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Allelopathic Effect of the Aqueous Extract of *Parthenium hysterophorus* and *Chromolaena Odorata* on the Seed Germination and Seedling Vigour of *Zea mays* L. *In vitro*

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Abstract: The allelopathic effect of the aqueous leaf extract of *Parthenium hysterophorus* and *Chromolaena odorata* on the seed germination, radicle and plumule growth of the seedlings of *Zea mays* L. was studied by applying five different treatments (2, 4, 6, 8 and 10%) of two plant leaf extracts viz., *Parthenium hysterophorus* and *Chromolaena odorata*. Results exhibited that seed germination on account of allelopathic inhibition was found in all levels of leaf extract. However, highest degree of inhibition in radicle and plumule growth of the test plant i.e., *Zea mays* (L.) was observed in 10% concentration i.e., 2.08cm and 7.82cm in *Parthenium hysterophorus* and 1.39cm and 2.36cm in *Chromolaena odorata* respetively.

Key words: Allelopathy · *Chromolaena odorata* · *Parthenium hysterophorus* · *Zea mays* L.

INTRODUCTION

The term "allelopathy" was coined to describe the effect of one plant on the neighbouring plants. The word allelopathy has been derived from two Greek words '*Allelon*' meaning 'each other' and '*Pathos*' meaning 'to suffer' i.e. the injurious effects of one plant upon another. However, allelopathy is also term to mean all the biochemical interactions (stimulatory and inhibitory) among the plants [1]. The term Allelopathy generally refers to the detrimental effects of higher plants of one species (the donor) on the germination, growth and development of another species (the recipient). Allelochemicals, which inhibit at certain concentrations, may stimulate the growth of the same or different species at a lower concentration. Allelopathy is generally associated with the interactions between living plants and has been observed in agricultural fields. Crops exert allelopathic effects on other crops and weeds. They may inhibit (-ve effect) or stimulate (+ve effect) the germination and growth of weeds in agro-ecosystems. Weeds are the plants, which grow where they are not wanted and they interfere with seed germination, growth, productivity and yield of the cultivated crops. Weeds are an important factor in the management of all land and water resources but their effect is greatest on agriculture [2, 3].

Keeping the above in view, in the present work some observations were made on the allelopathic potential of some locally available weed species (i.e. *Chromolaena odorata* and *Parthenium hysterophorus*) on the germination and growth of seeds of *Zea mays* L., which is an economically important crop plant.

MATERIALS AND METHODS

Collection of Plant Material: Fresh leaves of *Parthenium hysterophorus* and *Chromolaena odorata* in their vegetative growth stage were collected from the nearby agricultural fields around the Assam University campus. For germination test, the seeds of *Zea mays* (maize) were procured from the commercial suppliers.

Experiments: From the preliminary screening it was observed that leaf extract had the strongest allelopathic effect on the seed germination of maize, thus leaf has been selected for detailed experimentation. Ten gram of fresh

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leaves of allelopathic plants (i.e. *Parthenium hysterophorus* and *Chromolaena odorata*) was ground, mixed with 100ml distilled water, aqueous extract was obtained as filtrate of the mixture and final volume was adjusted to 100ml; this gave 10% aqueous extract. The extract was considered as stock solution and a series of dilutions with different strengths (2, 4, 6 and 8%) were prepared. Ten uniform and surface sterilized seeds (2% sodium hypochlorite for 15 min) of the selected seeds i.e. *Zea mays* L were kept for germination in sterilized Petri-dishes lined with double blotting paper and moistened with 10ml of different concentration of the aqueous leaf extracts (2 to 10%). Each treatment had three replicates (total no of test seeds; 10×3 = 30). One treatment was run as control and treated with distilled water only. The Petri dishes were maintained under the Laboratory conditions (room temperature 25°C at mid day and diffused light during the day) for one week. Equal volume of distilled water was added in the experimental Petri dishes when moisture content of the blotting paper declined. After one week, percentage of germinated seeds was recorded and the radical and plumule length were measured with the help of a slide caliper, observations were made five times, in two days interval.

RESULTS

Germination: In aqueous leaf extract of *Parthenium hysterophorus* and *Chromolaena odorata* treated seeds of *Zea mays* (L), germination was less in all the concentrations used as compared to control, higher inhibition was observed in 10 percent concentrations of *Parthenium hysterophorus* (36.6%) as compared to *Chromolaena odorata*, (66.6%) (Table 1). Earlier workers have also reported that foliar leachates of *Parthenium hysterophorus* reduced root and shoot elongation of *Oryza sativa* and wheat [4], maize and soyabean [5] as well as some common Australian pasture grasses [6]. This indicates that availability of the inhibitory chemicals in higher concentration in the leaves than in stem or roots [7].

Table 1: Effect of *Parthenium hysterophorus* and *Chromolaena odorata* leaf extract on the germination of *Zea mays* L. seeds

	Germination percentage after one week	
Treatments (%)	*Parthenium hysterophorus*	*Chromolaena odorata*
Control	66	70
2% extract	60	20
4% extract	60	20
6% extract	60	16
8% extract	43	13.3
10% extract	36.6	13.3

DISCUSSION

From the present work it has been observed that leaf extract of two test plants (i.e. *Chromolaena odorata* and *Parthenium hysterophorus*) had the strongest allelopathic effect on the seed germination of *Zea mays*. Higher inhibition was observed with *Chromolaena odorata* leaf extract as compared to *Parthenium hysterophorus*. In *Chromolaena odorata* with leaf extract higher inhibition was observed in 10 percent concentration (i.e. 1.39cm and 2.36 cm of radicle and plumule growth), while in *Parthenium hysterophorus* leaf extract it was found to be 6.94 cm and 7.82 cm in radicle and plumule growth respectively (Table 2 & 3).

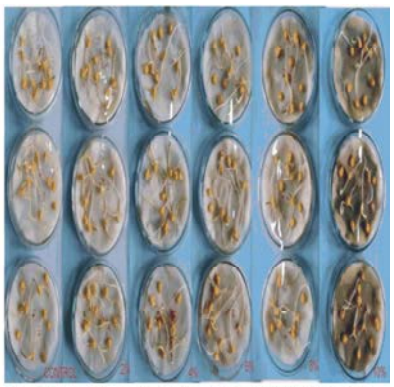
Table 2: Effect of aqueous leaf extract of *Parthenium hysterophorus* against the seeds of *Zea mays* L. Significant at p = 0.05

	Radicle (cm)				
Treatments	1st Observation	2nd Observation	3rd Observation	4th Observation	5th Observation
Control	5.26(± 0.69)	10.07(± 0.87)	11.27(± 0.92)	12.15(± 0.92)	13.65(± 0.63)
2%	2.89(± 0.68)	9.83(± 0.72)	11.13(± 0.69)	11.17(± 0.68)	11.46(± 0.67)
4%	2.76(± 0.57)	9.67(± 0.72)	10.51(± 0.68)	10.93(± 0.62)	11.07(± 0.57)
6%	2.55(± 0.67)	9.50(± 0.67)	9.98(± 0.68)	10.65(± 0.82)	10.81(± 0.80)
8%	2.17(± 0.70)	5.89(± 0.93)	7.01(±0.90)	7.12(± 0.93)	7.50(± 0.51)
10%	1.22(± 0.76)	5.59(± 0.81)	6.69(± 0.91)	6.83(± 0.89)	6.94(± 0.59)
CD at 5%	2.69	1.89	1.64	1.54	2.08
CD at 1%	5.89	3.16	3.68	3.69	4.92
			Plumule (cm)		
Control	2.64(± 0.74)	5.07(± 0.91)	9.13(± 0.8)	12.64(± 0.91)	13.56(± 0.56)
2%	0.85(± 0.55)	4.64(± 0.93)	8.57(± 0.91)	11.63(± 0.97)	11.96(± 0.40)
4%	0.68(± 0.57)	3.85(± 0.84)	7.89(± 0.81)	10.82(± 0.82)	10.68(± 0.32)
6%	0.61(± 0.47)	3.71(± 0.84)	7.26(± 0.96)	9.88(± 0.84)	10.41(± 0.53)
8%	0.53(± 0.4)	3.42(± 0.86)	6.36(± 0.83)	8.61(± 0.89)	8.69(± 0.52)
10%	0.43(± 0.28)	2.58(± 0.34)	6.14(± 0.40)	7.44(± 0.48)	7.82(± 0.48)
CD at 5%	3.53	1.21	1.45	3.37	2.87
CD at 1%	7.92	3.38	3.43	7.18	5.70

Table 3: Effect of aqueous leaf extract of *Chromolaena odorata* against the & growth of Maize (*Zea mays* L.*)* seeds. Significant at p=0.05.

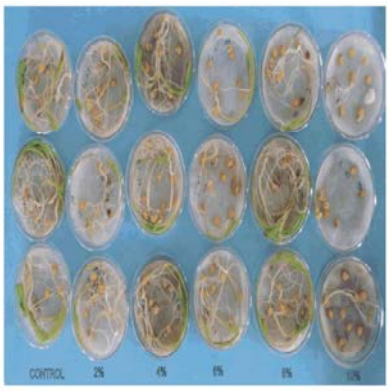
	Radicle (cm)				
Treatments (%)	1st Observation	2nd observation	3rd observation	4th observation	5th observation
Control	3.6(± 0.26)	4.11(± 0.29)	4.36(± 0.20)	4.63(± 0.22)	4.93(± 0.27)
2% extract	1.40(± 0.27)	2.46(± 0.23)	2.76(± 0.13)	2.79(± 0.20)	2.83(± 0.26)
4% extract	1.36(± 0.21)	2.23(± 0.24)	2.7(± 0.31)	2.75(± 0.25)	2.81(± 0.31)
6% extract	1.35(± 0.29)	1.88(± 0.32)	2.09(± 0.20)	2.36(± 0.22)	2.43(± 0.24)
8% extract	1.04(± 0.26)	1.80(± 0.24)	1.93(± 0.28)	1.93(± 0.28)	1.93(± 0.28)
10% extract	0.91(± 0.29)	1.24(± 0.22)	1.34(± 0.17)	1.35(± 0.19)	1.39(± 0.31)
CD at 5%	1.57	1.60	1.10	1.92	1.78
CD at 1%	3.24	3.41	3.11	3.20	2.13
			Plumule (cm)		
Control	3.54(± 0.22)	4.79(± 0.26)	5.76(± 0.24)	6.07(± 0.27)	6.37(± 0.18)
2% extract	1.12(± 0.29)	2.09(± 0.27)	3.39(± 0.34)	3.43(± 0.24)	3.5(± 0.33)
4% extract	0.99(± 0.32)	2.06(± 0.22)	2.97(± 0.33)	3.02(± 0.21)	3.07(± 0.27)
6% extract	0.78(± 0.25)	2.04(± 0.28)	2.86(± 0.25)	2.9(± 0.35)	2.95(± 0.26)
8% extract	0.72(± 0.29)	1.63(± 0.25)	2.66(± 0.26)	2.69(± 0.19)	2.7(± 0.34)
10% extract	0.69(± 0.33)	1.49(± 0.28)	2.30(± 0.17)	2.33(± 0.25)	2.36(± 0.18)
CD at 5%	3.37	1.84	5.85	1.39	2.06
CD at 1%	7.09	3.94	11.50	3.86	4.52

Parthenium hysterophorus L.



Zea mays L. with and without the *Parthenium hysterophorus* leaf extracts.

Chromolaena odorata L.



Zea mays L. seeds with and without the *Chromolaena odorata* leaf extract

Earlier it is report that *Chromolaena odorata* contains a large amount of allelochemicals especially in the leaves, which inhibit the growth of many plants in nurseries and plantations [8] and it is also observed that the inhibitory allelopathic effect of leaf extract was more powerful than of other vegetative parts [9]. Phytochemical analysis had already been reported higher accumulation of growth inhibitors in the leaves of *Parthenium hysterophorus* [7].

Parthenium hysterophorus is one of the best known plant invaders in the world linking allelopathy to exotic invasion [7, 10]. The unique allelopathic effect of some exotic species on native, 'inexperienced' communities also contribute to invasive success [11]. Allelopathy is expected to be an important mechanism in the plant invasion process. *Parthenium hysterophorus*, because of its invasive capacity and allelopathic properties, has the potential to distrupt natural ecosystems [12]. It has been reported earlier for causing a total habitat change in native Australian grasslands, open woodlands, riverbanks and flood plains [13, 14].

Parthenium hysterophorus has not been used for any purpose in Nepal [15]. Therefore this plant may become a high risk posed invasive species in the near future. Present results showed that concentrated aqueous leaf extract of *Parthenium hysterophorus* inhibited seed germination and seedling growth of the cereal, (i.e. maize) crop seeds tested, the other allelopathic plant *Chromolaena odorata* leaf extract also have shown similar inhibitory effect on the germination and growth of the seeds of the test crop plant i.e. *Zea mays*. Keeping the above in view it can be suggested that these plants should not be allowed to grow in the immediate vicinity of the agricultural fields (i.e. maize grown areas) and this should not be used as green manure either, Whether they can be used in compost or vermincompost needs to be worked out before they are considered for the same.

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