HERBICIDAL EFFICIENCY OF *Alhagi maurorum* FORMULATED EXTRACT AGAINST WHEAT SEED AS PATTERN FOR MONOCOTYLEDONOUS PLANTS

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ABSTRACT

This work is aimed to investigate the herbicidal activities of *Alhagi maurorum*, extracts against wheat as pattern for monocotyledonous plants. N.hexane, methylene chloride, ethyl acetate and methanol solvents were used in extraction. Three plant parameters, seed germination, root and shoot growth of wheat were taken as indicators for *A.maurorum* herbicidal efficiency**.** The most potent extract was used in the formulated form by using suitable solvent and emulsifier. The *A.maurorum* methanol extract was formulated as 30 % emulsifiable concentrate (EC), then their herbicidal effect was re-evaluated against wheat, it showed inhibition percentages against germination, root and shoot growth more than its methanol extract. This means that the formulation increased the herbicidal efficiency of initial extract.

KEYWORDS: *Alhagi maurorum* extract, germination, root and shoot growth and emulsifable concentrates

1. INTRODUCTION

Interference of weeds with agricultural crops causes enormous financial losses in agro-ecosystems **(Batish, et al., 2007)**. They are usually controlled by using of mechanical methods and synthetic herbicides as well. Meanwhile, mechanical methods are labor intensive and time consuming and using of herbicides not only creates perceived hazardous impacts on agricultural products but also enhances environmental pollution. Additionally, the risk of weed resistance development and high cost-benefit ratio are other disadvantages of synthetic herbicides and pesticides usage **(Batish, *et al.*, 2007 and Kordali, *et al.*, 2009)**. Weed control is one of the expensive and time-consuming activities in agriculture. Some of the plant products have an important role in allelopathy and their inhibitory effects on the other plants growth and germination have been reported **(Younesabadi, 2005)**. Recognition of new plants containing strong allelopathic potential, which may result in greater weed control, is very important to reduce the use of synthetic herbicides for weed management and therefore cause less pollution and safer agricultural products **(Singh, *et al.*, 2003; Khanh, *et al.*, 2007)** but more comprehensive studies are necessary for demonstrating their herbicidal potential.

The family Leguminosae is comprised of about 550 genera and more than 13,000 species **(Bolus, 2000)**. This family provides us with many edible plants as well as a variety of medicinal plants that constitute an important source of raw materials for industries. *Alhagi maurorum* Boiss (Leguminosae) also called is a species of legume commonly known, variously, as camelthorn, camelthorn bush,Caspian manna, and Persian manna plant. This name is linked to the capacity of this plant to exude a sweet resin that hardens and can be collected by shaking the bushes over a cloth spread on the ground **(Blume, 1985)**. This natural sweetener

is native to the region extending from the Mediterranean to Russia, but has been introduced to many other areas of the world, including Australia, southern Africa, and the western United States **(Church, 2007)**. It is widely used in folk medicine as an antitumor, anti-asthmatic, aphrodisiac, antipyretic, appetizer, antirheumatic, digestible, tonic, diuretic, demulcent, expectorant, laxative, cholagogue, and for the treatment of bronchitis and skin diseases **(Brown, 1995)**. *Alhagi maurorum* medic (Family:Fabaceae (Leguminosae) it is a plant of tropical and subtropical regions, found in Africa, abundant along riverbanks, canals, irrigation ditches and sometimes in cultivated field. It is very much branched with rigid spiny twigs about 1m in long. Leaves deciduous simple, small, present at base of each side twig, obviate to oblong, shortly petiolate, with rounded tip, up to 2 cm. Chemical investigation of the Alhagi species also revealed the presence of several compounds such as fatty acids and sterols, flavonoids, coumarins, alkaloids, glycosides, steroids, terpenoids, resins, tannins and vitamins are found in different extracts are the active constituents of *Alhagi* species **(Awaad Amani et al., 2006).**

The aim of this study was to investigate the herbicidal effect of *Alhagi maurorum medic* extracts on the seed germination, number and mass of wheat as model to monocotyledonous plants (*Triticum aestivum* L.) under laboratory conditions.

2. MATERIALS AND METHODS

2.1. Collection of (camel thorn) and their Extract preparation:

The plant was collected from roadsides or agricultural field margins of Giza. The aerial plant parts were partially dried at room temperature (26 ± 1°C) for five days and grounded using electric blender. The dried powders were stored at -20°C under dry condition until extraction. Sequential extractions were performed with organic solvents of increasing polarity: n.hexane, methylene chloride, ethyl acetate and methanol. Fifty grams of dried powder of each plant sample were soaked in the stated organic solvent for 7 days at room temperature then filtrations was carried out by using anhydrous sodium sulfate. The organic extracts were evaporated to dryness under reduced pressure at 45–50◦C, using a rotary evaporator. The residue was weighed and yield was determined. To prevent contaminating from external environment, the purified extracts were kept in the refrigerator at 5◦C until used. The herbicidal effects of the extracts were tested at six concentrations (0.5, 1,2,4,8 and 16 mg/ml)

2.2. Laboratory bioassays:

Petri-dish experiment was applied to investigate the herbicidal effects of *Alhagi maurorum* extracts on germination of wheat (*Triticum aestivum* L.). 30 seeds of wheat (monocotyledon) as a test plant were soaked in different tested concentrations for 20 sec. Each ten seeds were transferred to petri dish 9cm diameter, lined with two layers of whatman No.1 filter paper and wetted with 6 ml of distilled water, Petri dish was sealed with (PVC) electrical insulting tape. The distilled water was used as a control treatment. Treatments were arranged in a completely randomized design with three replications. Seeds were observed daily and the germination was determined by counting the number of germinated seeds at 24h intervals during 6 days.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds on petri dish}} \text{X100}$$

Shoot and root lengths were measured after seeds from control plate germinated. Data were transformed to percent of control for analysis.

The most effective plant extracts were selected for further experiments.

2.3.Preparation and characterization of emulsifiable concentrate formulation:

The formulated extract was prepared weight / volume (w/v.) in the form of emulsifiable concentrate according to the procedure of knowles (2008) for the purpose of evaluating of the physical properties of such formulation according to FAO and WHO specifications (2002). For the following characteristics: Spontaneity, emulsion stability, Foam test, Sedimentation, cold and heat stability tests for local formulation whereas the following properties were studied for spray solution, pH values were determined by using pH - meter (SCHOTT CG818), Conductivity was measured by water instrument YSI model 33S-C-T. Where μ MHOS is the unit of electric conductivity measurement, surface tension was measured by du Nouy tensiometer, and Viscosity was measured by using Brook Field apparatus.

2.4. Bioassay of the local formulation:

The experiment of bioassay was repeated in the same manner as mentioned before with plant extracts.

2.5.Statistical analysis:

Inhibition percentages were corrected using **Abbotts formula (1952)** and values were analyzed by **Finney(1971)**. The EC_{50}, and slope values were determined using Probit analysis

3. RESULTS AND DISCUSSION

The data in table (1) showed that, no significant effect on germination of wheat seeds as resulting to treatment with tested concentration of all extracts of *A.maurorum*. Where, the percent of germination in all tested extracts was approximately 100% except seeds treated with the highest concentration of the all plant extracts (8 - 16 mg/ml).

On the other hand, the methanol extracts reduced root and shoot length of wheat more than other extracts at all concentrations (Table 2). The methanol extracts recorded the highest inhibitory effect at 16 ppm concentration and reduced root and shoot length by 39.5%, 42.9%, respectively.

Table 1: Effect of *Alhagi maurorum* extracts on germination of wheat seeds under laboratory conditions

Concentration (mg/ml)	Percentage of germination			
	NH	Mchl	Ethas	Methanol
Control	100	100	100	100
0.5	100	100	100	100
1	100	100	100	100
2	100	100	100	100
4	100	100	96.66	93
8	93	90	90	86.66
16	90	86.66	83.33	73.33

With another point of view the lower concentrations (0.5, 1, 2 and 4 mg/ml) of all tested extracts caused increase of root and shoot length of wheat than control. This result about stimulatory effect of *Alhagi maurorum* is similar to **Younesabadi, *et.al.*, (2014)** who stated that the lowest concentration of the aqueous extract of *Alhagi graecorum* stimulated elongation of root and shoot of *Abutilon theophrasti*, while the highest concentration was inhibitory. On contrast, the highest concentration of plant extracts inhibited elongation of both root and shoot length of wheat (8 and 16 mg/ml). These results are in agreement with the literature in the fact that the inhibitory effect is dependent on the extract concentration (**AL-Sherif, *et al.*, 2013; El-Darier, 2002 and Ghareib, *et.al.*, 2010**). The inhibitory effect of the extracts was found to vary with the solvent used for extraction.

On the basis of Inhibition percentages the methanol extract was more toxic than methylene chloride, ethyl acetate and n-

hexane extracts. Reduction in growth may be attributed to water stress that reduces cell expansion or due to structural changes in membranes of the cells including alteration in membrane portions **(Einhellig, 2004).** Reduction in seed germination could be due to the reduction or delay in reserve mobilization under allelopathy stress conditions **(Gniazowska and Bogatek, 2005).** It was also found in many studies that allelochemicals, which inhibited the growth of some species at certain concentrations, might stimulate the growth of same or different species at lower concentrations **(Narwal, 1994).**

Table 2: Effect of *Alhagi maurorum* extracts on growth of root and shoot length of wheat seeds under laboratory conditions

Concentration mg/ml	NH		Mchl		Ethas		Methanol	
	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot
Control	15.3	11.68	15.3	11.68	15.3	11.68	15.3	11.68
0.5	19.88	17.53	18.15	15.62	17.47	13.19	15.63	12.93
1	18.39	15.36	16.94	14.70	16.93	12.52	14.29	11.36
2	16.89	14.97	15.71	13.14	15.77	11.87	12.48	10.87
4	15.33	13.84	15.06	12.17	14.58	10.32	11.56	9.27
8	14.96	11.41	14.53	11.45	12.76	9.92	9.87	8.53
16	13.74	10.17	12.98	10.39	10.34	9.31	9.25	6.78

3.1.Toxicity testing of formulated plant extracts:

As shown in Table (3), the formulated extracts were more toxic than the non-formulated extracts. It showed the highest herbicidal effect against shoot growth followed by root growth and germination, the respective EC_{50} values were 14.51, 16.49 and 32.8 mg/ml. This means that, the activity of the tested extracts increased as a result to formulation. This indication may be due to the role of the additives (emulsifiers and solvents) that was added to plant extract to improve the physical properties of this extract according to **Mohammed (2010),** formulation was the processing of a compound by any method which will improve the properties of storage, handling, application, effectiveness and safety. As regards to the toxicity index, the toxicity of plant extract was 44% compared with its formulation that recorded 100% toxicity.

Table 3: Toxicity Effect of *Alhagi maurorum* extracts and it's formulation on germination, growth of root and shoot length of wheat seeds

	EC_{50} (mg/ml) of Inhibition of germination	**EC_{50} (mg/ml)**		**Slope**		**Toxicity index**	
		Root	Shoot	Root	Shoot	Root	Shoot
Extract	38.55	36.89	29.18	0.8233	0.9604	44.731	49.74
Formulated extract	32.80	16.49	14.51	0.8051	0.8908	100	100

EC_{50} is the effective concentration that inhibits 50 % of the sample under study calculated.

3.2.Physical properties of the emulsifiable concentrate formulations (30% EC) of botanical extracts:

Table 4 showed the physico-chemical properties of the prepared local EC formulation. The prepared formulation passed successfully emulsion stability test also there is no oil separation, precipitation or cream separation. For the spontaneity the prepared EC. of the *Alhagi maurorum* methanol extract gave the highest percentage (94%) in T.W. Also there were no changes in the physico-chemical properties of the prepared local EC. formulation before and after heat and cold storage test.

Table 4**:** Physical properties of ethanol extract 30% emulsifiable concentrate formulation before and after heat and cold storage test :

physical properties		Spontaneous stability	Emulsion stability	Heat test	Cold test
Type of water	T.W.	94%	Stable	Pass	Pass
	H.W.	85%	Stable	Pass	Pass
	S.W.	78%	Stable	Pass	Pass

T.W: tap water. H.W.: hard water. S.W.: soft water.

Data in table 5 demonstrated the physical properties of spray solution of the prepared formulation. For conductivity, surface tension of spray solution tests, showed the highest values1225 µMHOS and 30.18 dyne/cm in H.W,. respectively. As the highest values of pH, and viscosity were 5.92 and 10.82 cm/poise in T.W., respectively. The decrease pH value of spray solution would lead to the deionization of insecticides with an increase in its deposit's and penetration in the tested surface with a consequence increase in their insecticidal efficiency **(Green and Hale, 2005).** It was also shown that the decrease in surface tension of pesticides spray solution gives a prediction of increasing wettability and spreading over tested surface with increasing pesticidal efficiency **(Osipow, 1964).** Also increasing viscosity of spray solution cause reduction drift and an increase in retention sticking and insecticidal efficiency **(Spanoghe *et al.*, (2007).** According to **El-Attal *et al.* (1984**) increased electric conductivity of the formulated extracts was coupled with increased mortality rate due to increased deposition and penetration of the formulated extracted particles.

Table 5: Physical properties of spray solution (0.5 %) of the local prepared formulation.

physical properties		pH	Conductivity (µMHOS)	Surface tension (dyne/cm)	Viscosity (cm poise)
Type of water	T.W	5.92	360	29.94	10.82
	H.W	5.76	1225	30.18	10.54
	S.W	5.35	170	29.86	10.37

T.W: tap water. H.W.: hard water. S.W.: soft water

4. CONCLUSION

All extracts from *Alhagi maurorum* plant showed no inhibition effect on germination of wheat, except methanol extract that showed good inhibition percentages against shoot and root growth. On the other hand its emulsifiable concentrate formulation showed an observed inhibition effect on germination, shoot and root growth by greater degrees than its extract, so that it could be used in the field of pest control after carrying out the necessary studies in the future.

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الملخص العربى

الكفاءة الابادية لمستحضر مستخلص نبات شوك الجمل كمبيد حشائش ضد القمح كنموذج للحشائش ذات الفلقة الواحدة

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قسم بحوث مستحضرات المبيدات - المعمل المركزى للمبيدات - مركز البحوث الزراعية

يهدف هذا العمل الى تقدير الكفاءة الابادية لنبات شوك الجمل على نبات القمح كنموذج للحشائش ذات الفلقة الواحدة. حيث استخدم اربع مذيبات هى الهكسان العادى، كلوريد الميثيلين، خلات الإيثيل و الميثانول فى أستخلاص نبات شوك الجمل. و قد إتخذت ثلاث معايير لإثبات أن نبات شوك الجمل له كفاءة إبادية للحشائش و هم إنبات البذور، نمو الجذر و نمو الساق. ثم تم اختيار المستخلص ذو الكفاءة الأعلى لتجهيزه على صورة مركز قابل للاستحلاب باستعمال مواد مستحلبة ومذيبات مناسبة. حيث وجد أن مستحضر مستخلص الميثانول أكثر كفاءة إبادية عن المستخلص نفسه.