Allelopathic Effect of Water Hyacinth (Eichhornia Crassipes) on Some Crops

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Introduction

Water hyacinth, *Eichhornia crassipes* (Mart) Solms, originated in the state of Amazon, Brazil, spread to other regions of South America and was carried by humans throughout the tropics, subtropics and as ornamental plant in India. It is now widespread and recognized as one of the top 10 weeds in the world. Water hyacinth has invaded Africa, Asia, North America and will occur in at least 62 countries by 2010. It causes extremely serious ecological, economical and social problems in regions between 40 degrees north and 45 degree south. *E.crassipes* forms dense monocultures that can threaten local native species diversity and change the physical and chemical aquatic environment, thus altering ecosystem structure and function by disrupting food chains and nutrient cycling. The large, dense monoculture formed by this species covers lakes and rivers, blocking waterways and interfering with the water transport of agriculture products, tourism activities, water power and irrigation of agricultural fields. Dense mats of water hyacinth can lower dissolved oxygen levels in water bodies leading to reduction of aquatic fish production. Water hyacinth is very efficient in taking up Calcium, Magnesium, Sulfur, Ferric, Manganese, Aluminum and Boron. Nitrogen, Phosphorus and potassium favoring its growth over other aquatic species.

When this macrophyte (water hyacinth) dies, sinks and decomposes, the water becomes more eutrophic due to the large release of nutrients. Water quality deteriorated, clean drinking water can be threatened and human health impacted. Aggressive growth of *E.crassipes* was correlated with increased temperature, high solar radiation and sunshine duration which may result in an intensive plant growth during summer that may be increased by global warming. High biomass production of water hyacinth corresponded with large amounts of phenolic allelochemicals in the water, which may also help in the process of invasion. High air temperatures in summer caused an increase in the rate of evapo-transpiration leading to decrease in water level and consequently a possible increase in allelochemical concentration in the aquatic habitats.

Abstract

Allelopathy plays an important role in the agroecosystems leading to a wide array of interactions between crop-crop and crop-weed. Generally, these interactions are harmful to the receiver plants but provide a selective benefit to the donor.The aquatic macrophytes are well known to exhibit

allelopathy. *Eichhornia crassipes* (Mart.) Solms was screened for their allelopathic potential to the growth of wheat seedlings. The 3% aqueous leachate was tested for seed germination of wheat (*Triticum aestivum* L. variety Raj. 1482 variety) in petriplates as well as pot culture. The *E.crassipes* was found to enhance the growth of wheat seedlings. The wheat seedlings were planted in pots with soil mixed with 3% (w/w) dried matter (Ag and Bg parts) of *E.crassipes.* The growth of wheat seedlings was highly promoted. This study suggested the future prospects of the integrated management of wheat crop using the potential of allelopathic potential of *E.crassipes.*

Key Words: Allelopathic potential, leachate and aquatic macrophytes, Water hyacinth, monoculture.

Introduction

Allelochemicals produced by the plants endogenously are chemicals, which after being released into the environment, subsequently alter and modify the growth and development of neighbouring plants[1]. These are biomolecules released from various plant parts by means of volatilization, leaching, decomposition of residue and root exudation[2].

The *E.crassipes* is emergent weed growing in the downstream areas of the reservoirs. The dominating nature of emergent macrophytes is normally associated with the accumulation of allelochemicals in the marshy places particularly in monospecific stands over a long period[3]**.** The *E.crassipes* is known to release phenolic compounds and exhibit allelopathic interactions. Thus, the use of phytochemicals of *E.crassipes* in the form of dried plant material in the field of wheat can replace the hazardous chemical fertilizer for better ecofriendly grain yield[4]**.**

MATERIALS AND METHODS

Collection of Plant Material

Above ground (Ag) and below ground (Bg) plant portions of *E.crassipes* was collected from canal near Dr. Bhim Rao Ambedkar Govt. College Sri Ganganagar. The above ground and below ground plant samples were cleaned with soft brush and dry. These samples were washed gently with tap water and distilled water thereafter and dried on absorbent paper.

I *In Vitro* Seed Germination and Seedling Growth Lab Bioassay

The *in vitro* seed germination and seedling growth bioassay experiments were performed in petriplates to explore the phytotoxicity of aqueous leachates of *E.crassipes* at 3% concentration on the growth of test crop wheat under laboratory conditions. The leachate of three percent concentration (dry weight/volume) of *E.crassipes* was prepared by soaking 3g plant material in 100 ml of distilled water, each for 24h and then filtered. The seeds of crops were surface sterilized with 0.1 % $HgCl_2$ solution for one minute and washed thereafter 4-7 times with sterilized distilled water and dried with filter paper. The pre-sterilized petriplates (9 cm) were lined with two filter papers. Ten healthy seeds of wheat crop (wheat variety RP-106) were placed at equidistance on top

of the filter paper in petriplates. Each treatment was replicated 3-5 times for each test species.As per treatment, each petriplate received 5 ml of leachate on first day and 3 ml leachate on 2, 4 and 6 days after sowing (DAS). The petriplates were kept in BOD incubator at 20-22^{O}C at 35-40^{O}C. The seedlings were harvested 7 days after sowing and germination of seeds, lengths of shoot and root of seedlings were measured. Subsequently, these were kept in an oven for drying at 80^{O}C for 24 h and weighed thereafter for total dry weight. The pot culture experiment was conduct to meet the objectives of i*n vitro* seed germination and seedling growth lab bioassay.

Observations

The data presented in Table 1 shows the impact of aqueous leachate of 3% (w/v) concentration of above ground (Ag) and below ground (Bg) plant parts of *E.crassipes* on germination and growth of wheat seedlings. The aqueous leachate of both Ag and Bg parts of *E.crassipes* effectively increased the germination and growth of wheat seedlings. The promotion was more pronounced in Bg part than Ag part.

The % germination was 104% of control in both Ag and Bg parts. The root length remained only 75% of control in Ag part on the other hand it sharply increased to 150 % of control in Bg part. In case of shoot, the length was 122 and 145% of control in Ag and Bg parts respectively. Like wise, total dry weight also showed an increase and observed 127% of control in Ag and 162% of control in Bg part at 7 DAS.

Discussion

Eichhornia crassipes was screened for investigation of their allelopathic potential wheat seed germination and seedling growth bioassay in laboratory as well as pot experiment. In the present study, *E.crassipes* has shown significant positive impact on the growth of wheat in pot culture experiments. The sets with dry matter (3% w/w) and aqueous leachate (3% w/ v) of *E.crassipes* significantly enhanced the growth of wheat seedling up to 147 and 125% of control, respectively. The shoot length measured up to 124 and 119% of control in sets treated with dry matter and aqueous leachate of *E.crassipes,* respectively. The total dry weight was also found 128 and 118% of control respectively. Hence, the present study confirmed that the *E.crassipes* plant has favorable impact on wheat.

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TABLE

Table 1 : Allelopathic impact of 3 % (w/v) aqueous leachate of above ground (Ag) and below ground (Bg) plant parts of *Phragmites karka* on test crop wheat

Growth parameters	Control	*P. karka*		LSD
		Ag	Bg	
Germination (%)	90.00 ± 5.77	93.3 ± 3.33	93.33 ± 3.33	12.30
GIR	-	-3.70	-3.70	-
Root length (cm)	1.81 ± 0.12	1.35 ± 0.02*	210 ± 0.12*	0.21
Shoot length (cm)	1.56 ± 0.17	1.90 ± 0.03*	198 ± 0.17*	0.28
Total dry weight (g)	0.026 ± 0.00	0.033 ± 0.00*	0.042 ± 3.33*	0.00

Mean ± SE, GIR -Germination inhibition rate, LSD -Least significant differences, * Significant at 0.05 % level by Dunnett's test applied after ANOVA, Ag=Above ground, Bg = Below ground