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Research Article

Allelopathic potential of paddy field weeds on the growth of *Cicer arietinum* L.

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ABSTRACT

A study was conducted to investigate the allelopathic potential of aqueous whole plant extracts of *Ammannia baccifera* L., *Eclipta alba* (L.) Hassk. and *Cyperus difformis* L. on germination and growth of *Cicer arietinum* L. plants. Different concentrations (10%, 15%, 20% and 25%) of whole plant extracts were prepared from three weed species. Experiments were conducted by petri plate culture. The germination percentage, root and shoot length, fresh and dry weight were adversely inhibited by *Cicer arietinum* L. seedlings with increasing the concentration of weed extract. From the study of result, *Ammannia baccifera* L. was high toxic and *Cyperus difformis* L. was less toxic to the germination and seedling growth of test crop.

INTRODUCTION

Allelopathy is the negative action of plants of one species (the donor) on the development of plants of another species (the recipient) [1]. Molisch [2] derived the term allelopathy from two Greek words: allelon ('to each other') and pathos ('to suffer'). Neighboring plants in natural or controlled agroecosystems can affect progressing of other species. Muller [3] proposed the term interference to describe the entire impact of one plant (including microbes) on another. Allelopathy is a significant mechanism of plant interference caused by the addition of phytotoxins produced by plants to the plant environment. Many phytotoxic chemicals found in plant tissue and soil have been recognized as causing germination and growth suppression. Allelochemics or allelochemicals are the names given to these substances [4]. Green plants create a diverse range of substances that are not involved in primary plant metabolism and are hence referred to as secondary products. Allelochemicals are secondary metabolites produced by plants that serve no physiological purpose in the maintenance of life [1].

Many phenolic acids, such as p-aminobenzoic, p-coumaric, ferulic, vanilic, and cinnamic acids, are produced by the degradation of plant wastes and accumulate in the soil [5]. Allelopathic potentials of such phenolic acids have been well documented on soybean. These acids effect seed germination, radicle and plumule elongation and dry matter accumulation in many crop species [6].

Allelochemicals specifically prevent the growth of other plants or of soil microbes. They are essential in the chemical warfare (allelopathic interactions) between plants and pesticides, phytoalexins (microbial inhibitors), and seed germination inhibitors. While many allelochemicals are solely defensive agents, others are offensive molecules that directly affect weed competitiveness, aggressiveness, and plant density [1].

The way plant reacts to the compounds or their microbial byproducts all play a role in the allelopathic influence on plant growth and development [7,8]. Because inhibitors are better retained in dry settings, they linger there for a longer period of time. An effort has been made in the current inquiry to examine the allelopathic effect of several paddy field weeds., namely *Ammannia baccifera* L., *Eclipta alba* (L.) Hassk. and *Cyperus difformis* L. which commonly grow in paddy fields. Aqueous extracts of the above said three weed species were employed to study their allelopathic effect on growth of *Cicer arietinum* L.

MATERIALS AND METHODS

Healthy, uniform colour and size were taken in to account for the selection of seeds for the present investigation. The experimental plants *Ammannia baccifera* L. (Fig. 1), *Eclipta alba* (L.) Hassk. (Fig. 2) and *Cyperus difformis* L. (Fig. 3), were collected from the paddy fields freshly for the experimental study, whenever needed.

Preparation of aqueous extract

Fresh plants were thoroughly cleaned before being chopped up. Each of the 25g chopped samples was mashed with distilled water in a pestle and mortar. The resulting aqueous extracts were filtered through muslin cloth and the volume was brought up to 100ml using distilled water. By adding distilled water, 25, 20, 15, and 10% solutions were created from this stock solution. Until they were needed, the extracts were kept in a deep freezer.

Germination study

After being surface sterilized with a 0.03% formalin solution for 20 minutes, the chosen seeds of *Cicer arietinum* L. were carefully rinsed with distilled water. Twenty seeds were put in sterile petriplates with two thicknesses of filter paper for the germination study. 10ml of leaf extracts and distilled water were added to each treatment's petri plate on the first day.

Fig. 1. Morphology of *Ammannia baccifera* L.

Fig. 2. Morphology of *Eclipta alba* Hassk.

Fig. 3. Morphology of *Cyperus difformis* L.

Control was distilled water. After that, 10ml leaf extracts/DW were added to each plate six, nine, twelve, and fifteen days after soaking to keep the filter paper moist. After that, the seeds were left to germinate in the growth chamber for 15 days at a temperature of 30C and a light intensity of 2 0.4 K. Lux. Five copies of each treatment, excluding the control, were made. Daily counts of the seeds that germinated in each treatment up to the tenth day following sowing were made in order to calculate the germination percentage. The development of radicle was considered proof of germination. The morphological analysis of the leaves of *Cicer arietinum* L. seedlings treated with a whole plant extract of *Ammannia baccifera* L., *Eclipta alba* (L.) Hassk., and *Cyperus difformis* L. was done on seedlings that were 15 days old. On the fifteenth day after sowing, five seedlings from each replicate were chosen for recording the morphological data such as length of shoot and root, fresh and dry weight.

Dry matter production

The fresh weights of the seedlings were recorded after root and shoot division. 48 hours were spent with the samples in a hot air oven set at 800C. With the aid of an electrical single pan balance, the dry weights were recorded.

RESULTS

Germination study (Table 1)

The aqueous whole plant extracts of the *Ammannia baccifera* L., *Eclipta alba* (L.) Hassk. and *Cyperus difformis* L. significantly decreased the germination of test crops compared to controls, with the amount of reduction varying depending on the extract concentration used.

Of the three weeds of the study a minimum inhibition of germination was caused by *Cyperus difformis* L. extract and intensity of inhibition increased in ordinal order by *Eclipta alba* (L.) Hassk. and *Aammannia baccifera* L. The aqueous whole plant extract of all the three weed species showed an identical pattern of adverse effect in *Cicer arietinum*.

Table 1. Effect of whole plant extracts of paddy field weed species on germination (%) of *Cicer arietinum* L.

Concentration %	*Ammannia baccifera*	*Eclipta alba*	*Cyperus difformis*
0	96	96	98
10	92 (-4.0)	94 (-2.0)	96 (-2.0)
15	80 (-16.6)	82 (-14.5)	86 (-12.2)
20	58 (-39.5)	60 (-37.5)	70 (-28.5)
25	42 (-56.2)	48 (-50)	56 (-42.8)

Data in parenthesis indicates % increase (+), decrease (-) over control.

Root and shoot length (Table 2)

The aqueous whole plant extracts of the three weed species significantly reduced the root and shoot growth of test crop over control and the magnitude of reduction differed depending upon the concentration of the extracts employed.

As the concentration increased from 10 to 20% the inhibitory effect increased and a maximum inhibitory effect was caused by 25% aqueous extracts. From three weeds of the study a minimum inhibition of germination was caused by *Cyperus difformis* L. extract and intensity of inhibition increased in ordinal order by *Eclipta alba* (L.) Hassk. and *Aammannia baccifera* L. The aqueous whole plant extract of all the three weed species showed an identical pattern of adverse effect in *Cicer arietinum*.

Table 2. Effect of whole plant extracts of some Paddy field weed species on Shoot length (cm/plant) of *Cicer arietinum* L.

Concentration %	*Ammannia baccifera*	*Eclipta alba*	*Cyperus difformis*
0	14	14	15
10	13 (-7.14)	13.2 (-5.7)	14.3 (-4.6)
15	10.5 (-25)	10.8 (-22.8)	11.8 (-21.3)
20	8.6 (-38.5)	9.0 (-35.7)	10.5 (-30.0)
25	6.0 (-57.01)	6.5 (-53.5)	7.3 (-51.3)

Data in parenthesis indicates % increase (+), decrease (-) over control.

Root length, fresh and dry weight (Table 3, 4)

The aqueous whole plant extracts of the three weed species caused a decrease fresh and dry weight in the *Cicer arietinum* L. seedlings over control.

As the concentration of the extracts increased from 10 to 20% the fresh and dry weight of the seedlings also decreased and a maximum inhibition was caused by 25% extracts. Among the three weed species of the study, a minimum decrease in fresh and dry weight was caused by *Cyperus difformis* L. and a maximum decrease was caused by *Aammannia baccifera* L. over the control.

Table 3. Effect of whole plant extracts of some Paddy field weed species on Root length (cm/plant) of *Cicer arietinum* L.

Concentration %	*Ammannia baccifera*	*Eclipta alba*	*Cyperus difformis*
0	6.5	6.5	6.5
10	5.4 (-16.5)	5.6 (-13.8)	5.8 (-10.7)
15	5.0 (-23.0)	5.2 (-20)	5.4 (-16.9)
20	3.7 (-43)	4.0 (-38.4)	4.3 (-40)
25	3.2 (-50.7)	3.4 (-47.6)	3.7 (-33.8)

Data in parenthesis indicates % increase (+), decrease (-) over control.

DISCUSSION

The whole plant extracts affected the germination percentage more at the higher concentration (25%). The extracts exhibited inhibitory (10%, 15, 20 and 25%) effects on the germination of *Cicer arietinum* L.

The germination of maize, cowpea, finger millet, and soybean was more severely inhibited by leaf extracts from various tree species, including *Grewia oppositifolia*, *Ficus roxburgh*, and *Bauhinia variegata* [9]. Different workers observed that leaf extract treatment similarly inhibited seed germination. The inhibitory effect of *Acacia tortilis*, *Chromolena odorata, Quercus glauca* and *Quercus leucotrichopora* on the germination of pearlmillet, cowpea, wheat, mustard and lentil [10,11] clearly supports the present findings.

Root and shoot length

The extracts whole plant extracts of three weeds caused inhibitory effect on the root and shoot length of *Cicer arietinum* L. over control. The similar results were reported by the application of Eucalyptus leaf extract on cowpea, sorghum, pearl millet, wheat, barely, potato, groundnut, maize, sunflower, and mustard [12-16].

Leaf leachates of different allelopathic tree species like, *Terminalia tomentasa*, *Sapindus emarginatus* and *Azadirachta indica* L. at the higher concentrations inhibit the growth of field crops. This result agree with present findings. But at lower concentrations radicle growth of field crops has been promoted [17].

According to Parvez et al. [18], the Tamarind tree's bark significantly inhibited the growth of the radicles and hypocotyls of asparagus, cucumber, lettuce, radish, sesame, tomato, and Welsh onion. According to Pande et al. [19], the aqueous extract of Prunus amygdalus aerial portions prevented wheat and finger millet roots and shoots from growing longer. On the other hand, a study by Tripathi et al. [20] found that soybean root and shoot length were increased by leaf extracts of *Albizia procera*, *Tactoria grandis*, and *Acacia nilotica*.

Fresh and dry weight

When the concentration of whole plant extracts was increased (10%, 15%, 20%), the fresh and dry weight dropped. The fresh weight of cucumber and Chinese cabbage seedlings were reduced by 58 and 52% respectively over control by full treatments of mikania leaf extract [21].

The study of Eyini et al. [22] revealed that the leaf extract of *Tephrosia purpurea, Albizzia ammara* and *Delonix regia* inhibited that the biomass on *Zea mays*. The leaf leachates of *Casuarina equisetifolia* reduced the dry weight on rice and cowpea [23]. These studies favour the present findings. The whole plant extracts of three weed species exhibited inhibitory effect (10, 15, 20 and 25%) in all the parameters i.e., germination root and shoot length, fresh and dry weight, chlorophyll, sugar, starch, aminoacid and protein in test crop (*Cicer arietinum* L.) over control.

The whole plant extracts of *Ammannia baccifera* L., *Eclipta alba* (L.) Hassk. and *Cyperus difformis* L. showed an adverse effect on growth and biochemical constituents of *Cicer arietinum* L. seedlings. But the maximum inhibitory effect was caused by *Ammannia baccifera* L.

The differential degree of inhibitory effect on germination and seedling growth of *Cicer arietinum* L. may be due to the presence of allelochemicals at different level in the different concentrations of whole plant extracts of *Ammannia baccifera* L., *Eclipta alba* (L.) Hassk. and *Cyperus difformis* L.

Table 4. Effect of whole plant extracts of Paddy field weed species on Fresh and Dry weight (mg/plant) of *Cicer arietinum* L.

Concentration (%)	Fresh weight			Dry weight		
	Ammannia baccifera	*Eclipta alba*	*Cyperus difformis*	*Ammannia baccifera*	*Eclipta alba*	*Cyperus difformis*
0	90	90	82	22	24	17
10	86 (-4.4)	87 (3.3)	80 (2.4)	19 (-13.6)	21 (-12.5)	16 (-5.8)
15	78 (-13.3)	81 (-10)	71 (-9.7)	17 (-22.7)	19 (-20)	14 (-17.6)
20	63 (-30)	65 (-27)	60 (-26.8)	13 (-40)	15 (37.5)	12 (-29.4)
25	48 (-46.6)	52 (-42.2)	49 (-40.2)	12 (-45.4)	14 (-41.6)	10 (-41)

Data in parenthesis indicates % increase (+), decrease (-) over control.

CONCLUSION

The differential degree of inhibitory (10, 15, 20and 25%) effect on germaination and growth of *Cicer arietinum* L. may be due to the presence of allelochemicals. Among the three weed species of this study, *Ammannia baccifera* L., was high toxic and *Cyperus difformis* L. was less toxic to the germination and seedling growth of *Cicer arietinum* L.

CONFLICTS OF INTEREST

The authors declare no conflict of interest

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