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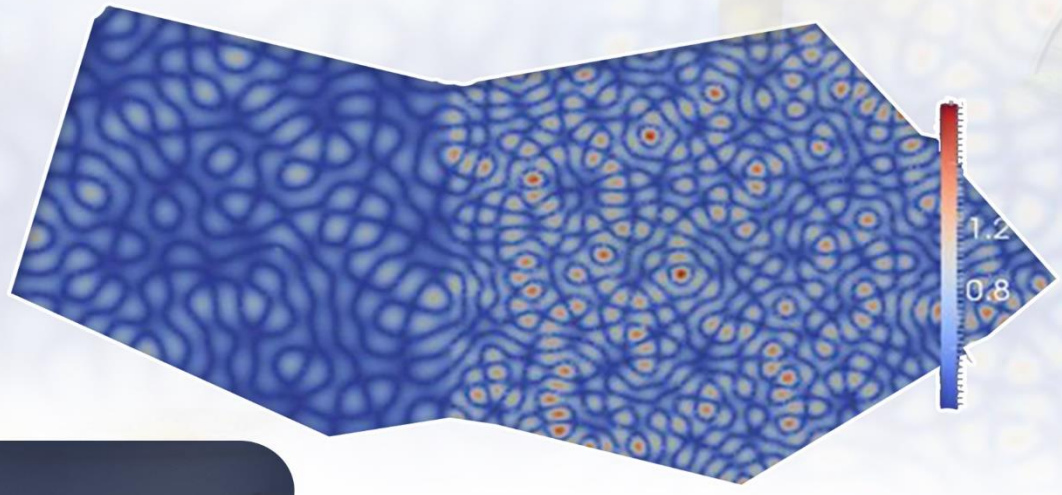

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Testing an Allelopathic Effect *Arum Cyreniacum* on Germination and Growth of *Pisum Sativum* L

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A B S T R A C T

Two experiments were conducted (laboratory - pots) at the lab of the biology Department/ Faculty of education/ Omar Al-Mukhtar University/ Al Bayda/ Libya, to aim testing allelopathic effects of aqueous extracts at concentrations of (6, 8 and 10%), adding the Crude powder to soil at a concentration of (3%) of (Tubers-Leaves) *Arum cyreniacum* on the germination of seeds and development seedlings of *Pisum sativum* with three replications according to a completely randomized design. The results of the laboratory experiment showed were significant differences in reduction of germination percentage, reduction of radical and plumule lengths between aqueous extracts, compared with control, also, all concentrations caused a clear delay in an average germination time. The results of a pots experiment showed a concentration (3%) reduced the percentage emergence of seedlings, and decrease root and shoot lengths, fresh and dry weights of seedlings. A concentration (3%) caused a decrease of content chlorophyll (a, b), and sodium, an accumulation of carotenoids, potassium and iron, compared to the control. The leaves had the highest inhibition rates compared to the tubers at inhibiting the growth of studied traits. This study concluded that A. cyreniacum has inhibitory effects against germination of *P.sativum.*

1 Introduction

Weeds are one of the most significant pests that obstruct human efforts to achieve adequate agricultural produce of high quality (Salih and Abdulrraziq, 2020). *Pisum sativum* L. is a Fabaceae family annual herb crop that is regarded as one of the most significant legumes. It is a vital source of energy as well as a high-protein food (Al-bozidy, *et al.*, 2019). Furthermore, it contains some critical minerals such as calcium, phosphorus, and iron, as well as 20-25 percent starch, 4-10 percent sugar, and 0.6-1.5 percent fat (Makasheva, 1983; Haque *et al.*, 2014). Susceptible to biotic and abiotic stressors, particularly allelopathic stress (Mohamed and El-Ashry, 2012; Benezit *et al.*, 2017). Allelopathy is described as a plant's direct or indirect, catastrophic effect on another plant caused by the release of toxins. (allelochemicals) which are secondary metabolites, which are present in all plant tissues including leaves, stems, flowers, roots, and seeds (Kumar *et al.*, 2018; Salih and Abdulrraziq, 2021).

Classified into various groups on the basis of their chemical properties, phenolics, alkaloids, terpenes, fatty acids, and indoles are the most ordinarily occurring allelochemicals in plants (kato-Noguchi, 2008). Allelopathic inhibition may be due to the toxic effects of a single compound or the interaction of a group of some chemicals (Li *et al.*, 2010) plants wild plays an important role in the formation of their natural habitats as it contains the allele-chemical compounds, enabling plants to compete with other species, where it inhibits crop growth and production (Ebid, 2016).

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Arum cyreniacum is a tuberous annual herb in the (Araceae) family that is used for both food and medicine. It is unique to the Cyrenaica region near agricultural regions, particularly in Libya's Al-Jabal Al-Akhdar region (Abdulrraziq and Salih, 2020). Allelochemical interactions with *Pisum sativum* have been documented in a variety of plants, including medicinal plants. In a study conducted in Saudi Arabia, aqueous extracts of two medicinal plants (*Artrmisia monosperma* and *Thymus vulgaris*) were found to lower growth capability, shoot and root length, total free amino acids, and proline in *P. sativum* (Al-Hawas and Azooz, 2018). Furthermore, an aqueous extract of *Ageratum conyzoides* has been demonstrated in a study (Singh, 2021) to have detrimental impacts on *P.sativum* germination, shoot length, root length, and biomass production. Furthermore, the aqueous extract of *Alhagi maurorum* lowered all growth indices of *P.sativum*, including photosynthetic pigments, total carbohydrate, and total protein (Khalil *et al*., 2017).

The purpose of this study was to see if aqueous extracts of *Arum cyreniacum* leaves and tubers at different concentrations (6, 8 and 10%) had an allelopathic effect on the germination of seeds of *Pisum sativum*, and if adding the crude powder of *Arum cyreniacum* to the soil at a concentration of (3 %) (tubers-leaves) had an allelopathic effect on the germination of seeds and the development of seedling.

2 Materials and Methods

2.1 Sample Collection:

Samples of *A.cyreniacum* (leaves- tubers) were collected from of Al-Bayda city, it is defined to classified according to (Abdulrraziq and Salih, 2020), washed with distilled water, then dried under natural conditions, grind with an electric grinder, finally preserved for use.

2.2 Laboratory Experiment:

2.2.1 Seed Selection:

Seeds of *Pisum sativum* were obtained from local markets, cleaned of impurities, and viability was tested by soaking in distilled water to get rid of empty seeds floating on the surface, were soaked in 1% sodium hypochloride solution for 3 minutes, washed with distilled water (Dafaallah *et al*., 2019).

2.2.2 Preparation of the Aqueous Extract:

The aqueous extract (leaves- tubers) was prepared separately by adding 100 g of air-dried powder to 1000 ml of distilled water for 24 h, after that the extract was filtered through filter paper and placed on a Shaker for 24 hours. Then it was centrifuged at the speed of 2000 rounds per minute for 15 minutes. The extract was passed through Whatman filter paper No.1. The obtained extract concentration was considered as the stock solution (10%) (Al-Hawas and Azooz, 2018). Then it was appropriately diluted with distilled water to give final concentrations of 6, 8, and 10%.

2.2.3 Seed germination:

Normally, 10 seeds per Petri dish, were lined with two Whatman No.1 filter papers, incubated at room temperature, three replications for each treatment, dishes were subjected to daily observation for 10 days and follow-up of germination in terms of addition of extracts to the treated dishes. add distilled water to Control as needed for each dish (Othman *et al*., 2018), germination was calculated by recording a number of germinated seeds in all treatments starting from the second day, which the first germination occurred, germination criterion is the appearance of radical outside seed cover (Ganatsas *et al*., 2008) at end of the experiment took final results of following qualities:

Germination percentage (PG %) = number of germinated seeds / total number of seeds × 100 (Yousif *et al*., 2020).

Mean germination time (MGT) = the total number of germinated seeds per day / total number of germinated seeds at end of the experiment (Das *et al*., 2017).

radical and plumule lengths: The root and plumule lengths were taken using a graduated ruler, the averages were calculated by taking 5 seedlings from each plate.

2.3. Pots Experiment:

The soil samples were finally sterilized at (90ºC for 48 h) to remove any microorganisms and weed seeds. Ten seeds of *P.sativum* were sown in plastic pots (16 cm in diameter) in pure culture practices with about 1000 g of sandy loam soil thoroughly mixed (w/w) with 3 % of electrically crushed crude powder of leaves and tubers of *A.cyreniacum.* One treatment was run as a control with zero percent of crude powder with three replicates. The plants were watered every two days on average with normal tap water. The experiment was performed under normal laboratory conditions (20±2°C temperature, 75±2% relative humidity, and 14/10 h light/dark photoperiod). After 21 days, the homogenous seedling was carefully collected from each treatment, washed with tap water to remove the adhering soil particles, and then, by distilled water, gently blotted with filter paper. The seedlings were separated into shoots and roots for the determination of seedling fresh weight as well as seedling length. Other samples were dried at 65ºC till constant weight to determine the seedling dry weight (Alaila *et al*.,2021).

2.3.1 Photosynthetic Pigments

The photosynthetic pigments (chlorophyll a and chlorophyll b) were determined spectrophotom etrically according to (Metzner *et al*., 1965).

2.3.2 Estimation of Minerals in Plant

Seedlings were carefully and thoroughly cleaned, blotted dry between absorbing paper and their dry weights were measured after oven drying at 70°C for 72h.Oven dry samples of seedlings were finely ground and assayed for-mineral ion content by the wet digestion method. Minerals (K, Fe and Na) were determined using an atomic absorption spectrophotometer and expressed on the basis of dry weight (Humphries, 1956).

Statistical Analysis:

The study of two experiments were designed according to the complete random design (CRD). Statistical analysis was performed using Minitab 17 program and ANOVA variance analysis tables. The averages were compared using Tukey's test at P <0.05.

3 Results:

The results of this study showed that aqueous extracts of A.cyreniacum have highly inhibitor activity to reduce germination percentage, radical and plumule Length, with increasing the average germination time of *P.sativum* seeds, after 10 days from the start of the experiment, compared to control. The data recorded in the table (1) that the concentration of (6%) of leaves and (6 and 8%) of tubers extract had no inhibitory effect on a germination percentage, but caused a clear delay in the average germination time, from 3.0 days of control to about 5.0 days. While this percentage decreased of leaves extract at a concentration (8, 10%) from 100% for control to 73, 26%, respectively. The concentration 10 of tubers extract also recorded a decrease in germination percentage with 60%. The results also showed that all concentrations caused a clear delay in the average germination time. The corresponding allelopathy effects on radical and plumule length were recorded. Data demonstrated that the radical and plumule length decreased significantly upon applying different concentrations of the extracts, especially, at 10% which did not show any plumule germination.

Table (1). Effect of *Arum cyreniacum* extracts on germination of *Pisum sativum* seeds.

Extract	Conc. (%)	Germination (%)	Mean Germination time	Radical length	Plumule length
Control		100 a	3.0 d	5.6 a	7.4 a
Leaves	6%	100 a	5.7 bc	2.5 bc	2.9 c
	8%	73 b	7.3 a	1.4 de	1.1 d
	10%	26 d	7.0 ab	0.7 f	0.0 e
Tubers	6%	100 a	5.0 c	3.0 b	3.4 b
	8%	100 a	5.5 c	1.9 cd	2.8 c
	10%	60 c	7.0 ab	1.2 ef	0.0 e

As shown in Table (2) and Figure (1) the results of adding crude powder (tubers - leaves) of *A.cyreniacum* to soil at a concentration (3%) on seedling emergence, Shoot and root length, fresh and dry weight of *P. sativum*, after 21 days from agriculture at pots, noted reduced of seedlings emergence from 100% for a control to (40, 66%) for the treatment of leaves and tubers, respectively. The results also indicate a decrease in shoot and root length, fresh and dry weight of *P.sativum*.

Table (2). Effect of *Arum cyreniacum* extracts on the germination and growth rates of *Pisum sativum* on pots.

Extract	Conc.	Number seedling (%)	Shoot length (cm)	Root length (cm)	Fresh weight (g)	Dry weight (g)
Control		90.0 a	17 a	26 a	43.5 a	21.3 a
Leaves	3%	40.0 c	4.5 c	2.7 c	19.4 c	8.5 c
Tubers	3%	66.0 b	7.6 b	5.2 b	24,1 b	13.0 b

Figure (1). Effect a concentration (3%) of *Arum cyreniacum* extracts on the germination and growth rates of *Pisum sativum*.

As shown in table (3), the results of an effect of adding the dry crude powder of *A.cyreniacum* (tubers - leaves) to soil at a concentration (3%) on the content of chlorophyll (a, b and carotenoids), and Minerals (K, Fe, and Na) of *P.sativum*. where the results showed a decrease of content chlorophyll (a, b) and an accumulation of carotenoids of *P.sativum* leaves, also led to an accumulation of potassium, iron, while a decreased sodium compared to the control.

Table (3). Effect of *Arum cyreniacum* extracts on a content of pigments, and some of the minerals *Pisum sativum*.

Extract	Conc.	Chlorophyll a	Chlorophyll b	carotenoids	K	Fe	Na
Control		1.13 a	1.44 a	1.84 c	88 c	1.3 c	0.8 a
Leaves	3%	0.69 c	0.81 c	3.3a	122 a	3.7 a	0.2 b
Tubers	3%	0.95 b	1.05 b	2.6 b	97 b	3.2 b	0.3 b

4 Discussion

Weeds and wild present around the fields exert their allelopathic influence on agricultural crops (Hayyat *et al.,* 2020). So this study was conducted to test allelopathic effects of aqueous extracts and the crude powder added to the soil from *A.cyreniacum*. which showed that the aqueous extracts of (leaves and tubers) *A.cyreniacum* have an allelopathic effect against germination rates of *P.sativum*, this result agreed with the findings of (Salih and Abdulrraziq, 2020) that the allelopathic compounds present in the aqueous extracts of many wild plants had high toxicity against growth *P.sativum*, Which has a negative role in impeding of germination of seeds and seedlings, by affecting a variety of biochemical and physiological attributes, and also caused cellular membrane injury in the germinating seeds (Ullah *et al.,* 2015). The powder added to the soil also had negative effects on the growth of *P.sativum* seedlings, These results were supported by (Khali *et al.,* 2017) were indicated to inhibit germination and seedling growth of (*Pisum sativum* L.) when using *Alhagi maurorum* extract. the concentration (3%) also led to Deterioration in the content of pigments and mineral elements, which this result agreed with (Mendez and miranol, 2015; Al-Hawas and Azooz, 2018).

5 Conclusions

We conclude from this study that *A.cyreniacum* has clear inhibitory effects against germination of *P.sativum*. Leaves are the most toxic than tubers, so this study recommends excluding *A.cyreniacum* and limiting its spread near agricultural lands, because of clear inhibitory effects that reduce crop productivity.

Conflict of Interest: The authors declare that there are no conflicts of interest.

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