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Allelopathic effects of shoot and root extracts of *Artemisia aucheri* Boiss. on germination, growth and photosynthesis of rocket (*Eruca sativa* L.) and *Goldbachia laevigata* L.

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ABSTRACT

Two independent experiments (laboratory and greenhouse) were conducted to evaluate the allelopathic potential of *Artemisia aucheri* Boiss shoot and root aqueous extract on germination, growth and leaf photosynthesis (*A*) of rocket plant (*Eruca sativa* L.) and *Goldbachia laevigata* L. Germination, growth and net photosynthetic rate of both plants were suppressed by aqueous extract of *Artemisia*. Root extract had a more inhibitory effect to all traits than shoot extract. High concentration (20 gL^{-1}) of shoot and root aqueous extract decreased seed germination of rocket by 20% and 37.1%, respectively compared to control. However, *Goldbachia laevigata* germination was more affected at the same concentrations by 31.4% and 51.9%, respectively. Seed germination rate of rocket and *Goldbachia* decreased by 39.7% and 49.1% at high concentration of shoot extract. While, high concentration of root extract decreased seed germination index of rocket and *Goldbachia* by 62.4% and 72.5%, respectively. The highest Artemisia root extract concentration (20 gL^{-1}) diminished the plant height, leaf area, shoot dry weight, leaf photosynthesis and stomatal conductance (*gs*) of rocket plants and *Goldbachia* by 35.5% and 33.3%, 41% and 42.6%, 34.8% and 38.1%, 46.2% and 55.3%, 53.6 and 54.4%, respectively. The results of this study suggest that the root and shoot extracts of *A.aucheri* contains water soluble allelochemicals which significantly reduce germination and growth of *E.sativa* and *Goldbachia*. Therefore, *Artemisa aucheri* can be considered as potential bio-herbicides in future screening programs.

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1. Introduction

The presence of weeds in fields and gardens is one of the basic and permanent problems for agricultural products. These plants are successful in competing with crops to obtain light, water, food, carbon dioxide, etc., and cause a quantitative and qualitative decrease in the yield of agricultural crops (Deligios *et al*., 2019). Consecutive use of chemical herbicides causes some problems such as environmental pollution, retention of herbicides in the soil, high cost of production, damage to agricultural products, reduction of biodiversity and increase of species resistant to chemical herbicides (Rezvani and Dadkhah, 2023). Therefore, it is important and necessary to use new methods to prevent and reduce the weeds population in the field.

Allelopathy refers to the biological phenomenon thereby a plant influences the growth, development, or physiological functions of neighboring plants via discharge of chemical substances into the root medium. These substances may be exuded from roots, leached from aerial parts, or released during the decomposition of plant residues. Allelochemicals are synthesized and stored in different parts of plant, including leaves, flowers, stems, roots, buds, and seeds. Numerous studies have demonstrated their potential to significantly suppress or completely prevent seed germination and seedling growth of weeds and other competing plants (Inuganti *et al*., 2021; Rezvani & Dadkhah, 2023). The modes of allelochemicals action are diverse and may involve interference with key physiological and biochemical processes such as cell division, hormonal regulation, membrane permeability, mineral absorption, stomatal movement, photosynthesis, respiration, and the activity of specific enzymes (Al-Wakeel *et al*., 2007; Chang *et al*., 2024; Dadkhah, 2012; Fu *et al*., 2019; Mushtaq *et al*. 2019; Zhao *et al*., 2022). The presence of many weeds in rapeseed fields is one of the basic and constant problems for farmers (Dastres *et al*. 2025). These unwanted plant species significantly contribute to yield losses and are considered a major limiting factor in rapeseed production by adversely affecting plant growth, seed yield, and quality. It is estimated that weed interference accounts for approximately 34% of crop losses, which is notably higher than the losses caused by pests and diseases, reported at around 16–18% (Asaduzzaman *et al*., 2020). Therefore, using the allelopathic property of medicinal plants to eliminate and control weeds can be a great help to improve and increase the yield of rapeseed.

Artemisia aucheri Boiss. is a member of Asteraceae family and one of the medicinal plants that has anti-parasitic, anti-viral and antiseptic properties, and its aerial parts are used in pharmaceuticals. It was reported that it has high allelopathic effect, due to the presence of many chemical compounds such as santonin, coumarin and flavonoids quercetin in its organs (Gholami *et al*., 2011; Houshmand *et al*., 2024). The allelopathic effects of three species of Artemisia including *Artemisia siebery*, *Artemisia auchary* and *Artemisia scoparia* were investigated on seed germination traits of *Amaranthus retroflexus*. It was shown that seedling growth of *Amaranthus retroflexus* significantly decreased with increasing *Artemisia* sp. leaf extract concentration of all three *Artemisia* spices. However, the most inhibition effect on seedling growth of *Amaranthus retroflexus* was related to the extract of *Artemisia auchary* (Samdani & Baghestani, 2005). In another research, the allelopathic effect of Artemisia on the germination and growth characteristics of *Avena fatua* and *Amaranthus retroflexus* were studied. It was reported that the leaf extract had more inhibition effect than other vegetative organs of *Artemisia*. It was also shown that the germination of *Amaranthus retroflexus* seeds less affected than that of *Avena fatua* (Ghorbanli *et al*., 2008). Some studies have shown that *Artemisia* species are rich in phenols and volatiles which possess allelopathic properties (Tojic *et al*., 2025). Decreasing the germination rate through the delay in germination and establishment of weed causes the crop plant to have more opportunity to grow and establish in the initial stage of growth, which helps the growth of the crop plant (Rezvani & Dadkhah, 2023).

Due to the limited available information regarding the allelopathic potential of *Artemisia aucheri* in weed management in Iran, the present study was designed to investigate the allelopathic effects of different organs aqueous extracts of *A. aucheri* on seed germination, early growth, and physiological traits of two dominant weed species commonly found in rapeseed (*Brassica napus* L.) fields, namely *Eruca sativa* L. and *Goldbachia laevigata* L.

2. Material and Methods

In order to study allelopathic influence of aqueous extracts of different parts (root and shoot) of *Artemisia aucheri*. Boiss. on the germination indices, growth parameters and leaf photosynthesis of two most important weeds (*Eruca sativa* and *Goldbachia laevigata* L.) of the rapeseed crop, two separate experiments (laboratory and greenhouse) were arranged in a completely randomized design with four replications. The experimental treatments including 5 concentrations of aqueous extract: zero (control), 10 and 20 gL^{-1} of aerial parts (stems and leaves) and 10 and 20 gL^{-1} of root.

2.1. Aqueous Extract Preparation

The roots and aerial parts of Artemisia were collected from rangeland of Shirvan city, North Khorasan province, Iran (37°24'12.00" N and 57°55'43.00" E; 1079 m above sea level; 270 mm annual rainfall; maximum temp. 21.2

and minimum temp. 5.6) in June 2023, when Artemisia plants were at flowering stage. Plant materials were thoroughly washed with distilled water and air-dried under shade at ambient temperature. Once dried, the roots and aerial parts (including stems and leaves) were separately ground into fine powder using an electrical mill.

For extract preparation, 20 grams of each plant part (shoot and root, separately) were placed into 2-liter Erlenmeyer flasks and then 1 liter of deionized water was added. The flasks were wrapped with aluminum foil to minimize photo degradation and then shaken on a rotary shaker at ~200 rpm for 24 hours. The resulting mixtures were filtered using Whatman No.1 filter paper using a vacuum pump. The pH and electrical conductivity (EC) of extracts were measured using a digital pH meter and conductivity meter. The pH (from 6.7 to 6.0) and EC (from 2.30 to 2.9 mS/cm) were within the tolerance range of target plants. The filtrates were considered as full concentration stock solutions. A series of solutions including the stock solution (extract of 20 g shoot dry weight in 1L water (S20), concentration dilution of 10 gL^{-1} (S10) (was prepared from the shoot stock solution), the root stock solution (extract of 20g root dry weight in 1L water (R20), root concentration dilution of 10 g (was prepared from root stock solution) (R10) and deionized distilled water (control) were used for germination and seedling growth test. The extra solutions were stored at -18°C for further use. The seeds of two weeds (*Eruca sativa* and *Goldbachia laevigata* L.) were gathered from rapeseed farm of the Shirvan Agricultural College at the end of spring season, June 2022.

2.2. Petri Dish Experiment

A laboratory germination test was performed in a completely randomized design (CRD) with four replications to assess the allelopathic effects of different concentrations of *A. aucheri* shoot and root extracts on the germination and seedling growth of *Eruca sativa* and *Goldbachia laevigata*. Pre-tested seeds with more than 90% germination were surface-sterilized by 2% sodium hypochlorite for 5 minutes, followed by rinsing distilled water. Thirty seeds were placed between two layers of Whatman No.1 filter paper inside 9-cm plastic Petri dishes. Each dish received 5 ml of the respective extract solution and was incubated in a germinator under a 12-hour photoperiod at temperature of 25±2°C (day) and 16±2°C (night) for 14 days. Germination (%), root and shoot length of seedlings were recorded at 12 days after germination.

2.3. Greenhouse Experiment

Two-week-old seedlings were transplanted into pots (30cm top width×20cm height×15cm bottom width) filled with loamy soil (pH 7.55, EC 2.9 dS/m). Two drops of dish washing liquid were used in a 2L hand sprayer to increase spreadability of water and extracts on plants. Extracts were applied as foliar sprays (20 mL per plant) at the 4–6 leaf stage, repeated three times at 5-day intervals. Controls received distilled water. Plants were grown under controlled conditions (temperature 18±2 to 32±2°C, relative humidity 30–55%) for 60 days after treatment. Leaf area was measured by AM350 portable leaf area meter, UK. Net photosynthesis (*A*) and stomatal conductance (*gs*) of the attached youngest fully expanded leaf were measured by enclosing the middle part of leaf in the cuvette of a Combined Infra-Red Gas Analysis System (CIRAS-1 Portable photosynthesis system, USA) at 4 weeks post-treatments. The area of cuvette that caught full illumination was 2.5 cm2. Measurements and results were displayed on the analyzer display panel and also recorded on the data storage system. Extraction of chlorophyll pigments from the finely ground leaf samples was carried out using 80% acetone. The absorbance of optically clear filtrates was measured at 664 and 647 nm using a Beckman spectrophotometer, U.K. (Porra *et al*., 1984).

2.4. Statistical Analysis

Both laboratory and greenhouse experiments were analyzed under a completely randomized design. Germination data were arcsine-transformed prior to statistical analysis to meet assumptions of normality. All collected data were subjected to analysis of variance (ANOVA) using the SAS software (version 9.1). Treatment means were compared using Duncan's Multiple Range Test (DMRT) at a 1% significance level ($p \leq 0.01$).

3. Results

Variance analysis of data showed that different concentrations of shoot and root aqueous extracts of *Artemisia aucheri* significantly inhibited the germination percentage (%), germination rate and seedling growth of rocket and *Goldbachia laevigata* (Table 1). However, the inhibitory effect was concentration-dependent. Sensitivity of G. laevigata to aqueous extracts was more than rocket plants. The low (10 gL^{-1}) and high (20 gL^{-1}) concentrations of shoot extract of Artemisia caused inhibition of 10 and 20% in seed germination (%) of rocket respectively, (Table 2), while the inhibition in seed germination of *G. laevigata* increased to 16.7 and 31.4%, respectively, then control (Table 2). Root extracts of Artemisia were more inhibitory effect than shoot extracts. The low (10 gL^{-1}) and high (20 gL^{-1}) concentrations of root extract of Artemisia caused inhibition of germination by 22.9 and 37.1% respectively, in seed germination (%) of rocket (Table 1) and 37.9 and 51.9%, of G. laevigata rather than control (Table 2).

Table 1. Analysis of Variance (Mean Square) of the alellopathic effect of different aqueous extract on some germination indicators of *Eruca sativa* L. and *Goldbachia laevigata* L. plants in laboratory conditions.

S. O. V	Degree of freedom	Germination percentage	Germination rate	Seedling dry weight	Seedling length	Seed vigor index	Total Chlorophyll
				Eruca sativa L.			
Aqueous extract of Artemisia	4	719.49**	8.57**	0.00021**	1028.90**	1635.42**	38.40**
Error	15	86.85	0.50	0.00001	26.76	29.20	2.45
CV%		12.20	14.53	18.86	9.26	12.02	13.81
				Goldbachia laevigata L.			
Aqueous extract of Artemisia	4	671.49**	10.40**	0.00004**	1607.88**	1678.65**	42.98**
Error	15	50.28	0.46	0.00030	75.09	91.17	2.6
CV%		10.37	14.99	23.55	18.43	27.20	14.51

* and ** are significant differences in 5% and 1% level, respectively.

Low aqueous extract concentration (10%) of shoot and root of Artemisia inhibited germination rate of rocket by 19.9% and 48.6%, and *G.laevigata* by 26.2% and 60.5%, respectively compared to control. While high extract concentration of shoot and root (20%) of Artemisia inhibited the germination rate of rocket by 39.7% and 62.4% and *G.laevigata* by 49.1% and 72.5%, respectively compared to control.

Seedlings length of both tested plants was severely inhibited by increasing concentration extracts. The low (10 gL^{-1}) and high (20 gL^{-1}) concentration of shoot and root extract of *Artemisia* decreased seedling length of rocket by 14.3%, 27.5%, and 24.6, 38.7%, respectively compared to control (Table 2). However, the seedling length of *Goldbachia* decreased 33.2%, 61% and 66%, 76.4% at the same treatments, respectively (Table 2). Seed vigor index of rocket and *Goldbachia* significantly decreased by increasing aqueous extract concentrations. Low and high shoot extract concentrations of *Artemisia* decreased seed vigor of rocket by 23.1% and 42.1%, respectively compared to control, while low and high root extract concentrations declined seed vigor of rocket by 41.8% and 61.4% respectively compared to control (Table2). *Goldbachia* was more sensitive than rocket to *Artemisia* aqueous extracts so that, high extract concentrations of shoot and root of *Artemisia* decreased seed vigor of *Goldbachia* by 71.2% and 87.9% respectively, over control (Table 2).

Environmental stress, including allelopathy, induces physiological and biochemical disruptions in plants (Andualem *et al*., 2024; Hasan *et al*., 2022; Saberi *et al*., 2021). Researchers stated that the presence of artemisinin bioactive compounds, which have toxic and inhibitory effects, decreases the germination percentage (Kil *et al*., 2000; Tojic *et al* 2025). Less germination percentage and germination rate as a result of allelochemical stress may be due to inhibition of water uptake and alteration in activity of gibberellic acid which is known to regulate de novo amylase production during germination process (Alemayehu *et al*., 2024; Al-Mahmudy *et al*., 2024; Gulzar & Siddiqui, 2017; Siddiqui, 2007). It was reported that several enzymes like proteases, lipases and α-amylases play an important role during seed germination. Many enzymatic functions are inhibited by the presence of allelochemicals. It was reported that allelopathic substances decrease the activity of enzymes that catalyze plant vital processes such as glucose 6-phosphate dehydrogenase, glucose phosphate isomerase and aldolase related to glycolysis and pentose phosphate pathways, which results reduction in ATP production consequently, reduction in mineral ions absorption and which causes a decrease in growth of shoots and roots (Dejam *et al*., 2017). Some studies have shown that allelochemicals entered the interior of weed seeds, consequently increased the abscisic acid content and decreased the α-amylase activity in seeds, ultimately leading to an inhibitory effect on maize seed germination (Li *et al*., 2024). The inhibition on seed germination by allelopathic effect could be confounded with osmotic effects on rate of imbibition, delayed initiation of germination and cell elongation (Al-Wakeel *et al*., 2007). Inhibition in seedlings growth was more pronounced than seed germination. Some researchers found that aqueous leaf extracts of several species suppressed the seedling growth in target plants more than seed germination (Ben-Hammouda *et al*., 1995; Kumar *et al*., 2025; Smith, 1991).

Table 2. Mean comparison of *Artemisia aucheri* aqueous extracts on seed germination of *Erouca sativa* L. and *Goldbachia laevigata* L. under laboratory conditions.

Treatment	Germination percentage (%)	Inhibition percentage (%)	Germination rate	Inhibition percentage (%)	Seedling dry weight (g)	Inhibition percentage (%)	Seedling length (mm)	Inhibition percentage (%)	Seed vigor index	Inhibition percentage (%)	Total Chlorophyll mg g^{-1} FW	Inhibition percentage (%)
Eruca sativa L.												
Control	93.33[a]	0	9.34[a]	0	0.0148[a]		102.23[a]		95.43[a]		62.1a	0
Aerial extract aqueous												
10%	84.00[b]	9.99	7.48[ab]	19.91	0.0107[b]	27.70	87.63[bc]	14.28	73.44[b]	23.04	56.8[b]	8.5
20%	74.66[c]	20.00	5.63[bc]	39.72	0.0078[cd]	47.29	74.13[de]	27.48	55.30[c]	42.05	49.4[c]	20.5
Root extract aqueous												
10%	72.00[c]	22.85	4.80[cd]	48.60	0.0070[de]	52.70	77.13[cd]	24.63	55.53[c]	41.81	53.2[b]	14.3
20%	58.66[d]	37.14	3.51[d]	62.41	0.0046[e]	68.91	62.73[e]	38.68	36.80[d]	61.43	47.3[c]	23.8
Goldbachia laevigata L.												
Control	88.00[a]	0	6.91[a]	0	0.012[a]	0	84.11[a]	0	74.28[a]	0	57.2[a]	0
Aerial extract aqueous												
10%	73.33[bc]	16.67	5.10[b]	26.19	0.008[b]	33.33	56.19[b]	33.19	41.23[bc]	44.49	51.2[b]	10.5
20%	60.33[cd]	31.44	3.52[c]	49.05	0.004[cd]	66.66	32.79[cd]	61.01	21.39[de]	71.20	48.2[c]	15.7
Root extract aqueous												
10%	54.66[de]	37.88	2.73[cd]	60.49	0.003[cd]	75.00	28.62[cd]	65.97	15.58[de]	10.77	44.1[d]	22.9
20%	42.33[e]	51.89	1.93[d]	72.50	0.002[d]	83.33	19.87[d]	76.37	9.01[e]	87.87	40.9[d]	28.5

In each column (for each plant separately) means with the same letter are significantly different at 5% level of probability using Duncan.

Plant leaf area, plant height and chlorophyll content of both plants affected by Artemisia aqueous extract. At the highest (20 gL-1) shoot and root aqueous extract concentrations, the leaf area of rocket plants was decreased by 32.3% and 42.7% compared to control, respectively. However, the leaf area of Goldbachia decreased by 34.9% and 42.6% at the same concentrations. Likewise, these extract concentrations decreased the plant height of rocket plants and Goldbachia by 16.2 and 35.5%, 23.5% and 33.3%, respectively, compared to control (Table 3). Highest shoot and root extract concentrations (20 gL^{-1}) decreased the shoot dry weight of rocket and Goldbachia by 27.8%, 34.8% and 25.8, 38.1%, respectively, over the control (Table 3).

Leaf photosynthesis (*A*) was decreased with increasing extract concentrations and this was similar to stomatal conductance *(gs*) (Table 3). The leaf photosynthesis (*A*) and stomatal conductance (*gs*)of rocket plants treated with high concentration (20 gL^{-1}) shoot and root extracts of Artemisia, decreased by 29.5% and 46.2%, respectively, than control plants. While *A* and *gs* of *Goldbachia* decreased by 45.6% and 55.3% at the same extract concentrations, respectively (Table 3).

Table 3. Effect of foliar application of shoot and root aqueous extract of *Artemisia aucheri* on plant leaf area, plant height, shoot dry weight, total chlorophyll content, photosynthesis and stomatal conductance. Each number is means ± S.D of five measurements. Means followed by the same letter are not significantly (p≤0.05) different by Duncan's multiple range test within rows.

Parameters	Control	Shoot extract 10% (S10)	Inhibition Percentage (%)	Shoot extract 20% (S20)	Inhibition Percentage (%)	Root extract 10% (R10)	Inhibition Percentage (%)	Root extract 20% (R20)	Inhibition Percentage (%)
***Eruca sativa* L.**									
Leaf area per plant (cm^2)	1050 ± 31^{a}	920 ± 34^{b}	12.4	711 ± 40^{d}	32.3	850 ± 29^{c}	19.1	602 ± 25^{e}	42.7
Plant height (cm)	51.3 ± 3.5^{a}	46.3 ± 3^{ab}	19.8	43.0 ± 2.9^{b}	16.2	42.1 ± 2^{b}	17.9	33.1 ± 3^{c}	35.5
Shoot dry weight (g. plant $^{-1}$)	18.7±2a	16.2 ± 1^{ab}	13.4	13.5 ± 1^{bc}	27.8	15.1 ± 1.3^{b}	19.3	12.2 ± 1^{c}	34.8
Total chlorophyll content (mg.g FW)	53.4 ± 1.5^{a}	47 ± 2^{b}	12.0	40 ± 3^{cd}	25.1	42 ± 1.8^{c}	21.4	36 ± 2.5^{d}	32.6
Photosynthesis (µmol CO_2 m^{-2} s^{-1})	13.2 ± 0.8^{a}	10.7 ± 1^{b}	18.9	9.3 ± 0.6^{b}	29.5	9.2±1b	30.3	7.1 ± 0.8^{c}	46.2
Stomatal Conductance (mmol H_2O m^{-2} s^{-1})	186 ± 11^{a}	160 ± 13^{b}	12.6	139 ± 10^{bc}	24.0	127 ± 8^{c}	30.6	85 ± 11^{d}	53.6
***Goldbachia laevigata* L.**									
Leaf area per plant (cm^2)	878 ± 35^{a}	751 ± 20^{b}	14.2	573 ± 42^{d}	34.5	690 ± 18^{c}	21.2	502 ± 21^{e}	42.6
Plant height (cm)	47.2 ± 5^{a}	41.4 ± 2^{ab}	12.3	36.1 ± 3^{bc}	23.5	38.6 ± 3.4^{b}	18.2	31.5 ± 2^{c}	33.3
Shoot dry weight (g. plant $^{-1}$)	16.3 ± 2^{a}	14.8 ± 1^{ab}	09.2	12.1 ± 1.5^{cd}	25.8	13.2 ± 1^{bc}	19.0	10.1 ± 1^{d}	38.1
Total chlorophyll content (mg.g FW)	49 ± 1^{a}	45±3a	08.2	41 ± 1.8^{bc}	16.3	38 ± 2.5^{c}	22.5	32±2.9d	34.7
Photosynthesis (µmol CO_2 m^{-2} s^{-1})	11.4 ± 0.4^{a}	8.6 ± 1^{b}	24.6	6.2 ± 0.9^{cd}	45.6	6.9 ± 1^{bc}	39.5	5.1 ± 0.6^{d}	55.3
Stomatal Conductance (mmol H_2O m^{-2} s^{-1})	168 ± 15^{a}	130 ± 11^{b}	17.7	112 ± 8^{bc}	29.1	121 ± 5^{bc}	23.4	72 ± 11^{c}	54.4

The observed suppressive effects of *Artemisia aucheri* aqueous extracts on seed germination and early growth parameters of the tested weed species are likely attributed to the presence of allelochemicals particularly phenolic compounds which accumulated in different plant organs. These phytochemicals can act individually or synergistically, and the cumulative effect of multiple compounds may enhance the overall allelopathic impact compared to isolated constituents (Deepmala, 2019). Phenolic acids, widely recognized for their biological activity, have been reported to interfere with various physiological processes during seedling establishment and vegetative development (Dadkhah, 2012; Gholami *et al*., 2011; Tojic *et al*., 2025). It was also reported that allelochemicals inhibit the physiological processes that leads to reduce growth. The effects of allelopathy on germination and growth of plants may occur through various mechanism (reduced mitotic activity in roots and hypocotyls, suppressed hormone activity, reduced rate of nutrients uptake, inhibition of protein formation, reduction in permeability of cell membranes and inhibition of enzyme action) (Dejam, 2007; Gholami *et al*., 2011; Fu *et al*., 2019; Tarbali *et al*., 2021). Leaf area reduction observed under allelopathic treatment can be explained by inhibited leaf initiation and expansion, which are themselves outcomes of reduced cell division and elongation under chemical stress (Dadkhah, 2012; De-Herrald *et al*., 1998). Likewise, dry biomass reduction may stem from impaired mineral uptake and decreased photosynthetic efficiency, both of which are common responses to phytotoxic stress (Dejam, 2017). Higher concentration of allelochemicals inhibits the amylase activity in wheat seedlings and application of allelochemicals at high concentrations decreases the protein content in wheat seedlings (Hegab *et al*., 2008). Some researchers reported that the inhibitory effects of allelochemicals on seed germination and plant growth could be attributed to the inhibition in water absorption (Oyun, 2006, Cheng & Cheng, 2015).

Photosynthesis reduction under allelopathic stress is likely influenced by both stomatal and non-stomatal limitations. Stomatal closure, often caused by hormonal imbalances or altered ion fluxes (notably potassium), reduces intercellular CO_2 concentration, limiting carbon fixation (Rai *et al*., 2003). In parallel, allelochemicals can impair chlorophyll biosynthesis, enhance its degradation, or exert both effects simultaneously, leading to a significant reduction in light absorption capacity (Yang *et al*., 2002). It was reported reduction in chlorophyll content can be attributed to the presence of allelochemical in aqueous extract which possibly target enzymes responsible for the conversion of porphyrin precursors (Siddiqui, 2007). Phytotoxin compounds may also negatively affect thylakoid membrane integrity, electron transport processes, and the Calvin cycle, further diminishing photosynthetic output (Rimando *et al*., 2003). Dry matter accumulation may be decreased by reduction in photosynthetic area or assimilation rate per unit leaf area.

Conclusion

The allelopathic potential of *Artemisia aucheri* was demonstrated against *Eruca sativa* and *Goldbachia* plants. Since seed germination is a vital phase in life period of weeds, the release of allelochemical from shoot and root of *Artemisia aucheri* may impact the competitive ability of weeds during the establishment stage. On the other hand, allelochemicals exerts a higher reduction in seed germination of weeds. Therefore, aqueous extracts or segregation allelochemicals of *Artemisia aucheri* can be developed as bio-herbicides for weeds bridle, thereby decreasing synthetic herbicide dependency in conventional weed management. The prospects for practical application will be investigated through further studies, which will include the identification and isolation of the most effective allelochemicals from this source and validation of the present results in vivo and under field conditions, as well as regarding different weeds and crops.

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