Effect of aqueous extract of *Sorghum halepense* (L.) Pers. on germination and growth of some weed species.

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Abstract-. *Sorghum halepense* (L.) Pers. is one of the most dangerous and widespread weeds in the world. It is an invasive plant that the allelopathic characteristic helps to establish and persist. This weed contains many allelopathic compounds that affect neighboring plants. In this research, the effect of aqueous extracts of the aerial parts of *S. halepense* on weed species; like these *Cuscuta campestris* Yunck., *Lolium temulentum* L., *Amaranthus blitoides* S. Wats., *Amaranthus retroflexus* L. and *Portulaca oleracea* L. as well as on eggplant (*Solanum melongena* L.) seedlings was studied at concentrations of 0, 2, 6, and 10% in greenhouse conditions. The percentage of germination, plant length, fresh weight and dry weight of studied weeds was determined, and the effect of extracts on the length of eggplant seedlings was calculated. It was found that the used eggplant variety is resistant to *C. campestris*, as the seedlings were not successful to parasitize on it, so only the percentage of germination was calculated. The results showed that *S. halepense* has a strong allelopathic effect that suppresses competing weeds in proportions that vary according to the species of weeds and the concentration of allelochemical compounds. The highest percentage of germination prevention was in *P.oleracea*, followed by *A.blitoides* at concentration 10%, and germination percentage for these species at this concentration was 33.67 and 38.95%, respectively. It was also found that the seedlings of the used eggplant variety were not affected by the different concentrations of *S. halepense* aqueous extract.

Index Terms- *Sorghum halepense*, Aqueous extract, Allelopathy, Germination

I. INTRODUCTION

S. halepense is distributed over a third of the total world area, causing significant losses in agriculture and natural biodiversity (Chirita et al., 2007). *S. halepense* is known for its detrimental effects on the growth and development of neighboring plants due to its strong competitive abilities and allelopathic potential (Huang et al., 2015). Allelopathy have harmful or beneficial effects of neighbor plant through the production of secondary chemical compounds that escape into the environment to accomplishment its effects (Khalid et al., 2002). Allelopathic effects are considered as a possible future alternative to herbicides (Uludag et al., 2005) *S. halepense* contains allopathic compounds secreted by roots, stems and roots. These compounds suppress plants growing around *S. halepense* and are found in the soil after the plant dies during degradation (Yazlik and Uremis, 2019). There are many allylochemicals such as phloroglucinol, dhurrin, taxiphylline, chlorogenic acid, 4-hydroxybenzoic acid, 4-hydroxylbenzyl alcohol, and sorgoleon. (Czarnota et al. 2003, Yazlık and Uremis, 2019). Sorgoleone was the predominant constituent identified in each accession's exudate. Other closely related compounds, including 5 ethoxy sorgoleone, 2,5-dimethoxy sorgoleone. Many of these compounds work as phytotoxic and inhibit some biological processes like photosystem II (Czarnota et al. 2003). These substances have a restraint effect on both cultivated plants and weeds. The inhibitory effect of aqueous root extracts on the germination of soybean, pea and vetch seeds varied between 28.8 and 86.3% (Kalinova et al. 2012). Allelopathic activities of *S. halepense* aqueous extract on the alvand variety of wheat have significant effects (Nouri and Tavassoli, 2012). *S. halepense* aqueous extract was found to negatively affect weeds such as *Avena fatua* L., *Lolium temulentum*. *Lathyrus sativa* L. and *Cephalaria syriaca* (L) Schard. The results showed that seedling growth was less for all weed species (Thahir and Ghafoor, 2011). This allelochemical has affected on different factors like the absorption of mineral materials, the relation of water and plant, the present of chlorophyll, respiratory and photosynthesis. For observing the morphologic quantity effects use of biological evaluation of seedling (Alsaadaw et al, 1986). *C. campestris* is the most common and the most important dodder type worldwide, which is a problem with a wide variety of plants, including vegetables, fruits, and ornamentals. It is complete parasite and has been reported as a weed in 25 crops in 55 countries (Lanini and Kogan, 2005). *L. temulentum*, which originated in the Mediterranean, is widespread in temperate regions where wheat and grains are grown (Holm et al., 1991). *L. temulentum* competes with winter crops like wheat and may seriously affect its yield and quality. This weed is found in many winter crops but becomes more harmful in wheat due to its shape and similar growth requirements to wheat during the early stages of development (Singh et al., 1999). *A. retroflexus* is an aggressive and competitive herbivore in a variety of row crops. It causes significant yield loss of cotton, corn, soybeans, and many vegetable crops (Weaver and MacWilliams, 1980). In many countries and crops, *A. retroflexus* is a major problem (Holm et al. 1997). It has been reported that it has allelopathic effects on both weeds and crops (Athanassova, 1996).

II. Materials and Methods

This experiment was execution in 2020 and lasted 40 days in the greenhouse at the Faculty of Agriculture, Kahramanmaras Sütcü Imam University, Turkey. The mean maximum and minimum temperatures ranged between 31-28 and 8-12 C°, respectively. While the average relative humidity was 70% during the trial period and in normal lighting conditions during the months of October and November. The seeds of the tested weeds collected from fields in Kahramanmaras province in 2019 were, washed, dried, and placed in plastic bags in room conditions. The aerial parts of *S. halepense* were collected during the flowering phase and dried in room conditions for a month, then they were ground and stored at a temperature of 10 ° C. In the greenhouse, pots with a height of 22 cm, a top diameter of 21 cm, and a bottom diameter of 15 cm were used. The soil was prepared by consisting of sand, peat, and soil in a ratio of 1: 1: 1, and the pots were filled with this soil. After that, three days before starting the experiment, the pots were sterilized using formaldehyde 37% with water at a concentration of 10%. The aqueous extract of *S. halepense* was prepared at concentrations (0, 2, 6, and 10%), and the concentration of 0% was a control. After the plant material was soaked with water according to the assigned concentration, it was left for 24 hours in room conditions at a temperature of 25± 1 C° then the extract was filtered. Eggplant seedlings variety (brigette 10- 44 f1 kamar), exception of *C. campestris*, the germination rate of the tested weed species was high, so the number of *C. campestris* seeds added to the pots was increased (Almhemed et al., 2020). Also 20 seeds of per weed species that used were added to each pot, according to the treatment (Ustuner, 2002; AL Sakran et al, 2020) and each pot was irrigated with 300 ml of extract intended for it. Germination data were taken three times per week. The length of the eggplant seedlings was also measured immediately after planting. At the end of the experiment, the percentage of germinated seeds was calculated based on the control according to the following formula.

$G= (X/K) \times 100$

G: The percentage of germinated weed seeds in the treatment

X: The number of seeds of germinated weeds per treatment

K: The mean number of seeds germinated in the control

The percentage of seeds that were prevented from germinating under the influence of the extracts was calculated by the following formula:

$P = (1-(X/K)) \times 100$

The seedlings of the weeds were taken, their length and fresh bananas were measured, then they were dried at 55 C° for 3 hours, and after that the dry weight was calculated. The difference between the length of the eggplant seedlings between the beginning and the end of the experiment was also calculated.

III. Results and Discussion

The percentage of *C. campestris* seed germination based on the control was high compared to the rest of the species under the influence of different concentrations of *S. halepense* aqueous extract. There was a significant difference between all treatments of concentrations. The percentage of germination ranged between 85.71% for 2% and 71.43% for concentrations 10%, Table (1) meaning that this concentration prevented 28.57% of the couscous seeds from germinating as shown in Figure (1). Likewise, for *L. temulentum*, the aqueous extract of *S. halepense* impeded the germination of 43% of the seeds at a concentration of 10%, and there was a significant difference between the concentrations. It is clear from Table (1) that the highest percentage of germination was at concentrations 2%.

Table (1). The percentage of germinated weed seeds under the influence of different concentrations of *S. halepense* aqueous extract

Germination rate %					
The concentrations	*C. campestris*	*L. temulentum*	*A. retroflexus*	*A. blitoides*	*P. oleracea*
2%	85.71**a**	80.49**a**	70.59**a**	53.85**a**	77.49**a**
6%	80.95**b**	68.29**b**	47.06**b**	46.15**b**	53.85**b**
10%	71.43**c**	56.10**c**	46.71**b**	38.95c	33.67**c**

Values followed by the same letter(s) in the same column are not significantly different from each other at 0.05 level of probability.

The ability of *A. retroflexus* seeds to germinate under the influence of the extract was affected and ranged between 70.59 and 46.71% for concentrations 2 and 10%, respectively. That is, more than half of the seeds were prevented from germinating, as shown in Figure (1).

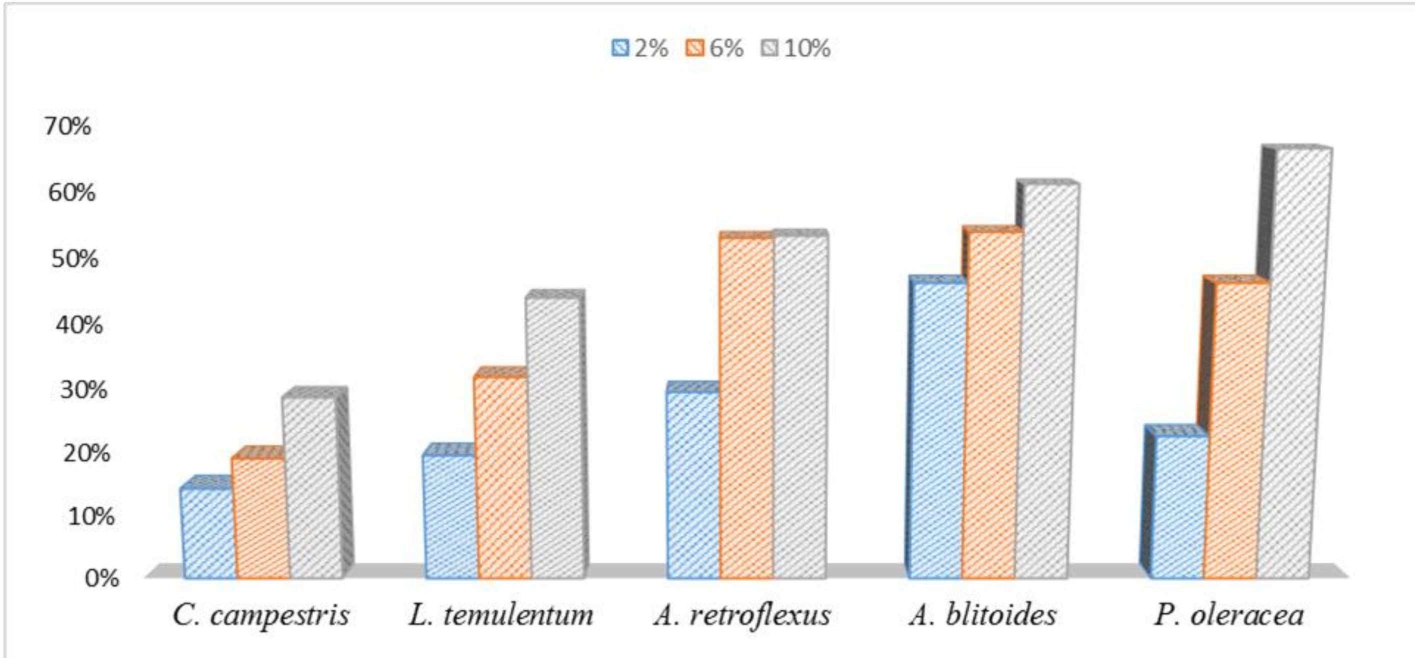

Figure (1). The percentage of preventing the germination of weeds seeds by concentrations of the aqueous extracts of *S. halepense.*

The results also showed that there was a significant difference between the concentrations 2 and 10%. The germination rate of *A. blitoides* ranged between 53.85 and 38.95% for each of the concentrations 2 and 10%, respectively, while the germination percentage of *P. oleracea* at concentration 2% was 77.49% and 33.67% at concentration 10%, Table (1). Figure (1) shows that the aqueous extract at the highest concentration reduced the germination of *A. blitoides* and *P. oleracea* by 61.05 and 66.33%, respectively.
Plant length, fresh weight and dry weight were affected by the aqueous extracts of *S. halepense*, and the increase in concentration also had an increase in the effect, except for *A. retroflexus*, the effect of concentration 6 and 10% on these indicators was similar as shown in Table (2, 3). The weeds most affected in terms of length were both *A. retroflexus* and *P. oleracea* at concentration 10%, as shown in Table (2), and both fresh and dry weight were significantly affected compared to all species of weeds. And *L. temulentum* was the most affected at 10% concentration with respect to fresh and dry weight, as shown in Table (3). Thahir & Ghafoor (2011), showed that the aqueous extract of sorghum influenced reducing the percentage of germination and seedling development of several species of weeds, including *L. temulentum*.
Table (2). Seedlings length under the influence of different concentrations of *S. halepense* aqueous extract

Plant length/cm					
The concentrations	*L. temulentum*	*A. retroflexus*	*A. blitoides*	*P. oleracea*	*S. melongena*
0%	36.4a	20.0a	9.4a	10.13a	8.89 a
2%	35.3b	16.5b	6.87b	8.37b	8.92 a
6%	30.0c	12.5c	5.4c	6.13c	8.88 a
10%	28.6d	7.5d	4.63d	3.73d	8.83 a

Values followed by the same letter(s) in the same column are not significantly different from each other at 0.05 level of probability.

Although eggplant was recorded as a host for *C. campestris*, as Bashar (2019) indicated that can cause a 64.11% decrease in eggplant yield. In this experiment *C. campestris*, the seedlings did not succeed in intruding on seedlings of the used eggplant variety, despite their wrapping on it. Perhaps the reason is due to the resistance of the used variety, as it was noticed that the stem is lignified from the bottom quickly Figure (2). Therefore, the germination percentage was calculated only for the *C. campestris*.
No significant difference was observed between the lengths of the eggplant seedlings in the coefficients of concentrations between them on the one hand and between them and the control on the other hand. That an evidence that *S. halepense* extracts had no effect on seedlings of the eggplant variety used.

Figure (2). Death of the *C. campestris* seedlings despite their success in reaching the host (eggplant) and wrapping it around

Table (3). Effect of *S. halepense* aqueous extract concentrations on fresh and dry weight of seedlings

The concentrations	*L. temulentum*		*A. retroflexus*		*A. blitoides*		*P. oleracea*	
	fresh	dray	fresh	dray	fresh	dray	fresh	dray
0%	12.42a	2.71a	10a	1.96a	1.12a	0.266a	12.54a	2.04a
2%	8.995b	1.97b	7.73b	1.53b	0.385b	0.074b	3.89b	0.64b
6%	5.525c	1.21c	5.25c	1.04c	0.2915c	0.07c	3.77bc	0.61bc
10%	4.645d	1.03d	5.175c	0.91c	0.1825d	0.044d	3.705c	0.6c

Values followed by the same letter(s) in the same column are not significantly different from each other at 0.05 level of probability.

IV. Conclusions

The results of this experiment showed that *S. halepense* has allopathic effects that impede the germination and growth of studied weeds in varying proportions that vary with different species of weeds, and the effect increases with increasing concentration and this is consistent with what was indicated Kalinova et al. (2012). Except for *A. retroflexus*, where an increase in concentration of 6% had no effect on germination percentage, fresh and dry weight, and no effect of the extracts was observed on eggplant length. The results of this experiment confirm the idea that great ability to of *S. halepense* invasion is enhanced by an allelopathic effect that suppresses the growth and development of competing weeds. As well as the possibility of using these allelochemicals to reduce the weed population growing in the crop fields, provided that the absence of negative effects of these extracts on the cultivated plant is tested.

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