



Allelopathic Effects of *Euphorbia helioscopia* and *Papaver rhoeas* on Germination and Initial Seedling Growth of Cereal Crops and Weed seeds

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Abstract

A laboratory study was conducted to investigate the allelopathic effect of aqueous extracts of fresh roots and leaves of sunspourge and field- poppy weeds on germination and growth of four different plant species; wheat, barley, wild mustard and seabious seeds. Maximum stimulation ratio of germination percentage was observed on barley seeds with sunspourge root extract was 23.46%. Maximum stimulation ratio of wheat root length was 59.16% with sunspourge leaf extract and was 33.02% for barley with field poppy root extract, while poppy leaf extract reduced wild mustard and seabious root length ratio by 37.22% and 29.99% respectively. The highest stimulatory ratio of wheat shoot length was 10.84% with poppy leaf extract at the same time reduced seabious shoot length by 18.52%. Maximum increasing of wheat fresh weight was 88.76% with poppy leaf extract and was 87.94% with sunspourge extract leaf for barley while sunspourge leaf extract decreased wild mustard fresh weight by 77.64%. The highest increasing ratio of barley seedling dry weight recorded with sunspourge leaf extract was 32-85%.

Introduction

The growth of crops is accompanied by weeds which besides competing for growth requirements, can also affect on growth through allelopathy. Entry of allelochemicals into environment by leaching and decay of litter is one of the greatest importances for the relationship of crops and weeds by inhibiting seed germination and growth of agricultural crops [1]. Agricultural researchers have found that weeds cause approximately 17-25 % losses in wheat annually due to their competitive and allelopathic nature [2]. While Jabeen *et al.* (2013) [3] indicated that weeds continue to cause annual losses of about 10% in agricultural production in the world, and economically estimated at more than 18.2 billion dollars. Weed control by chemical methods lead to environmental pollution and many weed species develop resistance against the particular herbicide [4]. Sunspourge and filed poppy are the most important dominant and competitive broad-leaved weeds in winter cereals [5], [6] and [7]. They are native to the temperate regions of Eurasia [8] and [9]. According to [1] mean germination time of wheat was significantly increased (4.81) in treatment with sunspourge leaf extract compared to the control. Ravlic *et al.* (2012) [5] has been reported the allelopathic of field poppy effect on germination energy and capacity of cereals, also indicated that water extracts from fresh plant parts of *Papaver rhoeas* significantly reduced germination of both wheat and barley. Field poppy can decrease wheat yield up

to 32% [6]. Wild mustard and syrian cephalaria seabious are two such exotic winter weed species belonging to the family Brassicaceae and Dipsacaceae respectively they are the common weeds in wheat and barley in Sulaimany province and successfully invaded a large area in Kurdistan region/ Iraq [11], both are rapidly spreading weed and had a major problem for the agriculturists, they have an edge over other weeds as it is a vigorous annual herb and has colonised cultivated lands in cereal crops [12]. To control weed plants there are alternative strategies such as non-chemical control that take into account by using aqueous extracts (bioherbicides) of weed plants [7]. Bioherbicides have the potential to create friendly eco-products for weed management and are easily biodegradable than synthesized herbicides [13].

The present study was carried out to explore the allelopathic effect of aqueous extracts from fresh leaves and root of sunspourge and filed poppy weeds which were used to observe the allelopathic activity on germination and early seedling growth on tested seeds; wheat, barley, wild mustard and seabious weed seeds.

Materials and methods

The experiment was conducted in May 2013 in the laboratory of Field Crop Department, Faculty of Agricultural Sciences/ University of Sulaimani/ Kurdistan, Iraq. Weed samples of Sunspourge (*Euphorbia helioscopia* L.) and filed poppy (*Papaver rhoeas* L.) were collected at maturity stage from different locations in Qlyasan Agricultural Station. All plant species were identified at herbarium of Faculty of Agricultural Sciences. Field grown weeds separated in laboratory into root and leaves, rinsed with tap water and distilled water to remove soil practices, cut into piece 2-3 cm, the fresh plant parts were ground separately in grinder and stored in air tight glass bottle. Aqueous extracts from fresh weed plant parts were prepared according to [14]. 100 gram of each ground plant parts soaked in 100 ml of distilled water 1:1 ratio (100 gram of weed plant material in 100 ml distilled water). Aqueous extracts were obtained by filtering herbage mixture through muslin cloth and after that through a whatman No.1 filter paper and stored in refrigerator for 24 hours at 4°C.

Wheat (*Triticum aestivum* L.), Barley (*Hordeum vulgare* L.), Wild mustard (*Sinapis arvensis* L.) and Syrian seabious (*Cephalaria syriaca* L.) seeds were used in the germination test. The seeds were surfaced-sterilized for 20 munities with 1% NaOCl, and then rinsed three times with distilled water. Ten seeds of each crop and weed seeds were placed in sterilized petri dishes (90mm in diameter) on the top of filter paper which are used as a medium of germination. In each petri dish 5% of prepared extracts was added, while distilled water was used as control. For germination test petri dishes were kept at room temperature 24°C ($\pm 4^\circ\text{C}$). Observed daily and additional distilled water was added to each dish as needed during germination course. Each treatment had three replications and germinated seeds were counted daily for nine days. Germination count was recorded on: 3, 5, 7 and 9th day after sowing (DAS) germination percentage was calculated for each replication using the formula:

$$G = \text{Germinated seeds} / \text{Total seed} * 100 \quad [15]$$

The germination index (G.I) was calculated by using the formula:

$$G.I = \frac{\text{No of Germinated seeds}}{\text{Days of first count}} + \dots + \frac{\text{No of Germinated seeds}}{\text{Days of final count}} \quad [16]$$

After an interval of nine days the mean of seedling; root and shoot length (cm), fresh and dry weight (g) were determined. The elongation of root and shoot of seedling were measured.

The collected data were analyzed with a computer program Statistical Social Sciences JMP7 software, Version 7, SAS Institute Inc., Cary, NC, 2007, and the differences between treatments mean were done according to the Duncan multiple range.

Results and Discussion

Results in table 1 and 2 were the effects of water extracts from fresh parts of leaves and roots of sunspourge and field poppy weeds on the germination ratio of wheat, barley, wild mustard and seabious weed seeds. It was showed that all weeds extracts had not affected significantly on germination ratio and germination index of wheat seeds and no variable data can be seen in its column 100% wheat seed are germinated. While all other aqueous extracts of weed parts treatments showed remarkable varied effects on the other tested seeds in germination ratio. The highest stimulatory ratio was observed with sunspourge root extract which increased germination ratio of barley by 23.46 %, while, sunspourge leaf showed the highest reduction of barley seed germination percentage followed by Field poppy root extract reached to 29.45 % and 22.40% respectively as compared with control these result agreed with [17] when reported that the allelopathic effects of various parts of the same plant also may be differ for their effects on germination percentage. Significant differences have been observed between treatments in influencing of extracts on wild mustard and seabious seed germination ratios as it is shown in table 1. All weed extracts showed inhibitory effect on seed germination of wild mustard except field poppy leaf extract which showed highest stimulatory effect of seed germination compared with all other treatments reached to 100 %. Ghodake, et al. (2012) [18] revealed that allelochemicals inhibit seed germination by blocking hydrolysis of nutrients reserve. In term of seabious , contrary, all weed parts extracts showed no significant effects on seed germination ratio as compared with control except sunspourge leaf extract which exhibited inhibition in germination percentage up to 43.32% Ghodake et al. (2012) [18] stated that some species of Euphorbia weed extracts exhibited inhibition in germination percentage in initial stages, while E. hirta showed stimulatory trend compared to control these result agreed with [19].

Table- 1: Effect of extracts on germination % of wheat, barley and weed seeds

Treatment	Germination % of seeds		
	Cereal crop		Weeds
	barley	wild mustard	seabious
Control	56.7 b	95.0 ab	98.8 a
Sunspourge leaf	40.0 d	83.6 bc	56.0 b
Sunspourge root	70.0 a	73.5 c	98.8 a
Field poppy leaf	53.3 bc	100.0 a	98.8 a
Field poppy root	44.0 cd	80.0 bc	95.5 a

Means followed by the same letter within the column are not significantly different at P<0.01

Evident from the data presented in table 2, indicated that all aqueous extracts of leaves and roots of sunspourge and field poppy significantly reduced germination index (G.I) of barley, wild mustard and seabious seeds, except sunspourge root extract which increased G.I was 61.7 for barley. Field poppy leaf extract reduced by 4.63% for wild mustard and two treated extracts for seabious seeds; sunspourge root 8.85% and field poppy leaf 18.10 % as compared with water treatment (control). Maximum reduction in G1 was observed in treatment with field poppy root extract was 37.92% in regard to barley, 24.53% for wild mustard seeds with sunspourge root and 23.57% related to seabiousin seeds with sunspourge leaf. These results are close to [12].

Table- 2: Effect of extracts on germination index of wheat, barley and weed seeds

Treatment	Germination index (GI)		
	Cereal crop		Weeds
	barley	wild mustard	seabious
Control	56.7 a	95.0 ab	76.8 bc
Sunspourge leaf	40.0 b	80.6 b	58.7 d
Sunspourge root	61.7 a	71.7 b	83.6 ab
Field poppy leaf	44.2 b	99.4 a	90.7 a
Field poppy root	35.2 b	75.1 b	68.5 bc

Means followed by the same letter within the column are not significantly different at P<0.01

Mostly, weed extract showed stimulatory effect on seedling growth of wheat and barley as it is shown in table 3. Significant differences have been observed between treatment in influencing on wheat and barley root length. As compared to the control, only field poppy leaf extract showed no significant increasing in wheat root length Obaid and Qasem, (2005) [20] reported that low volume of some weed extracts enhanced seedling growth of certain crops. Contrary, only field poppy root extract significantly increased barley root length Aziz *et al.*, (2008) [21] denoted that allelopathic effect of various parts of the same weed also differ for their effect on initial growth of plants. Maximum stimulation ratio was recorded for wheat with sunspourge leaf extract and with field poppy root was noticed for barley root length 59.16% and 33.02% respectively. Only field poppy leaf showed significant depressive effect on wild mustard root length was 37.22% while such depressive was not significant for seabious weed extract reached to 29.99% as compared to the control these results agreed with [17] and [21].

Table- 3: Effect of extracts on root length of wheat, barley and weed seeds

Extracts treatment	Root length (cm)			
	Cereal crop			Weeds
	wheat	barley	wild Mustard	seabious
Control	11.90 b	11.93b	6.26 ab	9.47 ab
Sunspourge leaf	18.95 a	14.60ab	6.00 ab	7.77 b
Sunspourge root	17.23 a	12.83b	5.27b	9.10 a
Field poppy leaf	14.80 ab	12.70 b	3.93c	6.63 b
Field poppy root	15.90 a	15.87a	7.37 a	10.10a

Means followed by the same letter within the column are not significantly different at P<0.01

Data in table 4. shows shoot length of test crops and weeds showed contrast results due to the effect of extract examined. Only root extract of sunspourge caused significantly reduction of barley shoot length by 22.29% as compared to the control treatment, result may be attributed to the negative effect of the extract on seedling length, this result are supported by [22]. Field pappy leaf extract behaved differently in their effect on this trait which exhibited significant increasing in shoot length of wheat plant by 10.84%. While, field poppy leaves and root extract caused significant depressive effects for barley shoot length by 8.66% and 6.61% respectively compared to the control. The mechanism of inhibition on the seedling growth caused by allelochemicals can be result of reduced cell elongation [23]. Although all weed parts extract have not affected significantly on wild mustard shoot length, mean, while weed extracts behaved differently in their effects on seabious shoot length. Although, differences in shoot length between leaf and root extracts effects were noticed for each sunspourge and field poppy extracts, but most extract parts had showed negative effects on crops contrary to weed shoot length. (Marinov-Serafimov(2012)[24] and Kalinova et al. (2012) [25] reported that the impact of Allechemicals in evident during seed germination, but is more pronounced during the growth of primary seedling.

Table- 4: Effect of extracts on shoot length (cm) of wheat, barley and weed seeds

Ttreatment	Shoot length (cm)			
	Cereal crop			Weeds
	wheat	barley	wild mustard	seabious
Control	13.47 bc	14.67 a	2.64 a	5.40 ab
Sunspourge leaf	13.70 bc	15.07 a	2.80 a	5.07 b
Sunspourge root	14.33 ab	11.40 c	2.77 a	6.23 a
Field poppy leaf	14.93 a	13.40 b	2.53 a	4.43 b
Field poppy root	13.30 c	13.70 b	2.37a	6.40 a

Means followed by the same letter within the column are not significantly different at P<0.01

Table 5 shows significant differences between treatments in influencing on cereals and weeds fresh weight. As compared to the control, only field poppy root extracts showed no significant increasing in wheat fresh weight, therefore sunspourge leaf, sunspourge root and field poppy leaf increased wheat fresh weight ratios by 72.67, 60.55 and 88.76% respectively. While, only leaf and root of sunspourge increased significantly barley

fresh weight reached to 87.95 and 65.26% respectively. Significant differences have been observed between treatments in influencing on wild mustard and seabious weeds fresh weight. All leaf and root extracts had significantly reduced wild mustard and seabious fresh weight except field poppy root extract. The maximum reduction ratio in seedling fresh weight of wild mustard 77.64% was with sunspourge leaf extract and 43.06% for seabious seedling with field poppy root extracts. Contrary to the root length trait, opposite results due to extract parts noticed on crops- weed seedling fresh weight. Results may be attributed to the stimulatory effects of low concentration uses of leaf and root extracts on roots and shoots length of tested plants. Obaid and Qasem (2005) [20] indicated that the inhibitory effects depend on extract level in the medium , with low volume of some weed extracts enhanced seedling growth of certain crops. While, Jabeen *et al.* (2013) [3] revealed that soil containing different level of *E.hirta* powder showed significant reduction in the fresh and dry shoot weight of wheat plant.

Table- 5: Effect of extracts on seedling fresh weight (g) of wheat, barley and weed seeds

Ttreatment	Seedling Fresh weight (g)			
	Cereal crops		Weeds	
	Wheat	Barley	Wild mustard	Seabious
Control	1.460 b	0.921 b	0.331 a	0.896 a
Sunspourge leaf	2.344 a	1.731 a	0.074 b	0.435 c
Sunspourge root	2.521 a	1.522 a	0.126 b	0.458 c
Field poppy leaf	2.756 a	0.786 b	0.085 b	0.710b
Field poppy root	1.449 b	0.803 b	0.407 a	0.417 c

Means followed by the same letter within the column are not significantly different at $P < 0.01$

Data presented in table 6 revealed that all weed parts extracts showed no significant effects on wheat seedling dry weight as compared to control treatment [13], mean while all weed part extracts exerted a significant increasing in barley seedling dry weight except field poppy leaf. The preponderance extracts can be ranked in the following order according to their potential in increasing barley seedling dry weight: sunspourge leaf > field poppy root > sunspourge root. Maximum increasing in barley seedling dry weight was observed in treatment with sunspourge leaf extracts was 32.85%. Although, sunspourge and field poppy leaf extracts showed no significant increasing for wild mustard seedling dry weight, but such increasing was significant due to sunspourge and field poppy root extracts by 76.78 and 42.86% respectively. All weed extract parts results showed no significant effect on seabious seedling dry weight as compared with control treatment except field poppy leaf extract which significantly reduced seedling dry weight up to 28.21%. These results are supported by [26], who stated that plants, produce bioactive compounds which produce direct or indirect effects on growth and development of other species in influencing negatively or positively namely they promote or suppress each other.

Table- 6: Effect of extracts on seedling dry weight (g) of wheat, barley and weed seeds

Ttreatment	Seedling Dry weight (g)			
	Cereal crops		Weeds	
	Wheat	Barley	Wild mustard	Seabious
Control	0.239 a	0.277 c	0.0056 c	0.078a
Sunspourge leaf	0.228 a	0.368 a	0.0070bc	0.069b
Sunspourge root	0.228 a	0.313 b	0.0099 a	0.077a
Field poppy leaf	0.195 a	0.276 c	0.0075bc	0.056b
Field poppy root	0.219 a	0.334 b	0.0080ab	0.079a

Means followed by the same letter within the column are not significantly different at $P < 0.01$

Conclusion

Based on the results of this study, it can be conclude that the aqueous extracts of the leaves and root extracts differently affected on the seeds germination. All aqueous extracts had not affected on germination percentage of wheat seed. The highest stimulation of wheat and barley seedling growth was by sunspourge leaves is followed by field poppy root extracts. Aqueous extracts of sun sponge leaves and roots exhibited allopathic

effects on wild mustard and seabious seed germination percentage. The barley germination index was increased with sunspurge root extract, while reducing wild mustard seeds. Field poppy leaf extract decreased wheat root length while their root extract increased it. The present investigation has suggested that seed extract part produced allelochemicals which positively influenced the germination and growth of wheat and barley crops. Therefore, for the which scale and commercial use of this plant, trials should be done the validate relevant concentration and economic values of using different biological therapeutic application.

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