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Allelopathic effect of Arta (*Calligonum Comosum* L' Her) extract on seed germination of arfaj (*Rhanterium epapposum* Oliv)

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Abstract

This study was conducted to estimate the effects of different concentrations (2.5, 7.5, and 12.5 g/l) of *Calligonum comosum* (leaves, stem and roots) extracts on the seed of *Rhanterium epapposum*. Germination parameters (e.g., percentage of germination, germination starting, coefficient of velocity were evaluated. Results showed that the stem and leaves extracts, have negative and significant effects on *Rhanterium epapposum* seeds' growth. Highly positive effect was observed for the application of the root extract on the seeds. The significant allelopathic effect remained up to 21 days. Coefficient of velocity decreased with the allelochemicals extracted from the stem and leaves. Based on the study results, stem and leaves residues of *Calligonum Comosum* should be eliminated from the field to avoid negative allelopathic effects of *Calligonum comosum* on *Rhanterium epapposum* growth.

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Introduction

Allelopathy interference between various species explains the effect of some plants on others, beneficially or in a destructive way through allelochemical compounds. These compounds are released from dead or live parts and cause various effects (Ridenour and Callaway, 2001; Rizivi and Rizivi, 1992; Brown *et al*., 1991). Allelochemicals usually are called secondary plant products or waste products of main metabolic pathway in plant. These may be water-soluble substances that are released into the environment through leaching, root exudation, volatilization, and decomposition of plant residues, they could affect (either positively or negatively) causing germination and growth inhibition. Allelochemicals interference must be species-specific to explain why nonindigenous species dominate an invaded community while they normally do not reach high dominance in their native community. It is difficult to find noticeable effect in the established communities because of possible adaptation of co-existing species allelochemicals released by competitors (Harper, 1977). The interactions between weeds and crops and their germination inhibition has been extensively studied in research on allelopathy (Narwal, 1994; Rice, 1984; Hegde and Miller, 1990; Williamson *et al*., 1992; Patil, 1994; Djurdjevic*et al*., 2004). It reported that allelopathy may play an important role in plant-plant interferences by those chemical compounds such asTannins, Trepenoids, Phenylpropans, Acetogenins, Terpenoids, Steroids, Alkaloids (Rice, 1984; Johnston, 1961; Rasmussen and Rice, 1971).

Plant used in this study is Calligonumcomosum (polygonaceae), is a small leafless shrub, which has reputation in folklore medicine as a stimulant and astringent, under the local names "ghardaq", "rusah" or "arta" (Muschler, 1912). It is naturally and widely spread in different areas of Saudi Arabia. The objective of this study is evaluate the effect of *Calligonum comosum* leaves, stem and roots extracts on the seed germination of wild plant *Rhanterium epapposum*.

Material and methods

The experiment was conducted at Faculty of Science laboratory, Department of Biology, Princess Nora bent Abdul-Rahman university, Riyadh, Saudia Arabia, during May-June 2013 for the study of the effects of naturally produced growth substances in *Calligonum comosum* plant on germination of *Rhanterium epapposum* seeds.

Preparation of aqueous leaf extracts

Aqueous extracts were prepared by using method of (Muller and Muller, 1965) and (Neill and Rice, 1971).The fresh and clean leaves, roots and stems of *Calligonum comosum* plant was cut into smaller pieces, and then grinded into powder. The water extract was prepared by soaking the rate of 2.5, 7.5, and 12.5 g/l, of leaves, roots and stems samples for extraction, in addition to control treatment (distilled water) for 24 hours at room temperature (23 ± 2 °C), and then filtered through Whatman filter paper #2 (Oudhia and Tripthi 2001). And then kept under 4 °C in the refrigerator. Seeds were obtained from the agriculture shop. Twenty selected seeds of *Rhanterium epapposum* were placed on filter papers inside a Petri-dish 9cm in diameter for germination, and 15- 20 ml of leaves, roots and stems extract or distilled water for control treatments was added, and each treatment was replicated three times. The petri dishes were kept in natural diffused light under laboratory conditions at 24±2°c temperature and relative humidity of 85±5% after placing. 5 ml of extract was used when needed per petri dish to keep constant moisture. The germination seeds were recorded every day for period 21 days.

Germination and growth indicators

Percentage of Germination (PG), germination starting compounds (GS) and Coefficient of Velocity (CV) were calculated according to the following equation:

1. Percentage of germination = 100 (n/N)
2. Germination start = The long time between seeds
3. Coefficient of velocity = 100 (ÓNi/ÓNi Ti).

Where N is the number of seeds germinated on initial day and T is the number of days from sowing.

Statistical analysis

Results obtained were tested statistically by applying probability (P) using one way analysis of variance.

Results

In the present study results showed that, allelopathic compounds from the aqueous extract of *Calligonumcomosum* roots increased the PG and CV of *Rhanterium epapposum* seeds when compared with the control (Table 1). Moreover, the germination of *R. epapposum* seeds was started two days earlier before the control. Regarding the different concentrations of *C. comosum* extract. It is notable that the higher the increasing the concentration of the extract up to (12.5%), the higher significantly positive impact on the CV of *R. epapposum* seeds was observed (Table 1).

Table 1. Seed Germination of *Rhanterium epapposum* in Responses to Aqueous Extract of *Calligonum comosum* root.

Treatment g L^{-1}	Days to firstgermination	Time to 50% Germination	PG %	Cv%
2.5	9	13	26,2 ±12,9	233,5± 102,6 b
7.5	9	13	24,7 ±10,9	222,5 ± 83,4 b
12.5	9	12	32,9± 14,7	291,6 ±115,7 a
CONTROL	11	15	15,1 ±8,9	130,42 ± 64,66 c

Table 2. Seed germination of *Rhanterium epapposum* in responses to aqueous extract of *Calligonum comosum* leaves.

Treatmentg L^{-1}	Days to first germination	Time to 50% Germination	PG %	CV%
2.5	13	17	6,1 ± 4,3 a	51,3 ± 30,9 b
7.5	13	17	4,1± 2,9 a	62,9 ± 39,5 b
12.5	13	17	2,6 ± 1,8 a	11,2 b 26,7±
CONTROL	11	15	15,1± 8,9 a	130,4 ± 64,6 a

Furthermore, negative impact of allelopathic compounds from the aqueous extract of *C. comosum* leaves and stem was predictable, reduction of the PG and CV of *R. epapposum* seeds was detected compared with the control (Table 2 and 3). Regarding the different concentrations of *C. comosum* extract, no significant variations were observed regarding PG and CV of *R. epapposum* seeds (Table 2 and 3).

Table 3. Seed germination of *Rhanterium epapposum* in responses to aqueous extract of *Calligonum comosum* stem.

Treatment g L^{-1}	Days to first germination	Time to 50% Germination	PG%	CV%
2.5	13	16	6,4 ± 4,5 a	52,4± 43,4 b
7.5	13	16	11,7 ± 7,8 a	97,1± 74,2 a
12.5	13	16	7,4 ± 5,16 a	62,8 ± 39,5 b
CONTROL	11	15	15,1 ± 8,9 a	130,4 ± 64,6 a

Discussion

This study, showed that the extracts of the leaves and stem of *Calligonum comosum* showed inhibitory effects on seed germination. The degree of inhibition effect increased with the extract concentration. At the highest extract concentration (12.5 g/l), all aqueous extracts significantly reduced seed germination compared with distilled water as control (Table 1, 2, 3). The results agree with most of previous results obtained by many other researchers, they found that the extracts of many plants inhibit germination of many other plants (Chang and Miller, 1995; Von Rencsse, 1997; Noor *et al.*, 1995). Furthermore results from different parts and different allopathic plants demonstrated that, the degree of inhibition increased with increased extract concentration (Chang and

Miller, 1995; Al-Zahrni and Al-Robai 2007; Munir and Tawaha, 2002). Leaf and stem extracts were the most inhibitory effect, while the extract of root was the lowest inhibitory. The results are agreed with (Turk and Tawaha, 2002) they reported that the most inhibitory effect of allelopathic plants produced by leaf extract. Also, (Al-Zahrni and Al-Robai 2007) found that high degree of inhibition occurred with leaf extracts at the highest concentrations in all tested crop plants, they used fifth plant species. The degree of reduction increased as the extract concentration progressively increased from 2.5 to 12.5 g/l . Moreover the effect of stem extracts was statistically similar to those of leaf extracts at 2.5 g/L concentrations. Rice, (1984) reported that many enzymatic functions important to plants are inhibited by the presence of allelochemicals, such as protease which plays an important role in the hydrolysis of proteins during germination. Although enzyme activity was not analyzed in this study, an indirect association between lower seed germination and allelopathic inhibition may have resulted to inhibition of water uptake and enzyme activity. This observation is in accordance to the study of Chung and Miller (1995) reported that, increasing the concentration of aqueous leaf extracts significantly inhibited the water uptake by germination of *Rhanterium epapposum* seeds. This study showed that the root of *Calligonum comosum* negatively affected the germination of co-occurring species of *Rhanterium epapposum*.

Conclusion

It can be concluded that *Calligonum comosum* plays an important role in the formation of its natural habitats as it contains the allelochemical compounds that enable the plant to compete with other species. This plant may change communities when recycled as a green manure in the soil for increasing organic materials in agro-ecosystems, where it inhibits crop growth and production. Further investigations is needed to determine the influence of seasonal and cultivar variations, and to identify the active compounds of auto toxicity and allelopathy involved in *Calligonum comosum*.

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