

EVALUATION OF ALLELOPATHIC IMPACT OF AQUEOUS EXTRACT OF ROOT AND AERIAL ROOT OF *Tinospora cordifolia* (WILLD.) MIERS ON SOME WEED PLANTS

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Abstract: The present laboratory experimental study was conducted to evaluate the allelopathic potential of *Tinospora cordifolia* (Willd.) Miers on seed germination and seedling growth of weed plants (*Chenopodium album* L., *Chenopodium murale* L., *Cassia tora* L. and *Cassia sophera* L.). Root and aerial root aqueous extracts of *Tinospora* at 0.5, 1.0, 2.0 and 4.0% concentrations were applied to determine their effect on seed germination and seedling growth of test plants under laboratory conditions. Germination was observed for 15 days after that the root length and shoot length was measured. Dry weight was measured after oven drying the seedlings. The aqueous extracts from root and aerial root had inhibitory effect on seed germination of test plants. Aqueous extracts from root and aerial root significantly inhibited not only germination and seedling growth but also reduced dry weight of the seedlings. Root length, shoot length of weed species decreased progressively when plants were exposed to increasing concentration (0.5, 1, 2 and 4%). Aqueous extract of aerial root shows the least inhibition. The pH of aqueous extracts of different parts of *T. cordifolia* does not show any major change when the concentration increases.

Key words: Allelopathy, aqueous extract, *Chenopodium album*, *Chenopodium murale*, *Cassia tora*, *Cassia sophera*, *Tinospora cordifolia*.

INTRODUCTION

Tinospora cordifolia (Neem giloy) is a deciduous climbing shrub of family Menispermaceae. Found throughout tropical India ascending to an altitude of 1000 feet and in South Asia, Indonesia, Philippines, Thailand, Myanmar, China and in Srilanka worldwide. It prefers wide range of soil, acid to alkaline and it needs moderate level of soil moisture. It is climbed generally up on neem trees and mango trees. It is highly medicinal and its parts used to cure various diseases like, fever, cancer, leprosy, etc. and it is also an immune modulator and memory booster. De Candolle [7] was probably the first person to suggest the possibility that many plants may excrete something from their roots which may be injurious to other plants. The term 'allelopathy' was proposed by [19] for expressing the harmful effects that one plant species may have on another through the mechanism of chemical retardants escaping into the environment. The concept of allelopathy was further supported and further developed by [5, 8, 9, 11, 21, 32]. Allelopathic effects are controversial and still poorly understood [17]. 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 plants. Of these plant parts, leaves seem to be the most consistent producers of these allelochemicals. The four ways in which allelochemicals escape from a plant are: (i) volatilization, during which the terpenes are released from the leaves of some plant species; (ii) leaching (which has shown that living or dead leaves of many plants contain growth inhibitors); (iii) exudation in which case roots of several crop and non-crop species release large quantities of organic compounds that inhibit the growth of other plants; and (iv) decomposition, through which allelochemicals are released from the plant residue. This article aims to

identify the allelopathical effect of *Tinospora cordifolia* and moreover to compare the inhibitory effect of the different parts extract on the germination and seedling growth of some weed plants.

MATERIALS AND METHODS

Preparation of aqueous extract

The *Tinospora cordifolia* plants which grew naturally in Aligarh Muslim University campus. root and aerial roots were collected at their mature stage for the experiment. The parts were brought into the laboratory and each part of the fresh plant was cut into small pieces, shade dried and then ground separately with help of electronic grinder and made fine powder. 4 g powder of root and aerial root of *T. cordifolia* were dipped in 100 ml of distilled water and filtrate through a muslin cloth followed by filter paper (No. 1. Whatman International, Maidstone, UK) after 24 h of soaking at room temperature and then further diluted so as to get 0.5 to 4% aqueous extract, respectively [24].

Treatments and experimental design

Fresh seeds of weeds were collected from the agricultural field and road sides of the Aligarh Muslim University. The seeds were thoroughly washed in running water and soaked in distilled water for 12 hours. Petri dishes were given a thorough washing with detergent using hot water as precautionary measure against pathogens and pollutants. Petri dishes of 9 cm diameter lined with filter paper used for germination trial. There were 10 treatments including four concentration levels (0, 0.5, 1, 2 and 4%) of each root and aerial root extracts. Seeds and filter papers were moistened with 10 ml each of 0.5, 1, 2 and 4% aqueous extracts. 10 ml of distilled water was added to the untreated control (0%). The treatments were arranged in completely randomized design (CRD) with three replicates kept at room temperature on a laboratory

bench with 12 h supply of fluorescent light during the night. The whole experiment was repeated once.

Determination of pH

The pH of each extract prepared from different parts of *T. cordifolia* was determined by immersing the electrode of a digital pH meter (EcoScan). The mean of five replicates were taken and presented.

Physical parameters

Germination counts were recorded daily for fifteen days. After fifteen days, the seedling root length (cm), shoot length (cm) and dry weight were determined (mg). The root and shoot length were determined manually while the dry weight with the help of 4 digit digital balance of Scientech, Model ZSA 120, Colorado (USA)

Statistical analysis

After fifteen days, the seedling root length, shoot length and dry weight were determined. The data were subjected to one way analysis of variance and the mean values were separated at $P < 0.05$ applying 2-sample t-test. The statistical analysis was done using SPSS/PC version 10 software.

RESULTS

Germination

The germination of different weeds was tested with different aqueous solution of *T. cordifolia*, root and aerial root. The percent germination of weeds was reduced in all aqueous extract over control. Cent percent germination was observed in control. Among the extract treatment root extract was the most toxic to the test plant followed by aerial root. The highest concentration of root extract (4%) shows 38.52% reduction in *C. murale*. Reduction was observed in the following order *C. murale* > *C. tora* > *C. album* > *C. sophera*. But in the case of aerial root aqueous extract *C. tora* shows maximum reduction (33.34%) in germination percentage. Minimum reduction was observed in *C. sophera*. Reduction was observed in the following order *C. tora* > *C. murale* > *C. album* > *C. sophera*. The suppression in germination of test seeds at higher concentration (4%) of the extracts indicates the inhibitory effect of *Tinospora* on these weeds (Fig. 1a & 2a).

Seedling growth

The root length, shoot length and dry weight of the test plants under investigation when grown in aqueous extracts of root and aerial root lesser than that of control (Fig. 1&2). Maximum reduction in root length was observed in *C. album* in both aqueous extract treatments at higher concentration. Minimum reduction (46.87%) in root length was observed in *C. murale* (46.87%) and *C. sophera* (33.88%) in root and aerial root aqueous extract treatment respectively (Fig. 1b &

2b). The values of correlation coefficient between root length and concentration of aqueous extract of root were strong and it range between -0.887 to -0.986. In the case of shoot length maximum reduction was observed in *C. album* (68.32%) and *C. murale* (64.97%) in root and aerial root aqueous extract treatment respectively. In both cases *C. tora* shows minimum reduction (40.13% and 17.83% respectively). Reduction in root length and shoot length was increased with increasing concentration and it was maximum at 4% of root extract (Fig. 1c&2c). The values of correlation coefficient between shoot length and concentration of aqueous extract of root were strong in each of the cases. The values ranged from -0.917 to 0.961.

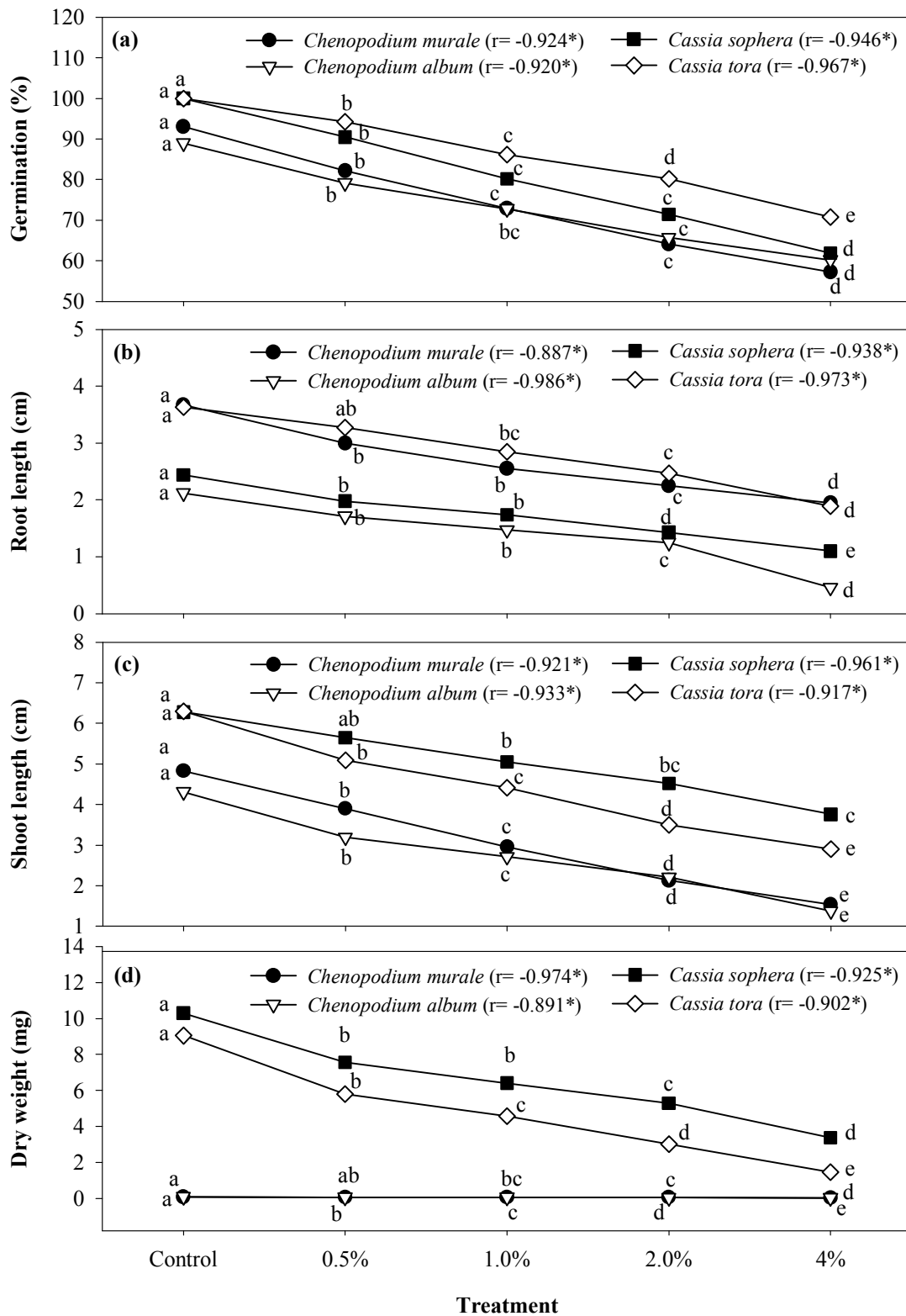
In the case of dry weight of the seedling *C. sophera* (83.87%) and *C. tora* (64.08%) shows maximum reduction and *C. murale* (63.46% and 44.52%) shows minimum reduction in root and aerial root aqueous extract treatment respectively. The values of correlation coefficient between the concentration of aqueous extract of roots and dry biomass were strong and reciprocal in all the test plants ranging from -0.891 to -0.974.

In the present study, pH of extracts (that is root and aerial root) ranged from 6.58 to 7.32 (Table 1). The pH also affects the growth of the weed plants. Presence of different type of alkaloids and terpanoids in root aqueous extract shows the maximum deleterious effect on weed plants followed by aerial root aqueous extract.

DISCUSSION

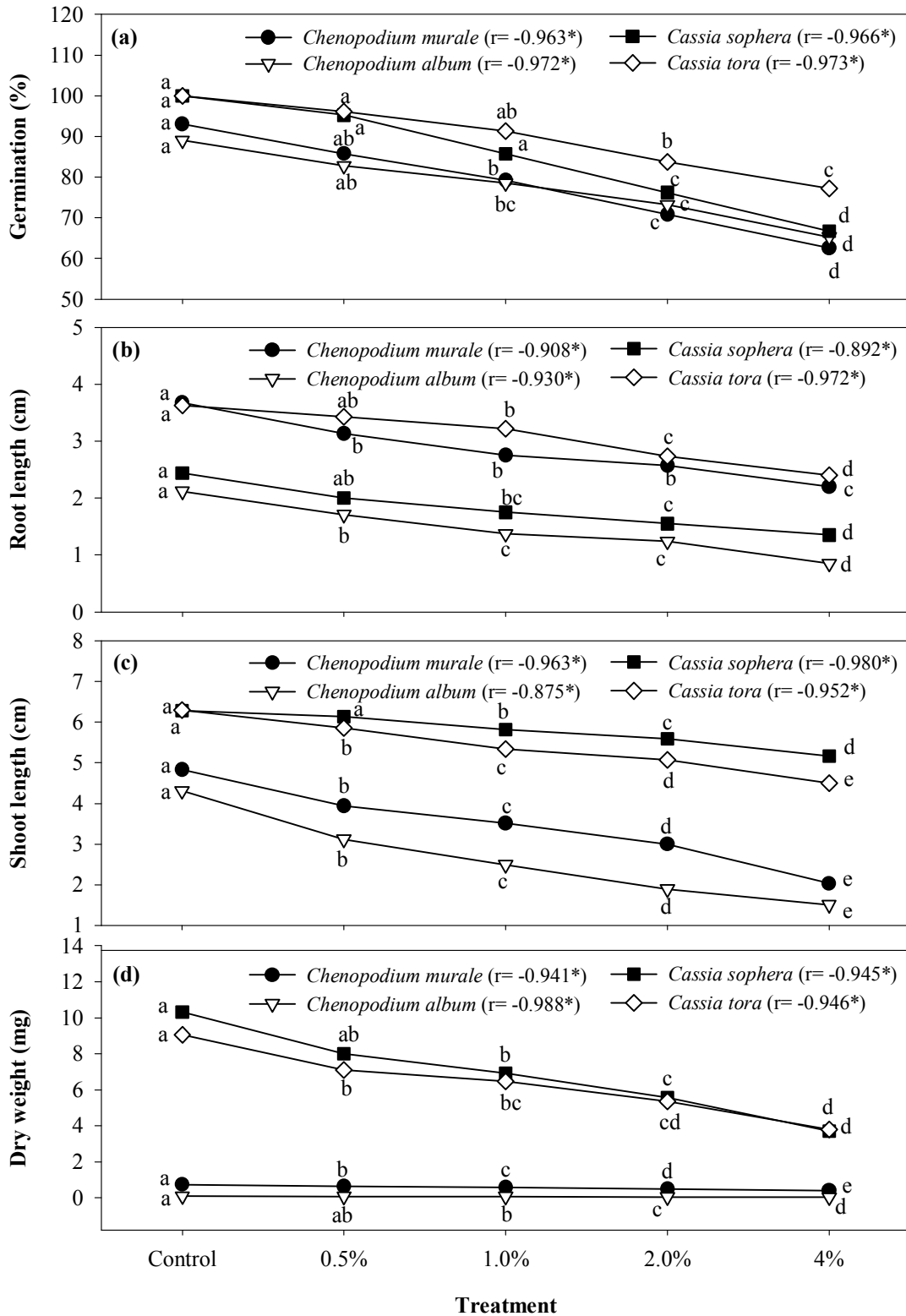
The results of the present study indicated that the allelopathic of *T. cordifolia* reduced germination percentages, root and shoot length and dry weight of the weeds. The inhibition effect was found to increase with increasing concentrations of different aqueous extracts [28, 29, 30]. Generally, in studies with aqueous extracts, the observed inhibitory effect are attributed to change in pH raising concern about allelopathy and its ecological existence and relevance [6, 13, 30]. After making these observations, it could be concluded that extract might possess some growth inhibitors. Some recent studies indicating the phytotoxic/ allelopathic effect of aqueous extracts of weeds include *Mikania micrantha* [14], *Cyperus rotundus* [22], *Cardaria draba* [16], *Parthenium hysterophorus* [2,25], *Brassica nigra* [31], *Raphanus raphanistrum* [20], *Ageratum conyzoides* [3,26,27], *Andrographis paniculata* [1], *Artisotlochia esperanzae* [10], *Baccharis dracunculifolia* [12], *Calotropis procera* [23] and *Chenopodium murale* [4]. All these studies indicate the release of phototoxic chemicals during the preparation of aqueous extracts. Based on this, studies were further extended to explore the impact of *T. cordifolia* (especially) leaves, as they possessed greater phytotoxicity on the emergence and growth of weed plants.

Figure 1. Effect of different concentration of aqueous extract of root on (a) germination, (b) root length (c) shoot length and (d) dry weight of test plants.



Different superscript symbols along a curve represent significant difference among themselves at $P < 0.05$ applying DMRT
 r represent correlation coefficient
 *represent significant significance of correlation at $P < 0.05$

Figure 2. Effect of different concentration of aqueous extract of aerial root on (a) germination, (b) root length (c) shoot length and (d) dry weight of test plants.



Different superscript symbols along a curve represent significant difference among themselves at $P < 0.05$ applying DMRT
 r represent correlation coefficient
 *represent significant significance of correlation at $P < 0.05$

Table 1. Values of pH in different concentration of extracts of leaves, stem, roots and aerial roots of *T. cordifolia*.

Extract concentration	Root	Aerial root
0.5	6.70 ^a	7.32 ^a
1.0	6.65 ^a	7.30 ^a
2.0	6.62 ^a	7.28 ^a
4.0	6.58 ^a	7.26 ^a

Same superscript symbols represent non significant among themselves at $P < 0.05$ applying DMRT

In conclusion the allelopathic aqueous extracts from root and aerial root of *T. cordifolia* showed an inhibitory effect on seed germination and seedling growth of *C. murale*, *C. album*, *C. tora* and *C. sophera*. The inhibition rate was maximum in root aqueous extract treatment as compared to aerial root. Hence the allelochemicals extracted from root and aerial root of *Tinospora* can be employed for the natural control of the tested weeds, thus achieving the aim of environmental safety. There is the need of further study to be carried out on identifying the inhibiting allelochemical in the parts investigated.

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