HERBICIDAL ACTIVITY OF *Ageratum conyzoides* AGAINST PARTHENIUM

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ABSTRACT

This study was carried out to explore herbicidal potential of an Ageratum conyzoides, a weed of family Asteraceae, against an exotic noxious weed parthenium (Parthenium hysterophorus L.). Different concentrations (0, 2, 4, 6, 8 and 10%) of aqueous extracts of various parts of the tested weed were used in laboratory bioassays. ANOVA revealed the significant effect of plant part bioassay and extract concentration on germination as well as various root and shoot growth parameters. Leaf extract was found as the most herbicidal where a 10% extract completely inhibited the germination and growth of parthenium. Root and inflorescence extracts were also highly inhibitory in suppressing the germination up to 89% and 95%, shoot length up to 80% and 89%, root length up to 86% and 91%, and plant biomass up to 89% and 98%, respectively. Stem extract showed the least herbicidal activity causing up to 46%, 59%, 73% and 37% reduction in germination, shoot length, root length and plant biomass, respectively. This study concludes that leaf, root and inflorescence extracts of A. conyzoides possess strong herbicidal potential against germination and growth of parthenium.

Keywords: *Ageratum conyzoides, Parthenium hysterophorus,* natural herbicides, noxious weed.

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INTRODUCTION

Parthenium is a ubiquitous aggressive annual weed native to Australia, Africa, Asia, Mexico, America and has spread to Pakistan in the last few decade (Shafiq *et al.*, 2020). It belongs to family Asteraceae and grows successively due to extensive viable seed production of 12000 to 15000 per plant, which may disperse on large land areas and germinate rapidly with enormous potential rate (Nguyen *et al.*, 2017). It has now become one of the world's most hazardous and devastating noxious weeds (Li *et al.*, 2018). It is commonly found in cultivated fields, disturbed sites, abandoned lands, roadsides, railway tracks, sidewalks, irrigation canals, drainage sites and forming huge (Ojija *et al.*, 2019). It has reached to the epidemic proportions and causes human health hazardous issues such as asthma, skin inflammation, hay fever, allergic rhinitis, eczema, burning, blisters, black spots, choking and breathlessness (Meena *et al.*, 2017). As it possesses harmful aspects, its eradication becomes a major challenging threat to the governments (Hassan *et al.*, 2018). Many chemical and physical measures are in practice to eliminate the weed but these methods are non-eco-friendly, time consuming and expensive (Ojija *et al.*, 2019). Keeping in view the detrimental effects of chemical herbicides, there is a strong need to develop least toxic, environment friendly alternative management strategies that are safe in use for both growers and consumers (Javaid and Khan, 2020).

Plant derived products are safe in use in comparison to the synthetic chemicals as they contain major bioactive compounds for the control of noxious weed plants (Mishra *et al*., 2018). *Ageratum conyzoides* L. is a well-known medicinal plant belongs to family Asteraceae (Raihan *et al.*, 2019). It is wide spread in China, Southeast Asia, Africa, South America, Australia and Pakistan (Saha *et al.*, 2018). It is a pioneer plant grows mostly on ruined and waste sites where sufficient water is available (Yadav *et al.*, 2019). It is a rich source of nematicide, insecticide and anti-microbial activities (Hassan *et al.*, 2017). It also contains secondary metabolites such as chromenes, flavonoids, terpenoids and benzofurans with inhibitory effects to other plants (Batish *et al.*, 2017). The major allelochemical constituents are α-bisabolene, β-caryophyllene, E- β-farnesene, agetochromene, glycoside, sesquiterpenes, monoterpenes, dimethoxy-ageratochromene and ageratochromene produces at early stages of plant growth with diverse functions (Ishak *et al.*, 2016; Kouame *et al.*, 2018).

Most of the previous studies have been carried out with regard to allelopathic effects of *A. conyzoides* on germination and growth of crop plants and literature concerned to such allelopathic inferences on growth of weeds is limited and very rare especially with reference to management of parthenium weed. Therefore, the present study was undertaken to explore the effects of aqueous extracts of *A. conyzoides* on germination and early seedling growth of parthenium.

MATERIALS AND METHODS

Plants of *A. conyzoides* were collected from Lahore Pakistan. These were washed under tap water, separated into different parts and sun dried. These dried parts were crushed thoroughly and 10 g of each part were soaked in 100 mL sterilized distilled water for 12 h. Thereafter, plant debris was separated from extract by passing through a cheese cloth. The extract was then filtered to get a 10% w/v extract of leaf, stem, root and inflorescence of the test weed species. From this stock solution, lower concentrations were prepared.

Bioassays were carried out with different concentrations (0, 2, 4, 6, 8 and 10%) of extract of each plant part using four replicates of each treatment. For this purpose, sterilized Petri plates were lined with filter papers and 25 seeds of parthenium were uniformly placed on filter paper bed in each plate. A volume of 3 mL of extract of each concentration was poured in each plate. Plates were incubated at room temperature for 10 days. After that, number of germinated seeds was counted in each plate to calculate percentage of germination in each treatment. Length of root and shoot as well as plant biomass were also recorded. All the data were analyzed by ANOVA followed by application of LSD test to separate treatment means at P≤0.05 using software Statistix 8.1.

RESULTS AND DISCUSSION

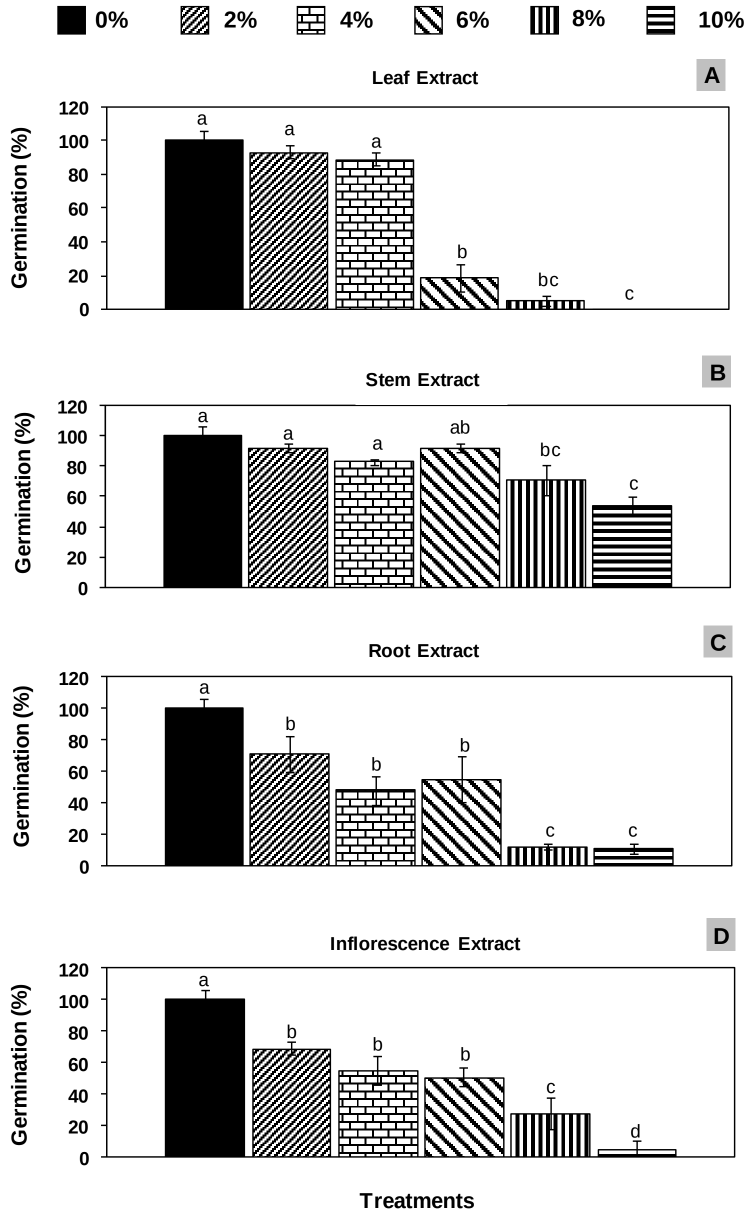
ANOVA presented in Table 1 clearly indicates that the effect of plant parts (P), extract concentrations (C) and P × C was sgnificant for germination as well as various parameters of root and shoot growth of parthenium. Leaf extract showed the best herbicidal activity. Lower concentrations of the extract *viz.* 2% and 4% had insignificant effect while higher concentrations (6% and 8%) significantly declined germination by 82% ad 95%, respectively. The highest concentration (10%) completely arrested the germination (Fig. 1A). Both root and inflorescence extracts also had pronounced herbicidal activity where all concentrations caused 29–89% and 31–95% reduction in germination over control. The efefct of stem extract on germination was not very much pronounced where 2–6% concentrations had insignificant effect and only the higher concentrations 8% and 10% significantly suppressed germination just by 29% and 46% over control, respectively (Fig. 1B-D). Earlier, Kato-Noguchi (2001) found similar herbicidal effects of shoot extract of *A. conyzoides* against germination of *Lactuca sativa, Amaranthus caudatus* and *Digitaria sanguinalis.* Previous studies also showed that germination of parthenium seeds is sensitive to extracts of other allelopathic plants such as *Alstonia scholaris, Datura metel,* sorghum, sunflower and rice (Javaid *et al.,* 2006, 2008, 2010a,b).

Similar to that of germination, the leaf extract also showed the best inhibitory effect on shoot length. Both 8% and 10% extracts completed contrlled the shoot growth. Lower concentrations ranging from 2–6% reduced shoot length by 50–81% over control (Fig. 2A). All the concentrations of stem and root extract significantly retarded shoot length by 50–59% and 39–80%, respectively (Fig. 2B&C). The effect of 2% concentration of inflorescence extract was insignificant, however, higher concetrations reduced shoot length by 41–89% over control (Fig. 2D). Root growth of parthenium was highly sencitive to various extract of the test weed species. All the concentrations of leaf, stem and root extract significantly reduced root length by 45–100%, 70–79% and 65–73%, respectively, over control. Inflorescence was less toxic to root growth and its different concentrations reduced root length by 1–91% over control (Fig. 3A-D). Leaf extract had the most adverse effect on dry biomass of parthenium causing 34–100% reduction in this plant growth parameter. In case of root and inflorescence extracts, only the two higher concentrations i.e. 8% and 10% significantly reduced shoot dry weight by 85–89% and 71–98%, respectively, while the lower concentrations had insignificant effects. Stem extract showed the least inhibitory effect on dry weight of parthenium seedlings where none of the concentration exhibited significant effect as compared to control (Fig. 4A-D). Suppression of plant growth in parthenium due to different extracts especially leaf extract may be attributed to allelopathic nature of *A. conyzoides* (Fei and Chuihua, 1997; Kaur ad Sharma, 2016). Leaf extract of *A. conyzoides* is known to reduce height, dry weight and chlorophyll contents of soybean (Wardani *et al.,* 2018) and pea (Kumar *et al.,* 2018). Singh *et al.* (2014) reported severe growth inhibition in checkpea, mustard and rice when grown either in *A. conyzoides* affected soil or soil amended with residues of the weeds, possibly due to release of phenolic allelochemicals. Nasrin (2013) identified gallic acid, proteocatechins acid and coumaric acid as allelochemicals in this weed which are known to suppress growth of some plants. In addition, precocenes and their derivatives and many mono- and sesquiterpenes are also known as possible allelochemicals of this wed (Kong *et al.,* 2002). Allelochemicals belonging to other groups such as Alkaloids, flavonoids, saponins and tannins are have also been reported in *A. conyzoides* (Okunade, 2002). Allelochemicals are responsible for oxidative stress to plants that is a condition of cell damage caused by reactive oxygen species (ROS). When concetration of ROS becomes above the normal limits, it causes damage to tissues and impaired functions of the plant (Sharma *et al.,* 2003). Phenolic allelochemicals also alter membrane permeability that causes inhibition in nutrient uptake, infuence synthesis of plant hrmones, affect enzyme activity, alter the processes of protein synthesis and photosynthesis, and adversally cell division and elongation. As a consequence these factors, plant growth is inhibited (Wardani *et al.,* 2018).

Table-1. Analysis of variance (ANOVA) for the effect of different concentrations of aqueous leaf, stem, root and inflorescence extracts of *Ageratum conyzoides* on germination of *Parthenium hysterophorus*.

Trait	df	Mean squares			
		Germination	**Shoot length**	**Root length**	**Plant biomass**
Plant parts (P)	3	5958**	0.362**	0.200*	128**
Concentration (C)	5	15830**	1.369**	2.271**	119**
P × C	15	1202**	0.109**	0.135*	18**
Error	72	189	0.034	0.057	4.9
Total	95				

*, **, significant at P≤ 0.01 and P≤



0.001.

Fig. 1. Effect of aqueous extracts of different parts of *Ageratum conyzoides* on germination of parthenium weed. Vertical bars show standard errors of means of three replicates. Values with different letters at their top show significant difference ($P \leq 0.05$) as determined by LSD Test.

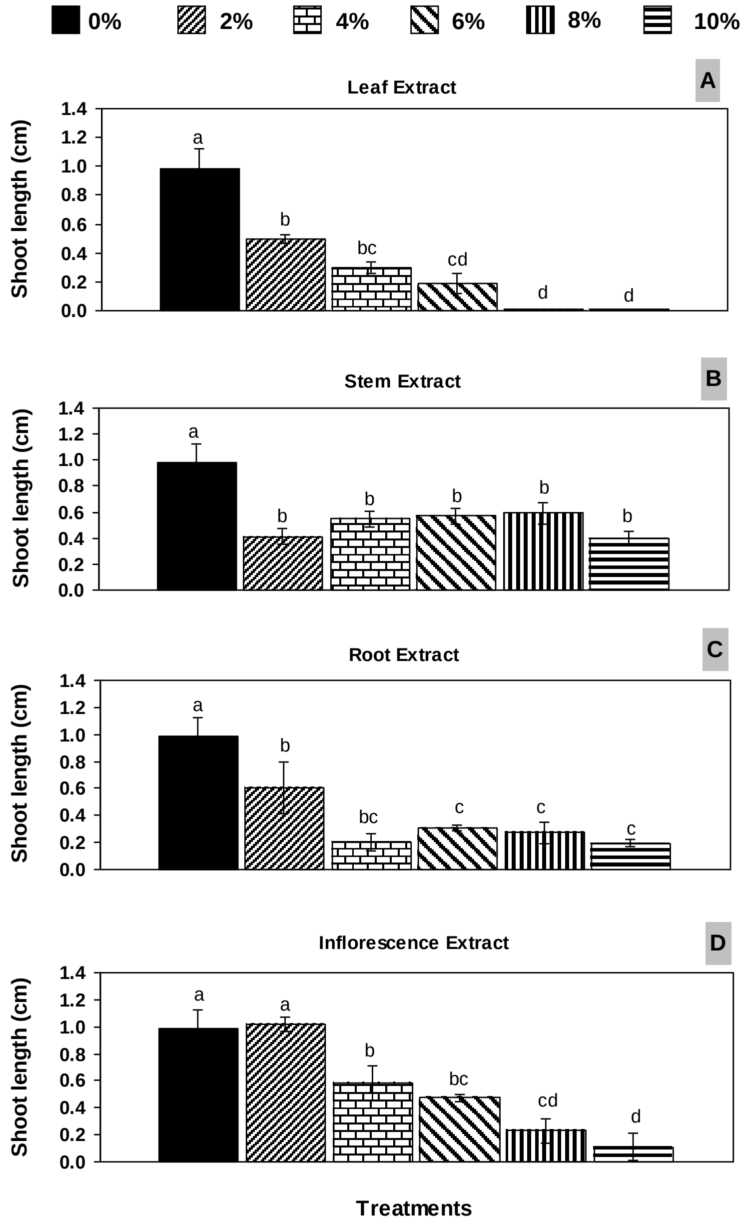


Fig. 2. Effect of aqueous extracts of different parts of *Ageratum conyzoides* on shoot length of parthenium weed. Vertical bars show standard errors of means of three replicates. Values with different letters at their top show significant difference ($P \leq 0.05$) as determined by LSD Test.

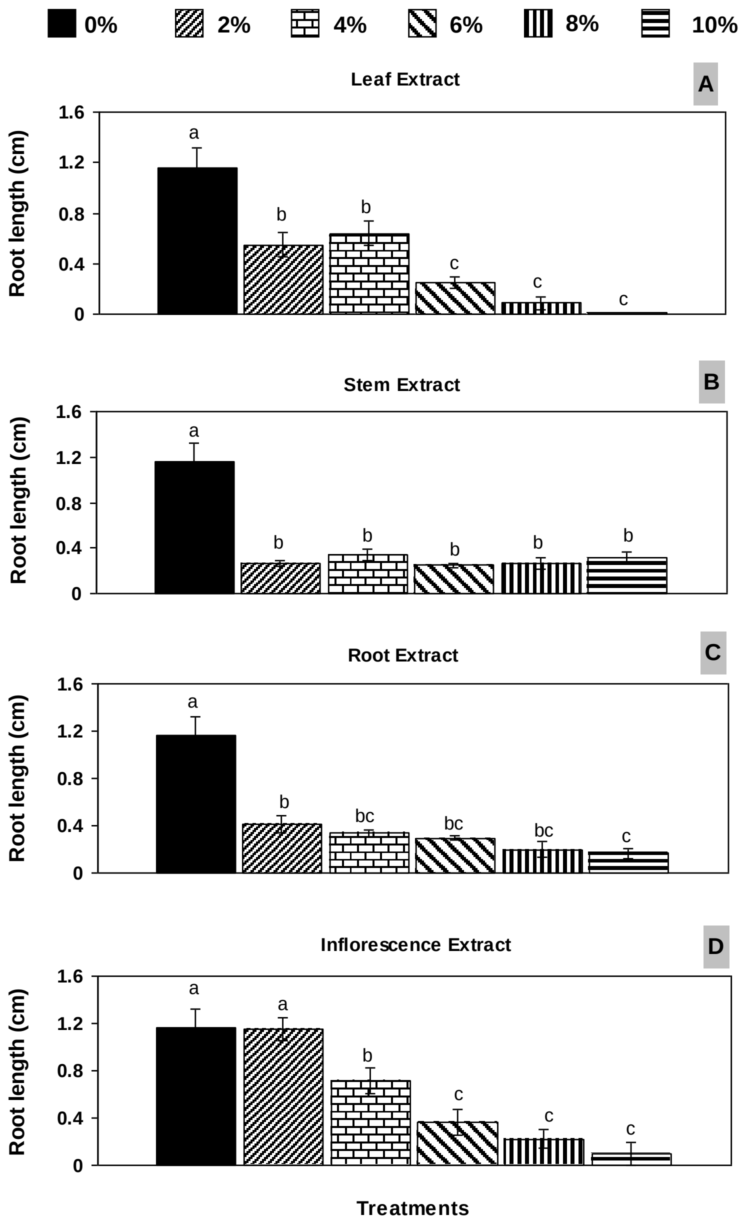


Fig. 3. Effect of aqueous extracts of different parts of *Ageratum conyzoides* on root length of parthenium weed. Vertical bars show standard errors of means of three replicates. Values with different letters at their top show significant difference (P ≤ 0.05) as determined by LSD Test.

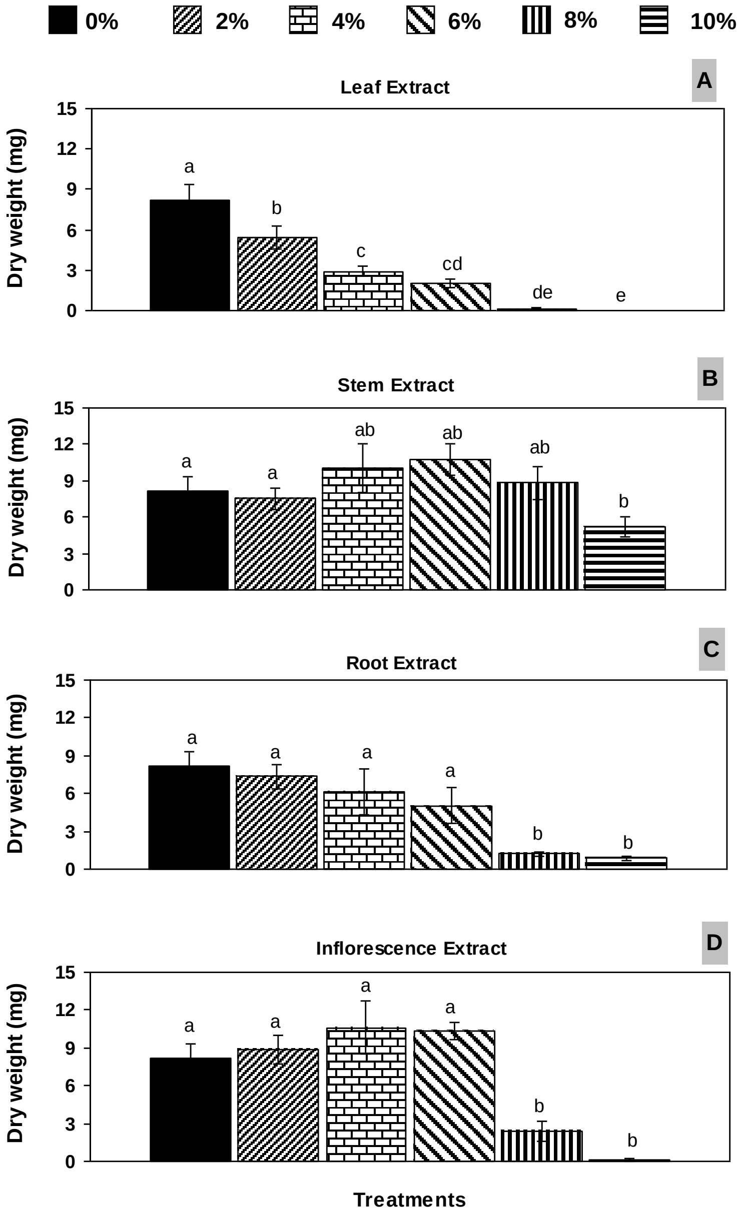


Fig. 4. Effect of aqueous extracts of different parts of *Ageratum conyzoides* on dry weight of parthenium weed. Vertical bars show standard errors of means of three replicates. Values with different letters at their top show significant difference ($P \leq 0.05$) as determined by LSD Test.

CONCLUSION

This study concludes that all parts of *A. conyzoides* have herbicidal potential against germination and growth of parthenium. However, leaf extract was found to be the most effective against all the studied parameters of parthenium.

Further studies are suggested to isolate the herbicidal constituents from leaves of this weed to be used as analogues for preparation of natural product based herbicides for control of parthenium weed.

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