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Short Communication

ALLELOPATHIC EFFECTS OF AQUEOUS LEAF EXTRACTS OF TWO INVASIVE PLANTS (*CHROMOLAENA ODORATA* (L.) R. M. KING & H. ROB. AND *SPHAGNETICOLA TRILOBATA* (L.) PRUSKI) ON SEED GERMINATION OF *AMARANTHUS CRUENTUS* L

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ABSTRACT

The present study was aimed to assess the allelopathic activity of leaf extracts of two invasive plants of Asteraceae family (*Chromolaena odorata* (L.) R.M. King & H. Rob. and *Sphagneticola trilobata* (L.) Pruski) against the seed germination of red amaranthus (*Amaranthus cruentus* L.). For the study, 10, 20, 30, and 40 percent solutions of aqueous leaf extracts of both plants were prepared using the shade dried leaves. The experiments were conducted in sterilized petridishes of 9 cm diameter lined by two layers of filter papers. 50 seeds were placed in each of the petridishes. Distilled water was used as control. The numbers of germinated seeds were recorded every day for seven days. By calculating the germination percentage after seven days of experiment, it was clear that the germination percentage decreases with increasing concentrations of leaf extracts. The comparative evaluation of the allelopathy of both extracts showed that the extracts of *Chromolaena odorata* showed slight increased inhibitory effect on the seed germination than that of *Sphagneticola trilobata*. It is concluded that the high allelopathic property of both these plants can be responsible for the rapid spreading and successful establishment of these plants and the evaluation, identification and isolation of the allelochemicals in these plants can be a subject for future researches for the production of natural herbicides.

Keywords: Allelopathy, *Chromolaena odorata*, *Sphagneticola trilobata*, *Amaranthus cruentus*, Germination percentage.

1. INTRODUCTION

Allelopathy is defined as the beneficial or unfavourable effects of metabolic secretions of plants or micro-organisms on other plants or microorganisms in the environment [1]. Allelopathic inhibition is complex and can involve the interaction of different classes of chemicals with mixtures of different compounds sometimes having a greater allelopathic effect than individual compounds alone. Different plant parts, including flowers, leaves, leaf litter and leaf mulch, stems, bark, roots, soil, and soil leachates and their derived compounds, can have allelopathic activity that varies over the growing season [2]. Plant allelopathy is one of the modes of interaction between receptor and donor plants and may exert either positive effects (*e.g.,* for agricultural management, such as weed control, crop protection, or crop reestablishment) or negative effects (*e.g.,* autotoxicity, soil sickness, or biological invasion) [3].

Efforts on understanding mechanism of productions of allelochemicals, their release into environment influence on the neighbouring plant, the mechanism of action of allelochemicals at molecular level, their influence of soil and ultimately the application of all these in the management of natural and agricultural ecosystem are the subject of interest for those engaged in allelopathic research worldwide [4].

Chromolaena odorata (L) King and Robinson Asteraceae commonly known as Siam weed, is a fast-growing perennial and invasive weed native to South and Central America. It has been introduced into the tropical regions of Asia, Africa and other parts of the world. It is an aggressive competitor that occupies different types of lands where it forms dense strands that prevents the establishment of other flora. It is a menace in plantations and other ecosystems. It suppresses young plantations, agricultural crops and smothers vegetation as it possesses allelopathic potentialities and growth inhibitors [5-7]. It spreads rapidly in lands used for forestry, pasture and plantation crops such as rubber, coffee, coconut, cocoa and cashew. The plant can be poisonous to livestock as it has exceptionally high level of nitrate (5 to 6 times above the toxic level) in the

leaves and young shoots; the cattle feeding on these die of tissue anoxia [8, 9].

Sphagneticola trilobata (L.) Pruski., is a member of the family Asteraceae the sunflower or daisy family. The species is commonly referred to by its former name, *Wdelia trilobata* (L.) Hitchc. *Sphagneticola trilobata* (L.) Pruski., is a soil creeper and forms a thick carpet. The genus Sphagneticola, has about 70 species with tropical and subtropical distribution. The species is native to Mexico, Central America and throughout the Caribbean, now designated by IUCN as one of World's 100 worst invasive species. The plant species is usually introduced as an ornamental or ground cover in gardens and reproduced by vegetative mode. It rapidly forms a dense ground cover, crowding away and preventing other plant species from regenerating. It is a perennial herb with a creeping habit [10].

Amaranthus cruentus or the 'red amaranth' or the 'Mexican grain amaranth' is a flowering plant that belongs to the Amaranthaceae family. It is an annual, pseudo-cereal broad leafed plant that is used as a high-protein grain, leafy vegetable, or forage crop. It produces edible seeds that are eaten as a cereal grain or cooked into porridge, and the leaves are cooked like spinach. Amaranth is drought tolerant and requires warm growth conditions for germination (65°-75°F) [11].

Seed germination is the foremost and inescapable stage of plant survival and reproduction, during plant growth. In this stage, the inhibition or promotion of other plants will affect the seed germination. The main objectives of this study were to evaluate and compare the allelopathic effect of two invasive plants (*Chromolaena odorata (*L.*)* R.M. King & H. Rob. and *Sphagneticola trilobata* (L.) Pruski) on the seed germination of red amaranthus (*Amaranthus cruentus* L.) by analyzing the germination percentage of seeds exposed to four different concentrations of leaf extracts.

2. METERIAL AND METHODS

2.1. Preparation of extract

The leaves of *Chromolaena odorata* and *Sphagneticola trilobata* were collected, washed and shade dried. The dried leaves of both plants were powdered separately. The aqueous leaf extracts were prepared by soaking 10g of dried powder in 100ml of distilled water separately and kept for 48 hours in room temperature to get 10% stock solution. Then it was filtered using Whatman filter paper No.1 and centrifuged at 3500 rpm for 15 minutes. The supernatant were collected and used for the preparation of 10%, 20%, 30%, 40% of solutions of both leaf extracts and the solutions were stored in refrigerator.

2.2. Experimental Treatment

The seed of *Amaranthus cruentus* L. were collected and sterilized by washing with 1% $KMnO_4$ and distilled water. The tests were carried out by petri dish method. 50 seeds were placed in each sterilized Petri dishes of diameter 9cm lined by double layer of filter papers and treated with the four concentrations of leaf extracts for seven days at room temperature. Another petridish containing 50 seeds were treated with distilled water and considered as control. The no. of germinated seeds on each days of experiment were recorded and after seven days germination percentage were calculated using the following equation:

Germination %= (Number of seeds germinated/Total number of seeds) x100 [12]

3. RESULTS AND DISCUSSION

The effect of aqueous leaf extracts of *Chromolaena odorata* and *Sphagneticola trilobata* on germination percentage of red amaranthus (*Amaranthus cruentus* L.) seeds are given in table 1. 80% of seeds were germinated in the control (distilled water). The germination percentage of seeds found decreasing according to the increasing concentrations of test solutions *i.e.,* the higher concentrations of both the leaf extracts (40%) showed maximum inhibitory effect on the seed germination. In the case of *Chromolaena odorata* the germination percentage on seventh day of observation was 60% (30 out of 50 seeds were germinated) in the 10% concentration of extract, 54% (27 of 50 seeds) in 20% of test solution, 44% (22 of 50 seeds) in 30% of test solution, only 28% (14 of 50 seeds) in the 40% solution (Fig.1). The seeds exposed to different concentrations of *Sphagneticola trilobata* leaf extracts also showed a significant decrease in germination percentage according to the increasing concentrations of test solutions *i.e.,* the germination percentage on the seventh day of the study were 62% (31 of 50 seeds) in 10% of extract, 58% (29 of 50 seeds) in 20% of extract, 50% (25 of 50 seeds) in 30% concentration of the extract, 36% (18 of 50 seeds) in the 40% concentration (Fig. 2). This inhibitory effect of leaf extracts of the selected invasive plants on the seed germination can be caused by the allelochemicals present in them. From the Fig. 3, it is clear that when

comparing the effect of two leaves extracts on the germination rate of seeds, the extracts of *Chromolaena odorata* showed a higher inhibitory effect on the seeds in all concentrations of the extract than that of *Sphagneticola trilobata*.

Allelopathic property of the aqueous extracts of leaves and roots of *Chromolaena odorata* were already proved by analysing seed germination and seedling growth on ten herbaceous plants of china [13]. Allelopathic Effects of two Asteraceae Weeds (*Artemisia annua* and *Taraxicum officinalis*) on Germination of Maize and Wheat also documented similar results [14].

Table 1: Effects of different concentrations of leaf extracts of *Chromolaena odorata and Sphagneticola trilobata* on germination percentage of red amaranthus (*Amaranthus cruentus* L.) seeds.

Concentrations	Germination%	
	Chromolaena odorata	*Sphagneticola trilobata*
Control	80	
10%	60	62
20%	54	58
30%	44	50
40%	28	36

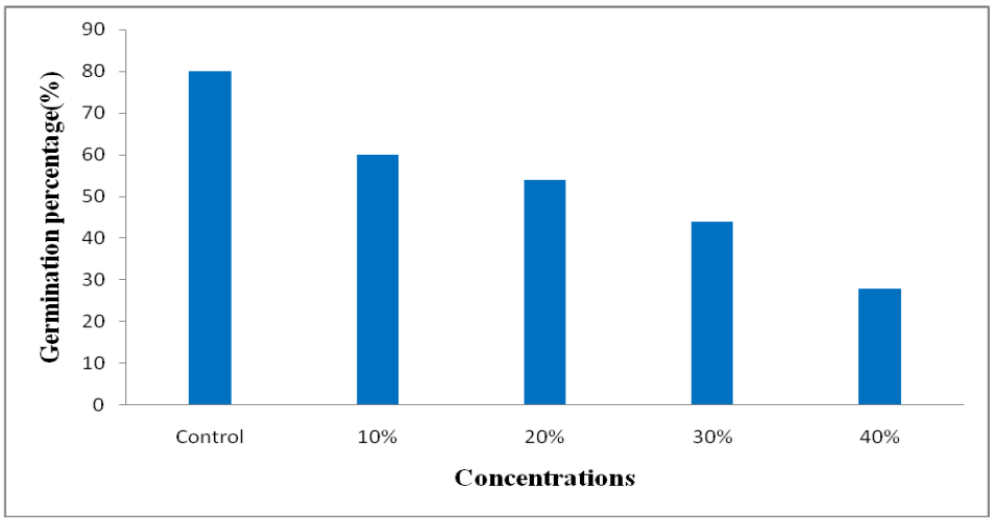

Fig. 1: Allelopathic effect of different concentrations of leaf extracts of *Chromolaena odorata*on germination percentage of red amaranthus seeds.

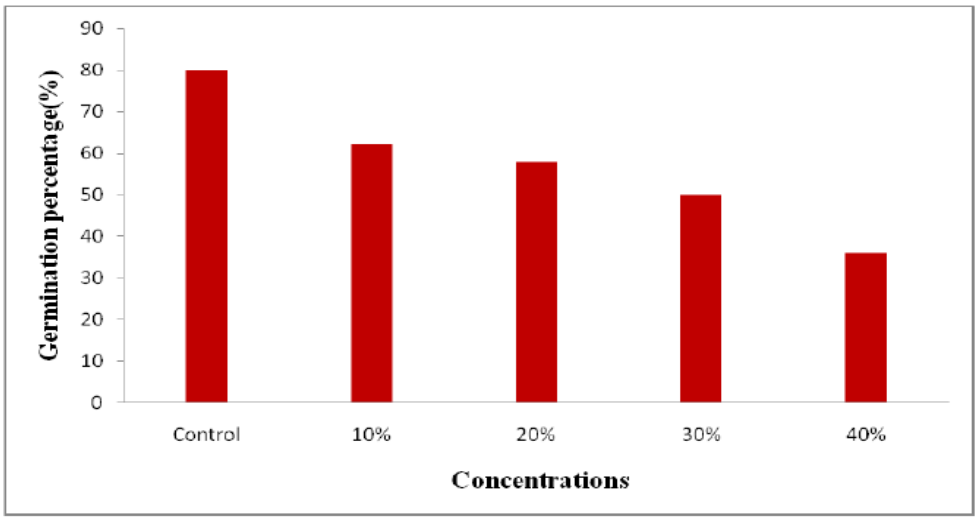

Fig. 2: Allelopathic effect of different concentrations of leaf extracts of *Sphagneticola trilobata* on germination percentage of red amaranthus seeds.

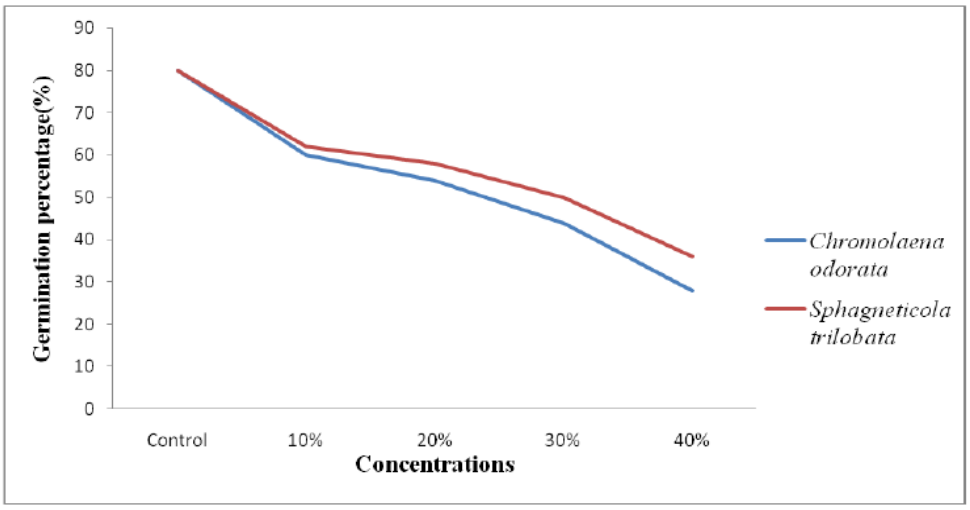

Fig.3: A comparison of allelopathic effect of leaf extracts of *Chromolaena odorata*and *Sphagneticola trilobata* on germination percentage of red amaranthus seeds

4. CONCLUSION

The study showed that the aqueous leaf extracts of both *Chromolaena odorata* and *Sphagneticola trilobata* have potential inhibitory effect on the seed germination of *Amaranthus cruentus*. The findings of this study suggest that the allelopathic property of both these invasive plants may contribute to their ability to become dominant among the invaded plants in Kerala. The evaluation, identification and isolation of the allele-chemicals in these plants can be a subject of future researches for the production of natural herbicides.

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