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HERBICIDAL ACTIVITY OF SOME MEDICINAL PLANTS EXTRACTS AGAINST *Parthenium hysterophorus* L.

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ABSTRACT

Extracts of three medicinal plants namely ginger (Zingiber officinale Roscoe), onion (Allium cepa L.) and garlic (Allium sativum L.) were assessed for their herbicidal activity against noxious parthenium weed (Parthenium hysterophorus L.). Aqueous as well as n-hexane extracts of the three test plant species effectively declined germination and early seedling growth of the weed. However, herbicidal potential of the extracts varied with the plant species and the extracting solvent. Herbicidal activity of aqueous extracts of garlic and onion was more pronounced than aqueous extract of ginger. The highest suppressive ability was exhibited by extracts of garlic where 10% and 15% concentrations completely inhibited germination, and root and shoot growth of parthenium. Similarly, n-hexane extract of ginger was found highly effective resulting in complete suppression of germination and seedling growth of parthenium. This study concludes that aqueous extracts of garlic and n-hexane extract of ginger are highly effective for management of parthenium weed.

Key words: Herbicidal activity, noxious weed, *Parthenium hysterophorus,* plant extracts.

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INTRODUCTION

Parthenium hysterophorus L.is native to tropical America and Mexico but during the last 60 years it has spread in parts of Asia, Africa and Australia. Imported food grains provided its foyer in Indian subcontinent in 1955. Later on, this weed extensively occupied different areas of Pakistan including Kashmir, Punjab and Khyber PakhtoonKhawa and became dilemma during the last two decades

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(Javaid and Anjum, 2005; Riaz and Javaid, 2010; 2011). The severe impact of this weed on ecosystems and agricultural crops is well-documented (Chippendale and Panetta, 1994; Javaid *et al*., 2009). Whereas, nonexistence of natural agents that help to impede its multiplication, efficient seed dispersal mechanisms, high productiveness, toxic allelopathic consequences on nearby plants, unsuitability for grazing and wide adaptability to varying soil and climatic conditions have empowered parthenium invasion over diversity of the environments (Evans, 1997; Javaid *et al.,* 2007).

Parthenium weed can be managed by using synthetic herbicides namely buctril super, chwastox, chlorimuron ethyl and metasulphuron (Mishra and Bhan, 1994; Javaid *et al*., 2006; Javaid 2007; Shabbir, 2014). However, because of environmental concerns associated with the use of synthetic herbicides and emergence of numerous herbicide-resistant weed biotypes, substantial efforts have been made to design alternative environmental friendly weed-management strategies (Teerarak *et al.,* 2010; Akbar *et al.,* 2014). Natural compounds from plants can be used as model for herbicide production (Schabes and Sigstad, 2007). Certain allelopathic and medicinal plants such as rice (*Oryza sativa* L.), mango (*Mangifera indica* L.), *Withania somnifera* and *Datura metel* contain herbicidal compounds which can be used for the management of parthenium weed (Javaid *et al*., 2010 a,b,c; Chaudhary and Iqbal, 2013). The current investigation aimed to evaluate the herbicidal potential of aqueous and *n*-extracts of three medicinal plants namely ginger, garlic and onionon seed germination and seedling growth of parthenium weed.

MATERIALS AND METHODS

Laboratory bioassays

Fresh plant materials (25 g) of three medicinal plants viz., garlic, onionand gingerwere crushed in 100 mL of distilled water. Homogenized plant mixture was allowed to stand for 24 hours at 25 ºC and filtered to obtain 25% (w/v) extracts. Further dilutions of 5, 10, and 15% w/v were made by diluting 25% stock solution with desired amount of distilled water. The extracts were stored at 4 ºC in a refrigerator for further use. Similarly 25 g of crushed plant materials of each of the three test plant species were soaked in 100 mL *n*-hexane for 24 hours at 25 ºC. After filtration, organic extract was evaporated on rotary evaporator under reduced pressure. Stock solution (25% w/v) was prepared by mixing the concentrated extract with distilled water and raised the volume up to 100 mL, and it was further diluted to make contractions of 5, 10 and 15%.

Bioassays were performed by placing ten seeds of parthenium on Whatman No. 1 filter papers in sterilized Petri plate (9-cm

diameter). Afterward, each concentration of the extract (5-15%) of test plants was poured in each of the respective Petri plate. Control treatment was prepared similarly with distilled water. There were three replicates of each treatment. Plates were incubated at 25 ºC for 21 days. Different germination and growth parameters of the seedling were recorded after completion of the experiment.

Statistical analysis

All the data were analyzed statistically by analysis of variance followed by application of Duncan's Multiple Range Test to separate treatment means at 5% level of significance (Steel and Torrie, 1980). Vertical bars in all the figures show standard errors of means of three replicates. Values with different letters at their top, given in the figures below, show significant difference ($P \leq 0.05$) as determined by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Effect of medicinal plants extracts on partheniumgermination

Aqueous extracts of all the three species showed marked herbicidal activity against germination of parthenium seeds. Aqueous extract of garlic was found the most effective, where 10% and 15% concentrations completely inhibited the seed germination, while the lowermost (5%) concentration significantly retarded the germination of the weed by 97%. Similarly, different concentrations of aqueous extract of onion significantly reduced seed germination up to 52% (Fig. 1A). Djurdjevic*et al.* (2004) have reported similar inhibitory effect of volatile *Allium ursinum* constituents on seed germination of amaranth (*Amaranthus caudatus* L.), lettuce (*Lactuca sativa* L.) and wheat (*Triticum aestivum* L.). Earlier, there were reports that the aqueous extracts of medicinal plants can retard the germination of parthenium seeds significantly (Javaid *et al.,* 2010b). In the present study, aqueous extracts of ginger showed the least inhibitory activity against parthenium seeds germination (Fig. 1A). In contrast to aqueous extracts, *n*-hexane extract of ginger was highly effective where all the extract concentrations completely inhibited the germination of parthenium seeds. Similarly, all the concentrations of *n*-hexane extract of garlic significantly reduced seed germination by 26-70%. Conversely, onion extract exhibited the least activity against germination of parthenium seeds resulting 11-18% reduction in germination (Fig. 1B).

Effect of garlic extracts on growth of parthenium seedlings

Aqueous extract of garlic exhibited pronounced inhibitory potential against shoot as well as root growth of parthenium. All the concentrations of the extract significantly reduced root and shoot growth. The lowest concentrations (5%) of aqueous extract reduced

length and dry biomass of parthenium shoot by 97% and 98%, respectively. Higher concentrations (10% and 15%) of this extract completely arrested root and shoot growth of the target weed species (Fig. 2 and 4). Inhibitory effect of *n*-hexane extract of garlic was comparatively less pronounced than that of aqueous extract. The lowest concentration (5%) of *n*-hexane extract of garlic was stimulatory and failed to suppress length and biomass of shoot of parthenium seedlings, while higher concentrations significantly reduced all the studied parameters of shoot growth. There were 4-83% and 65-87% reduction in length and biomass of shoot, respectively, due to 10 and 15% concentrations of *n*-hexane extract. Root growth was more susceptible to *n*-hexane extract than the shoot growth. All the *n*-hexane extract concentrations significantly reduced various root growth parameters of parthenium seedlings (Fig. 3 and 5). Likewise, previously more sensitiveness of the root growth than that of shoot have been observed due to allelopathic plant extracts on different plant species (Javaid *et al.,* 2008a; 2008b). Hence roots are the generally the first point of contact with chemical compounds and probably provide translocation route to other plant part. Therefore, any abnormal growth in root is obvious sign of chemical toxicity by allelopathic plants (Javaid and Shah, 2007). The phtotoxicity of garlic could be due to presence of volatile compounds like diallyl disulfide (Wu *et al.,* 1996) that have been previously reported to cause growth reduction, tip burn followed by leaf scorch and ended in death of wild oat (Chen and Elofson, 1978).

Effect of onion extracts on growth of parthenium seedlings

Herbicidal activity of onion extracts against parthenium growth was generally less pronounced that of garlic extracts. The effect of aqueous extract on shoot dry biomass was insignificant (Fig. 2). Whereas, root growth was comparatively more susceptible to onion extracts than the shoot growth. Root length was significantly reduced by 12% and 60% due to 10% and 15% aqueous extract, respectively. Whereas, all the concentrations of aqueous extract significantly reduced fresh and dry biomass of root by 12-62% and 38-88%, respectively. The effect of *n*-hexane extract on shoot length was insignificant, while the highest extract concentration (15%) significantly reduced parthenium shoot biomass by 70% and 73%, respectively (Fig. 3). Similarly, all the concentrations of *n*-hexane extracts significantly suppressed length, and fresh and dry biomass of roots of parthenium seedlings by 17-75%, 27-80% and 23-92%, respectively (Fig. 4 and 5). Earlier, Macharia and Peffley (1995) reported that biomass of *Amaranthus spinosus* L. and *Kochia scoparia*(L.) Schrad. was significantly reduced when grown with *Allium fistulosum* and *A. cepa.* High content of phenolics (gallic acids and

ferulic acid) (Pérez-Gregorio *et al*., 2010), flavonoids (mainly quercetin) and sulphur (thiosulphinates) (Lu *et al*., 2011) may be responsible for herbicidal activity against parthenium.

Effect of ginger extracts on growth of parthenium seedlings

Aqueous extracts of ginger proved comparatively less toxic against parthenium growth. Generally, various concentrations of aqueous extract showed insignificant effect on shoot growth. However, all the studied parameters of root were significantly reduced by aqueous extract over control. There was 36-70%, 62-74% and 18-68% reduction in length, fresh and dry weight of roots of parthenium seedlings due to different concentrations of aqueous extract (Fig. 2 and 4). In contrast, *n*-hexane extract of ginger was found highly effective and completely arrested the root and shoot growth (Fig. 3 and 5). Stems and leaves of the ginger are known to exhibit stronger phytotoxicity, which adversely affect seed germination, seedling growth, water uptake and lipase activity of soybean and chiveHan *et al.,* 2008). The phtotoxicity of ginger against targeted weed could be due to presence of several active compounds like gingerol and hexahyrocurcumin (Tiwari *et al*., 2006; Park *et al*., 2008).

CONCLUSION

It is concluded that aqueous and *n*-hexane extract of garlic and ginger were the most effective against germination and seedling growth of parthenium. Further studies are needed to isolated effective natural herbicidal constituents from these extracts for the management of parthenium.

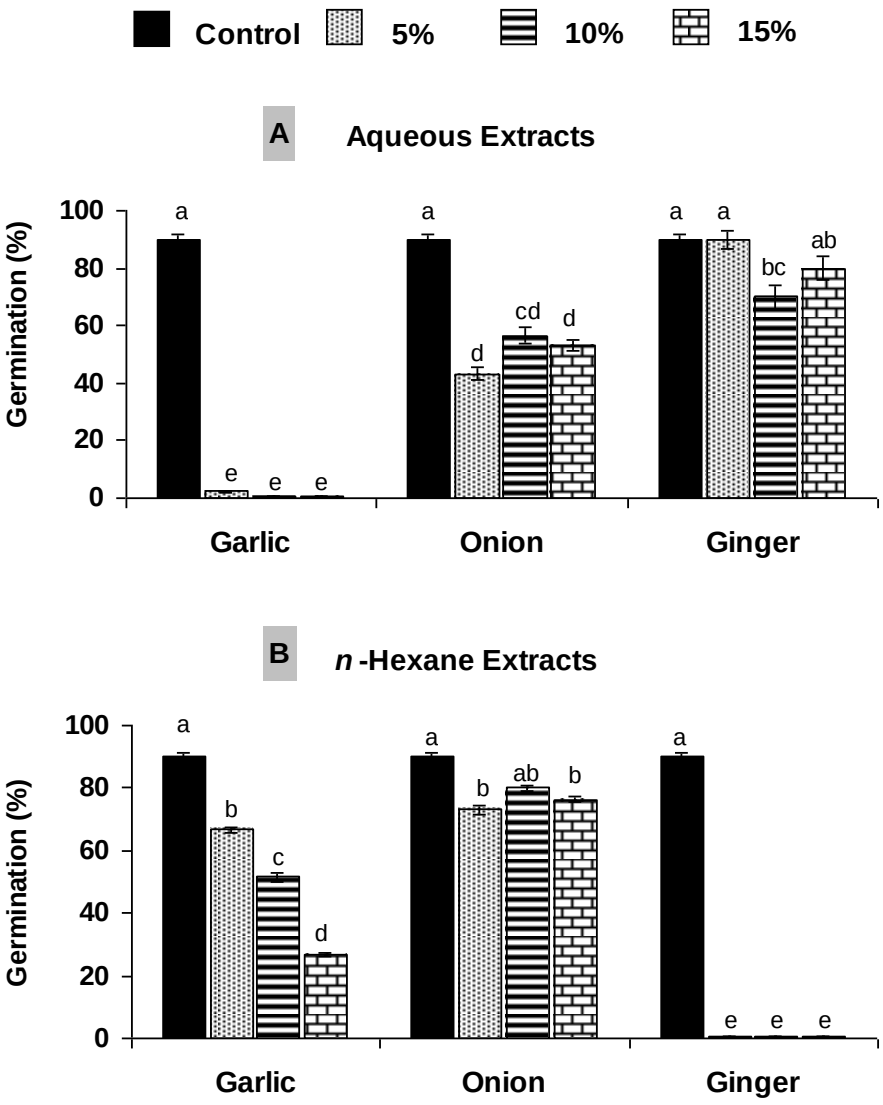

Figure 1. Effect of aqueous and *n*-hexane extracts of three medicinal plants on germination of parthenium seeds.

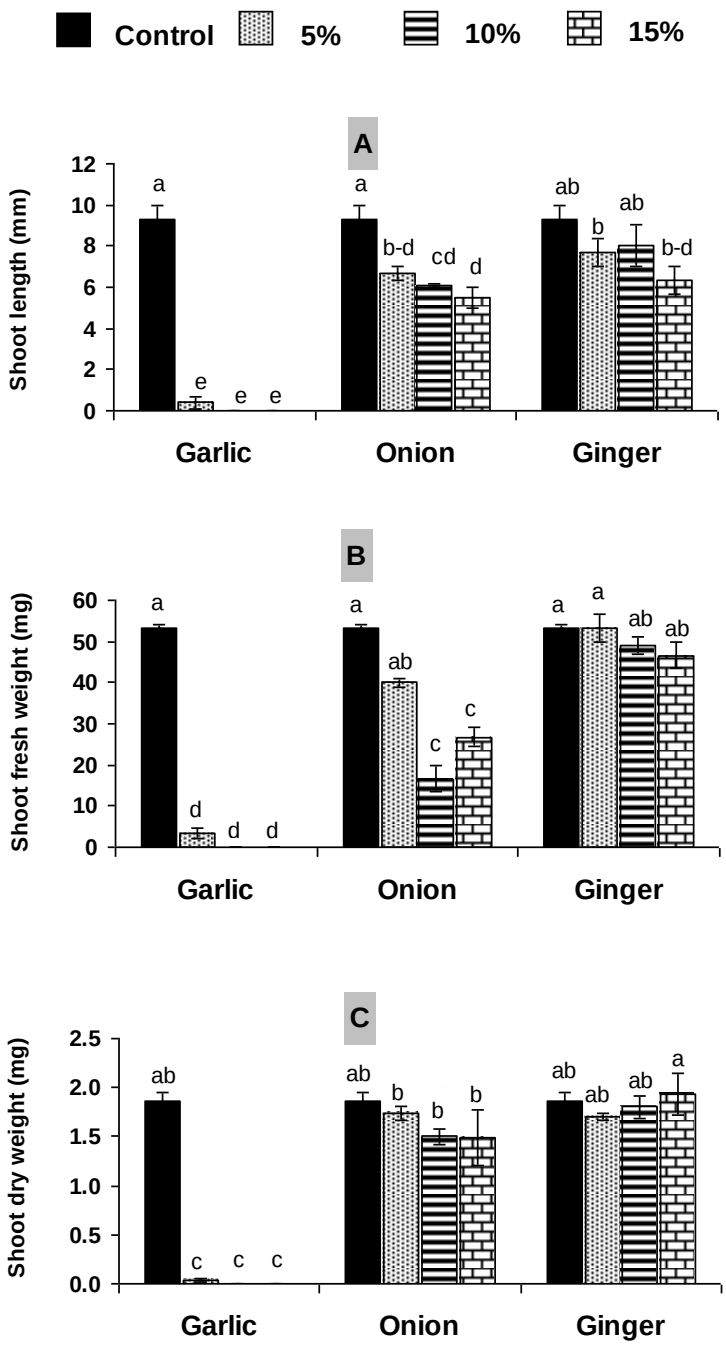

Figure 2. Effect of aqueous extracts of three medicinal plants on shoot growth of parthenium.

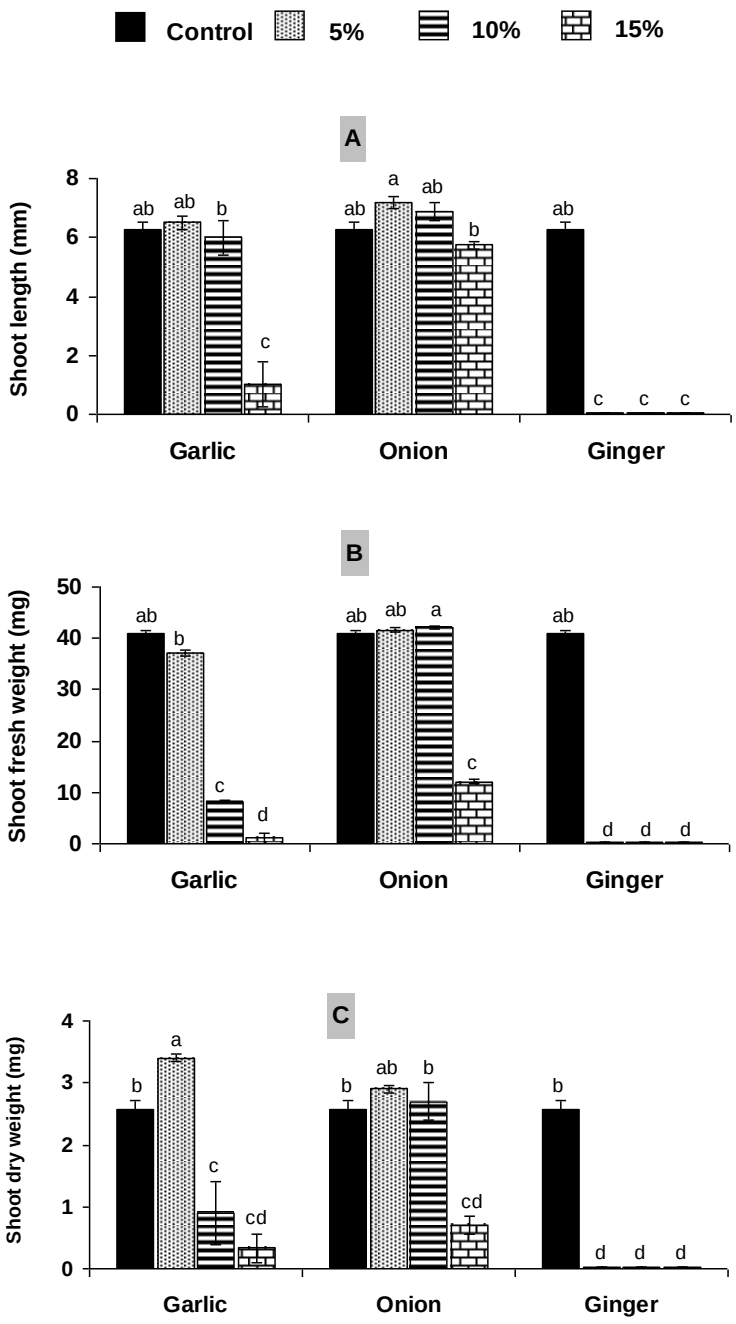

Figure 3. Effect of *n*-hexane extracts of three medicinal plants on shoot growth of parthenium seeds.

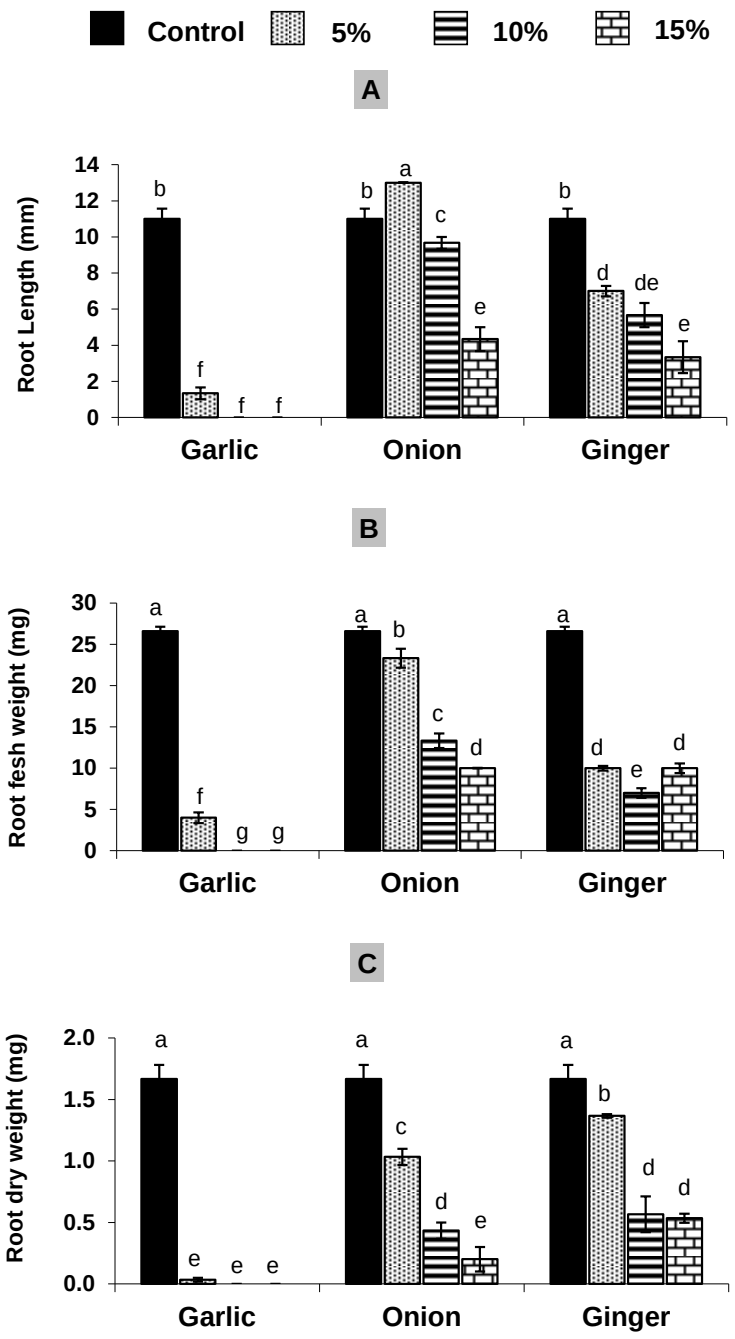

Figure 4. Effect of aqueous extracts of three medicinal plants on root growth of parthenium seeds.

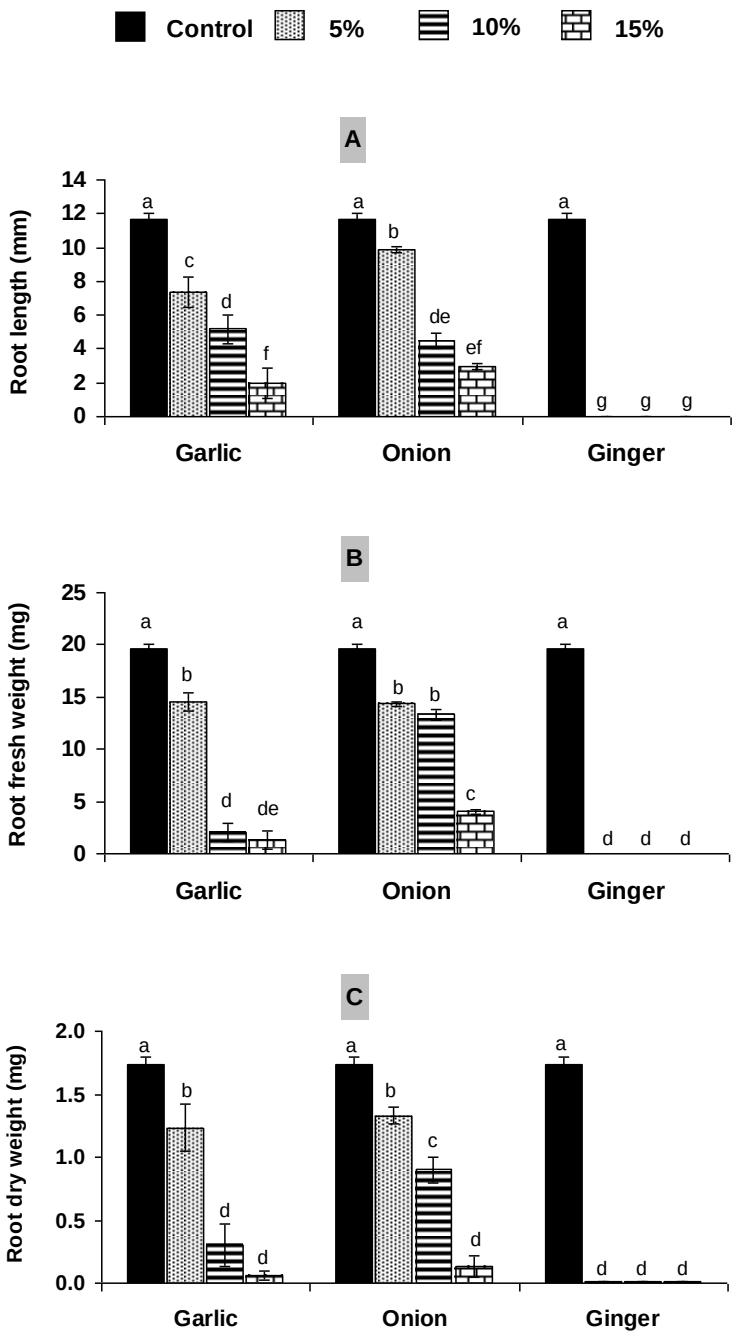

Figure 5. Effect of *n*-hexane extracts of three medicinal plants on root growth of parthenium seeds.

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