

## HERBICIDAL ACTIVITY OF *WITHANIA SOMNIFERA* AND *DATURA ALBA* AGAINST *RUMEX DENTATUS*

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### ABSTRACT

A study was conducted at the Institute of Mycology and Plant Pathology, University of Punjab, Quaid-e-Azam Campus, Lahore, Pakistan during 2008. Herbicidal activity of aqueous extracts of two medicinal plants of family Solanaceae viz. *Withania somnifera* Dunal and *Datura alba* Nees was evaluated against *Rumex dentatus* L., one of the most problematic weeds of wheat in Pakistan. Aqueous extracts of root and shoot of both test medicinal plant species resulted in pronounced suppression in germination as well as seedling growth of target weed species. However, variability in herbicidal potential of different types of employed extracts was evident. Germination was comparatively less susceptible while root growth in *R. dentatus* was highly susceptible to all aqueous extracts. Application of aqueous extracts caused 68 percent reduction in germination, 62 percent in shoot length, 96 percent in root length and 68 percent in seedling biomass.

**KEYWORDS:** *Withania somnifera*; *Datura alba*; *Rumex dentatus*; seedling; Pakistan.

### INTRODUCTION

Wheat (*Triticum aestivum* L.) is regarded as staple food of Pakistan. It occupied an area of 8.14 million hectares during 2005-06 with an average grain yield of 2278 kg per hectare (1), which is very low as compared to yield potential possessed by most of its cultivars. Among the reasons for this low yield, weeds are the most important. As many as 31 and 45 weed species have been reported from wheat growing areas of Punjab and Sindh, respectively (15, 18). These include frequently occurring and densely populated weeds i.e. *Phalaris minor*, *Medicago polymorpha*, *Coronops didymus*, *Melilotus parviflora*, *Chenopodium album* and *Poa annua*. These weeds are known to cause 20-60 percent yield losses in different wheat cultivars (18). Various chemical herbicides such as Topic 15WP, Affinity 50WDG, Buctril Super, etc. are very effective in controlling weeds in wheat

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field in Pakistan (3, 5). However, in recent years, use of chemicals has increased consumer concern and their use is becoming more restrictive due to carcinogenic effects, residual toxicity problems, environmental pollution and high inputs (12, 16). Further high cost associated with the use of herbicides is a limiting factor in profitability of crops (14). For more sustainable and eco-friendly integrated weed management strategies, there is a growing trend for searching alternatives to chemical herbicides, which are less herbicide dependent or based on naturally occurring compounds (7). One such alternative strategy is to manage weeds by natural herbicidal constituents from plants (4, 20).

Among broad-leaved weeds, *Rumex dentatus* L. is of major concern in irrigated wheat under rice-wheat system of Pakistan and India (6, 18). It is a highly competitive weed and can cause drastic yield reduction under heavy infestation (6).

The present study was carried out to investigate the herbicidal activity of two solanaceous medicinal plants viz. *Withania somnifera* and *Datura alba* against germination and seedling growth of *Rumex dentatus*.

## MATERIALS AND METHODS

The study was conducted at the Institute of Mycology and Plant Pathology, University of Punjab, Quaid-e-Azam Campus during 2008. Fresh samples of shoot and root of *Withania somnifera* and *Datura alba* were collected from University of Punjab, Quaid-e-Azam Campus, Lahore during January 2008 and rinsed thoroughly under tap water, dried with blotting paper and chopped into small pieces. Aqueous extract of water-soluble ingredients of plant material was prepared according to Bajwa *et al.* (2). A 20 percent W/V stock solution of each plant extract was attained by soaking crushed plant materials in sterilized distilled water for 48 hours at  $30 \pm 2^\circ\text{C}$ . Afterwards, material was filtered through muslin cloth followed by Whatman No. 1 filter paper. This stock extract was stored at  $4^\circ\text{C}$  and used within four days. The lower concentrations of 5, 10 and 15 percent aqueous extracts of shoot and root of each plant were prepared by adding appropriate quantity of sterilized distilled water to 20 percent stock solution.

Effect of different concentrations of extracts of test plants on germination and early seedling growth of *Rumex dentatus* was studied in a laboratory bioassay. Ten seeds of *R. dentatus* were plated in each pre-sterilized petri plate of 9 cm diameter lined with a Whatman No. 1 filter paper. Each petri plate was separately moistened with three ml of respective concentration of

shoot or root extract of two test plant species. Control received the same amount of distilled water. Each treatment was replicated thrice. Petri plates were arranged in a completely randomized design in a growth room at 25°C. After 12 days of incubation, germination of *R. dentatus* seeds was recorded. Shoot length, root length and fresh biomass of root and shoot were recorded and average data per plant were calculated. The data were analyzed by analysis of variance (ANOVA) followed by Duncan's multiple range test to delineate the treatment means (19) using SPSS computer software.

## RESULTS AND DISCUSSION

Analysis of variance showed that there was insignificant difference between two solanaceous test species for all studied parameters i.e. both test species were equally effective against the target weed. Effect of plant parts (root/shoot extracts) was significant for germination and root length while effect of extract concentration was also significant for all studied parameters. Only interactive effect of plant part and extract concentration (P x C) was significant for germination and root length. However, all other interactive effects were insignificant for all studied parameters (Table).

**Table.** Analysis of variance for the effect of different concentrations of aqueous extracts of shoot and root of two medicinal plants on germination and seedling growth of *Rumex dentatus*.

Trait	Df	Mean squares			
		Germination	Shoot length	Root length	Plant fresh weight
Treatments	19	1063***	57***	253***	11.8***
Species (S)	1	27 <sup>ns</sup>	3.5 <sup>ns</sup>	7.89 <sup>ns</sup>	7.15 <sup>ns</sup>
Plant part (P)	1	1500**	24.4 <sup>ns</sup>	79.9**	4.89 <sup>ns</sup>
Concentration (C)	4	3806***	248***	1143***	40.4***
S x P	1	107 <sup>ns</sup>	1.2 <sup>ns</sup>	1.54 <sup>ns</sup>	0.14 <sup>ns</sup>
S x C	4	64 <sup>ns</sup>	10.3 <sup>ns</sup>	8.73 <sup>ns</sup>	4.13 <sup>ns</sup>
P x C	4	554**	2.2 <sup>ns</sup>	27.1*	3.83 <sup>ns</sup>
S x P x C	4	219 <sup>ns</sup>	1.3 <sup>ns</sup>	0.90 <sup>ns</sup>	4.56 <sup>ns</sup>
Error	40	132	15.4	8.55	2.21
Total	60				

\*, \*\*, \*\*\*, Significant at  $P \leq 0.05, 0.01$  and  $0.001$ , respectively.

ns = Non significant.

### Herbicidal activity of *W. somnifera*

Germination of *R. dentatus* was suppressed both by shoot and root extracts of *W. somnifera*. However, shoot extract was found to be more toxic than root extract. Effect of lower concentration of 5 and 10 percent of shoot extract was

insignificant while 15 and 20 percent shoot extract significantly reduced seed germination by 48 and 68 percent, respectively. The adverse effect of all root extract concentrations against germination was insignificant (Fig.1a) Similar herbicidal activity of aqueous extracts of *W. somnifera* has also been reported by Javaid *et al.* (9) against germination of *Phalaris minor*.

Both shoot and root extracts showed pronounced herbicidal activity against shoot length of *R. dentatus*. All concentrations of two types of extracts except 5 percent significantly declined shoot length. Shoot extract was comparatively more toxic than root extract. There was 27-60 and 17-50 percent reduction in shoot length due to various root and shoot extract concentrations of *W. somnifera*, respectively (Fig. 1b). *W. somnifera* is known to synthesize withasteroids (13). Major source of withanolides in *W. somnifera* has been reported to be in its leaves possessing an excellent selective COX-2 inhibitory activity (11).

Root length was more susceptible to aqueous extracts of *W. somnifera* than shoot length. All concentrations of shoot extract significantly suppressed the root length of *R. dentatus* seedlings. There was 50-96 percent reduction in root length due to various concentrations of shoot extract. Root extract was comparatively less toxic than shoot extract. Effect of 5 percent root extract was insignificant while higher concentrations of 10-20 percent significantly declined the studied parameters by 80-89 percent (Fig. 1c) Greater sensitivity of root growth than shoot growth to allelopathic plant extracts have also been demonstrated in other plant species (9,10). Since roots are the first to absorb chemical compounds and are route of translocation, thus these may show their abnormal growth in response to these chemicals resulting in reduced length (8).

All concentrations of shoot extract significantly suppressed biomass of *R. dentatus* seedlings. There was 30-68 percent decline in plant biomass due to various concentrations of shoot extract. Maximum adverse effect was recorded due to 10 percent shoot extract. Higher concentrations of 15 and 20 percent showed significantly greater shoot biomass as was recorded in 10 percent extract treatment (Fig. 1d). Similar unusual trend has also been reported by Javaid *et al.* (10) where 5 percent shoot extracts of different rice varieties showed more pronounced adverse effect on shoot growth of parthenium weed than 10 percent extracts. Root extract also exhibited pronounced toxicity. There was a gradual decrease in plant biomass as the root extract concentration was increased from 5 to 20 percent. Effect of all root extract concentrations was statistically significant (Fig. 1d).

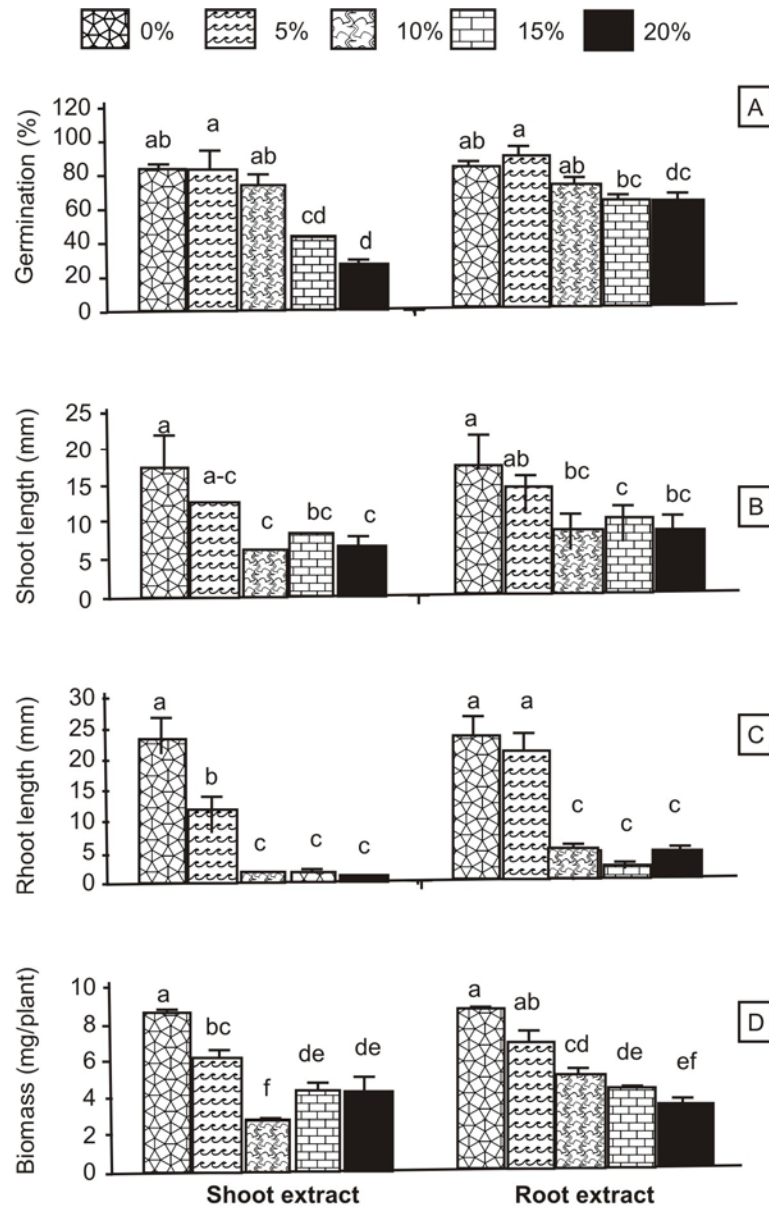


Fig. 1 Effect of aqueous extracts of shoot and root of *Withania somnifera* on germination and early seedling growth of *Rumex dentatus*. Vertical bars show standard errors. Bars with different letters show significant difference ( $P \leq 0.05$ ) as determined by Duncan's multiple range test.

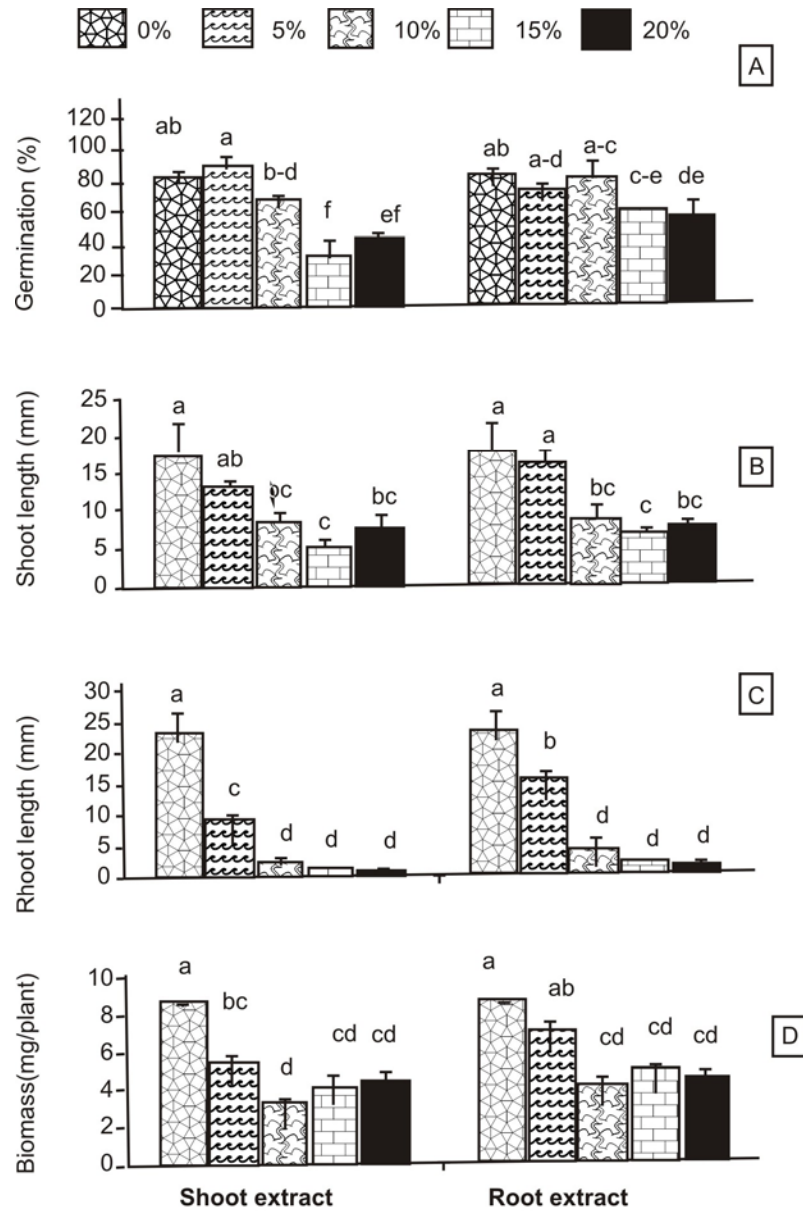


Fig. 2 Effect of aqueous extracts of shoot and root of *Datura alba* on germination and early seedling growth of *Rumex dentatus*. Vertical bars show standard errors. Bars with different letters show significant difference ( $P \leq 0.05$ ) as determined by Duncan's multiple range test.

### Herbicidal activity of *D. alba*

Lower concentrations (5 and 10%) of both root and shoot extracts of *D. alba* showed insignificant effect on germination of *R. dentatus* seeds. Higher concentrations of 15 and 20 percent of shoot extracts significantly suppressed the germination by 60 and 48 percent, respectively. Similarly, 15 and 20 percent root extract also exhibited significant effect resulting in 28 and 32 percent decline in germination of target weed species, respectively (Fig. 2a). Recently Shafique *et al.* (17) have reported similar effects of *D. alba* aqueous extracts against germination of *Phalaris minor* seed.

Response of shoot length of different extracts was similar to that in case of germination. Lower concentrations of both root and shoot extracts showed insignificant effect on shoot length of *R. dentatus* seedlings. Conversely, higher concentrations (10-20 percent) exhibited significant adverse impact against studied parameters. There was 52-71 and 51-62 percent reduction in shoot length due to 10-20 percent shoot and root extracts, respectively (Fig. 2b). Root length was highly susceptible to both root and shoot extracts. All concentrations of root and shoot extracts of *D. alba* significantly suppressed root length of *R. dentatus*. There was a parallel increase in toxicity with increase in extract concentration. A significant decrease of 60-96 and 34-93 percent in root length was recorded due to different concentrations of shoot and root extracts of *D. alba* (Fig. 2c).

All concentrations of shoot extracts significantly reduced seedling biomass by 37-62 percent. Root extract also proved very effective in retarding the seedling biomass. However, phytotoxic effect of root extract was comparatively lower than that of shoot extract. Adverse effect of lowest concentration (5 percent of root extract) was insignificant while all other extract concentrations significantly declined the studied parameters (Fig. 2d).

### CONCLUSION

The study concludes that aqueous extracts of both *W. somnifera* and *D. alba* contain herbicidal constituents which are effective against one of most problematic weed of wheat. Further studies regarding isolation of herbicidal ingredients is in progress. Once identified, these potential ingredients may be used as a structural lead to prepare safer synthetic herbicides for the control of *R. dentatus*.

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