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COMPARATIVE STUDY ON ALLELOPATHIC POTENTIAL OF *PETROSELINUM CRISPUM* (MILL.) FUSS

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Abstract: Allelopathy is a biological phenomenon in which an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms. This paper reports studies on the allelopathic effects of parsley (*Petroselinum crispum* (Mill.) Fuss) extracts on several weed species. The effects of extracts obtained from seeds, roots and aerial parts of parsley, were assayed on seed germination, and growth of three common weed species: ragweed (*Ambrosia artemisiifolia* L.), knotweed (*Polygonum aviculare* L.) and Johnsonn grass (*Sorghum halepense* (L.) Pers.). The extracts were prepared with distilled water. For the germination experiments were used Petri dishes and the control treatment was distilled water. The aqueous extracts from roots, stems and leaves and seeds of parsley demonstrated allelopathic potential by inhibiting the germination of weeds seeds. The extracts influenced also the radicle elongation of all tested species. On the other hand, the weed species showed different responses to the treatment with parsley aqueous extracts. The use of allelopathy principles and strategies, such as the use of allelopathic cultivars, intercropping with allelopathic weed suppressive plants, the use of allelopathic cover crops and residues, and rotational sowing of allelopathic crops can play an important role in achieving sustainable and integrated weed control.
Keywords*:* allelopathy, plant-plant interaction, inhibiting effect.

Introduction

Allelopathy is a natural phenomenon, representing the release in the environment of plants substances (named allelochemicals) that can exert beneficial or detrimental effect on neighboring plants. This influence is mediated by the production of chemical compounds that can lead to death or slow of the growth of other plants. Production of these substances is one of the mechanisms for the protection of plants against pests, pathogens, as well as a means of improving the competitive position of a plant species in relation to other plants (Rice, 1984).

The release of allelopathic substances is considered a major factor influencing the distribution of species and their density and multiplication within plant communities, especially related to the success of invasive plants in both natural and agroecosystem (Inderjit et al., 2011; Zheng et al., 2015). The integration of allelopathic principles into current agricultural practices can considerably attenuate the extensive utilization of pesticides (Shennan, 2008) and synthetic fertilizers, some of these resulting in devastating changes for the plants biology (Lingorski and Churkova, 2011) inducing environmental (air, soil and water) degradation.

The use of allelopathy principles and strategies, such as the use of allelopathic cultivars, intercropping with allelopathic weed suppressive plants, the use of allelopathic cover crops and residues, and rotational sowing of allelopathic crops can play an important role in achieving sustainable and integrated weed control (Jabran et al., 2015).

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Parsley (*Petroselinum crispum* (Mill.) Fuss) is a biannual herb plant belonging to family Apiaceae, and cultivated as a medicinal herb, aromatic plant, and a vegetable, all over the world. Its main constituents subsume coumarins, furanocoumarins (bergapten, imperatori), ascorbic acid, carotenoids, flavonoids, apiole, various terpenoic compounds, phenyl propanoids, phathalides, and tocopherol. Parsley is a rich source of flavonoid and antioxidants, especially luteolin, apigenin, folic acid, vitamin K, vitamin C, and vitamin A (Kurowska and Gałązka, 2006; Mahmood et al., 2014; Meyer et al., 2006).

The aim of the present work was to evaluate the allelopathic effect of aqueous extracts prepared from different *Petroselinum crispum* (Mill.) Fuss plant parts on the germination and vegetative growth of several commonly known weeds species.

Materials and methods

Plant material

The effects of extracts obtained from seeds, roots and aerial parts of parsley, were assayed on seed germination, and vegetative growth of three common weed species as follows: ragweed (*Ambrosia artemisiifolia* L.), knotweed (*Polygonum aviculare* L.) and Johnsonn grass (*Sorghum halepense* (L.) Pers.).

The seeds, aerial parts and roots of parsley were washed with tap water and placed for 5 min. in containers containing a solution of sodium hypochlorite (2.5%) prepared with sterilized distilled water. After repeated washing with sterilized distilled water, the vegetal material was homogenized to fine powder using a mechanical blender.

Preparation of extract

An exact quantity of powdered material was extracted by maceration in distilled water, 1:10 ratio, at room temperature, for 24 hours. The extract was filtered through Buchner funnel and the resulted solution was evaporated to dryness using rotary evaporator. The extracts were stored at 4°C, in a refrigerator.

Germination assay

The allelopathic potential of parsley was investigated against three weed species, namely, ragweed (*Ambrosia artemisiifolia* L.), knotweed (*Polygonum aviculare* L.) and Johnsonn grass (*Sorghum halepense* (L.) Pers.).

For the germination experiments were used Petri dishes of 90 mm diameter and the control treatment was considered distilled water. A number of 100 seeds from each weed species were placed on filter paper and aqueous extract of *Petroselinum crispum* (Mill.) Fuss was added at every 24 hours for a period of five days. The Petri dishes were placed in dark at 24°C.

The germination percentage was estimated to every other day and the growth of sprouts was analyzed by counting the germinated seeds and measuring the length of the radicle and hypocotyl/coleoptile.

Results and discussions

Allelopathy is a biological phenomenon in which an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms.

The aqueous extracts obtained from different plant parts (roots, aerial parts-stems and leaves and seeds) of parsley showed allelopathic potential by inhibiting seed germination and radicle elongation of the weeds species.

It was revealed that the maximum inhibitory activity of the seed germination has been evidenced in the root extract when treating the knotweed seeds (48.1%) and the minimum inhibitory activity was achieved on the knotweed seeds (72.5%) by aerial part parsley extract (Table 1). The parsley extract acted as an inhibitory solution of the germination and growth of the seeds of the weeds tested (Fig. 1). These are all commonly found weeds, which are hard to control, and need alternative control management solution for the agricultural and horticultural crops.

Table 1. Overall mean values of weed seedlings grown under treatment with parsley extract

Ragweed (*Ambrosia artemisiifolia* L.)				
Characters	**Control**	**Parsley extract**		
		Root	Aerial part	Seeds
Germination (%)	98.2±0.01	57.1±0.02	70.5±0.07	65.3±0.03
Radicle length (mm)	6.3±0.02	1.5±0.7	2.3±0.5	5.9±0.3
Hypocotyl length (cm)	5.22±0.1	4.30±0.3	4.93±0.2	5.10±0.2
Knotweeed (*Polygonum aviculare* L.)				
Characters	**Control**	**Parsley extract**		
		Root	Aerial part	Seeds
Germination (%)	99.8±0.01	48.1±0.03	72.5±0.02	63.3±0.01
Radicle length (mm)	3.35±0.02	2.23±0.2	2.31±0.6	1.89±0.3
Hypocotyl length (cm)	6.22±0.01	4.32±0.03	5.23±0.02	4.53±0.06
Johnsonn grass (*Sorghum halepense* (L.) Pers.)				
Characters	**Control**	**Parsley extract**		
		Root	Aerial part	Seeds
Germination (%)	99.5±0.01	66.1±0.02	70.5±0.07	68.3±0.03
Radicle length (mm)	8.3±0.1	3.2±0.7	5.3±0.5	7.2±0.3
Coleoptile length (cm)	8.37±0.01	2.32±0.03	5.23±0.02	4.53±0.02

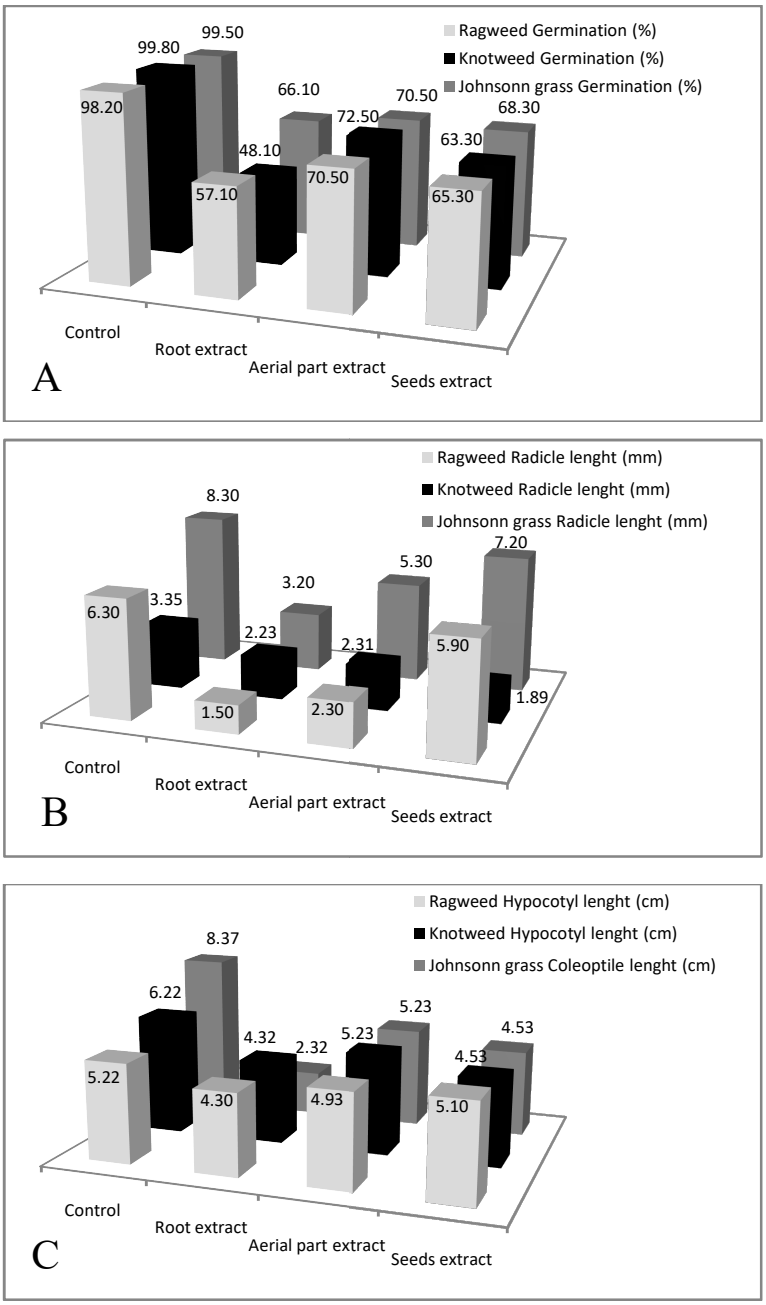

Figure 1. Allelopathic activity of parsley extract on *Ambrosia artemisiifolia* L., *Polygonum aviculare* L . and *Sorghum halepense* (L.) Pers.: A – germination; B – radicle length; C – hypocotyl/coleoptile length.

The common ragweed *A. artemisiifolia* L. is a quarantine weed which has been actively expanding its range in the Eastern and Western Europe during the recent years (Gladieux et al., 2011; Gerber et al., 2011).

Sorghum halepense (L.) Pers. is widespread species across the world covering a large part of the agricultural land cultivated with various crops. It is a herbaceous plant of grass family, representing one of the most harmful weeds for agricultural crops, especially in the dry regions (Stef et al., 2013). It was reported its resistance to common herbicides in different parts of the world. *Polygonum aviculare* L. is one of the most widespread weeds in the world. It is a ruderal plant infesting crops, pastures, disturbed sites and waste areas (Royo-Esnal et al., 2015).

Mutual relationship between cultural and weed plants are largely regulated by the biochemical interaction, and this is called allelopathy. The study of interaction between cultivated plants and weeds found that weed seeds are able to inhibit the germination of seeds of cultivated plants and vice versa (Rice, 1984).

Conclusions

The aqueous extracts from roots, stems and leaves and seeds of parsley demonstrated allelopathic potential by inhibiting the germination of weeds seeds. It was observed that the tested extracts exerted negative influence on the radicle elongation of all tested species. However, the weed species reacted different when treated with parsley aqueous extracts.

The major impact that allelopathy principles can have in the complex interactions occurring in the environment is being under current attention of the scientific community, as a solution for the integrated pest management in farming practices. Therefore, the study of interaction between cultivated plants and weeds found that weed seeds are able to inhibit the germination of seeds of cultivated plants and *vice versa*.

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