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Allelopathic Effect from some Medicinal Plants and Their Potential Uses as control of weed

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Abstract. The aim of the present study was to investigate the potential allelopathic effects of *Euphorbia* guyoniana and *Retama retam,* (donor species) aqueous extract on germination efficiency of two weeds (*Bromus tectorum* and *Melilotus indica*) and one crop species (*Triticum aestivum*) under laboratory conditions. The germination efficiency, plumule and radicle length of *Bromus* was completely inhibited at the highest concentration of aqueous extracts of the donor species level (10%). the two recipient species exerted weak measures as affected by the highest concentration level of all donors. This inhibition was markedly in obvious *Bromus tectorum* than in *Melilotus indica* indicating that *Bromus tectorum* is more sensitive to all of tested donors, while the *Melilotus indica* is more adapted to the aqueous extract than the *Bromus tectorum*.

Key words: Allelopathy , Medicinal plants, Germination, Weeds.

1. Introduction

The definition so that the term allelopathy refers to any process involving secondary metabolites (allelochemicals) produced by plants, microorganisms, viruses and fungi that influence the growth and development of agricultural and biological systems including positive and negative effects. Allelochemicals from plants are released into the environment by exudation from roots, leaching from stems and leaves or decomposition of plant material [1, 2, and 3]. Plants or organisms that release these compounds are called "donor species", while those that are influenced in their growth and development are called "target or recipient species". Allelopathy includes plant-plant, plant-microorganisms, plant-virus, plant-insects, and plant-soil-plant chemical interactions. Allelopathic effects can be stimulatory or inhibitory, depending on the identity of the active compound on the static and dynamic availability, persistence and fate of organics in the environment and on the particular target species [4].Allelopathy offers the potential for biorational weed control through the production and release of allelochemicals from leaves, flowers, seeds, stems and roots of living or decomposing plant materials [5]. Also, allelopathy is generally accepted as a significant ecological factor in determining the structure and composition of plant communities **[6]**.The weed have allelopathic superiority over crops besides their competition superiority [7]. In allelopathy, relations between weeds and crops, between weeds and weeds and between crops and crops [1, 8]. because the modern agriculture relays on synthetic chemicals to get rid of these unwanted plants.

Contemporary research in allelopathy focuses on isolating, identifying and quantifying specific active allelochemicals. Once these substances are identified and characterized they can be used either as natural herbicides [9].Medicinal plant, had inhibitory effects[10.11] on selected weeds and its allelochemicals inhibiting weed growth was identified [11**]. In addition, the previous results**[12,13].confirmed that it was

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easier to screen allelopathic plants from medicinal plants than other plants possibly because there existed certain metabolic compounds curing many diseases of mankind in medicinal plants.

The present research is a part of a specific study carrying out in Algeria to explore the allelopathic effects of *Euphorbia guyoniana* and *Retama retam,* (donor species) aqueous extract on germination efficiency of two weeds (*Bromus tectorum* and *Melilotus indica*) and one crop species (*Triticum aestivum*) under laboratory conditions.

2. Material and Methods

A number of fresh samples from the aerial shoots of the donor species were collected from the natural habitats in the study area during the vegetative stage. The samples were air- dried then after ground in a Wiley Mill to fine uniform texture and stored in glass jars until use. Stock aqueous extract was obtained by soaking 50 g air-dried plant material in 500 ml of cold distilled water (10% w/v) at room temperature (20 ±2°C) for 24 hours with occasional shaking. The mixture were filtered through two layers of cheesecloth and centrifuged for 20 min. at 10.000 r.p.m to remove particulate material and the purified extract was adjusted to pH 6.8 with 1M HCl. Different concentrations (2.5, 5, 7.5 and 10%) were prepared from the stock solution in addition to the control (distilled water). To achieve this experiment, ten seeds of each of the weed and crop species were arranged in 9-cm diameter Petri-dishes lined with two discs of Whatman No.1 filter paper under normal laboratory conditions with day temperature ranging from 19-22°C and night temperature from 12-14°C. Two ml of each level of the donor species extract (2.5, 5, 7.5 and 10%) were added daily to three replicates. Before sowing, the seeds were surface sterilized with 2% sodium hypochlorite for 2 minutes then rinsed four times with distilled water. The sterilized seeds were soaked in aerated distilled water for 24 hours. The germination percentage (GP), plumule (PL) and radicle length (RL) were recorded after one weak at the end of the experiment. Relative reduction or stimulation of seed germination and radicle length as affected by the allelopathic substance were calculated according to the general equations:

Statistical analysis: data of the present study were subjected to standard one-way analysis of variance (ANOVA) using the COSTAT 2.00 statistical analysis software manufactured by CoHort Software Company (1986).

3. RESULTS

3.1. The allelopathic effect of *Euphorbia guyoniana*

Germination Percentage (GP)

The GP of *Bromus tectorum* was significantly (P≤0.01) affected by the increase at different concentrations *Euphorbia guyoniana* Aqueous Extract (EGAE). (Table 1 &Figure 1**).** At control and 2.5% EGAE, GP value was about 100%. The percentage was reduced to 36.6% at 5 and 7.5% EGAE concentration level and to 10% at 10% EGAE concentrations. Generally, GP of *Melilotus indica* seeds were apparently varied with of EGAE concentrations (Table 1&Figure 1) which is supported statistically (P≤ 0.01). At control conditions the attained GP values (60%) were increased upon applying 2.5 and 5% EGAE concentrations (55 and 50% respectively). However, this current motivation goes to a marked reduction at 7.5 and 10% concentrations (40 and 35% respectively). Table 1& Figure1demonstrates a great variation in the calculated values of GP of wheat seeds. The GP was significantly (P≤0.01) affected by the increase in EGAE concentrations. at control, 2.5 and 5% EGAE, GP values were about 100%. The percentage was reduced to 95 % at7.5 and 10% EGAE concentration level.

Plumule length (PL)

Findings of PL of *Bromus* tectorum imply the downbeat effect of the allelopathic substances on seedling stage (Table 1& Figure 2**).** Evidently, PL was significantly reduced (P≤ 0.01) either due to each main effect as treatment. Additionally, the value of PL was 19.66 mm at control level. Afterward, it reduced to 10.66 mm at 2.5% EGAE concentration. Expectedly, the maximum allelopathic action of 5, 7.5 and 10% EGAE concentration has completely inhibited PL. The allelopathic effect of EGAE concentration on PL of *Melilotus indica* is illustrated in Table 2& Figure 2, the plumule elongation was not completely inhibited by the extract, but it was less at higher concentration levels. Obviously, all allelopathic concentrations have reduced PL. Statistically, the applied concentrations of EGAE was highly significant (P≤ 0.01). Actually, at control level, PL of *Melilotus indica* was 20 mm. On the other hand, 2.5, 5, 7.5 and 10 % concentrations were considered as inhibitory concentrations (the values about 18, 11.5, 8.5and 2.5mm respectively). The PL of wheat was significantly (P≤ 0.01) either due to each main effect (Table 2& Figure 2). Additionally, The value of PL about 42 mm at control level. Afterward, it reduced to 37.3 mm at 2.5% EGAE concentration. Expectedly, the maximum allelopathic action of 5, 7.5 and 10% EGAE concentration was 26.5, 19 and18mm were recorded.

Radicle length (RL)

A slight difference was observed among *Bromus tectorum* RL assessment in seeds culture (Table 3 & Figure 3). The control value was 34 mm. Elevated EGAE concentrations have possessed a significant inhibitory effect on radical growth (P≤ 0.01). At 2.5% EGAE concentration, it was 5.66 mm. Upon applying the highest EGAE concentration (10%), it has reduced to 1.33mm. Compared to control, a gradual decrease in RL of *Melilotus indica* was observed along gradual increase in EGAE concentrations. RL implication was significantly affected by the treatment at P≤ 0.01. At control, the values of RL were 28 mm. higher concentrations of EGAE were notably active disturbing radicle emergence. at 2.5, and 5% concentrations, RL decreased to 14.5 and 13.5mm. Constantly, it continues reduction till it attained a value of about 11 and 5 mm at 7.5 and 10% concentration level. In the control values of RL of wheat was 56.66,70 mm. Elevated EGAE concentrations have possessed a significant inhibitory effect on radical growth (P≤ 0.01) (Table 3 &Figure 3). At 2.5% EGAE concentration it was 22.5 mm. Upon applying the highest EGAE concentration (10%), it has reduced to 17mm and at 5 and 7.5% EGAE the values were 19 and 17.5 mm.

Table1: Effect of Euphorbia guyoniana aqueous extract on germination percentage of Bromus tectorum, Melilotus indica and Triticum aestivum

	Germination percentage (%)					
aqueous extract	**0%**	**2.5%**	**5 %**	**7.5%**	**10%**	**Statistical analysis**
Bromus tectorum	100.0[a]	100.0[a]	36.6[b]	36.6[b]	10.0[c]	**
Melilotus indica	60[a]	55[ab]	50[b]	40[c]	35[d]	**
Triticum aestivum	100.0[a]	100.0[a]	100.0[a]	95.0[b]	95.0[b]	**

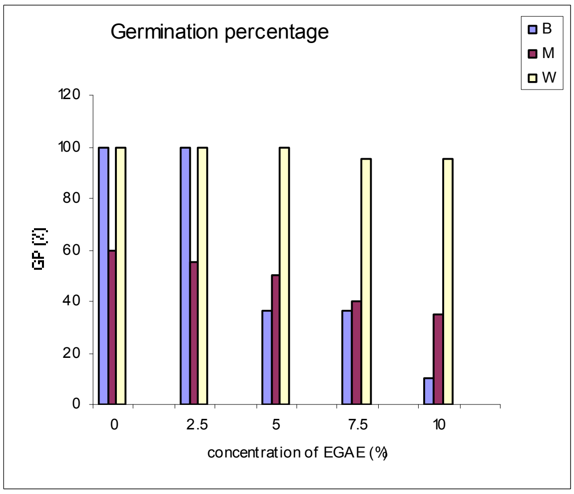
Table2: Effect of Euphorbia guyoniana aqueous extracts plumule length of Bromus tectorum, Melilotus indica and Triticum aestivum

	plumule length (mm)					
aqueous extract	**0%**	**2.5%**	**5 %**	**7.5%**	**10%**	**Statistical analysis**
Bromus tectorum	19.66[a]	10.66[b]	0.00[c]	0.00[c]	0.00[c]	**
Melilotus indica	20.00[a]	18.00[b]	11.50[b]	8.50[c]	2.50[d]	**
Triticum aestivum	42.00[a]	37.50[b]	26.50[c]	19.00[d]	18.00[d]	**

Table 3: Effect of Euphorbia guyoniana aqueous extract on radicle length of Bromus tectorum, Melilotus indica and Triticum aestivum

	radicle length (mm)					
aqueous extract	**0%**	**2.5%**	**5 %**	**7.5%**	**10%**	**Statistical analysis**
Bromus tectorum	34[a]	5.66[b]	2.66[c]	1.83[c]	1.33[c]	**

Melilotus indica	28.00[a]	14.50[b]	13.50[b]	11.00[c]	5.00[d]	**
Triticum aestivum	56.66[a]	22.50[b]	19.00[c]	17.50[d]	17.00[d]	**



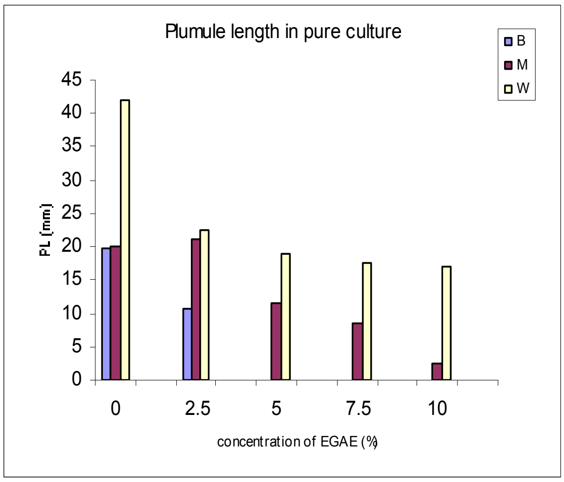


Figure 1 :Variation in the germination percentage (GP) of Bromus tectorum, Melilotus indica and Triticum aestivum as affected by different concentrations of Euphorbia guyoniana aqueous extract (EGAE).

Figure 2 Variation in the plumule length (PL) of Bromus tectorum, Melilotus indica and Triticum aestivum as affected by different concentrations of Euphorbia guyoniana aqueous extract (EGAE).

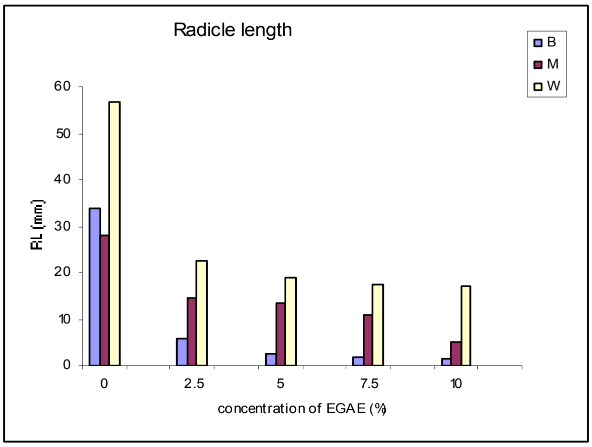


Figure 3 Variation in the radicle length (RL) of Bromus tectorum, Melilotus indica and Triticum aestivum as affected by different concentrations of Euphorbia guyoniana aqueous extract (EGAE).

3.2. The allelopathic effect of *Retama retam*

Germination Percentage (GP)

The attained GP of *Bromus tectorum* values at control conditions (100%) was increased upon applying at 2.5 and 5% RRAE concentrations to 96.6 and 93.6%, respectively. However, this current motivation goes to a marked reduction at 7.5 and 10% concentrations (43.3 and 40% respectively). The results in Table 4 & Figure 4 indicate GP of *Melilotus indica* seeds were apparently varied with of RRAE concentrations which is supported statistically (P≤ 0.01) the GP values at control conditions (60 %), this value was increased to 70 % at 2.5% RRAE concentrations on the other hand were increased upon applying 5, 7.5 and 10% RRAE concentrations (55,35 and 25%). The germination percentage (GP) of wheat seeds were apparently varied with of RRAE concentrations (Table 4& Figure 4) which is supported statistically (P≤ 0.01). The attained

GP at control, 2.5,5 and 7.5% RRAE conditions (100%) were increased upon applying 10% RRAE concentration (95%).

Plumule length (PL)

The demonstrated data in Table 5& Figure 5 pointed up that PL of *Bromus tectorum* was significantly affected ($P \leq 0.01$) by each treatment. The values of PL there was a noticed reduction, the control value was about 19.66 mm decreased to 9.66, 4.66, 0.66 and zero mm at 2.5, 5, 7.5 and 10% RRAE concentrations, respectively. The PL data of *Melilotus indica* showed in Table 5 & Figure 5 was significantly affected ($P \leq 0.01$) in RRAE concentration was significantly. There was a noticed reduction in values of PL. The control value was about 20 mm increased to 21.5mm at 2.5 % RRAE concentrations However at 5 and 7.5% RRAE was similar value obtained (11mm) this value decreased to 2 mm at 10% RRAE concentration .The PL of wheat was significantly ($P \leq 0.01$) (Table 5& Figure 5**)**. At control the value was about 42 mm decreased to 22, 21, 18 and 9 mm at 2.5, 5, 7.5 and 10% RRAE concentrations, respectively

Radicle length (RL)

Evaluation of RL correlated with higher RRAE concentrations has demonstrated their depressing influence on *Bromus tectorum* growth process (Table 6& Figure 6). Furthermore, RRAE concentration was significantly ($P \leq 0.01$) affecting RL at the control the value was about 34mm. At 2.5, 5, 7.5 and 10% RRAE concentrations there has been a marked reduction in RL (6.33, 10.33, 1.16 and 2.5 mm, respectively). The RRAE concentrations and interaction were highly significant ($P \leq 0.01$) affecting RL of *Melilotus indica* (Table 6 &Figure 6). The control value was about 28mm. The values of RL were about 10, 9, 8 and 3.5 mm at 2.5, 5, 7.5 and 10% RRAE concentrations, respectively.The influence of RRAE concentrations on wheat growth process Furthermore, RRAE concentration was significantly ($P \leq 0.01$) affecting RL. the control value was about 56.66 mm, and At 2.5, 5, 7.5 and 10% RRAE concentrations were marked reduction in RL about 21.5, 14, 11 and 9 mm respectively. (Table 6 &Figure 6)

Table4: Effect of Retama retam aqueous extract on germination percentage of Bromus tectorum, Melilotus indica and Triticum aestivum

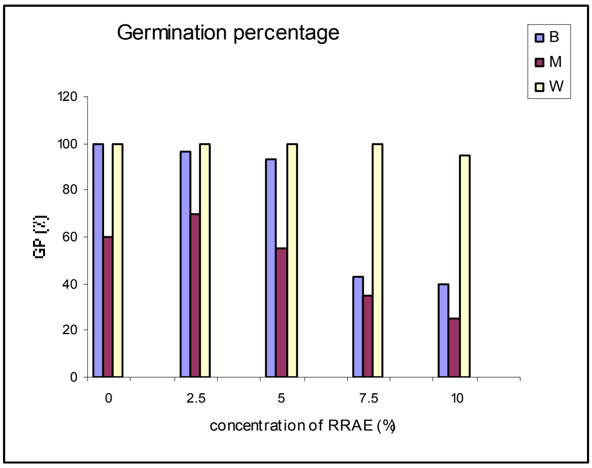
	Germination percentage (%)					
aqueous extract	**0%**	**2.5%**	**5 %**	**7.5%**	**10%**	**Statistical analysis**
Bromus tectorum	100.0 ^{a}	96.6^{b}	93.3^{c}	43.3^{d}	40.0^{e}	**
Melilotus indica	60^{b}	70^{a}	55^{bc}	35^{c}	25^{d}	**
Triticum aestivum	100.0^{a}	100.0^{a}	100.0^{a}	100.0^{a}	95.0^{b}	**

Table5: Effect of Retama retam aqueous extracts plumule length of Bromus tectorum, Melilotus indica and Triticum aestivum

	plumule length (mm)					
aqueous extract	**0%**	**2.5%**	**5 %**	**7.5%**	**10%**	**Statistical analysis**
Bromus tectorum	19.66	9.66^{b}	4.66^{c}	0.66^{d}	0.00^{d}	**
Melilotus indica	20.00^{b}	21.50^{a}	11.00^{c}	11.00^{c}	2.00^{d}	**
Triticum aestivum	42.00^{a}	22.00$^{.b}$	21.00$^{.b}$	18.00^{d}	9.00^{d}	**

Table 6. Effect of Retama retam aqueous extract on radicle length of Bromus tectorum, Melilotus indica and Triticum aestivum

aqueous extract	radicle length (mm)					
	0%	2.5%	5 %	7.5%	10%	Statistical analysis
Bromus tectorum	34.00^{a}	10.33^{b}	6.66^{c}	2.50^{d}	1.16^{e}	**
Melilotus indica	28.00^{a}	10.00^{b}	9.00^{bc}	8.00^{c}	3.50^{d}	**
Triticum aestivum	56.66^{a}	21.50^{b}	14.00^{c}	11.00^{d}	9.00^{e}	**



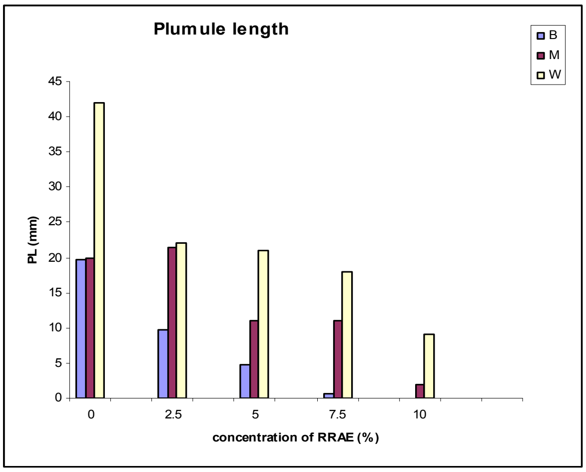


Figure 4 Variation in the germination percentage (GP) of Bromus tectorum, Melilotus indica and Triticum aestivum as affected by different concentrations of Retama retam aqueous extract (RRAE).

Figure 5 Variation in the plumule length of (PL) Bromus tectorum, Melilotus indica and Triticum aestivum as affected by different concentrations of Retama retam aqueous extract (RRAE).

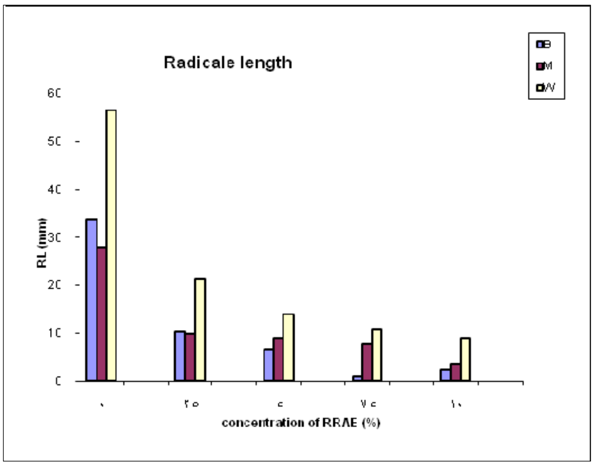


Figure 6 Variation in the radicle length of (RL) Bromus tectorum, Melilotus indica and Triticum aestivum as affected by different concentrations of Retama retam aqueous extract (RRAE).

4. Discussion

The present work was carried out as a preliminarily study to investigate any possible herbicidal activity of the selected species against widely spread weed. The allelopathic effect of 2.5,5,7.5 and 10% aqueous extract beside the control from aerial shoots of *Euphorbia guyoniana* and *Retama retam,* (donor species) was clearly demonstrated on germination percentage, plumule and radicle length of two weeds (*Bromus tectorum* and *Melilotus indica*) and one crop species (*Triticum aestivum*). Considering the foregoing results, it seemed that there are significant phototoxic effect of Euphorbia *guyoniana* and *Retama retam* on germination and plumule and radicle length. These results correlated with the findings that Allelochemicals presented in the aqueous extracts of different plant species have been reported to affect different physiological processes through their effects on enzymes responsible for phytohormone synthesis and were found to associate with inhibition of nutrients and ion absorption by affecting plasma membrane permeability[14]**.***Euphorbia guyoniana* and *Retama retam* species have phototoxic effect on germination and plumule and radicle length of *Bromus tectorum* and *Melilotus indica* the germination and plumule and radical length was sensitive to the increasing concentration of the aqueous extract. This inhibition was markedly in obvious *Bromus tectorum* than in *Melilotus indica* indicating that *Bromus tectorum* is more sensitive to all of tested donors, while the *Melilotus indica* is more adapted to the aqueous extract than the *Bromus tectorum*.

The aqueous extract of the donor plants showed a wide range of activities from partial and complete inhibition to stimulation which may indicate the presence of certain allelochemicals causing inhibition [15, 16]. [7] stated that, plant directly affecting another plant either positively or negatively through exuding chemical substances. Germination percentage (GP) of the tow investigated recipient species demonstrated a gradual decrease with applying higher concentrations of the donor species as follows: *Bromus tectorum >Melilotus indica* Some species under the present study exhibited a stimulatory effect upon the recipient species which may be through hormonal activities or promoting growth through adequate mineral supply. Other workers indicated that the effect of a given compound or plant metabolites may be inhibitory or stimulatory depending on their concentration in the surrounding medium [17, 18, 19].

Chemically, *Euphorbia* guyoniana has received little attention apart from the work done recently on the aerial parts from which two new diterpene polyesters with jatrophane skeleton have been isolated [**20**]. These results are in agreement with those obtained by [21] The allelopathic effects of diterpenes, have been evaluated on the seed germination and seedling growth Mediterranean species and weeds (*Amaranthus retroflexus* and *Avena fatua*). All of the structures have been elucidated on the basis of their spectroscopic features. The bioassays data, analyzed by principal component analysis, showed more negative effects on weeds respect to coexisting species. Data of the current study indicated that the donor species containing essential oils such as *Retama retam* exhibited potent allelopathic effects on seed germination and growth of the recipient weeds compared with the other donor species. The metabolism of essential oils has been investigated in various plant tissues which contain or produce these compounds [22; 23; 24]. Germination inhibition by essential oils, when applied to dry seeds, has been reported [25; 26]. One of the most prominent results in this work is that extracts were more harmful to weeds extracts, which may be due to the presence of allelochemicals such as alkaloids, amino acids, carbohydrates and phytohormones at higher concentrations in shoots [27].

Based on the results of this study: The species with the strongest allelopathic potential such as *Euphorbia guyoniana* and *Retama retam,* must be examined for their selective action on other specific plants including weeds and crops under field conditions, their allelopathic activity will be much more detailed. Analysis of possible allelochemicals in these plants is also required. The isolation and characterization of growth inhibitors, which might be responsible for the strong allelopathic potential of these species is needed. There is possibility of using these allelochemicals directly or as structural leads for the discovery and development of environment friendly herbicides to control weeds.

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