International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Allelopathic Effect of Invasive Weed, *Chromolaena odorata* on Seed Germination and Seedling Growth of Cowpea

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Abstract: ***The present study is concerned with the Allelopathic effect of C.odorata on seed germination and seeding growth of cowpea (V.unguiculata) Leaf, stem, root and inflorescence extracts of C.odorata inhibit seed germination and seeding growth of cowpea. The inhibitory effect increased with increase in concentration of the extracts. Treatment with higher concentration showed remarkable increase in the rate of inhibition. In control there was 100% germination and more growth than other concentration. Inflorescence extract have more inhibitory effect on seed germination and seeding growth. This may be to the presence of more allelochemicals in inflorescence compared to leaf, stem and root.***

Keywords: Allelopathy, Invasive weed, Seed germination

1. Introduction

Invasive species are a real threat to our environment and economy. These biological invasions produce severe, often irreversible impacts on agriculture, recreation and natural resources. Invasive species threaten biodiversity, habitat quality and ecosystem function. They are the second greatest threat to native species, behind habitat destruction. India's biodiversity, too, has been affected by introduction of alien species. For example, weed such as *Parthenium sp.*, which came to India accidentally with a consignment of wheat from the United States, have spread over large forest areas at the expense of native species. This lead to progressive depletion of our local biodiversity.

Invasive species defined as an introduced species that has spread widely and causes harm. Not every nonnative species is an unwelcome intruder. Nonnative species are still transported world wide, both legally and illegally, for agriculture, horticulture, forestry, biological control of insects and weeds, erosion control, the aquarium and pet business, and sport. An invasive plant has the ability to thrive and spread aggressively outside it's natural range.

Allelopathy is a biological phenomenon in which some plants produce certain biochemicals that influence the germination, growth and development of other plants. The biochemicals, called allelochemicals can have a beneficial or detrimental effect on neighbouring organisms. They are not required for metabolism, that is the primary life processes (growth, development and reproduction) of the allelopathic organism, thus they are secondary metabolites. The beneficial effect can be called positive allelopathy, the detrimental effect negative allelopathy. Allelochemicals (inhibitors) are produced by plants as end products, by-products, and metabolites, and are contained in the stem, leaves, roots, flowers, inflorescence, fruits, and seeds of the plant.

Allelopathic interactions are also thought to be an important factor in the success of many invasive weeds. Common invasive weeds are *Ageratum Conyzoides* (Asteraceae), *Cassia Occidentalis* (Fabaceae), *Chromolaena odorata* (Asteraceae). *Eichhornia crassipes* (Pontederiaceae), *Grevillea robusta* (Proteaceae), *Lantana camara* (Verbanaceae), *Mimosa pudica* (Fabaceae) etc.

Chromolaena odorata (L.) King & Robinson, a member of the family Asteraceae and a native of Central America, now grows wild in different parts of the world and possess to be a menace as weed in India (moni & George 1959 ; Muniappan & Marutani 1988.

C. odorata grows as an aggressive coloniser in different habitats like areas cleared for developing new plantations, nurseries, young and open plantations, agricultural fields, pasture lands, waste lands, road sides, riverbanks, tree tops, thatched roofs, rocky areas, slash and burnt areas (Chakrabarthi et al. 1967; Soerohaldoko 1971; Ambika and Jayachandra 1980 b) in different parts of the world.

Chemical analysis of this plant extracts revealed the presence of flavone and flavonoid, tannin, alkaloid, saponins, and others phenolic compounds. The leaves of *C.odorata* contain a large amount of allelochemicals (Ambika and Jayachandra 1980), which may retard the growth of crop plants. The phytochemical screening of *C.odorata* revealed that alkaloids, cyanogenic glycosides, flavonoids (Aurone, chalcone, flavones, flavonol) are slightly present; phytates and tannins are moderately present; saponins are highly present (lgboh M.Ngozi. 2000).

Chromalaena odorata is a common weed present in the cowpea fields. Cowpea is one of the most ancient crops known to man. It constitutes an important part of people's diet. Cowpeas were often known as a 'poor man's' food. It belongs to the family Leguminosae. It is highly nutritious. It supports not only protein, but also carbohydrates, fats, vitamins and some minerals. The present work was conducted to study the effect of aqueous extracts of leaf, stem, root and inflorescence of *Chromalaena odorata* on

seed germination and seedling growth of *Vigna unguiculata.*

2. Materials and Methods

***Chromolaena odorata* (L.) King & Robinson**

Synonym - *Eupatorium odoratum* L.
Family - Asteraceae
Common name - Communist pacha, Leafy spurge
Vernacular Name- Siam weed, Bitter bush, Christmas bush, Baby tea, Eupatorium etc
C. *odorata* is an erect, perennial, densely branching shrub.

***Vigna unguiculata* (L.) Walp**

Family - Fabaceae (Leguminosae)
Sub Family - Papilionaceae
Common name - Cowpea

Cowpeas are one of the most important food legume crops in the semi-arid tropics covering Asia, Africa, Southern Europe and Central and South America. It is twining or trailing herb.

The *Vigna unguiculata* seeds, Kanakamani variety were brought from Agricultural University Mannuthy. The seeds used in the study were steeped in water to determine their viability; those that floated were not used. The seeds were cleaned by washing in running tap water. Then surface sterilized with 0.1% $HgCl_2$ solution for 3 to 4 minutes and thoroughly washed in distilled water and dries on filter paper to eliminate fungal attack.

Chromolaena odorata was collected from the fields. The leaf, stem, root and inflorescence were collected at various intervals for conduct the experiments. The plant part in each experiment were collected from the field and washed in running tap water. Then surface sterilized with 0.1 % $HgCl_2$ solution for 3 to 4 minutes and thoroughly washed in distilled water. Then the plant parts were crushed and grinded for extraction. The extract were filtered through "Whatman No. 1" filter paper and stored in a refrigerator. The pure extract obtained taken as stock solution (100%) and further diluted to various concentrations such as 25%, 50%, and 75% by adding distilled water. The distilled water serving as control. The sterilization of petridishes was done in an autoclave at 120^0C under 15 pound pressure for 20 minutes. Sterilized seeds were then arranged equidistantly over filter paper in petridishes. Each pertidish contained 25 seeds. The seeds were moistened with requisite amount of extract solution. In control seeds were moistened with distilled water. For each treatment three replicates were maintained. The petridishes were kept at room temperature (28-30^0C). the filter paper were moistened with the appropriate extracts. Radical emergence was considered as the criteria for seed generation. Germination count in each treatment was recorded. The data analyzed statistically. Cumulative germination percentage (C.G.P) can be calculated by the following formula.

Germination value

C.G.P = x 100

Total number of seeds used.

Germination value (G.V) is the average germination of seeds.

Three germinated seeds from each treatment and control were then transferred to each polythene bag (25x30cm), which contain the soil from the field. Three replicates were always maintained.

3. Result

1. Effect of leaf extract on seed germination

In 25% concentration, the germination value is 19.6 and their C.G.P is 26.1. In 50%, G.V is 18.3 and C.G.P is 24.4. In 75% concentration, G.V and C.G.P are 16 and 21.3 respectively. In 100% concentration G.V and C.G.P are 10 and 13.3 respectively. The control shows positive response, all seeds are germinated. **(Table 1), (Plate II.1).**

2. Effect of leaf extract on seeding growth

In 25% concentration, the shoot length is 22cm and root length is 5.5cm. In 50%, shoot length is 21.3cm and root length is 3.4cm. In 75% shoot length and root length are 17.6cm and 1.6cm respectively. In 100% concentration, shoot length is 14.5cm root length is 1.1cm. In control have shoot length is 22.6cm and root length is 5.8cm. **(Table 2).**

3. Effect of stem extract on seed germination.

In 25% concentration, the germination value is 22 and their C.G.P is 29.3. In 50%, G.V is 21 and C.G.P is 28. In 75% concentration, G.V and C.G.P are 17 and 22.6 respectively. In 100% concentration, G.V and C.G.P are 16 and 21.3 respectively. The control shows positive response, all seeds are germinated. **(Table 3).**

4. Effect of stem extract on seeding growth.
In 25% concentration, the shoot length is 21cm and the root length is 5.6cm. In 50%, shoot length are 19.7cm and root length is 4.1cm. In 75% shoot length and root length are 19.7cm and 2.2cm respectively. In 100% concentration, shoot length is 18.5cm root length is 1.4cm. In control have shoot length is 22.3cm and root length is 5.8cm. **(Table 4)**

5. Effect of root extract on seed germination.

In 25% concentration, the germination value is 20 and their C.G.P is 26.6. In 50%, G.V is 19 and C.G.P is 25.3. In 75% concentration, G.V and C.G.P are 18 and 24 respectively. The control shows positive response, all seeds are germinated. **(Table 5)**

6. Effect of extract on seeding growth.

In 25% concentration, the shoot length is 20.9cm and the root length is 5.7cm. In 50%, shoot length is 20.5cm and root length is 3.7cm. In 75% shoot length and root length are 20cm and 2.9cm respectively. In 100% concentration, shoot length is 19.5cm and root length is 2.5cm. In control have shoot length is 22cm and root length is 5.9cm. **(Table 6).**

7. Effect of inflorescence extract on seed germination.

In 25% concentration, the germination value is 19 and their C.G.P is 25.3. In 50%, G.V is 17 and C.G.P is 22.6. In 75% concentration, G.V and C.G.P are 8.6 and 11.4 respectively. The control shows positive response, all seeds are germinated. **(Table 7)**

8. Effect of inflorescence extract on seeding growth.

In 25% concentration, the shoot length is 20.3cm and the root length is 5.3cm. In 50%, shoot length is 19.9cm and root length is 3.5cm. In 75% shoot length and root length are 14cm and 1.2cm respectively. In 100% concentration, shoot length is 11.8cm and root length is0.4cm. In control have shoot length is 22.5cm and root length is 5.9cm. **(Table 8).**

Above observations revealed that the inhibitory effect is increased with increase in concentration of the extracts. It is also found that inflorescence extract have more inhibitory effect on seed germination and seedling growth when compared to leaf, stem and root extracts.

The correlation studies were made for cumulative germination percentage, shoot length and root length are negatively correlated with the different concentration of the extract.

Table 1: Effect of leaf extract on seed germination

Concentration of the extract	Number of seeds treated	Number of seeds germinated	Germination Value (G.V)	Cumulative Germination % (C.G.P)
25%	75	59	19.6	26.1
50%	75	55	18.3	24.4
75%	75	48	16	21.3
100%	75	30	10	13.3
Control	75	75	25	33.3

Table 2: Effect of leaf extract on shoot and root length

Concentration of the extract	Shoot length in cm.(Average)	Root length in cm. (Average
25%	22	5.5
50%	21.3	3.4
75%	17.6	1.6
100%	14.5	1.1
Control	22.6	5.8

Table 3: Effect of stem extract on seed germination

Concentration of the extract	Number of seeds treated	Number of seeds germinated	Germination Value (G.V)	Cumulative Germination % (C.G.P)
25%	75	66	22	29.3
50%	75	63	21	28
75%	75	51	17	21.6
100%	75	48	16	21.3
Control	75	75	25	33.3

Table 4: Effect of stem extract on shoot and root length

Concentration of the extract	Shoot length in cm.(Average)	Root length in cm. (Average
25%	21	5.6
50%	20.3	4.1
75%	19.7	2.2
100%	18.5	1.4
Control	22.3	5.8

Table 5: Effect of root extract on seed germination

Concentration of the extract	Number of seeds treated	Number of seeds germinated	Germination Value (G.V)	Cumulative Germination % (C.G.P)
25%	75	60	20	26.6
50%	75	57	19	25.3
75%	75	54	18	24
100%	75	45	15	20
Control	75	75	25	33.3

Table 6: Effect of root extract on shoot and root length

Concentration of the extract	Shoot length in cm.(Average)	Root length in cm. (Average
25%	20.9	5.7
50%	20.5	3.7
75%	20	2.9
100%	19.5	2.5
Control	22	5.9

Table 7: Effect of inflorescence extract on seed germination

Concentration of the extract	Number of seeds treated	Number of seeds germinated	Germination Value (G.V)	Cumulative Germination % (C.G.P)
25%	75	57	19	25.3
50%	75	51	17	22.6
75%	75	26	8.6	11.4
100%	75	3	1	1.3
Control	75	75	25	33.3

Table 8: Effect of inflorescence extract on shoot and root length.

Concentration of the extract	Shoot length in cm.(Average)	Root length in cm. (Average
25%	20.3	5.3
50%	19.9	3.5
75%	14	1.2
100%	11.8	0.4
Control	22.5	5.9

4. Discussion

The present study is concerned with the Allelopathic effect of C.odorata on seed germination and seeding growth of cowpea (V.unguiculata) Leaf, stem, root and inflorescence extracts of C.odorata inhibit seed germination and seeding growth of cowpea. The inhibitory effect increased with increase in concentration of the extracts. Treatment with higher concentration showed remarkable increase in the rate of inhibition. In control there was 100% germination and more growth than other concentration. Inflorescence extract have more inhibitory effect on seed germination and seeding growth. This may be to the presence of more allelochemicals in inflorescence compared to leaf, stem and root.

Inhibition of seed germination at concentration of plant extract was observed by many works such as Tefera (2002), Al-Robai (2007), Ayyaz khan (2008), Abu-Romman (2010) ect. Datta and Bandopadhaya (1981) reported leaf extract of Eupatorium odoratum drastically reduced growth of wheat and mustard seedlings. Agnes Csizar (2009) reported that allelopathy play an important role in the invasion success of adventitive plant species. The present find ings are agreement with the above observations.

For the successful cultivation of cowpea, C.odorata should be removed periodically. It should be physically removed from cowpea fields before the allelochemicals was down with the rain. Bess and Haramota (1971) reported, biological control of Chromolaena species using Gall fly (Procecidochares utilis) has been out throughout world including Nepal. It was successful in Hawaii, U.S.A. and elsewhere.

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