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RESEARCH ARTICLE

Taxonomy and Ecology of Obnoxious Weed *Alternanthera Philoxeroides* Grisebach (Family Amaranthaceae) on Spore Germination in *Ampelopteris Prolifera* (Ketz.) Cop.

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ABSTRACT
Alternanthera philoxeroides, the alligator weed is an invasive species that is native to South America. From the invasive point of view A. philoxeroides has proved to be second in the world after Parthenium. The plants are cosmopolitan in distribution. Because of its invasive nature, high rate of vegetative reproduction, as well as the ability to produce several allelochemicals, it has gradually threat to our biodiversity. The present paper deals with the distribution of A. philoxeroides in the district of Midnapore and its association and effect on other crops. It also deals with the studies of the effect of aqueous extracts from various plant parts (inflorescence, stem, root and leaves) of A. philoxeroides on the spore germination of the edible pteridophytes Ampelopteris prolifera . Stem and root extracts were found to exhibit maximum allelopathic potentiality causing a decrease in the spore germination percentage than leaf extract. Increase filamentous growth and decrease rhizoidal growth has been attributed to the presence of alkaloids and phenols in the extracts of A. philoxeroides. It has been found that these toxic substances are synthesized in the leaf but gradually they are translocated to the various plant parts like stem and roots.
KEY WORDS: *Invasive nature, allelochemicals, biodiversity, germination, growth, allelopathic alkaloids, phenols, extracts*

INTRODUCTION

After receiving a great deal of scrutiny for several decades, allelopathy has received renewed attention in the literature part because of its potential to explain the dramatic success of some invasive plants. *Alternanthera philoxeroides,* alligator weed is an invasive species. *A. philoxeroides* have been allelochemicals. Chemicals released from plants and imposing allelopathic influences are allelochemicals or allelochemics. Allelochemicals produced in the tissues of such plants may enter soils as leaf leachates or root exudates or during tissue decomposition [1].

Chemicals with allelopathic potential are present in almost all plants and in many tissues such as leaves, stems, inflorescence, fruits, seeds, roots that these chemicals under specific conditions are released in to the environment and can positively or negatively affect on growth and development of vegetation [2]. Allelopathic compounds influence physiological processes such as cellular expansion, cell wall constraction, phytohormonal balance, activity of specific enzymes like indolacetic acid oxidase, pollens, spores and seeds germination, mineral uptake, stomatal movement, pigment synthesis, photosynthesis, respiration, protein synthesis, leghemoglobin biosynthesis, N_2-fixation, plant water relations, DNA and RNA modification and activation of cellular antioxidative [3,4]. An aqueous leachates from inflorescence, stem, root and leaves of *Alternanthera philoxeroides* Grisebach were found to inhibit the germination and seedling growth of *Ampelopteris prolifera* (Ketz.). Allelopathic inhibition is complex and can involve the interaction of different classes of chemicals like phenolic compounds, flavanoids, terpenoids, alkaloids, steroids, carbohydrates and amino acids with mixtures of different compounds sometimes having a greater allelopathic effect than individual compounds alone. Allelochemicals may be more biodegradable than traditional herbicides but may also have undesirable effects on non-target species, necessiating ecological studies before widespread use. Although, seedling must be done in a suitable moisture and temperature. Reports indicate that some allelochemicals to inhibit the germination. Therefore, in the present study, the effects of some allelopathic compounds of *Alternanthera philoxeroides* to inhibit on spore germination and growth of *Ampelopteris prolifera.*

Ampelopteris prolifera is hairy, hairs unicellular, forked or simple, long, often flagelliform, dark brown, deciduous plant and axillary vegetative buds also present (Fig. 5). A low altitude thicket forming hardy fern found in the plains along river banks, ponds, marshy places, water courses and also in the foothills upto 1500 altitude. It is found in India as well as Midnapur district in West Bengal. The study was carried out to analyze traditional knowledge including local names such as "Dhekishak", general distribution, sporing period, part used, habit, habitat, medicinal and other uses, like –

1. Occasionally cultivated as an ornamental plant in gardens.
2. The people are used as food vegetables.

As well as *Alternanthera. philoxeroides* also used a small amount of food vegetables in rural & tribal area. But it has allelopathic effect which is inhibit to germination, growth & development of *Ampelopteris prolifera.*

MATERIALS AND METHODS

Study area

This work was carried out during June 2009 to October 2009 in Paschim Medinipur district (Lat. $22^0 27'$N & Lon. $87^o 20'$ E). It lies in subtropical region with characteristic favourable season. Seasons: hot and dry summer (Last week of March to June), hot and moist rainy season (July to 1st week of October) and cold and dry winter (November to February). Maximum temperature ranges from 35^0C to 42^0C in summer and 12^0C to 22^0C in winter and minimum temperature from 28^0C to 32^0C in summer and 8^0C to 10^0C in winter. Soil in this area is red lateritic and very suitable for paddy and vegetables growing.

Fig. 1 Map of the Study area

Experimental Work (Allelopathic study)

The Allelopathic effect of aqueous extracts of Inflorescence, stem, root and leaves of obnoxious weed *Alternanthera. philoxeroides* were examined to inhibit the spore germination and growth of *Ampelopteris prolifera.* The spores were collected from the different vegetational spots where the plants were naturally grown. On 5 gm. of fresh plant parts and crushed by distilled water and allowed to centrifugal process. Aqueous extract was obtained and final volume was adjusted to 50ml. The extract was considered as stock solution and a series of solution with different strengths (20%, 40% & 60%) were prepared by dilution (Fig. 2). Sieved spores allowed to germinate in Petri dishes (5 mg. in each) with deep layer of cotton and whatman filter paper by aqueous extract of different concentrations (Fig. 3). An experiment using distilled water was also performed as control. The Petri dishes were maintained at room temperature (maximum temperature during midday: 28^0C-32^0C) and natural photoperiod for 9^{th} days on 10^{th} day during observation. An additional millilitre of each maximum dilution (more than 80%) solution was added every 24 hour for kept the favourable condition and observed the climatic data on period of spore germination (Table-1, Fig. 9, Fig. 10).

RESULT AND DISCUSSION

Species Description : *Alternanthera philoxeroides*

Alligator weed, *Alternanthera philoxeroides,* is a non-woody perennial aquatic / shoreline plant found in first Florida but non-native to the U.S. Although this alligator weed native in USA but gradually threat to the biodiversity. Presently in India this plant dominated through out India and shows as a invasive species

Table: 1. Climatic data on period of spore germination

DAY	TEMPARATURE (°C)		HUMIDITY (%)	
	High	Low	High	Low
1^{st} day	34	24.2	92	42
2^{nd} day	34	24.4	99	42
3^{rd} day	34	24	99	49
4^{th} day	33	23	86	47
5^{th} day	33.2	24	87	48
6^{th} day	33	24	89	46
7^{th} day	32.9	23.5	87	48
8^{th} day	32	23	86	46
9^{th} day	32	20	86	47
10^{th} day	31.9	20.1	85	48

Table: 2. Different concentration grade of *A. philoxeroides* from different plant parts on spore germination of *A. prolifera*

Hours (h)	Control (length of the germ tube)	Inflorescence			Stem			Root			Leaf		
		20%	40%	60%	20%	40%	60%	20%	40%	60%	20%	40%	60%
24 h	No germination	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
48 h	No germination	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
72 h	0.98 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
96 h	1.091 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
120 h	1.1 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
144 h	1.220 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
168 h	2.220 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
192 h	3.450 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
216 h	4.062 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.
240 h	6.098 µm	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.	N.G.

** N.G.= No Germination*

Fig. 2: Different concentration grade of *Alternanthera philoxeroides*

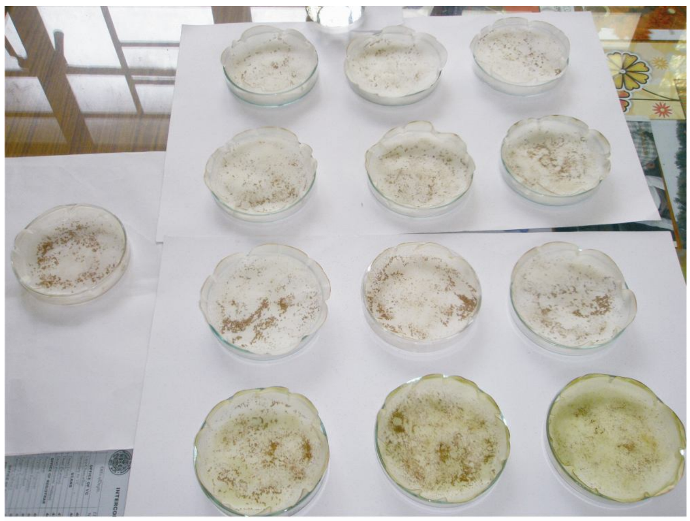

Fig. 3. Different gradation of *A. philoxeroides* on petridishes (germination)

Fig. 4. A bundle of *Alternanthera philoxeroides* collected from study area

Fig. 5. A field of study area dominating of *Ampelopteris prolifera*

Fig. 6. Normal spore of *Ampelopteris prolifera* under light microscope

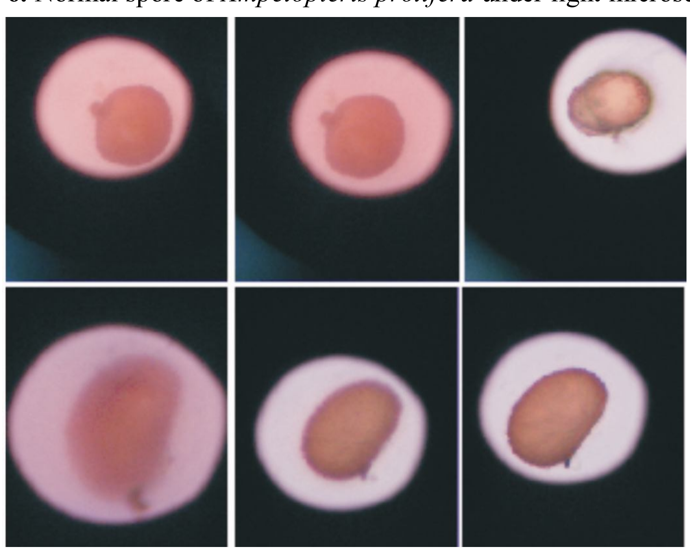

Fig. 7. Spores of *Ampelopteris prolifera* sharing germination under light microscope

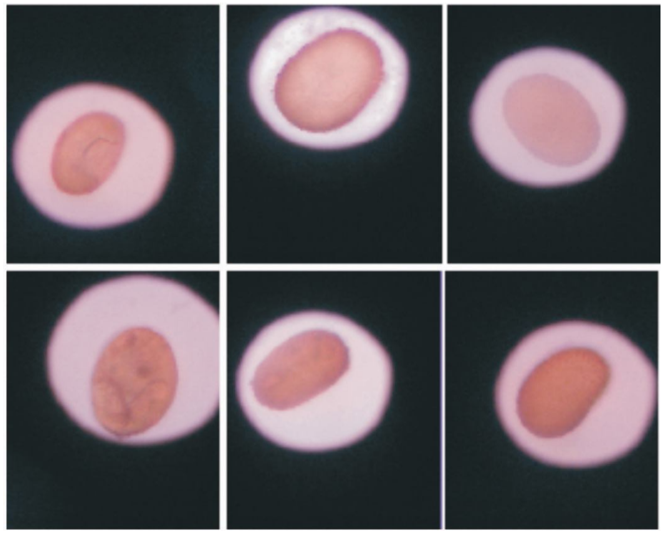

Fig. 8.Non-germinated spores of *Ampelopteris prolifera* followed by different concentration grade from different plant parts (Inflorescence, Stem, Root and Leaf) of *Alternanthera philoxeroides* under Light Microscope

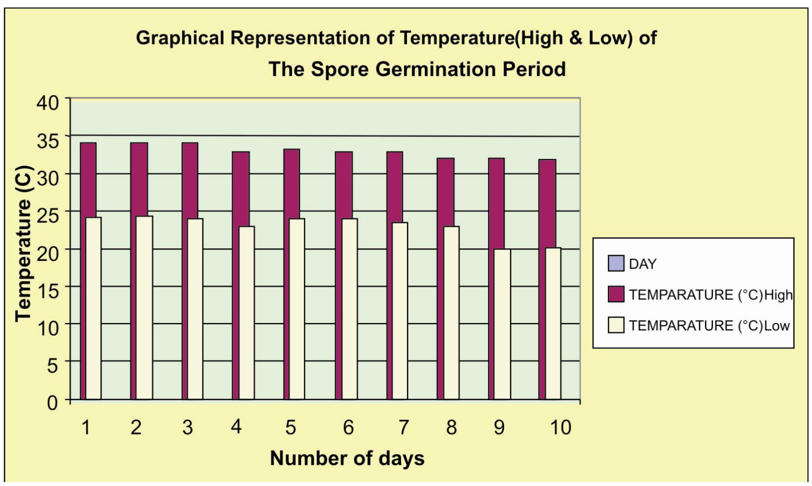

Fig. 9. Graphical representation of temperature (high & low) of the spore germination period

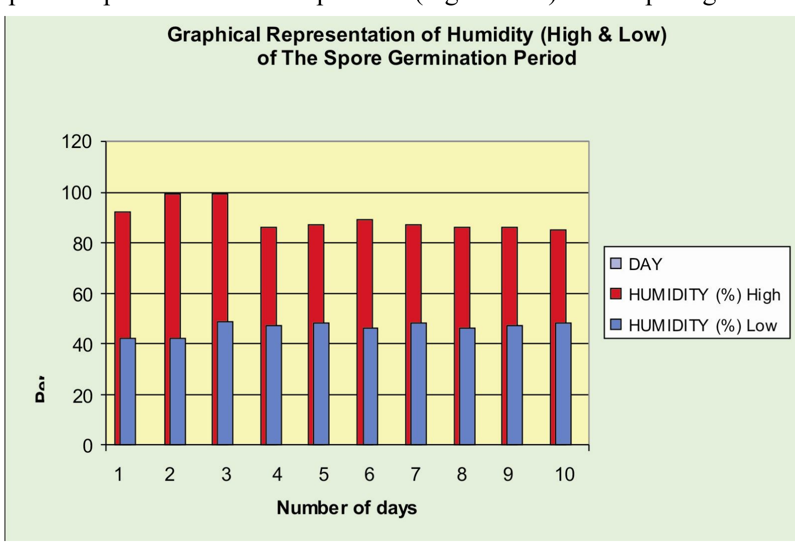

Fig. 10. Graphical representation of humidity (high & low) of the spore germination period

Leaves and stems vary greatly in size and shape. Fleshy, succulent stems can grow horizontally and float on the surface of the water, forming rafts, or form matted clumps which grow onto banks. The horizontal stems (called stolons) may reach a length of 10 m. The leaves are opposite in pairs or whorls, with a distinctive midrib, and range in size from 5-10 cm (Fig. 4).

Fibrous roots arising at the stem nodes may hang free in water or penetrate into the sediment /soil. Flowers, which appear from September to December, are thin and clover-like in shape. The white flowers grow on stalks and are approximately 1.25 – 7.6 cm in length and 13 mm in diameter.

Alligator weed occurs in a range of habitats ranging from dry terrestrial to aquatic. To facilitate buoyancy, plants growing in aquatic habitats tend to have stems that are hollow and larger than those of plants growing on land [5].

About Invasiveness of *Alternanthera philoxeroides*:

Alligator weed now occurs as an invasive exotic in subtropical to temperate regions of the Americas, Asia, Australia, New Zealand and a number of Pacific island nations.

The ability of *A. philoxeroides* to persist in terrestrial, semi-aquatic, and aquatic environments, the ability to rapidly take root along waterway banks, and the ability to propagate via vegetative fragmentation and waterborne dispersal of vegetative propagules all contribute to its success as an invasive species.

Possible Global Economic Consequences of Invasion Species (*Alternanthera philoxeroides*):

Alternanthera philoxeroides has adverse economic impacts as an invasive species in several ways like,-

1. It is capable of chocking waterways and thereby impacting boating and sportfishing a activities.
2. Aquatic alligator weed mats provide breeding habitat for mosquitoes.
3. The terrestrial form of the plant can also invade agricultural and pasture lands, and drainage and irrigation may be impacted as well.

Mechanical removal of *A. philoxeroides* mats is costly, and often results in the dispersal of large numbers of vegetative fragments that can exacerbate the infestation (GBEP/HARC 2006). Although biocontrol by means of the aligatorweed flea beetle (*Agasicles hygrophila*) and other control agents has greatly attenuated the threat of this plant, the cost associated with carefully studying, planning and managing the release of biocontrol agents is substantial.

CONCLUSION

In the present study, we have shown that allelopathic compounds inhibit percentage of germination as compared with the control. Findings showed that several allelopathic compounds are structurally similar to plant hormones [6], but the allelochemicals suppresses the activity of plant hormones. Allelochemicals did not influence on spore germination. The effects of allelopathic compounds of *Alternanthera philoxeroides* to inhibit spore germination of *Ampelopteris prolifera* due to the presence of phenolic growth inhibitors (Table-2, Fig. 8). Thus, the control method shown to the spore germination capacity in day by day ranging from 0.98 μm to 6.098μm length (Fig. 7, measured by Leica DM 1000) in natural environmental condition (Normally shows that, spores of *Ampelopteris prolifera* is brown, length 25-31μm and breadth 16-21 μm in diameter, Fig. 6). Different evidences showed that exogenous control germination by limiting distilled water might be to the changes at the level of membrane protein such as sporopollinine.

So, this present study we have concluded that *Alternanthera philoxeroides* belongs to allelochemicals which has inhibitory chemicals, effect of some plants on germination, growth and development.

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REFERENCES

[1] Inderjit, S Duke (2003). Ecophysiological aspects of allelopathy. *Planta* 217; 529 – 539.

[2] Nasr M. and M. Shariati (2005). *Journal of Agronomy* 4(**2**); 147-150Isfahan M.N. and M. Shariati (2007); *American Eurasian J. Agric. & Emeiron. Sci*. 2(**5**); 534 –538.

[3] Rice E. L. (1984). *Allelopathy*, Academic press; New York.
[4] Weston L.A. (1996). Utilization of allelopathy for weed management in agroecosystems, *Agron J.* 88; 860-866.
[5] Julien M.H., A.S. Bourne, and V.H.K. Low (1992). Growth of the weed *Alternanthera philoxeroides* (Martius) Grisebach, (alligator weed) in aquatic and terrestrial habitats in Australia, *Aquatic Botany*. 7:102-108.
[6] Isfahan M.N. and M. Shariati (2007); *American Eurasian J. Agric. & Emeiron. Sci*. 2(**5**); 534 –538.