conducted on composite soil samples from investigated sites. Inorganic nitrogen was presented as sum of ammonium nitrogen (determined by spectrophotometer method using Nesler reagent) and nitrate nitrogen (determined by Grandval-Lajoux colorimetric method). The soil organic carbon content was determined according to Kotzman's method.

Seed germination was tested in laboratory conditions by incubating seeds at constant temperature of 25 °C in thermostat chamber. Seeds were sterilized with 70% ethanol for 30 seconds prior to seeding and transferred into Petri dishes containing filter paper soaked in distilled water. Four replicates of 25 seeds were used for each level of degradation. Seeds were considered germinated when the length of radicle was >1 mm. Filter paper was saturated by moisture and kept constant during the experimental period that lasted 7 days. Cumulative number of germinated seeds was recorded daily. Fresh and dry weight of germinated seeds was measured after the experiment.

Germination percentage (GP, %) was calculated as ratio of total number of seeds germinated and number of seeds tested. Germination energy (GE, %) was calculated as number of germinated seeds after 3 days and total number of germinated seeds. Germination index (GI) was calculated as $\sum N_i/T_i$ where N_i is number of germinated seeds during days of experiment, and T_i is number of days from the start. Mean germination time (MGT) is calculated as $\sum (N_i \times T_i) / \sum N_i$ where N_i is number of seed germinated on given day (T_i), and $\sum N_i$ is total number of seeds germinated during the experiment. Seedling vigor index II (SVI-II) is calculated as the product of germination percentage and seedling dry weight. Dry matter content (DMC, %) was calculated as ratio between dry weight and fresh weight.

Data were tested for normality using the Shapiro–Wilk test and for homogeneity of variance using Levene’s test. Germination percentage (GP), germination index (GI) and dry matter content (DMC) were transformed (by arcsine square-root transformation for GP and logarithmic transformation for GI and DMC) to meet the assumptions of parametric analysis. Additionally, differences among seeds from rangelands of different degradation levels were assessed using one-way analysis of variance (ANOVA), followed by Tukey’s HSD test for multiple comparisons. As germination energy (GE) data did not meet assumptions of normality and homogeneity of variance even after transformation; Welch NOVA has been used to analyse the data. All statistical analyses were performed at a significance level of $p < 0.05$ in Statistica StatSoft 8.0 and Minitab 22 statistical software.

RESULTS AND DISCUSSION

Analysis of soil inorganic N (form of nitrogen immediately available to plants) and SOC showed increasing trend from low to high grazed sites (Figure 1), reflecting the difference between sites and available nutrition conditions for plants.

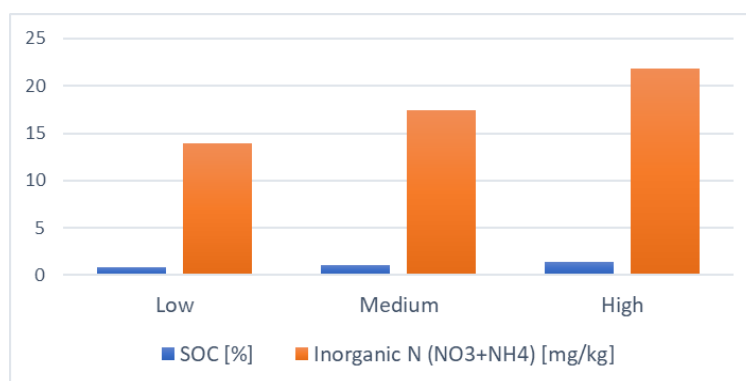


Figure 1 Content of soil organic carbon (SOC) and inorganic N in Karnabchul soils under different levels of grazing

Cumulative number of germinated seeds was presented in Figure 2, revealing highest number of germinated seeds from sites under high grazing pressure.

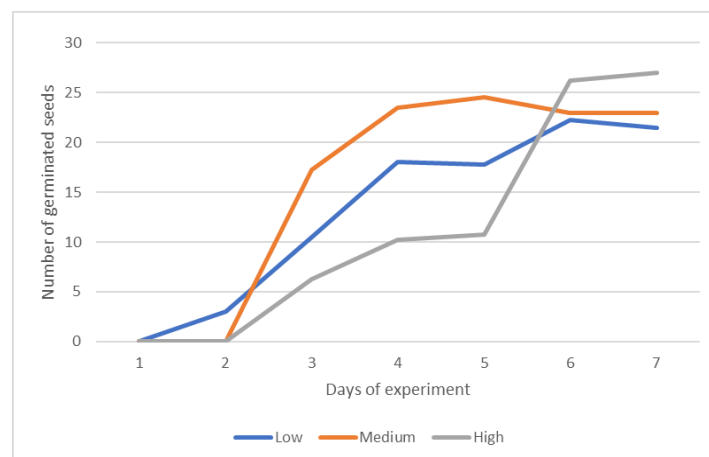


Figure 2 Cumulative number of germinated *A. diffusa* seeds by day

Results of analysis of variances on calculated germination indices and dry matter content are presented in Table 1. They revealed statistically significant differences between germination percentage, mean germination time and dry matter content among seeds originating from rangelands with different levels of degradation.

Table 1 Analysis of variance (ANOVA) for germination indices of *A. diffusa* seeds from rangeland sites with low, medium and high grazing pressure, followed by post-hoc Tukey HSD test (statistically significant differences are marked with *)

Germination indices	Low grazing intensity site	Medium grazing intensity site	High grazing intensity site	F-values	p-values
GP [%]	71.7 ± 3.33 ^a	76.67 ± 15.87 ^{ab}	90 ± 2.72 ^b	5.196	0.032*
GE 3 [%]	35.0 ± 39.0	57.5 ± 30.0	20.83 ± 4.19	2.730	0.176
GI	19.83 ± 8.01	23.64 ± 2.42	15.03 ± 1.37	3.889	0.061
MGT	22.43 ± 5.58 ^{ab}	25.02 ± 2.53 ^a	17.03 ± 0.82 ^b	5.233	0.031*
SVI II	0.007 ± 0.0003	0.014 ± 0.0088	0.018 ± 0.0062	3.029	0.099
DMC [%]	0.536 ± 0.304 ^a	1.469 ± 0.635 ^{ab}	5.552 ± 3.224 ^b	12.897	0.002*

Germination percentage showed a significant increase with increasing grazing intensity, and it was in line with average laboratory seed germination ranges for *A. diffusa* of 46–94% reported by Gintzburger (2003). The highest GP was recorded in seeds originating from high grazing sites (90 ± 2.72%), which differed significantly from percentages obtained from seeds originating from low grazing rangelands (71.7 ± 3.33%), while seeds from medium grazed site showed intermediate values and did not differ significantly from either group. Seeds from highly grazed site exhibited the lowest mean germination time (17.03 ± 0.82), indicating faster germination compared to medium grazing sites (25.02 ± 2.53), whereas low grazing site showed intermediate values. Dry matter content was tenfold higher in seeds from high grazing environments (5.552 ± 3.224%) in comparison to seeds from low grazing sites (0.536 ± 0.304%), indicating enhanced resource provisioning. These sites were also characterized by higher levels of inorganic nitrogen and soil organic carbon content, suggesting more nutrients immediately available to plants. Dry matter content in seeds reflects stored reserves, including carbohydrates, proteins, and lipids, being important components for supporting early seedling growth. This is likely a characteristic for adaptive maternal response, where environmental conditions experienced by the mother plant regulate seed provisioning with essential nutrients, hormones, and proteins that further influence seed metabolism and influence germination processes under stress conditions. This is in line with previously reported physiological and biochemical adaptations of *A. diffusa* plants on habitats with varying grazing intensities [3].

CONCLUSION

The present study revealed that seeds of *Artemisia diffusa* originating from rangeland sites of different grazing intensities showed differences in germination behaviour. Seeds collected from high grazing intensity sites exhibited significantly higher germination percentage, reduced mean germination time, and increased dry matter content in laboratory conditions, indicating enhanced seed quality and faster establishment potential under more intensively

grazed conditions. Observed differences are likely reflecting environmental maternal response and adaptation to the stress conditions. However, further research across a broader range of rangeland localities prone to grazing intensity gradients are necessary to determine whether the observed patterns are consistent for *A. diffusa* and to gain deeper insight into the ecological and physiological mechanisms responsible for the observed differences in germination behavior. Additionally, such results can be further utilized for rangeland restoration and management, particularly in terms of seed sourcing.

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