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Allelopathic Effects of Shoot and Root Extracts From Three Alien and Native Chenopodiaceae Species on Lettuce Seed Germination

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Abstract. One basic method of improving rangelands in the country is the use of native as well as exotic species of adaptable plants. Some species of Atriplex, like *Atriplex canescens* and *Atriplex nummularia* has been introduced in many thousands hectares of rangelands since more than 20 years, it feeds some debates on the algerian scientific community, so that's why it is important to know the impact and necessary to consider its effects on native species. In the current study the effect of chemical competition of *Atriplex canescens* and *Atriplex nummularia* comparing to native *Atriplex halimus* by observing the effect of aqueous extracts of leaves, stems and roots of the three chenopod species assayed at 0.06, 0.63, 1.55, 3.12 and 6.25 g /l on the germination of lettuce seed test. Seed germination was significantly inhibited by shoot alien species extracts especially *A.nummularia* at concentrations ranging from 1.55 to 6.26 g/l with decrease rate of 20% in the lettuce seed tests indicating the presence of allelopathic substances, in 0,06 the germination increased to more than 10% comparing to the water irrigated seeds. An opposed effect than the expected had been found because *Atriplex canescens* had a less allelopathic effect than our native plant *Atriplex halimus*.

Key words*:* *Atriplex halimus, Atriplex canescens, Atriplex nummularia*, allelopathy, germination, rangeland.

Introduction

In Algerian highlands, rangelands extend over more than 20 million ha. The majority of these rangelands, 7,5 millions ha in 1995 were considered in poor to fair conditions (BENSOUIAH, 2003). Several authors have recognized the decline in productivity of rangelands by the decrease of some important range plant species and increase in unpalatable ones over the last few decades (LE HOUEROU, 1968; AIDOUD, 1989, LE HOUEROU, 1991; LE HOUEROU, 1992, AIDOUD, 1996; BEDRANI, 2001; NEJRAOUI, 2003; NEJRAOUI, 2006).

One basic method of improving these rangelands in the country is the plantation of native as well as exotic species of palatable plants (Fig. 1). Some species of Atriplex, *Atriplex canescens* and *Atriplex nummularia* has been introduced in many thousands hectares of rangelands since more than 20 years, it feeds some debates on the

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north African scientific community (BENABADJI & BOUAZZA, 2002; BENABADJI *et al.,* 2004; BENABDELI, 2008; BENARADJ, 2010) so that's why it is important to know the impact and necessary to consider its effects on our native species.

Algerian ecologists pulled alarm to denounce the negative impact due to the introduction of imported atriplexes because their unsociability, beyond the ecological approach, we preferred a biochemical methodology because of semiochemical or more precisely allelopathic effect of some plants giving the ability of a plant to inhibit or promote germination and growth of plants of the same or different species in the same space Allelopathic plants interfere with nearby plants by dispersing chemicals into the soil that may inhibit neighboring plant growth, nutrient uptake or germination (ABHILASHA *et al*., 2008) typical allelopathic inhibitory effects result from the action of groups of allelochemicals that collectively interfere in various physiological processes altering the growth patterns of plants (KIL & SHIM, 2006). That action of allelochemicals can affect the respiration, photosynthesis, enzyme activity, water relations, stomatal opening, hormone levels, mineral availability, cell division and elongation, structure and permeability of cell membranes and walls (CHOU, 1999; REIGOSE *et al.,* 1999), through these actions, allelopathic substances may play a role in shaping plant community structure in semi-arid and arid lands (JEFFERSON & PENNACCHIO, 2003). Our work consists at first in the study of the allelopathic activity of native Atriplex like *A.halimus* and indigenous species as *A. canescens*, *A. nummularia* on germination.

Fig. 1. Plantation of *Atriplex canscens* in Ouest Algeria rangeland, Ain Skhouna (Saida).

Fig. 2. Degraded rangeland, Maamoura, Saida.

Materials and Methods

1-Extraction procedure: fresh plant material of *Atriplex halimus*, *Atriplex canescens* and *Atriplex nummularia* were collected from the rangelands of Saida situated in East Algeria (Fig. 2), after washing with distilled sterilized water and dried, plants were separated into root, stem and leaves, extracts were obtained by soaking 0.06, 0.63, 1.55, 3.12, 6.25 grams of crushed plant materials in 1L of distilled sterilized water for 24 hours and the, filtered , the extract were stored at 4 °C when not used, however (JEFFERSON & PENNACCHIO, 2003). The extracts were generally used within a week.

2- Lettuce seed germination bioassay: Seeds were surface sterilized with a 5% aqueous solution of sodium hypochlorite for 2 min, rinsed five times with distilled sterilized water and dried between two sterilized paper towels. Twenty uniform seeds of lettuce were germinated in sterilized petri-dishes lined with two layers of Whatman No. 1 filter paper and moistened with 5 mL of solution concentration in treatment, distilled water was used in control, each treatment had five replicates, incubated at 25±2°C in growth chamber of culture, seeds were considered germinated when the radicle extended through the seed coat. The germinated seeds were counted for determining the germination rate.

Results and Discussion

The results of our study show that the leaves of all three chenopod species produce allelopathic compounds (Fig. 3). These compounds inhibited seed germination in the lettuce seed test; our findings are consistent with those reported elsewhere for other species in a variety of plant families (CHIAPUSIO *et al*., 1997; MACIAS *et al*., 1999; ESCUDERO *et al*., 2000; MACIAS *et al*., 2000).

The degree of inhibition was largely dependent on the concentration of the extracts being tested and to the species from which they were derived, the inhibition of seed germination were accentuated on the approximately all the treatment with a decrease level mostly on root and leaf solution extract followed by stem solution extract on *A. nummularia,* the root solution extract of *A. halimus* had the most inhibitory effect comparing to the other organs of this plant, the same finding was observed with *A. canescens* (Fig. 4, Fig. 5).

We can note that *Atriplex nummularia* had the most allelopathic effect with a maximum reduction level of 30% comparing to the germination control in the biggest concentrations but also promote the germination by removing the dormancy with a germination rate exceeding the control treatment on the lowest treatment of 0,06 g/l of all organs. We can also say that *A. canescens*, the most introduced forage plant in Algeria had no more effect than *A. halimus* the native one, the inhibitory effect on germination is also depending on the salinity level of the plant, because *A. halimus* contain more salinity on his leaf then the other species.

Conclusions

The results from this study strongly suggest that allelopathy in exotic Atriplex may be a possible mechanism controlling the timing of the other plant germination and seedling establishment, after our preliminary research we can plan to study the allelopathic effect of our three atriplex on germination and seedling growth of our most important economically and ecologically perenéen plants as *Stipa tenacissima*, *Lygeum spartum* and *Artemisia herba alba.*

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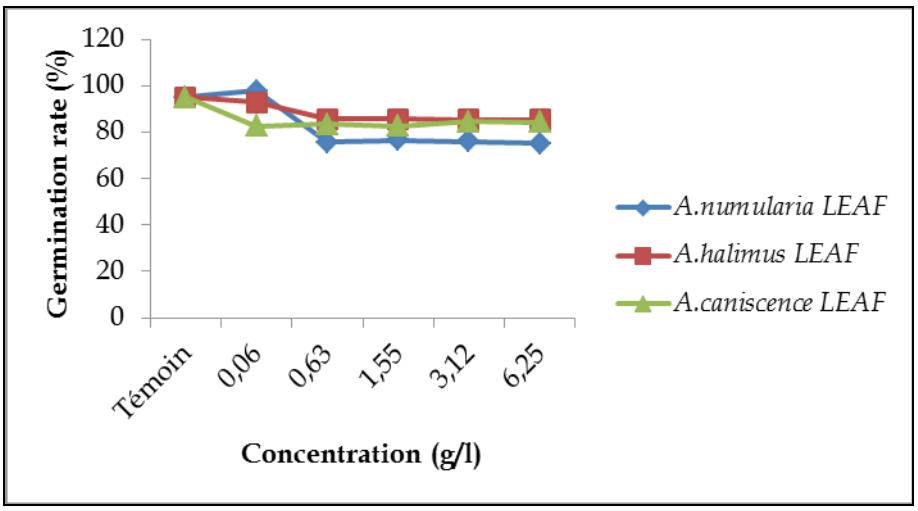

Fig. 3. Germination rate of lettuce seed under difference aqueous extracts concentration from the leaves of the three species.

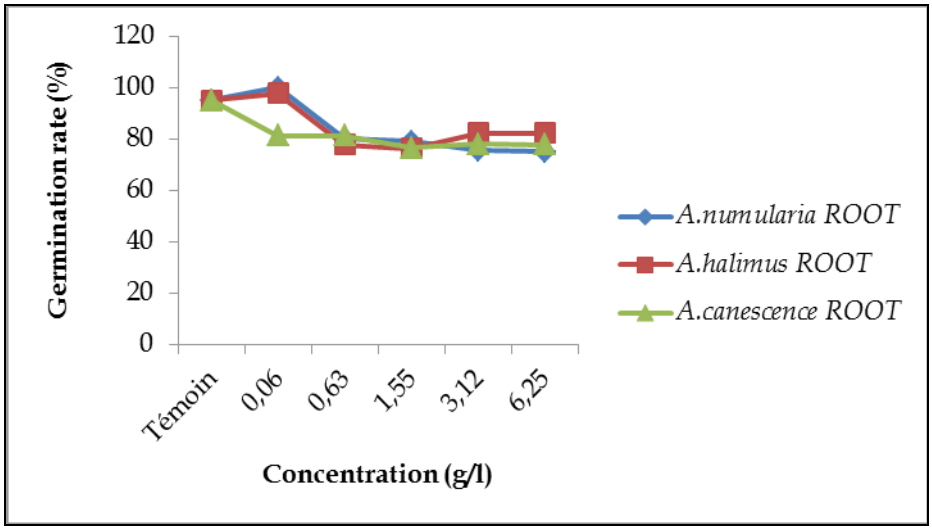

Fig. 4. Germination rate of lettuce seed under difference aqueous extract concentration from the roots of the three species.

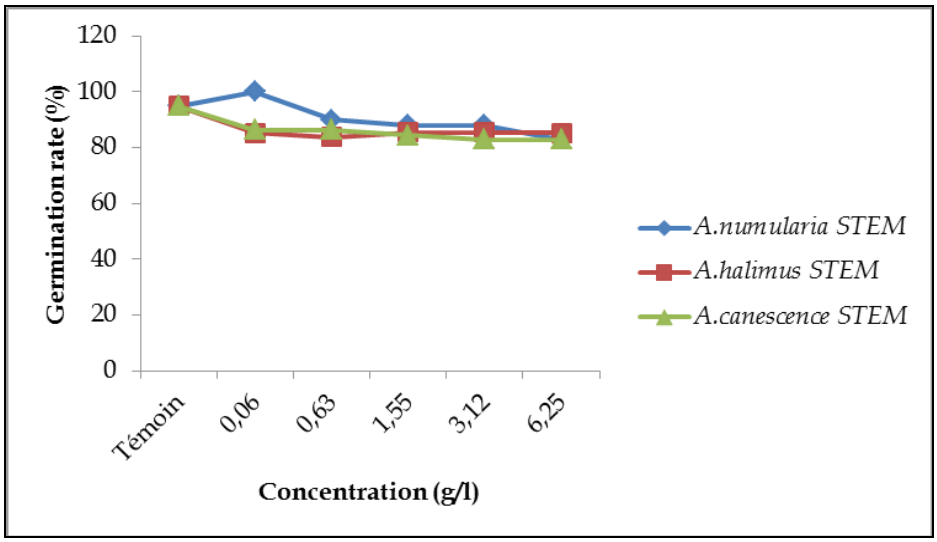

Fig. 5. Germination rate of lettuce seed under difference aqueous extract concentration from the stems of the three species.

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