

EFFECTS OF STORAGE PERIOD AND SCARIFICATION ON SEED GERMINATION OF THREE INDIGENOUS SHRUBS GROWN IN NORTHERN SAUDI ARABIA

Saud L.R. Al-Rowaily

Plant Production Department, College of Agric., King Saud University,
P.O. Box 2460, Riyadh 11451, Saudi Arabia.
E-mail: srowaily@ksu.edu.sa.

ABSTRACT

There is a limited information regarding germination of native rangeland species in Saudi Arabia. The objectives of this study were to investigate the effects of storage duration and scarification on seed germination pattern of three important native shrubs in rangelands of Saudi Arabia (*Atriplex halimus*, *A. leucoclada* and *Salsola villosa*). Seeds were collected from native rangeland in northern Saudi Arabia on 1990, 1992, 1994 and 1996. The study was carried out in a germination chamber for two weeks at a constant temperature of 22°C and 95% relative humidity with 12 h light where germination recorded daily. Results showed significant variability in seed germination among species and within different treatments. *A. halimus* showed the highest germination rate (60% to 83%) within two weeks. On the other hand, *S. villosa* and *A. leucoclada* had significantly lower and slower germination < 25% and < 15%, respectively, for all years. Seed scarification (bract or wing removal) significantly improved germination of all species regardless of years. Germination reached 100% for *A. halimus* for all years within eight days, over 60% for *S. villosa* for both 1994 and 1996, and over 80% for *A. leucoclada* for all years. Germination from older seed lots was lower for all species, especially for *S. villosa* where seed germination for 1990 seeds was less than 2% and 6% compared to over 24% and 65% for 1996 seeds for both seeds with and without bracts, respectively. Results suggest rangelands reseeding success can improve through the use of new seed lots and/or seed treatments.

Key words : Germination rate, scarification, *Salsola villosa*, *Atriplex halimus*,
Atriplex leucoclada

INTRODUCTION

Atriplex halimus L. and *Atriplex leucoclada* Boiss., members of the Chenopodiaceae family, are important forage sources on Saudi Arabian rangelands. These native perennial *Atriplex* species or saltbush are important group of aridity

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and salinity tolerant where they are adapted to saline areas (Tag El Din, 1994). It is represented by five native species in Saudi Arabia (Chaudhary and Al-Jowaid, 1999). *Salsola villosa* Del. Ex Roem. Et Schltz = *S. vermiculata* L., *S. vermiculata* L. subsp. *Villosa* (Del.) Eig., *S. vermiculata* var. *villosa* Moq.; is a perennial shrub and a member of the Chenopodaceae family. It is widely spread in eastern, central and northern regions of the country where it can be found on rocky slopes or silty bottom of basins (wadis) (Chaudhary, 1999). It is the single most important bush in the northern region of the country. It is one of the more valuable forage shrubs thus considered by nomadic people (Bedouins) to be the most important and favorite grazing species for camels and sheep (Chaudhary and Al-Jowaid, 1999).

Important native shrubs have disappeared or depleted in many of their ecological sites because of intense grazing pressure due to their high relative palatability and can only be found in protected areas (Hemestra and Al Hassan, 1990; Al-Rowaily, 1999). As forage sources, their high drought resistance and high productivity, these shrubs hold a great potential for use as pasture shrubs in desert areas. They have been used in degraded rangeland rehabilitation projects in northern region of Saudi Arabia (Mirrah, 1996). Efforts to restore to reestablish native species on degraded rangeland must include ecologically sound and effective techniques through direct artificial seeding. However, a limiting factor to rangeland rehabilitation in the country is the availability of quality seed of desired species. In addition, there is a limited information regarding germination of native species. With the scope of rangeland revegetation programs, the primary objective of the present study was: (1) to investigate the effect storage duration on seed germination of three native shrub species, *Atriplex halimus*, *A. leucoclada* and *Salsola villosa* (2) to determine whether seed scarification could be used to facilitate and increase seed germination of these native shrubs thus increase initial establishment in degraded rangeland.

MATERIALS AND METHODS

Seeds of the three shrubs (*Salsola villosa*, *Atriplex halimus* and *A. leucoclada*) collected on different years (1990, 1992, 1994, and 1996) from native rangeland in northern Saudi Arabia were obtained from Range & Animal Development Research Center, Al-Jouf, Saudi Arabia. Seeds were stored at room temperature in unheated, uncooled typical warehouse condition. Before the studies, the seeds were sorted out to reject those which were insect-damaged or broken and selected the fully developed ones. Germination tests on the seeds were conducted either in their fruiting bracts (wings) or bracts were hands removed (scarified).

Germination trials were carried out in 1999 in Petri dishes lined with 0.5 cm thick absorbent cotton which was moisten each day with distilled water. For each species in each year of sampling, three replicates of 100 seeds and with or without seed wings were placed in each Petri dish. The Petri dishes were placed randomly in a germination chamber for two weeks at a constant temperature of 22°C and 95% relative humidity with 12 hours light. Number of germinated seeds was recorded at a 24 h interval and all germinated seeds were discarded immediately. A seed was considered to have germinated when the radicle emerged. The experiment was subjected to analysis of variance with SAS as a 2 (species) X 2 (treatments) X 4 (years) factorial in a completely randomized design.

RESULTS

Scarified and nonscarified seed germination rates for the three shrubs, *Atriplex halimus*, *A. leucoclada* and *Salsola villosa*, from the different years are shown in figure (1). Germination rate and total percent germination found to be highly variable among seeds of the three shrubs (Fig. 1 and Table 1). Comparing nonscarified seeds lots, germination rate was the highest for *Atriplex halimus* for all years where it reached over 80% for both 1992 and 1994 within 10 days and over 50% of the seeds from all years germinated within seven days. *Salsola villosa* had the next highest germination. On the other hand, *A. leucoclada* had the lowest germination rate (less than 10% within 14 days) and apparently unaffected by year of collection. Unlike *A. leucoclada* where seed germination was not affected by years of storage, *S. villosa* had a 20 percent loss of germination viability over two years even when seeds were scarified. Scarified seeds exhibited significantly ($p < 0.01$) higher seed germination rate of all species regardless of years. Not only scarification led to higher germination but advanced mean germination time by many days. *Atriplex halimus* total germination reached 93% for 1990 and 100% for the others years within 5 days of the study. *Atriplex leucoclada* benefited more from scarification than the two other species where seed germination reached 80% and above for all years within 5 days compared to less than 10% for nonscarified seed. Similarly, *Salsola villosa* seed germination was increased by many folds when seed wings were removed except the 1990 seed where seed germination increased from 2% to 6% only.

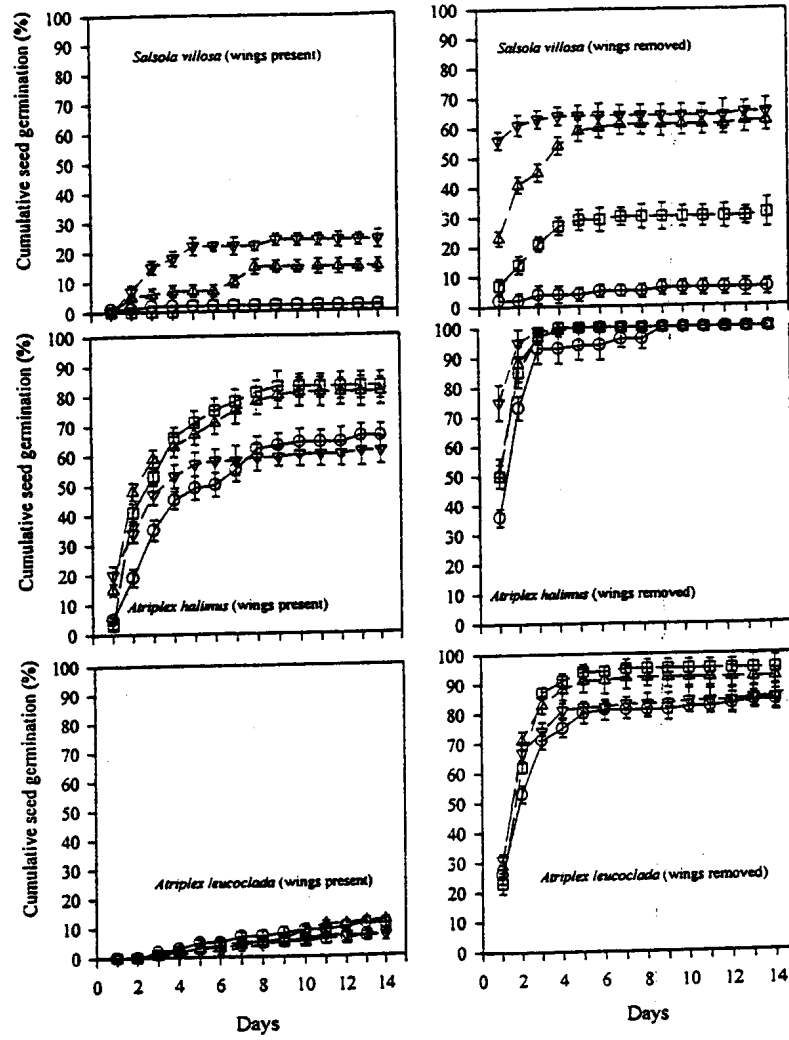


Figure 1: Effects of storage duration and hand scarification on the seeds of three native shrubs in rangeland of Saudi Arabia —○— 1990 —□— 1992 —△— 1994 —▽— 1996

Table (1): Mean percent total germination of three species in response to storage period and scarification.

Species	Year	Treatment	% total germination
SV	1990	wings present	2
SV	1990	wings removed	6
SV	1992	wings present	2
SV	1992	wings removed	31
SV	1994	wings present	44
SV	1994	wings removed	62
SV	1996	wings present	24
SV	1996	wings removed	65
AH	1990	wings present	66
AH	1990	wings removed	100
AH	1992	wings present	83
AH	1992	wings removed	100
AH	1994	wings present	81
AH	1994	wings removed	100
AH	1996	wings present	71
AH	1996	wings removed	100
AL	1990	wings present	11.5
AL	1990	wings removed	84
AL	1992	wings present	9.5
AL	1992	wings removed	95.5
AL	1994	wings present	12
AL	1994	wings removed	92
AL	1996	wings present	6.5
AL	1996	wings removed	84.5

SA = *Salsola villosa*; AH = *Atriplex halimus*; AL = *A. leucoclada*

LSD_{0.05} species = 3.757
LSD_{0.05} treatments = 3.068
LSD_{0.05} year = 4.338

DISCUSSION

Germination varied greatly among species where each species exhibited its own germination characteristics that varied with age. Stenvens and Jorgensen (1994) studying germination of over 32 rangeland species stored in a warehouse

through 25 to 40 years showed that germination varied according to species and age. This study showed that mechanical scarification increased seed germination of *Atriplex halimus*, *A. leucoclada* and *Salsola villosa*. Scarification is a common practice used to improve germination of wild plant seeds especially those with hard seed. Osman and Ghassali (1997) reported a similar finding that bract removal significantly increased seed germination of both *Atriplex halimus* and *Salsola vermiculata*. Seed germination of Indian ricegrass (*Oryzopsis hymenoides*) was improved when seeds were treated with sulfuric acid as a chemical scarification (McDonald and Khan, 1977). In addition, Pandeya and Pathak (1978) reported an increase in germination of buffel grass (*Cenchrus ciliaris*) seeds when glumes were removed. Studying the effects of scarification on date palm (*Phoenix dactylifera* L.), Al-Wasel and Warrag (1998) reported significant improvement in seed germination. Improvement in seed germination could be attributed to eliminating chemical inhibitors, which restrict germination (Osman and Ghassali, 1997; Al-Charchafchi and Clor, 1989; Harper, 1977; Begon *et al.*, 1990) and/or eliminating seed coats imposing a barrier to water uptake (McDonald and Khan, 1977; Harper, 1977; Begon *et al.*, 1990). Enhanced germination and thus establishment could be achieved through seeding management that alter seed

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الملخص العربي

تأثير التخزين والخدش على إنبات بذور ثلاثة شجيرات محلية منزرعة في شمال المملكة العربية السعودية

سعود ليلى رجاء الرويلي

قسم الإنتاج النباتي - كلية الزراعة - جامعة الملك سعود

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المملكة العربية السعودية

تتوفر معلومات محددة عن إنبات الأنواع المحلية في مراعي المملكة العربية السعودية. أجريت هذه الدراسة بغرض دراسة تأثير مدة التخزين والخدش على إنبات بذور ثلاثة أنواع من الشجيرات المحلية في مراعي شمال المملكة العربية السعودية وهي: القطف والزرغل والروثة. لقد تم جمع البذور في الأعوام التالية: ١٩٩٠ و ١٩٩٢ و ١٩٩٤ و ١٩٩٦ حيث أجريت الدراسة في غرفة النمو لمدة أسبوعين تحت درجة حرارة ٢٢°م ونسبة رطوبة ٩٥% وتحت فترات إضاءة طولها ١٢ ساعة. أظهرت نتائج الدراسة تباينا واضحا في نسبة إنبات البذور بين الأنواع والمعاملات. حقق القطف أعلى معدلات الإنبات لتصل ما بين ٦٠% إلى ٨٣% خلال أسبوعين. بينما أظهرت الروثة والزرغل أقل المعدلات حيث وصل إنبات الروثة إلى أقل من ٢٥% بينما وصل إنبات الزرغل لأقل من ٢٥% لجميع السنوات. وأوضحت النتائج أن إنبات البذور المخدوشة كان أسرع وبمعدلات أعلى لجميع الأنواع في السنوات المختلفة. فلقد وصل إنبات بذور القطف إلى ١٠٠% خلال ثمانية أيام لجميع السنوات كما أعطى الخدش معدل إنبات أعلى للروثة حيث وصل إلى ٦٠% لعامي ١٩٩٤ و ١٩٩٦ كما أعطى الخدش نسبة إنبات قد تصل إلى ٨٠% للزرغل لجميع السنوات. كما أظهرت هذه الدراسة التأثير السلبي لطول مدة التخزين على الإنبات وخاصة في نبات الروثة حيث وصل إنبات البذور المخدوشة وغير المخدوشة لأقل من ٦% و ٢% في البذور المخزنة منذ عام ١٩٩٠ مقارنة مع ٦٥% و ٢٤% للبذور الخاصة بعام ١٩٩٦. من هذه النتائج يتبين أهمية استعمال بعض معاملات البذور وبذور جديدة عند استزراع المراعي.

كلمات مدخلية: نسبة الإنبات ، الخدش ، الروثة ، القطف ، الزرغل .

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