

Short Communication

Allelotoxicity of *Oudneya africana* R. Br. aqueous leachate on germination efficiency of *Bromus tectorum* L. and *Triticum aestivum* L.

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This present study was conducted to investigate the possible allelopathic effect of *Oudneya africana* (donor species) on *Bromus tectorum* (weed species) and *Triticum aestivum* (cv. Sahel1; crop species) through germination bioassay experiment. *B. tectorum* is a winter annual grass that grows in winter wheat and other crops and in both disturbed and undisturbed grasslands. The effect of *O. africana* aqueous leachate (OAAL) on germination and seedling growth of *B. tectorum* and *T. aestivum* was investigated. Higher concentrations of the aqueous leachate significantly reduced the germination rate of *B. tectorum*. Similarly, coleoptile (CL) and radicle (RL) lengths of *B. tectorum* seeds was significantly inhibited. To go through with this, seedling growth of the weed species was also affected. On the other hand, the germination parameters of wheat seeds were slightly affected with applying different OAAL concentration levels compared to *B. tectorum*. In conclusion, allelochemicals extracted from the donor species caused a significant reduction in germination and growth parameters of *B. tectorum* > *T. aestivum*.

Key words: Aqueous leachate, *Oudneya africana*, *Bromus tectorum*, germination rate.

INTRODUCTION

Allelopathy was defined as the direct or indirect harmful or beneficial effects of one plant or another through the production of chemical compounds that escape into the environment (Rice, 1984). Hence, Plants or organisms that release these compounds are called "donor species", while those that are influenced in their growth and development are called "target or recipient species" (Torres et al., 1996; Inderjit and Keating, 1999). Allelochemicals are plant secondary metabolites mainly produced from medicinal and aromatic plants (Delabys et al., 1998); have been identified, including the phenolic acids, coumarins, terpenoids, flavonoids, alkaloids, glycosides and glucosinolates. These chemical substances (phyto-

toxic) are known to be exuded by plants to suppress emergence or growth of the other plants; allelopathic effects of these compounds are often observed to occur early in the life cycle, causing inhibition of seed germination and seedling growth. These compounds exhibit a wide range of mechanisms of action and interpretations of mechanisms of action are complicated by the fact that individual compounds can have multiple phytotoxic effects (Einhellig, 2002).

Medicinal plants have inhibitory effects (Lin et al., 2003, 2004) on selected weeds and its allelochemicals inhibiting weed growth. Therefore, it was easier to screen allelopathic plants from medicinal ones than other plants

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Table 1. The effects of *Oudneya Africana* aqueous leachate on germination and seedling growth of *Bromus tectorum* and *Triticum aestivum*.

Concentration (%)	0%	2.5%	5%	7.5%	10%	Statistical analysis
Germination (%)						
<i>Bromus tectorum</i>	100.0 ^a	73.3 ^b	26.6 ^c	13.3 ^d	6.6 ^e	**
<i>Triticum aestivum</i>	100.0 ^a	100.0 ^a	100.0 ^a	100.0 ^a	90.0 ^b	**
Coleoptile length (mm)						
<i>Bromus tectorum</i>	19.66 ^a	6.33 ^b	0.66 ^c	0.00 ^c	0.00 ^c	**
<i>Triticum aestivum</i>	42.00 ^a	25.00 ^b	22.5 ^c	18.00 ^d	15.50 ^e	**
Radicle length (mm)						
<i>Bromus tectorum</i>	34.00 ^a	3.00 ^b	1.66 ^{bc}	0.83 ^c	0.83 ^c	**
<i>Triticum aestivum</i>	56.66 ^a	26.50 ^b	17.5 ^c	16.00 ^c	12.00 ^d	**

Different letters within each column indicate significance at $P < 0.05$ one-way ANOVA; **: Significant at 0.01.

possibly because they have the ability to accumulate certain metabolic compounds curing many diseases of mankind (Qasem and Hassan, 2003). The genus *Oudneya* belongs to the Brassicaceae family and it comprises four thousands species (Quezel and Santa, 1963). They occur mainly in temperate and cold regions of the Northern Hemisphere (Brooks, 1987). *O. africana* (locally named Henat l'ibel) is an endemic plant of sahara and is used in folk medicine by local people of Ouargla (Algeria) to treat wound cicatrization and against the scorpion's bites. The phytochemical tests of the aerial parts of *O. africana* showed the presence of saponosids, flavonoids, sterols, steroids and tannins in different quantities (Bouhadjera et al., 2005).

The present research is a part of a specific study carried out in Algeria to explore the allelopathic effects of *O. africana* (donor species) aqueous leachate on germination efficiency of *B. tectorum* (weed species) and *T. aestivum* (crop species) under laboratory conditions.

MATERIALS AND METHODS

Samples from the aerial shoots of *O. africana* were collected from the natural habitats. The samples were air-dried, ground in a Wiley Mill to fine uniform texture then stored in glass jars until use. Stock aqueous extract was obtained by soaking 50 g air-dried plant material in 500 ml of cold distilled water (10% w/v) at room temperature ($20 \pm 2^\circ\text{C}$) for 24 h with occasional shaking. The mixture were filtered through two layers of cheesecloth and centrifuged for 20 min at 10,000 r.p.m to remove particulate material and the purified extract. Different concentrations (2.5, 5, 7.5 and 10% of *O. africana* aqueous leachate; OAAL) were prepared from the stock solution in addition to the control (distilled water). To achieve this experiment, 10 seeds of each of the weed and crop species were arranged in 9-cm diameter Petri-dishes lined with two discs of Whatman No. 1 filter paper under normal laboratory conditions with day temperature ranging from 19 to 22°C and night temperature from 12 to 14°C . 2 ml of each level of OAAL were added daily to three replicates. Before sowing, the seeds were surface sterilized with 2% sodium hypochlorite for 2 min then rinsed

four times with distilled water. The sterilized seeds were soaked in aerated distilled water for 24 h. The germination percentage (GP), coleoptile (CL) and radicle (RL) lengths were recorded after one week at the end of the experiment.

Statistical analysis

Data of the present study were subjected to standard one-way analysis of variance (ANOVA) using the COSTAT 2.00 statistical analysis software manufactured by CoHort Software Company (Zar, 1984).

RESULTS

Germination percentage (GP)

The present data implies the significant promoting influence ($P \leq 0.01$) of OAAL on GP of *B. tectorum* (Table 1). At control, GP values were 100% thereafter decreased to 73.3, 26.6, 13.3 and 6.6% at 2.5, 5, 7.5 and 10% OAAL concentrations respectively. Table 1 also showed that GP of wheat seeds were apparently varied with applying different OAAL concentration levels which is supported statistically ($P \leq 0.01$). At control, 2.5, 5 and 7.5% OAAL concentrations, the values were 100% while it was 90% at 10% OAAL concentration.

Coleoptile (CL) and radicle (RL) lengths

Statistically, the applied concentrations of OAAL are significantly ($P \leq 0.01$) affecting CL of *B. tectorum* (Table 1). The values of CL were 19.66 mm at control level thereafter it reduced to 6.33 mm at 2.5% OAAL and was completely inhibited at 7.5 and 10% OAAL concentrations. Regarding *T. aestivum*, the values of CL were 42, 60 mm at control level. Afterward, it reduced to 25 and 22.5 mm at 2.5 and 5% OAAL respectively. Expectedly, the maximum

allelopathic action of 7.5 and 10% OAAL concentration has reduced CL to 18 and 15.5 mm. Compared to the control, a gradual decrease in RL of *B. tectorum* was observed along gradual OAAL concentrations. RL implication was significantly affected at $P \leq 0.01$ (Table 1). At control, RL was 34 mm and at 2.5 and 5% concentrations, RL decreased to 3 and 1.66 mm, respectively. Constantly, it continues reduction till it attained a value of about 0.83 mm at 7.5 and 10% OAAL concentration level. With respect to *T. aestivum* RL attained a value of about 56.66 mm at control level and values of 26.5 and 17.5 mm at 2.5 and 5% of OAAL concentrations, respectively. At 7.5 and 10% OAAL concentration levels the values were about 16 and 12 mm, respectively.

DISCUSSION

The allelopathic effect of 2.5, 5, 7.5 and 10% of *O. africana* aqueous leachate (OAAL) beside the control was clearly demonstrated on germination percentage, coleoptile and radicle length of *B. tectorum* a weeds associated with crop species (*T. aestivum*). Considering the foregoing results, it seemed that there are significant phytotoxic effect of the donor species on germination and coleoptile (CL) and radicle (RL) lengths. These results correlated with the findings that allelochemicals presented in the aqueous extracts of plant species have been reported to affect different physiological processes through their effects on enzymes responsible for phytohormone synthesis and were found to associate with inhibition of nutrients and ion absorption by affecting plasma membrane permeability.

The reduction in germination could be attributed to inhibitory effect of allelopathic substances present in the extract. According to the study of Diwani et al. (2009), *O. Africana* contain substances such as phenolic compounds, which succeeded to be used as natural antioxidant for the protection of oils. The results appeared to be in agreement with that of Swaminathan et al. (1989) who reported that the potential compounds, which are able to induce inhibitory effect on germination, are identified as phenolic acids. The release of phenolic compounds adversely affects the germination and growth of plants through their interference in energy metabolism, cell division, mineral uptake and biosynthetic processes (Rice, 1984).

The results of Dias et al. (2005) appeared that the extracts of some plants inhibit the growth of others. With regard to allelopathic effects of plant secondary metabolites, it is now generally recognized that some terpenoids, mainly monoterpenes and sesquiterpenes present in the volatile fractions (Fischer, 1991; von Poser et al., 1996) and phenolic compounds are the principal responsible for growth inhibition of competing plants (Harborne, 1993). Polyphenol compounds such as tannins, flavonoids and phenolic acids were the most prominent components of the crude extracts investigated

and could contribute to the germination and growth inhibitory activity of the *Hypericum* species extracts (Dall'Agnol et al., 2003). Many biological activities of the flavonoids including pollinator attractants, oviposition stimulants, feeding attractants and deterrents, phytoalexins and allelopathy have been found. Several flavonoids such as quercetin, isoquercitrin, rutin, and quercetrin among many others have shown effects on plant growth (Rivera-Vargas et al., 1993; Parvez et al., 2004; Iqbal et al., 2005).

Conclusion

The study reveals OAAL affect the germination efficiency of both weed and crop species and the effect was highly prominent in the weed compared to the crop species. Based on the results of this study the species with the strongest allelopathic potential such as *O. Africana* must be examined for their selective action on other specific plants including weeds and crops under field conditions, their allelopathic activity will be much more detailed. Analysis of possible allelochemicals in these plants is also required. There is possibility of using these allelochemicals directly or as structural leads for the discovery and development of environment friendly herbicides to control weeds.

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