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SCREENING AND EVALUATION OF *Euphorbia pulcherrima* FOR WEED MANAGEMENT

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ABSTRACT

Keeping in view the serious threat of weeds to agriculture, the present study was conducted to evaluate the phytotoxic activity of Euphorbia pulcherrima aqueous extract against weeds. Concentrations (50, 75 and 100%) of E. pulcherrima aqueous extracts were applied on Avena fatua, Rumex dentatus, Euphorbia helioscopia and Sorghum halepense. Shoot length of Avena fatua and Rumex dentatus was not affected by any of the extract concentrations; whereas all the concentrations significantly reduced the shoot length of Euphorbia helioscopia and Sorghum halepense. In case of E. helioscopia reduction in shoot length was concentration dependent. Root length of all the tested weeds was reduced significantly at all three concentrations. Germination of A. fatua remained unaffected by all extract concentrations whereas E. helioscopia and S. halepense germination was reduced at higher concentrations. In R. dentatus, germination was significantly enhanced at 75% extract concentration. It was concluded that E. pulcherrima aqueous extract could be used for the eradication of weeds posing serious threats to crop yield.

Keywords: Allelopathy, aqueous extract, bioassay, *Euphorbia pulcherrima*.

INTRODUCTION

Living organisms interact with each other and form ecological niche on the earth. Such interactions have long been known and studied on a global scale. Allelopathy observed in many plants that release chemicals in to the nearby environment either from their arial or underground parts in the form of leaf leachates or root exudates and volatilizes (Rice, 1984).

The chemical compounds released in to the environment act on other organisms such as weeds, plants, animals and micro-organisms and their effects are either inhibitory or stimulatory. Although allelopathy is considered a separate phenomenon to competition (Muller, 1969) but it is a factor that can influence the outcome of competitive interactions (Reigosa *et al*., 1999). However, the allelopathic effect on the next trophic level, named as herbivores that

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feed on the infected plant, is only starting to be addressed on aphid acceptance of barley cultivars is reduced when the plants are exposed to volatiles emitted from undamaged plants of other cultivars (Pettersson *et al*., 1999).

Until now different field, pot and lab experiments were used in allelopathy. A new germination bioassay in allelopathy was evaluated by Pellissier (2012) in which quantity of allelochemicals was calculated by seeds biometry. A biometric enhanced seed test (BEST) was used in comparison with conventional method. The BEST method gave more pronounced and differential results as compared with conventional method.

Sinigrin is present highly in the roots of *Armoracia rusticana*. To check its allelopathic potential against germination and seedling growth of cereals, different concentrations (5, 15, 25, 50, 75 and 100%) of aqueous extracts of *Armoracia rusticana* metamorphosed roots were used and it was found that 5 and 15% concentrations stimulated the kernel germination ability of all tested cereals (*Triticum aestivum*, *Hordeum vulgare* and *Triticosecale*). Both of these concentrations also increased fresh and dry biomass of wheat and triticale but not of barley. Inhibitory effect of aqueous extract was in relation with its concentrations (Sipos *et al.*, 2012). In an experiment carried out by Khaliq *et al.* (2012) used different concentrations of Sorghum and Sunflower extracts against germination and growth of Dragon Spurge. 100% extract concentrations highly inhibited the germination and growth of the test species.

Euphorbia belonging to the family Euphorbiaceae and consist of about 2160 species, *Euphorbia* is one of the most diverse genera in the plant kingdom. Members of the family and genus are sometimes referred to as Spurges. The genus is primarily found in the tropical and subtropical regions of Africa and the Americas, but also in temperate zones worldwide. The plants are annual or perennial herbs, woody shrubs or trees with a caustic, poisonous milky sap (latex). The roots are fine or thick and fleshy or tuberous. Many species are more or less succulent, thorny or unarmed (Steinmann and Porter, 2002). In a recent study allelopathic effect of *Euphorbia hirta* and *Celosia argentea* was evaluated on seedling physiology of *Sorghum bicolor*, *Vigna radiata* and *Cicer arietinum*. Lower concentration (1:4%) of leaf extracts of both of allelopathic plants was more effective to stimulate biochemicals whereas higher concentration (1:1%) proved to be inhibitory in this regard (Saswade and Dhumal, 2012).

Subsequent experiments showed that aqueous extract, decaying residues, and root exudates of *E. prostrata* were inhibitory to most of the test species including *C. dactylon*. It was also found that allelopathy is the major component of the interference by *E. prostrata* against *Amaranthus retroflexus*, *Medicago sativa* and *Gossypium*

hirsutum (Sakeri and Al-Dulaimy, 1990). Keeping in view the previous studies the objectives of the present study was to evaluate the phytotoxic activity of *E. hirta*.

MATERIALS AND METHODS

Sample collection

Three *Euphorbia* species viz., *E. helioscopia, E. hirta* and *E. prostrata* as well as seeds of weeds such as *Avena fatua*, *E. helioscopia* and *Rumex dentatus* were collected from different locations of Rawlpindi. Plant material was screened and evaluated for allelopathic activity by using Bioassay technique.

Extract preparation

Leaf materials of Euphorbia species were thoroughly washed for several times with tap water to remove dust and were dried under shade and their powder was used for evaluation. All dried samples were ground and passed through sieve (20 mm). Ten gram powder was dissolved in 200 ml water for 24 h and then filtered through watman filter paper. The residues were subsequently extracted with distilled water and then stored in freezer. Dry plant material was stored in cabinet untill use. For each Euphorbia species, four treatments i.e., T_1 control, T_2 50%, T_3 75% and T_4 100% and five replicates were used.

Bioassay technique

Ten to 20 healthy seeds of the respective test weeds were thoroughly washed with water for several times. Selected weed seeds were sown to all the petri dishes having twenty five grams of soil. Then 12-15 ml water in control and extract in treated petri plates was poured. Each treatment was replicated for five times. Petri dishes were incubated at suitable temperature depending upon weed species. Growth of the weed was observed after regular interval during the period of one month then weeds were harvested and studied for different parameters.

Germination bioassay

For the germination, weed seeds were washed with sterile distilled water. 5ml extract was poured with the help of pippete into 15 petri dishes underlain with filter paper. 5 ml distilled water was used in 5 petri dishes as control. Five replicates were used for each of four treatments. The dishes were then placed in incubator for fifteen to twenty days. After this period, the dishes were observed and studied for several parameters and then placed in an oven for twenty four hours at 56 ^{0}C. Germination will be deemed to have occurred when the radicle protruded beyond the seed coat by at least 1 mm.

Three parameters were studied in this experiment. (1) Root length of all the germinated weeds was recorded in centimeters with the help of scale. Then average root length of all the seedlings in a

petri dish was calculated. (2) Shoot length of all the germinated weeds was recorded in centimeters with the help of scale. Then, at the end average shoot length was calculated. Percentage growth of root/shoot was calculated by applying following formula:

$$\text{Percentage growth} = \frac{\text{Average length of root/shoot in particular treatment}}{\text{Average length of root/shoot in control}}$$

In this way root/shoot growth was calculated in percentage with reference to control. Number of seedlings germinated in each Petri dish was recorded after 15-20 days and then percentage germination was calculated.

Statistical analysis

ANOVA Table was generated with the help of a statistical software Statistix 8.1. This software was applied to calculate the results.

RESULTS AND DISCUSSION

Extract of *Euphorbia pulcherrima* was evaluated for allelopathic potential on weed seed germination, root and shoot growth. Preliminary screening showed that leaf extracts had allelopathic effects on seed germination and growth of tested weeds.

Shoot length

Among concentrations, *Euphorbia helioscopia* (P= 0.0000) and *Sorghum halepense* (P= 0.0198) showed significant reduction in shoot length when different concentrations of *Euphorbia pulcherrima* extract were applied. While *Avena fatua* (P= 0.86) and *Rumex dentatus* (P= 0.67) showed non significant difference in shoot length under different concentrations of *E. pulcherrima* extract as compared to control. Among species significant differences were observed. *Sorghum halepense* showed the highest inhibitory activity (1.36 cm) followed by *Euphorbia helioscopia* (2.22 cm), while rest of the species were less susceptive to the tested extract (Table-1). Recently an investigation was carried out to check the allelopathic potential of two aquatic plants (*Lemna minor* and *Pistia stratiotes*). Their aqueous methnol extracts were applied on *Lepidium sativum*, *Medicago sativa*, *Lectuca sativa*, *Echinochloa crus-galli*, *E. colonum*, *Digitaria sanguinalis*, *Phleum pretense* and *Lolium multiforum* to check their effect on growth. Shoot and root growth of all these plants was reduced (Bich and Noguchi, 2012).

Percentage growth of shoot of weeds under extract of *Euphorbia pulcherrima*

Shoot length percentage of *Avena fatua* was non significantly changed as compared to control when treated with extract of *E. pulcherrima* (Figure 1) as it was recorded as 111.62%, 97.6% and 101.3% under 50% (T_2), 75% (T_3) and 100% (T_4) respectively. It reveals that concentrations of *E. pulcherrima* extract have no effect on shoot length of

A. fatua. In the case of *E. helioscopia* (Figure 2), shoot length percentage showed highly significant reduction that was recorded as 73.8%, 8.9% and 0% under 50% (T_2), 75% (T_3) and 100% (T_4) respectively. In the case of *R. dentatus* initially shoot length increased non significantly under T_2 (138.8%), T_3 (118.83%) but again decreased at T_4 (109%) (Figure 3). In the case of *S. halepense* shoot length percentage was recorded as 56%, 62% and 54% at T_2, T_3 and T_4 respectively (Figure 4).

Root length

All of the four weeds i.e., *A. fatua* (P= 0.00), *E. helioscopia* (P= 0.00), *R. dentatus* (P= 0.00) and *S. halepense* (P= 0.0078<0.05) showed highly significant difference in root length as compared to control when treated with different concentrations of *E. pulcherrima* extract (Table-2). Among species, *E. helioscopia* showed much significant reduction in root length (0.52 cm), followed by *S. halepense* (0.74 cm) and *R. dentatus* (1.65 cm) respectively. A similar study was carried out by Mirri (2011) in which he used extracts of 20 crop plants on germination and root growth of wild barley and wheat. Chickpea, chuckling pea and sunflower extracts showed more inhibitory effect on wild barley than wheat. Almost all plant species extract showed reduction in root growth and germination of wild barley and wheat.

Percentage growth of roots of weeds under extract of *Euphorbia pulcherrima*

In the case of root length all of the four tested weeds showed highly significant reduction in the percentage growth of roots when treated with different concentrations of *E. pulcherrima*. In the case of *A. fatua* root length percentage was recorded as 62.2%, 51.7% and 31.1% under 50% (T_2), 75% (T_3) and 100% (T_4), respectively (Figure 1). While in case of *E. helioscopia* the percent growth was recorded as 32.4, 6.8 and 0% under 50% (T_2), 75% (T_3) and 100% (T_4), respectively (Figure 2). In the case of *R. dentatus* it was recorded as 12.2%, 22% and 12.2 % (Fig 3). In the case of *S. halepense* it was recorded as 40.7%, 69.5% and 40.7% under 50% (T_2), 75% (T_3) and 100% (T_4) respectively (Fig 4). It shows that percentage growth of root of *S. halepense* is concentration independent under various concentrations of *Euphorbia pulcherrima.*

Germination

Among the treatments, *E. helioscopia* (P= 0.00) showed highly significant reduction in germination after treatment with *E. pulcherrima* extract as compared to control while rest of weed species showed non significant results (Table-3). Among weed species, *E. helioscopia* showed reduction in germination (25%) followed by *R. dentatus* (45.6%). As compared to this Tantiado and Saylo (2012) evaluated that *Eleusine indica*, *Chloris barbata* and *Saccharum spontaneum* seed extracts significantly inhibited germination of *Lactuca sativa* but differ in

germination rate. *Saccharum spontaneum* showed lowest germination rate while *E. indica* showed highest germination rate.

Percent germination of weeds under extract of *Euphorbia pulcherrima*

Avena fatua showed 88%, 80%, 92% and 82% germination under control (T_1), 50% (T_2), 75% (T_3) and 100% (T_4) respectively (Fig 5). While E. helioscopia showed much reduction in percentage germination and was recorded as 63%, 30%, 7% and 0 under control (T_1), 50% (T_2), 75% (T_3) and 100% (T_4), respectively (Figure 6). In the case of *R. dentatus* 31%, 48%, 56% and 48% germination was recorded under T_1, T_2, T_3 and T_4 respectively (Figure 7).

While in the case of *Sorghum halepense* non significant reduction in germination as recorded germination was 65%, 52%, 44% and 44% under T_I, T_2, T_3 and T_4, respectively (Figure 8).

Table-1. Shoot length (cm) of weeds under four different concentrations of aqueous extract of *Euphorbia pulcherrima*

Weed species	Concentrations				Species mean	P-value	LSD (0.05)
	Control	50%	75%	100%			
Avena fatua	11.88 A	13.26 A	11.60 A	12.03 A	12.19	0.8655	4.4513
Euphorbia helioscopia	4.85 A	3.58 B	0.43 C	0 C	2.22	0.0000	0.8954
Rumex dentatus	2.68 A	3.72 A	3.17 A	2.92 A	3.12	0.6766	1.9086
Sorghum halepense	2 A	1.12 B	1.24 B	1.08 B	1.36	0.0198	0.6042
Treatments mean	5.35	5.42	4.11	4.01	---	---	---

Table-2. Root length (cm) of weeds under four different concentrations of aqueous extract of *Euphorbia pulcherrima.*

Weed species	Concentrations				Species mean	P-value	LSD (0.05)
	Control	50%	75%	100%			
Avena fatua	10.31 A	6.41 B	5.33 B	3.21 C	6.32	0.0000	1.6243
Euphorbia helioscopia	1.48 A	0.48 B	0.1 C	0 C	0.52	0.0000	0.3305
Rumex dentatus	4.51 A	0.55 B	1.00 B	0.55 B	1.65	0.0000	0.5889
Sorghum halepense	1.18 A	0.48 B	0.82AB	0.48 B	0.74	0.0078	0.4058
Treatments mean	4.37	1.98	1.81	1.06	---	---	---

Table-3. Germination of weeds under four different concentrations of aqueous extract of *Euphorbia pulcherrima.*

Weed species	Concentrations				Species mean	P-value	LSD-value
	Control	50%	75%	100%			
Avena fatua	88 A	80 A	92 A	82 A	85.5	0.6052	2.0771
Euphorbia helioscopia	63 A	30 B	7 C	0 C	25	0.0000	1.4687
Rumex dentatus	31 B	48 AB	56 A	48AB	45.6	0.1997	3.1527
Sorghum halepense	65 A	52 AB	44 B	44 B	51.3	0.1018	2.4862
Treatments mean	61.8	52.5	49.8	43.5	---	---	---

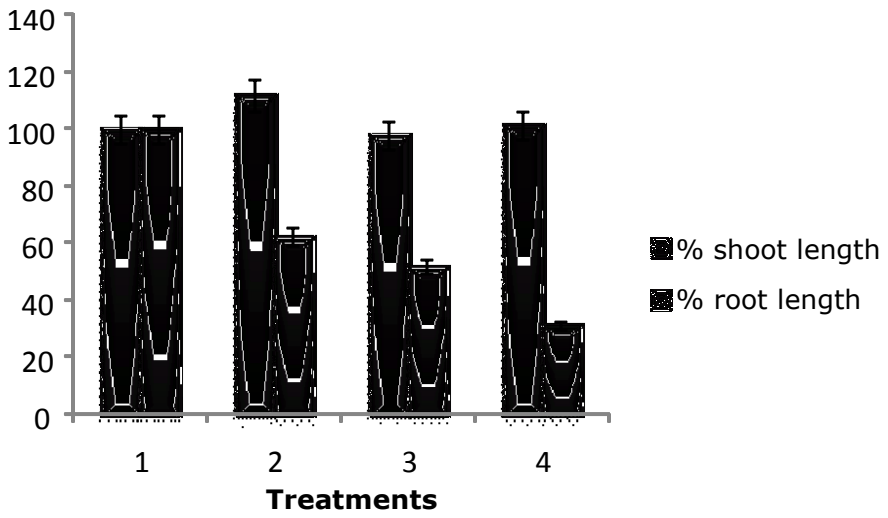

Figure 1. Effect of *Euphorbia pulcherrima* extracts on percent growth of shoot length and root length of *Avena fatua.* (1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

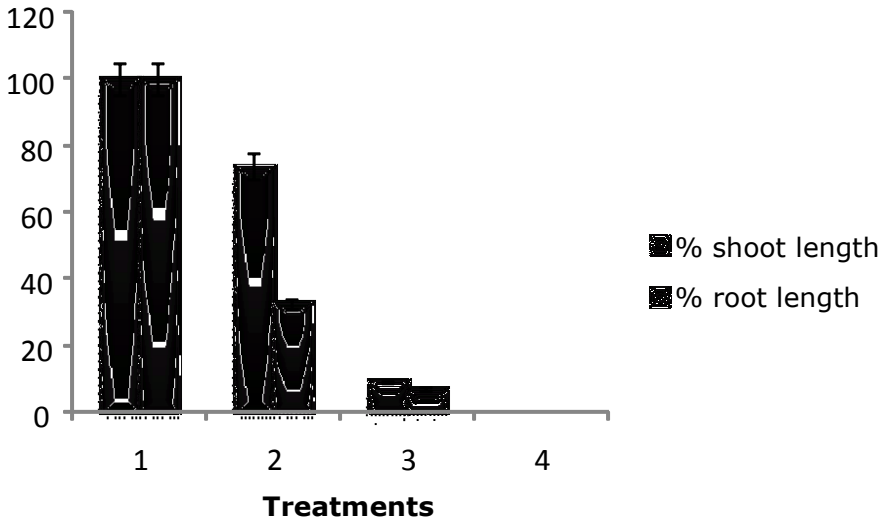

Figure 2. Effect of *Euphorbia pulcherrima* extracts on percentage growth of shoot length and root length of *Euphorbia helioscopia* (1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

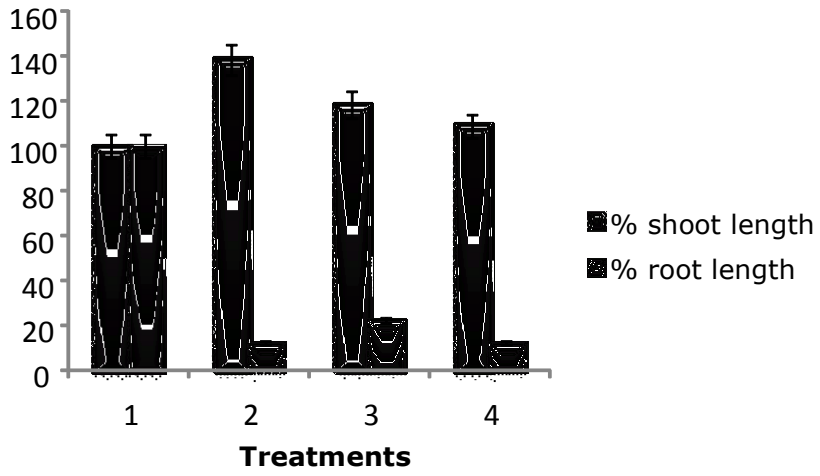

Figure 3. Effect of *Euphorbia pulcherrima* extracts on percentage growth of shoot length and root length of *Rumex dentatus*(1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

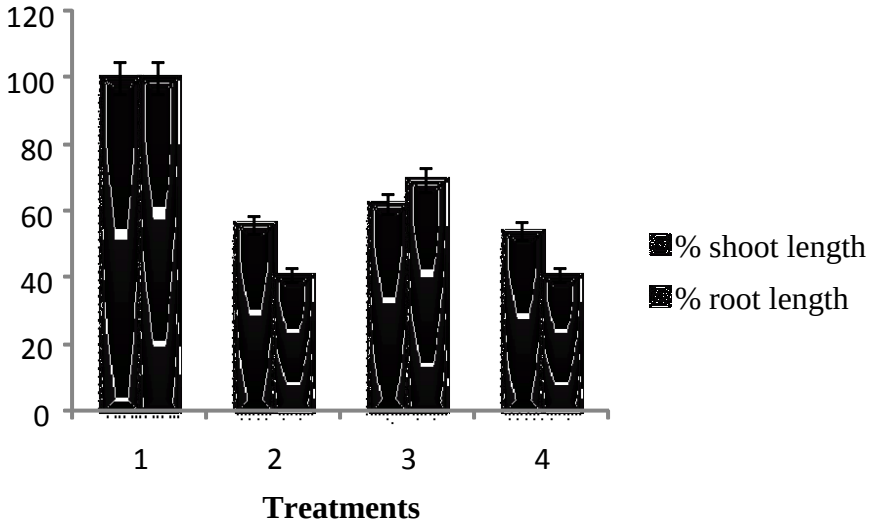

Figure 4. Effect of *Euphorbia pulcherrima* extracts on percentage growth of shoot length and root length of *Sorghum halepense* (1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

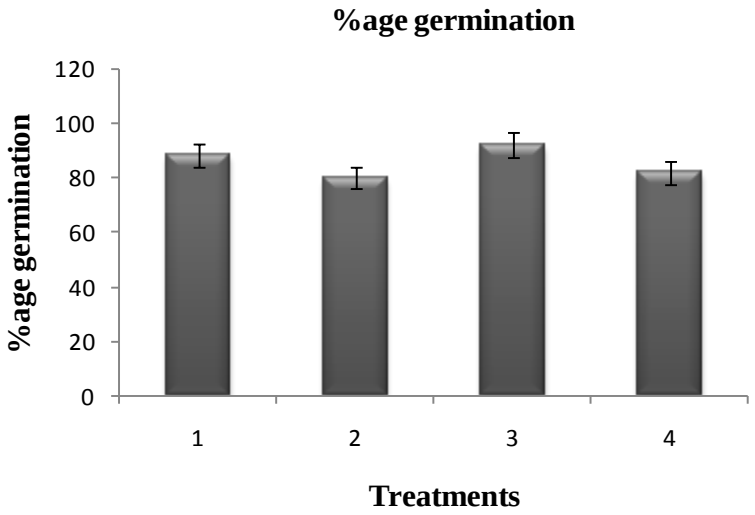

Figure 5. Effect of *Euphorbia pulcherrima* extract on percentage germination of *Avena fatua*(1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

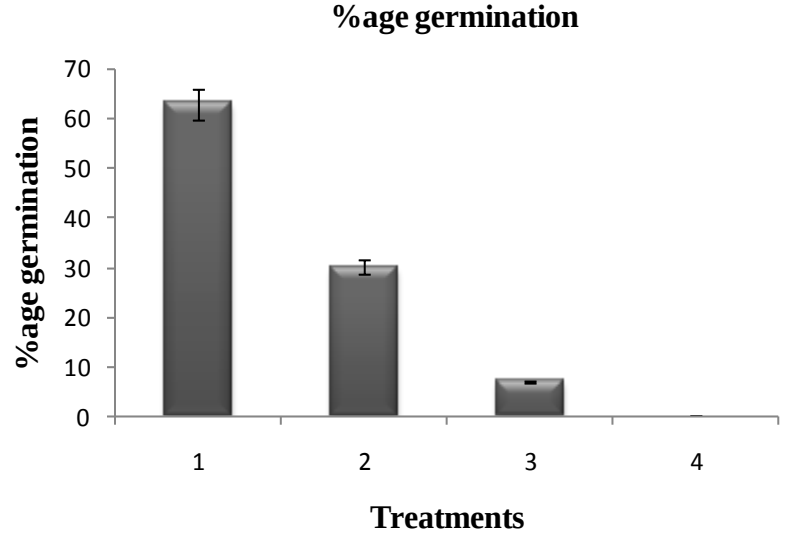

Figure 6. Effect of *Euphorbia pulcherrima* extract on percentage germination of *E. helioscopia*(1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

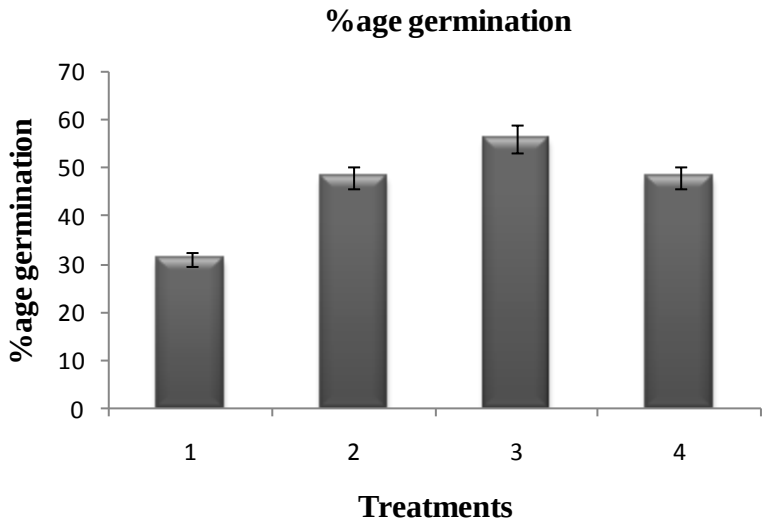

Figure 7. Effect of *Euphorbia pulcherrima* extract on percentage germination of *R. dentatus* (1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

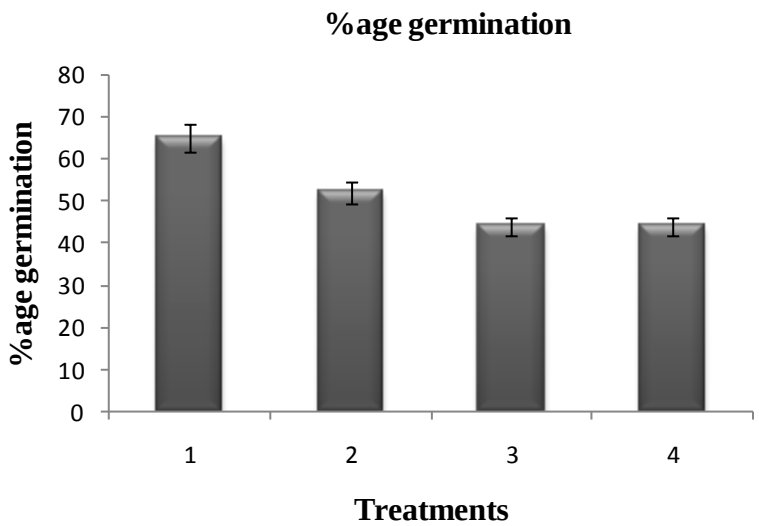

Figure 8. Effect of *Euphorbia pulcherrima* extract on percentage germination of *S. halepense* (1= control, 2= 50% concentration, 3= 75% concentration, 4= 100% concentration).

CONCLUSION

Results indicated that aqueous extract of *E. pulcherrima* could be used to reduce germination, shoot and growth of *Avena fatua*, *Rumex dentatus*, *Euphorbia helioscopia* and *Sorghum halepense*. Before using it as a bio-herbicide, isolation and identification of its active compounds as well as field study is required for further evaluation of growth inhibiting effects.

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