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Allelopathic potential of *Lagenaria siceraria* (Mol.) Standl

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ABSTRACT

Allelopathic influences of Lagenaria siceraria (Mol.) Standl. was examined on seed germination and seedling growth of Phaseolus aconitifolius Jacq. var – 'Abhaya'. Leachates and Decomposition bioassay methods was followed for detection of allelopathic activity. Root shows dominant as compare to other three plants in leachates bioassays. In decomposition bioassay Lagenaria siceraria shows the allelopathic activity on seedling growth and seed germination of P. aconitifolius. It was further observed that radicle growth was more hampered of the test plant by leachates bioassay. Inhibition of seedling growth of test plant by leaf, stem and root leachates and decomposition bioassay of Lagenaria siceraria were significant and concentration correlated. Inhibition of Phaseolus seedling growth was in an order to Root < Stem < Leaf.

Keywords: Allelopathy, *Lagenaria siceraria, Phaseolus aconitifolius,* Leachates, Decomposition bioassay.

INTRODUCTION

The term allelopathy was derived from Greek word, which means mutual harm. This term covers both the detrimental and beneficial reciprocal biochemical interactions. Allelopathy is defined as any direct or indirect, harmful or beneficial effect of one plant on another plant through release of chemicals into the environment [1]. It involves the complex chain of chemical communications between plants species leading to either inhibitory or stimulatory effects [2] [3].

Allelopathic chemicals can be present in any part of the plant. They can be found in roots, stem, leaves, flowers, fruits, seeds. They can also be found in the surrounding soil. These plant parts release allelochemic compounds into the environment by process like root exudation, leaching, volatilization and decomposition of plant residues [4]. The use of plants with strong allelopathic properties for weed control has shown promising results and allelopathy holds great prospect for meeting some of these demands [5]. Many crop and weed species have been observed to have allelopathic properties [6]. Nazir [7] evaluated allelopathic potential of 3 herbal species (*Rheum emodi, Saussaurea lappa and Potentilla fulgens*) against some traditional crops. Germination of all crops was reduced significantly by aqueous extracts of *S. lappa and P. fulgens.* Allelopathic effects of 4 medicinal plants was studied by using various methods [8]. Allelopathic activities of 14 medicinal plant species growing in plain area of Pakistan with semi-arid conditions on growth of lettuce (*Lactuca sativa*) [9].

In the present study, plant parts of *Lagenaria siceraria* (Molina) Standley syn. *L. leucantha* Rusby; *L. Vulgaris* Ser. (Family: Cucurbitaceae) which is commonly known as Bottle gourd, was selected in order to find out its allelopathic effects on seeds of *Phaseolus aconitifolius*. Review of literature revealed that the allelopathic studies of *Lagenaria siceraria* have remained unexplored. The literature available on these plants are mostly pertaining to the chemistry [10], medicinal uses [11] and very little or nothing about its allelopathic activity. Hence, it was proposed to undertake allelopathic study of *Lagenaria siceraria*.

MATERIALS AND METHODS

Plant materials: *Lagenaria siceraria* (Molina) Standley plant were collected from Tal. Wai, District Satara, M.S. India, and identified from Botanical Survey of India, Pune. Mature seeds of *Phaseolus aconitifolius* Jacq. var.-'Abhaya' was collected from agricultural shops. They were surface sterilized with 0.1% Mercuric chloride ($HgCl_2$) followed by washing with distilled water; carefully dried and used for bioassay for seed germination and seedling growth. To evaluate the allelopathic activity of *L. siceraria* on *Phaseolus aconitifolius* seeds, two types of bioassays were conducted in the laboratory.

Leachates Bioassay [12]: To find out effectiveness of inhibitors leaching out from the medicinal plants, 100g of healthy and cleaned plant parts including root, stem and leaves separately were soaked in equal amount of distilled water for 72 hrs. each type of leachates was filtered through Whatman No.1 filter paper and the filtrate of each plant parts was used for bioassays. In order to study whether these leachates of *L. siceraria* show allelopathic effects on test crop, surface sterilized 10 seeds of *P. aconitifolius* were placed in sterilized petridishes (11cm. diameter) containing Whatman No. 1 filter paper, moistened with 10ml of root, stem and leaves separate leachates solution were used for moistening filter paper. Each petridish containing 10 seeds of *P. aconitifolius* were kept in triplicate at room temperature (28 ± 2^OC). A petridish containing filter paper moistened with 10 ml distilled water served as control. These petridishes were wrapped by brown paper to avoid direct sunlight. The emergence of radical was considered as the criterion for seed germination and was observed daily till 7 days and expressed as % seed germination. The observations of seed germination and simultaneously hypocotyl and radical length were measured after 7 days of sowing.

Decomposition Bioassay [13]: To judge the activity of the decaying plant parts, healthy plant parts of plant species were taken from freshly collected plant. These plant parts including leaves, stem and roots were dried in shade for 8 to 10 days. Then these plant parts were ground thoroughly and mixed with loamy soil (250g) at the rates of 2g, 4g, 8g, 16, and 32g and allow withering away for 40 days in the pots. The pots containing soil and grounded plant parts were kept wet by addition of equal amount of distilled water. The pots were periodically observed to ensure them to remain wet. After 40 days of withering these mixtures were dried in air and placed in sterilized petridishes at the rates of 20g per petridish. These petridishes were lined with Whatman No.1 filter paper wetted with 10 ml of distilled water and surface sterilized 10 seeds of *Phaseolus aconitifolius* were kept in triplicate at room temperature (28 ± 2^OC). A petridish containing 20g of soil free from decaying plant parts and Whatman No.1 filter paper wetted with 10 ml of distilled water served as control.

Statistical Analysis:
In the present investigation statistical tests were applied to find out the mean values of radicle and hypocotyl of test plants under the influence of treatments of different bioassay. Data were analyzed by one-way ANOVA; Duncan Multiple Range Test (DMRT) by using SPSS software. Data of Radicle and Hypocotyl were expressed by Mean $\pm$ Standard Error ($n = 3$). Values followed by the same letter (a, b, c, d and e) were not significantly different at 0.5% level.

RESULTS

Leachates Bioassay: It was observed that stem leachates of *L. siceraria* fully suppresses the seed germination as well overall seedling growth of *Phaseolus*. The leachates of root, stem and leaves significantly affect the seed germination and seedling growth of *Phaseolus*. It is observed that the root leachate fully hampered the radicle growth and also suppresses the average seed germination at 50.00%. The magnitude of inhibition followed the order: root > stem> leaf. (Table No.1)

Decomposition: It has been observed that overall seedling growth as well as seed germination showed appreciable inhibitory effects at higher amount of dry material of plant parts of *L. siceraria*. The germination percentage as well as seedling growth is significantly reduces in higher amount of plant material allowed for decomposing. The remarkable inhibition in average seed germination percentage was 50.00% at 32g plant material. Incorporation of the plant material in the soil significantly reduces more radicle length than hypocotyl elongation. The effect is more pronounced at higher rates (32g plant material/ 250g of soil) on seedling growth. However, at low rate of plant material (2g and 4g/ 250g of soil) slightly affected seed germination percentage while increased or not significantly inhibited seedling growth of *Phaseolus*. (Table No.2)

Table No. 1: Inhibitory effects of Leachates of *L. siceraria* on *P. aconitifolius* seeds.

Types of Leachates	Radicle Length (Mean $\pm$ SE)	Hypocotyls Length (Mean $\pm$ SE)	Average Seed Germination (%)
Control	5.9 ± 0.4^{a}	7.2 ± 0.4^{a}	100
Root	0.9 ± 0.09^{b}	1.8 ± 0.2^{b}	50.00
Stem	1.3 ± 0.1^{b}	3.2 ± 0.1^{b}	63.33
Leaf	1.7 ± 0.03^{b}	4.1 ± 0.06^{b}	70.00

Data were analyzed by one-way ANOVA; Duncan Multiple Range Test (DMRT) using SPSS software. Data of Radicle and Hypocotyls were expressed by Mean±SE (n = 3). Values followed by the same letter were not significantly different at 5% level (DMRT).

Table No. 2: Inhibitory effects of Decomposition of *L. siceraria* on *P. aconitifolius* seeds.

Quantity of plant parts in decomposition (g/250g soil)	Radicle Length (Mean $\pm$ SE)	Hypocotyls Length (Mean $\pm$ SE)	Average Seed Germination (%)
Control	10.0 ± 0.1^{a}	11.6 ± 0.08^{a}	100
2g	6.2 ± 0.3^{b}	8.0 ± 0.5^{b}	90.00
4g	5.9 ± 0.06^{c}	6.9 ± 0.08^{c}	80.00
8g	3.9 ± 0.1^{d}	4.9 ± 0.2^{d}	73.33
16g	1.6 ± 0.2^{e}	2.3 ± 0.4^{de}	66.66
32g	0.8 ± 0.1^{f}	1.6 ± 0.2^{e}	50.00

Data were analyzed by one-way ANOVA; Duncan Multiple Range Test (DMRT) using SPSS software. Data of Radicle and Hypocotyls were expressed by Mean±SE (n = 3). Values followed by the same letter were not significantly different at 5% level (DMRT).

DISCUSSION

Allelopathy in agricultural practices has become more important with the main objectives of using this phenomenon in biological control of weeds [1]. As a possible approach, this fact shall be further evaluated and utilized for screening allelopathic plant species [14]. It was also reported that effectiveness of receiver plants to allelochemicals was concentration dependent of inhibitory substances with a response threshold [15, 16, 17 &18]. Inhibitory effects of these medicinal plants were different on test plant. The variation might be attributed to the differences in kind, total amount as well as properties of allelochemicals produced by different species used in this study. The extracts from lettuce plant had potent allelopathic activity and the activity differed depending on cultivar, extract or fraction [19]. However, the growth inhibitory effects of medicinally important plant *L. siceraria* were confirmed by test plant in the present research. The root leachate shows dominant as compare to other three plants in leachates bioassays. In decomposition bioassay the germination percentage as well as seedling growth is significantly reduces in higher amount of plant material allowed for decomposing. Incorporation of the plant material in the soil significantly reduces more radicle length than hypocotyl elongation. The allelopathic activity of *L. siceraria* on seedling growth and seed germination of *Phaseolus aconitifolius* by leachates and decomposition bioassay may be the candidates for isolation and identification of allelochemicals. Further studies, however, should be conducted under greenhouse and field conditions to help evaluate the implications of this plant species.

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