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The allelopathic effects of *Atriplex canescens* (Four wing saltbush) on seed germination of *Salsola rigida*

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Abstract

One basic method of improving rangelands in a country is the use of native as well as exotic species of plants adaptable. Among the but introduced species, *Atriplex canescens* has been introduced in many rangelands, but it is important and necessary to consider it's effects on native species. In the current study the effect of chemical competition (allelopathy) of *Atriplex canescens* on germination of *Salsola rigida* has been taken into account. *Salsola rigida* is known as a native species of good quality traits in arid and semi-arid rangelands. In this survey 10% weight/volume (w/v) of extract from leaves and fruits of *A. canescens* was prepared and 25%, 50%, 75% and 100% concentrations were obtained through addition of distilled water. Distilled water was used as control treatment. Altogether five treatments of four replicates, based on a completely randomized design (CRD) were studied germination during 8 days. Different groups of treatments were categorized through Duncan's new multiple range test. The results indicated that the available material in shoots of *Atriplex canescens* (fruits and leaves) exhibited allelopathic effect on germination of *Salsola rigida*. The highest percentage of germination was obtained from control while the lowest from the 100% treatment. In fact after exceeding of 25% concentration, germination reached its lowest percentage due to *Atriplex* effects.

Keywords: Allelopathy; *Atriplex canescens*; *Salsola rigida*; Germination

1. Introduction

Allelopathy was for the first time introducted by Molish in (1937). It is derived from the Greek words, *alleon* and pathos meaning adversive effects of a plant on another. *Alleo* chemicals are found in tissues of all kinds of plants (11). This phenomenon is established through an introduction of new species in a region. Apart from studies to be allocated to an investigation of allelopathy other factors such as ecological demand, water competition, light, temperature, nutritive materials, etc are also to be considered in conjunction with native species (13). In 1965, experts, for the first time, cultivated *Atriplex canescens* as a foreign species to bring an improvement to the arid and semi-arid rangelands of Iran. This process has been continued till today. There are different views concerning cultivation of this plant in rangelands. Peymanifard (15) and Naseri (14) have discouraged the cultivation of this plant in salt-marsh. Henteh (5) concluded that *Atriplex canescens* has preventive effects on such native species as *Artemisia sieberi* in rangelands, while Jafari *et.al.* (7), Khalkhali (9), and Tavakoli (18) believe *Atriplex* is of positive ecological effects on environments, where it is cultivated.

Salsola rigida is one of the highly qualitative native species of arid and semi-arid regions of the country. It belongs to the family of *Chenopodiaceae*. It has been admirably considered by grazier because of being

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desirably grazed by livestock. The weight of livestock as well as milk quality has been reported to increase through grazing of this plant. Unfortunately, and because of an extensive grazing and other demolition factors of rangelands, density of this plant has been decreased, and there are only wooden remains, without any shoots being left in the region (13).

Atriplex canescens is a good forage for sheep and goat, especially goats desire it more, but it is a moderately palatable feed for cattle. The process of degeneration of the worthy *Salsola* species in rangelands where this species is present calls for preventive destructive, and promotion of improvement measures. Comprehensive studies regarding chemical (*allelopathy*), and non-chemical competition (water, light, nutritive materials, …) are to be conducted taking into account the improved, as well as native species.

The current study has been conducted to study the *allelopathic* effects of fruit and leaf extracts of *Atriplex canescens* on germination of *Salsola rigida* seed as a native species. The purpose is to consider a proper management of cultivating foreign species of *Atriplex canescens* in regions where *Salsola rigida* is present as a native species.

2. Materials and methods

An investigation (*allelopathic* effects of *Atriplex canescens* on germination of *Salsola* seeds) was conducted in germinator conditions in the laboratory. In order to prepare an extract of *Atriplex canescens* species, the shoots bearing fruits and leaves were collected from Zarande Saveh region in October 2006 (end of growing season) dried in open air, then ground into powder form. In a next stage the powder prepared from *Atriplex canescens* was mixed with distilled water (1 portion of powder and 9 portions of distilled water). The 10% weight volume aquatic solution mixture was used to follow the tests after a pass time of 72 hours. The desired concentrations, namely: 25%, 50%, 75%, and 100% were prepared through addition of distilled water. Petry dish and filter paper were employed for seeds to be grown on. Each petry dish contained 38 seeds. Germinator temperature was set 25 at 25˚C. The experiment was conducted as based on a completely randomized design (CRD) with 5 treatments each of 4 replicates. The number of germinated seeds were recorded during an 8 day duration (Table 1).

Table 1. The variance analysis results of *Allelopathic* Effects of *Atriplex canescens* on Seed Germination of *Salsola rigida*

Source	d.f	Sum of squares	Mean square	F	P
Treatment	4	3.0882	0.7720	23.27	0.0000
Error	14	0.4646	0.0332		
Total	18	3.5527			

Variance analysis test was used for analyses, while Duncan Test being employed for grouping of treatment means. Statistical analysis was performed using Minitab statistical software, and logarithms employed to transform the data.

3. Results

The results of variance analysis showed that the extract of *Atriplex* leaf and seed affect the germination of seed, in *salsola*.

As indicated in Table 1, the concentration effect of *Atriplex canescens* extract on germination of *salsola rigida* is significant at a level of 1% ($p<0.01$).

According to Table 2, it can be seen that there is no significant difference observed in germination for control as well as for 25% treatment, so the control and 25% treatments stand in one group (a), but there were significant differences observed between control and 25% on the one hand, and 50%, 75%, and 100% treatments on the other. There were no significant difference observed among 50%, 75% and 100% treatments (b) as germination is concerned.

Table 2. A comparisons of germination percentage in treatments

Treatment	Mean ± S.E
1	1.4 ± 0.12 a
2	1.21 ± 0.04 a
3	0.43 ± 0.44 b
4	0.78 ± 0.08 b
5	0.4 ± 0.03 b

1: Control treatment, 2: 25% treatment,
3: 50% treatment, 4: 75% treatment, 5: 100% treatment.
Similar Letters denote no difference between (among) groups

The first significant difference become evident between control and 25% treatments with the 50% treatment.
Finally it was determined that the highest percentage of germination occurred in the case of control and 25% treatments and while the lowest in the case of 100% treatment.

4. Discussion and conclusion

The results indicated that the shoots (fruits and leaves) extract of *Atriplex canescens* have allelopathic effect on germination of *Salsola rigida*. Henteh *et al.* (5) reported that *Atriplex canescens* had allelopathic effect on germination of *Artemisia sieberi*. Allelopathic effects of different *Atriplex* species have also been reported by Davis (2).

Kiarostami (9) in his study concluded that the reactionary effect of aquatic extracts of various weeds differed significantly among different weed species. Hejazi *et al.* (3) in their study point to the fenolic exudations of wheat root in irrigation water to exert the most fenolic effect on growth and yield of sunflower seed. Samadani *et al.* (17) during an evaluation of allelopathic effects of different species from genus *Artemisia* on wild oat seed germination and on embryo growth, discovered the most preventive effect to belong to *Artemisia auchari*. In the present study results indicate that the highest percentage of *Salsola* germination occurs in control and the lowest in 100% treatment and therefore the germination percentage decreasing with an increase in extract concentration.

Askham *et al.* (1) and Jeferson *et al.* (8) have also reported the existence of saponin in *Atriplex* plant organs and it`s preventive effect on germination of seeds in other plants.

In generally it can be stated that *Atriplex* exerts allelopathic effects on germination of *Salsola rigida* seed. It has significant preventive effects on the seed germination when over 50% concentrations and this effect becomes more severe with an addition of concentration. As a result, in management and rangeland improvement, the allelopathic effect of plants should be taken into consideration. Allelopathic effect could affect rangeland plant cover structure in the long run and could result in the extinction of some species. So researchers should study allelopathic effects of species on each other. It should be noticed that this experiment was performed in a completely controlled environment and the result may not be applicable in natural environment because of the existence of other affecting factors. Also in order to better realize and more accurately find out about the effect of *Atriplex* plant on *Salsola*, different concentrations of the extract can be tested. It is also suggested to study the allelopathic effect of *Atriplex canescens* on other plant species of the region as well.

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