A Study of the Allelopathic Effect of *Euphorbia heterophylla* L. on Germination and Growth of Seedlings of Wheat, Mustard and Cucumber

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ABSTRACT: *Laboratory experiments were conducted to study the effect of the aqueous extract of the vegetative parts of Euphorbia heterophylla L. and at different concentrations of (5%, 10%, 15%, 20%) on Wheat (Triticum durum), Mustard (Sinapis arvensis) and Cucumber (cucumis sativus) germination and growth. The results showed that the effect was inhibitory the germination percentage in Wheat and Mustard, and the highest inhibition rate reached 44.44 % at the concentration of 20 % in Mustard, while the effect was stimulatory for germination of Cucumber seeds at the concentration of 5% and had no effect at the other concentrations. On the other hand, the effect was inhibitory to the length of the peduncle on Wheat at all the concentrations, and on Mustard at the two concentrations of 15%, 20%, while the effect was stimulatory for the length of the peduncle at the two concentrations of 5%, 10% on Mustard, and in all the concentrations on Cucumber and the highest stimulation rate at the concentration 10% reached at 66.90 %. As for the rootlet, a stimulant effect was observed at the concentration of 5% on Wheat and Mustard and an inhibitory effect at the other concentrations, while the effect was inhibitory at all concentrations on Cucumber and the highest rate of inhibition on Wheat at concentration 20% reached 44.71 %. The inhibition is attributed to allelopathic antibiotic compounds found in the aqueous extract of Euphorbia heterophylla L., which adversely affects test plants.*

Keywords: Euphorbia heterophylla, Alellopathy, germination, growth.

I. INTRODUCTION

Herbs cause major economic losses on agricultural crops as a result of their competition as the percentage of production loss exceeds 24%. The damage caused by herbs is not limited to their competition to the requirements of life, but exceeds them to the allelopathic effect, which increases the amount of damage to plant crops [1].

The phenomenon of allelopathy was known about 300 BC ago, when the Greek botanist Theophrastus was the first to realize the allelopathic characteristics of some plants when he noticed and recorded that chickpea plants spoil the soil and destroy herbs [2]. Allelopathy is the mechanism, by which chemical compounds called Allelopathic compounds or Allelochemicals, are produced, and which are considered secondary Metabolic products (metabolites), and can be produced from various plant parts (leaves, stems, roots, flowers, and fruits) and these compounds can get released to the surrounding in several ways: Leaching, Volatilization, Root exudation. They can also be caused by the decomposition of plant waste in the soil by microorganisms. In general, the release of allelopathic compounds by the aforementioned methods will be stabilized in the soil and may be absorbed directly from neighboring or accompanying plants or be subjected to chemical or biological transformations so that they change the characteristics and nature of the soil, which is reflected adversely or positively on the plant cultivated in the soil [3].

Euphorbia heterophylla L. species (Euphorbiaceae) is considered a highly competitive herb and responsible for large agricultural losses in some crops such as soybeans and Maize [4]. There are many studies on the Allelopathic effect of this specie on many crops and herbs, including a study of root extracts of *Euphorbia heterophylla* L. showed that it has a toxic effect on the germination and growth of the two species, *Sorghum bicolor*, *Lactuca sativa* [5]. A study of 10 types of herbs on the germination and growth of Maize (*Zea mays* L.) showed that the type *Euphorbia heterophylla* L. has an inhibitory effect on the seed germination percentage and the length of the peduncle and rootlet, especially when using leaf extract [6].

In a study conducted to find the allelopathic effect of three types of herbs: *Cyperus rotundus* L., *Bidens pilosa* L., and *Euphorbia heterophylla* L. on germination and growth of four types of leafy vegetables, the results showed a decrease in the

germination percentage of seeds, the length of the peduncle and rootlet, and the average of germination speed of all tested vegetables. The two types *Bidens pilosa* L., *Euphorbia heterophylla* L were the most inhibitory [7].

A study by re. [8] on five types of herbs for germination and growth of *Sorghum vulgare* Pers. (Jawar) seeds, showed that *Euphorbia heterophylla* L had a mild inhibitory effect on seed germination, peduncle and rootlet length. As a result of great spreading of *Euphorbia heterophylla* L. in agricultural fields, it was necessary to study the possible or potential allelopathic effect on crop plants. Therefore, this study aims to study the effect of the aqueous extract of *Euphorbia heterophylla* L. on the germination and growth of Wheat, Mustard and Cucumber seeds.

II. MATERIALS AND METHODS

Euphorbia heterophylla L. plant samples were collected from various locations in Lattakia Governorate in 2019 and the plant's vegetative parts were air-dried at room temperature. Three types of crop plants: Wheat, Mustard, and Cucumber were chosen to determine their sensitivity to the studied specie. The experiment was designed using the method of complete random distribution to study the allelopathic effect of *Euphorbia heterophylla* L. in petri dishes and an agar agar environment.

A) Preparing the Extract

Air dry parts were ground to powder and then 20 g of the powder were taken and put in 100 ml distilled water and stirred by magnetic vibrator for 24 hours, and then the extract was filtered by 1 mm waltman filter paper and concentrations of 15, 10, 5% were prepared by adding distilled water and distilled water alone was used as a control.

B) Preparing Cultivation Milieu (Medium):

Agar agar was used as a culture medium [9] and it was prepared by adding 8 g of agar to 1 liter distilled water and placed on the heater until complete dissolution, then the environment was sterilized by Autoclave at a temperature of 121 °C for a period of 20 minutes, then the agar was poured in Petri dishes of 15 cm diameter at a rate of 40 ml per dish and 4 replicates were prepared for each treatment. The seeds of each plant were sterilized separately with a sodium hypochlorite solution of 5% concentration for two minutes to prevent contamination, and then were washed with distilled water and distributed after drying on the surface of the agar agar environment and 5 ml of extracts according to the used concentrations of (5%, 10%, 15%, 20%) were added and Distilled water as a control. The dishes were covered and placed in the incubator at 22 ° C for 7 days.

The statistical study analyzed the results statistically and calculated the value of the least significant difference L.S.D among the treatments themselves and between the control and the treatments using the statistical program (Genstat 12 edition) and the least significant difference between the averages (1%).

III. RESULTS AND DISCUSSION

A) Effect of aqueous extract of Euphorbia heterophylla L. herb on germination and growth of Wheat, Mustard, and Cucumber plants:

For wheat plant (*Triticum Durum*): It was found from Table (1) that the concentrations used had an inhibitory effect on the germination percentage where the germination percentage decreased with increasing concentrations and the germination percentage decreased to 50% at concentration of 20% and no significant differences were observed among the same treatments while a significant difference was found between The control and the two concentrations of (15%, 20%). As for the length average of the peduncle, the effect was also inhibitory with the increase in concentration and the peduncle length reached 1.72cm at the concentration of 20%. We did not notice any significant differences between the control and the concentrations used, while a significant difference was observed between the concentration of 5% and the concentration of 15 %, and between the concentration of 20% and the two concentrations of (5%, 10%). In respect to rootlet length, an inhibitory effect that is directly proportional to the increase in concentration was observed, and the highest rate of inhibition was at the concentration 20%. No significant difference was observed between the control and the two concentrations of (5%, 10%), while a significant difference was found between the control and the two concentrations of (15%, 20%) and a significant difference between concentration of 5% and the two concentrations of (15%, 20%) and between concentration of 10% and the two concentrations of (15% , 20%) .

Table (2): shows the germination percentage, the length average of peduncle and root of Wheat.

	Average germination%	Average peduncle length cm	Average root length cm
Control	a 85	abc 2.92	a 5.08
Concentration 5%	ab 65	a 3.56	a 5.83
Concentration 10%	ab 60	ab 3.02	a 4.71
Concentration 15%	b 52.5	bc 2.07	b 2.84
Concentration 20%	b 50	c 1.72	b 2.81
LSD	26.76	1.16	1.46

Figure 1: the length of the peduncle and the rootlet varies with increasing concentration in wheat

For the Mustard plant (*Sinapis arvensis*), an inhibitory effect of *Euphorbia heterophylla* L. on germination percentage was found and was proportional to the increase in concentration, significant differences were found between the control and the treatments. A significant difference was also found between the concentration of 5% and the concentration of 20%. As for the length of the peduncle, the effect was stimulatory at the two concentrations of 5% and 10% where the length of the peduncle reached 9.31cm at the concentration of 5% and to 7.47cm at the concentration of 10%, while the effect was inhibitory at the two concentrations of 15% and 20% and there were no significant differences between the control and the treatments nor among the treatments themselves. As for the rootlet length, the effect was stimulatory at the concentration of 5% where rootlet length reached 5.80cm, while the effect was inhibitory at the concentrations of 10%, 15%, 20%, and there were no significant differences among the treatments themselves and between the control and the treatments Table (2).

Table (2): shows the germination percentage, the length average of peduncle and rootlet of Mustard.

	Average germination%	Average peduncle length cm	Average root length cm
Control	a 90	a 7.31	a 4.53
Concentration 5%	b 72.5	a 9.31	a 5.80
Concentration 10%	bc 65	7a 7.4	a 4.34
Concentration 15%	bc 57.5	a 7.18	a 4.13
Concentration 20%	c 50	a 6.89	a 3.75
LSD	15.69	4.03	3.05

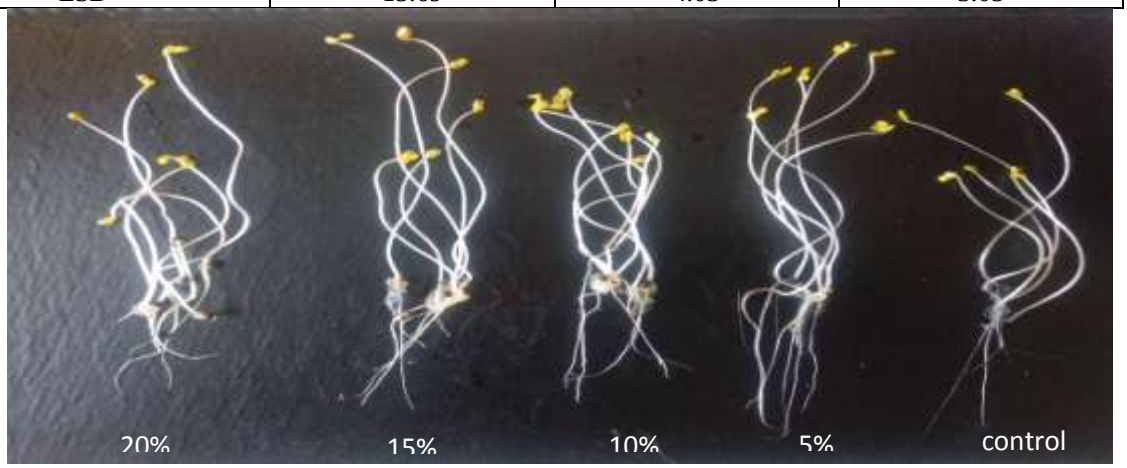

Figure (2): The length of the peduncle and the rootlet varies with increasing concentration in Mustard

As for the Cucumber (*cucumis sativus*) plant, the extract had a stimulatory effect on the germination percentage at the concentration of 5% where the germination percentage reached 95%, while the other concentrations had no effect on the germination percentage. It had a stimulatory effect on the length of the peduncle, the highest peduncle length was recorded at the concentration of 10% and reached 16.94cm, and there were no significant differences among the treatments themselves and between the control and the treatments. With regard to the length of the rootlet, an inhibitory effect of the concentrations used was observed, and the lowest rate of inhibition at the concentration of 10% was recorded, while the highest inhibition rate at the concentration of 20% and the rootlet length reached 8.23cm. No significant difference was observed among the treatments themselves but a significant difference between the control and the two concentrations of 15%, 20% was found.

Table (3): shows the germination percentage, the length average of the peduncle and the rootlet of Cucumber

	Average germination %	Average peduncle length cm	Average root length cm
Control	a 90	a 10.15	a 13.08
Concentration 5%	a 95	a 11.76	ab 9.87
Concentration 10%	a 90	a 16.94	ab 10.61
Concentration 15%	a 90	a 12.74	b 8.56
Concentration 20%	a 90	a 15.68	b 8.23
LSD	31.83	6.298	3.709

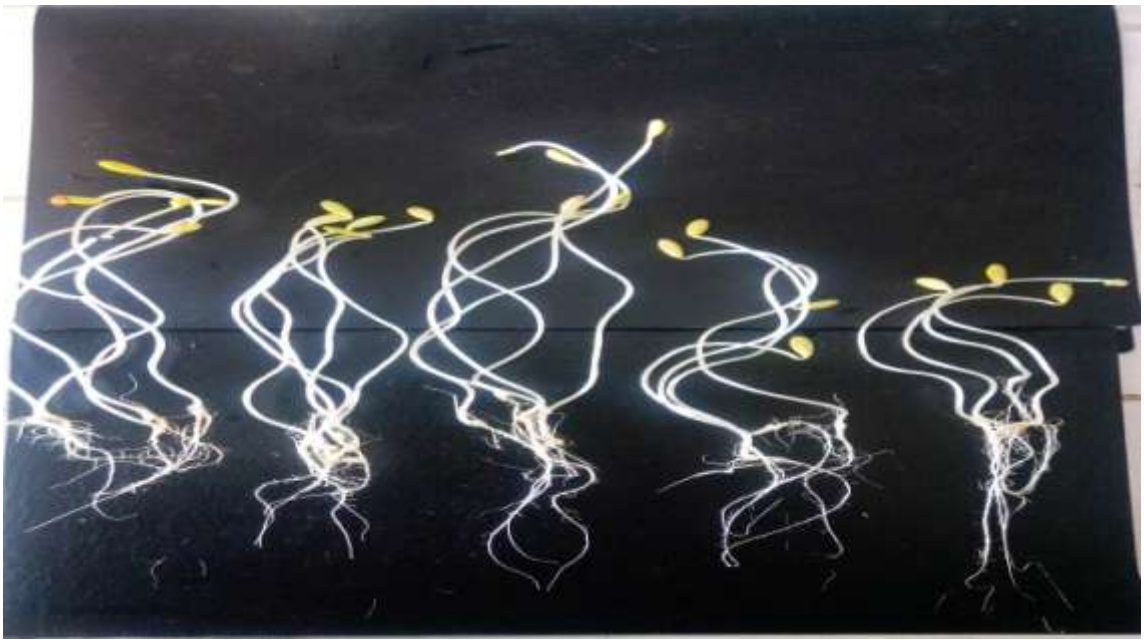

Figure (3): The length of the peduncle and the rootlet varies with increasing concentration in cucumber

The difference in the effect of the aqueous extract of the *Euphorbia heterophylla* L. is attributed to the chemical and physical properties of allelopathic compounds that are soluble in water, which affects adversely or positively in test plants, especially at the lowest concentration where it has a similar hormonal nature in the effect of some growth regulators such as gibberellin that stimulates the growth of vegetative parts [10]. (An *et al*.1997). This may be due to the effect of antibiotic compounds on cell division and elongation by affecting the action of regulating hormone of growth [11].

Therefore, we note the stimulatory effect of the length of the peduncle, in contrast, we note that allelopathic compounds that inhibit the length of the

root system work to bind with the enzymes and reduce their effectiveness, especially the reactions that lead to the synthesis of oxine as it impedes its composition or is installed in very small quantities that are not sufficient to elongate the root [12]. It is also observed that some compounds have an inhibitory effect at high concentrations, while their effect is stimulated in low concentrations, or a slightly inhibitory effect [3].

B.)Comparing the effect of aqueous extract on the germination and growth of Wheat, Mustard, and Cucumber seedlings.

The aqueous extract of *Euphorbia heterophylla* L. showed an inhibitory effect of germination of Wheat and Mustard seeds, reaching 41.18% at concentration of 20% on Wheat, and 44.44% at concentration of 20% on Mustard, While the concentration of 5% showed an increase in the germination percentage of Cucumber seeds by up to 5.56%, but no significant effect was shown in the germination of seeds at concentrations of 10%, 15%, and 20% (Figure 4).

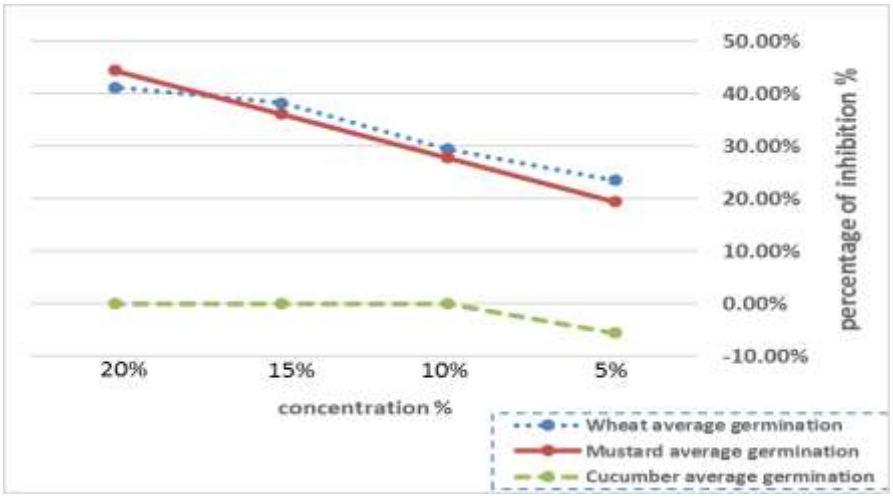

Figure (4): Comparing the effect of aqueous extract on the seed germination percentage of the three studied species.

As for the length of the peduncle, the effect was inhibitory on Wheat, as the rate of inhibition increased by increasing the concentration that it reached 51.56% at the concentration of 20%, while on Mustard, the effect was stimulatory at the two concentrations of 5%, 10%, and then the effect became inhibitory at the concentrations of 15%, 20%. As for Cucumber, the effect was stimulatory in all concentrations, and the highest rate of stimulation at the concentration of 10% reached to 66.90%. Figure 5.

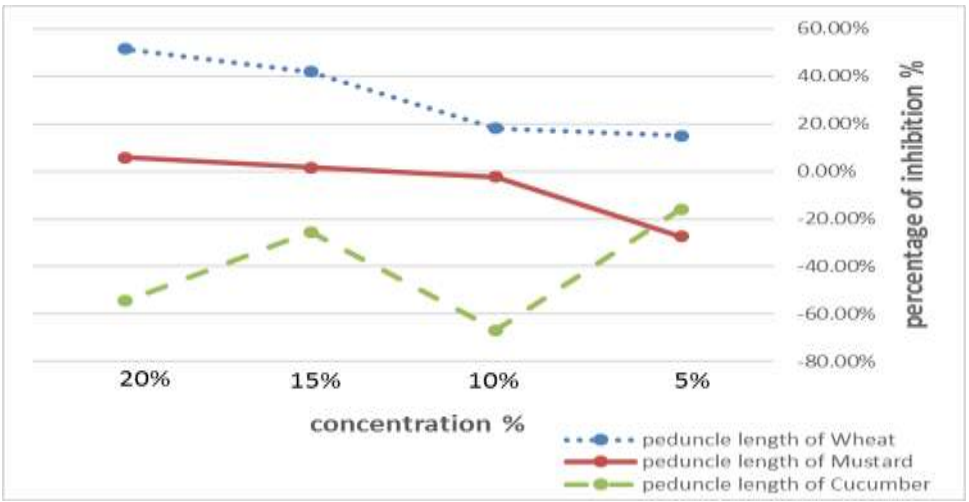

Figure (5): Comparing the effect of the aqueous extract on the peduncle length of the three studied species

Figure (6) shows the comparison of the effect on rootlet length. The effect was stimulatory for Wheat and Mustard at the concentration of 5%, while it was inhibitory at the other concentrations. Wheat was more sensitive as the length of the rootlet decreased to 44.71% at the concentration of 20%. As for Cucumber, the effect was inhibitory at all concentrations where the rate of inhibition was 24.54% at concentration of 5% and the rate of inhibition decreased to 18.88% at concentration of 10%, and then the rate of inhibition at the two concentrations of 15%, 20% increased that it reached 37.08% at concentration 20%.

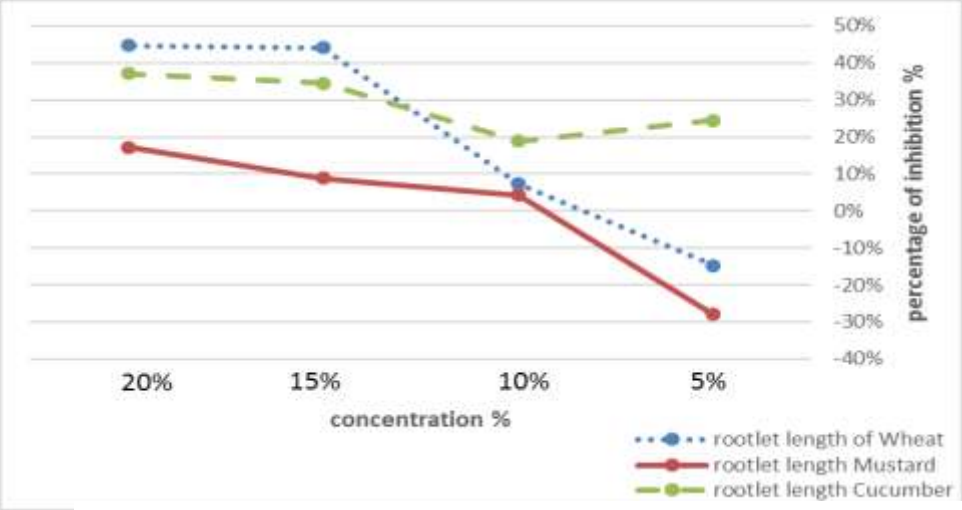

Figure (6): Comparing the effect of the aqueous extract on the rootlet length of the three studied species

CONCLUSION

The results showed an inhibitory effect of *Euphorbia heterophylla* L. on germination of Wheat and Mustard seeds and a stimulatory effect on Cucumber seeds.

The effect was inhibitory on the peduncle length of Wheat seeds, stimulatory at low concentrations and inhibitory at high concentration on Mustard seeds while the effect was stimulatory on Cucumber seeds.

The effect is stimulatory for the length of the rootlet at low concentration and inhibitory at higher concentrations at Wheat and Mustard seeds. As for the Cucumber, the effect was inhibitory in all concentrations.

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