Indian J. Applied & Pure Bio. Vol. 38(3), 1557-1562 (2023). **ISSN: 0970-2091**
A Web of Science Journal

Allelopathic effect of aqueous extracts of *Cleome viscosa* L on seed germination and seedling growth of Maize (*Zea mays*. L)

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Abstract

Cleome viscosa is one of the most common weeds grown in Maize fields. It is used to determine the allelopathic potential on the growth and developmental changes on crop plants. The present study was conducted to evaluate the allelopathic effects of *C. viscosa* on the seed germination and seedling growth of Maize plants. Aqueous extracts of root and shoot of *C. viscosa* with the concentration of 10, 30 & 50% were applied on the Maize seeds in petri dishes; however plants treated with distilled water included as control. Seed germination, length of hypocotyl and root number was measured on 3rd, and 5th day respectively. Results from the present study demonstrated that the seed germination, length of hypocotyl and root number of Maize was significantly decreased with the increase of extract concentrations. Therefore, it is concluded from the above study that, both the root and shoot extracts of *C. viscosa* showed inhibitory effect on the germination growth percentage of Maize seeds over control from lower to higher concentration (10, 30 & 50%). The root number and shoot length also decreased with the increase in the concentrations of root and shoot extract. Inhibitory effects of aqueous extracts may be due to the presence of allelochemicals in *C. viscosa*. However, in-depth underlying mechanism of the inhibitory effect needs to be further explored.

Key words : Allelochemicals, Aqueous extracts, Hypocotyl, Seed germination.

Allelopathy is a common biological phenomenon by which higher plants of one species (the donor) have negative impacts on the germination, growth and development of the plants of a different species (the recipient)[12]. The effect of some plant species on the growth of others nearby remained an inexplicable phenomenon 22 until Theophrastus (300 B.C) conceptualized it as allelopathy[18]. Rice[19] described allelopathy as the result of the

discharge of chemical substances into the environment in 1974[19]. Nowadays, the widely accepted definition of allelopathy is "any process involving secondary metabolites produced by plants, algae, bacteria, and fungus that affect the growth and development of agricultural and biological systems" (International Allelopathic Society 1996).

Many of the phytotoxic compounds found in plant tissues and soil that are thought to limit development and inhibit germination have been identified and are known as Allelochemicals[28]. Interaction between weeds and crops is simultaneously and/or sequentially, with direct or indirect effect of one plant species to another, through the synthesis of various chemical compounds – allelochemicals, that are released into the environment and affect (inhibit and/or stimulate) the germination of seeds and the development of a number of crop and weeds[7,9,17]. Agriculture is one of the most studied applications of allelopathy in engineered environments. The effect of weeds on crop, crops on weeds and crops on crops have all consistently been studied for allelopathic effects. Additionally, the potential application of allelochemicals as organic insecticides and growth regulators supported sustainable agriculture[16].

Various crops, such as *Medicago sativa, Fagopyrum esculentum, Zea mays, Oryza sativa, Secale cereale, Sorghum bicolor, Helianthus annuus, Triticum aestivum,* etc., are impacted either by their own toxicity or phytotoxin exudates when their leftover break down in the soil[8,12]. Some of the toxic effects of decomposition products on plants are inhibition of seed germination, stunted growth, and inhibition of the primary root system and increase in secondary roots, inadequate nutrient absorption, chlorosis, slow maturation and delay or failure of reproduction[14,15]. Toxins from the decomposing crop residues could affect young crop plants sown between the mature plants e.g., in relay cropping or into the stubbles of the preceding crop in multiple sequential cropping[25]. If the weed parts containing water soluble allelochemicals, it is likely that crop seedlings would be subjected to growth inhibition. The objectives of this research were to assess the impact of weed species *C. viscosa* on the seed germination and seedling growth of Maize plant.

Collection of plants :

Plants were collected from Maize fields located in Moinabad districts in the month of June 2022. Collected plants were clean thoroughly, separated its roots and shoot with the help of knife, dried at room temperature followed by grind and stored them.

Preparation of extracts solutions:

At the time of treatment fresh aqueous extract was prepared. Four gm of dried root and shoot powder soaked in 100ml of distilled water for 48 hr[11]. The extract was filtered through muslin cloth and Whattman filter paper no1. Filtrate considered as stock solution, stored in glass bottle until needed. Required concentrations (10, 30 & 50%) were prepared by dissolving aqueous extract in distilled water.

Experimental procedure:

Hybrid Maize seeds (Shivani KSMH-1980) were surface sterilized with 2% sodium

hypochlorite solution then washed with distilled water several times. 10 seeds were placed in petri-dishes with double layered Whattman filter paper no1. Each petri dish was treated with 8ml of each concentration (10, 30 & 50%) and each treatment was replicated three times (Fig. 1). All treatments were kept at room temperature at 30°C± 2°C in BOD incubator.

Root and shoot extract :

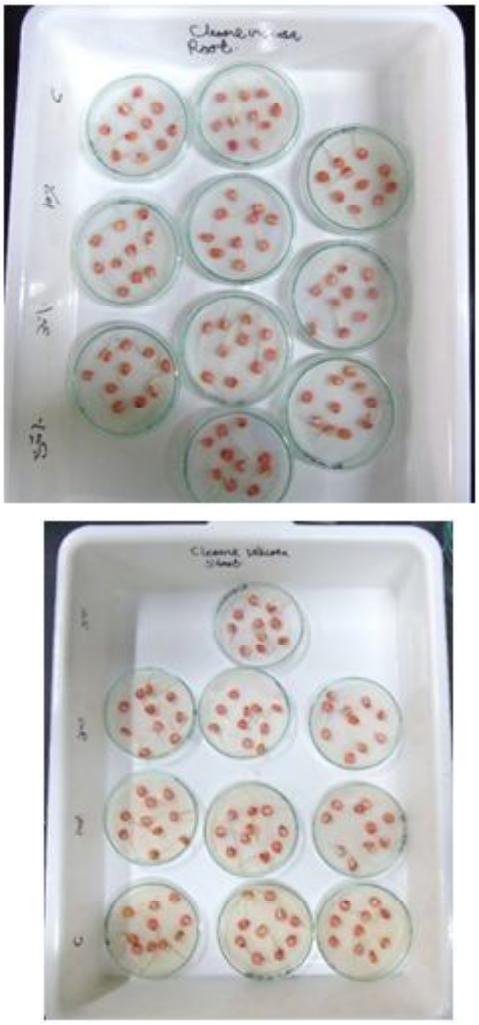

Fig1: Day1 Experimental setup

Analysis :

Seed germination was observed after 3rd day, the radicle emergence was taken as criteria for germination. On the 5th day morphological attributes like length of hypocotyl and root number were measured.

Aqueous root extracts of *C. viscosa* shown significant impacts on seed germination of Maize. This is observed that germination growth percentage of Maize seeds decrease at higher concentration (50%). (Fig. 2). The reduction in length of hypocotyl and root number was observed with the increase in concentration.

Table-1. Effect of aqueous extracts of root of *C. viscosa* on seed germination and seedling growth of Maize

Root extract	*Cleome viscosa*			
	Control	10%	30%	50%
Germination growth%	10	9	7.3	6.3
No. of roots	3.9	3.2	2.7	2.1
Length of Hypocotyl	1.8	0.7	0.37	0.35

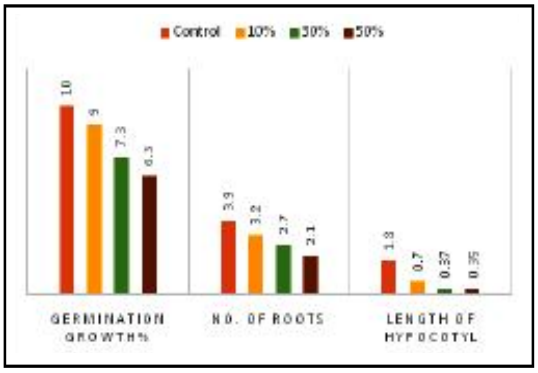

Fig. 2. Effect of root extracts on Maize seeds

Whereas aqueous shoot extracts of *C. viscosa* alsoshowed similar result on the germination of Maize seeds over control at higher concentration (50%). With the increase of aqueous extracts concentration degree of inhibition of seed germination growth percentage was decreased and the reduction in length of hypocotyl and root number was observed with the increase in concentration (Fig. 3).

Table-2. Effect of aqueous extracts of shoot of *C. viscosa* on seed germination and seedling growth of Maize

Shoot extract	*Cleome viscosa*			
	C	10%	30%	50%
Germination growth%	10	9.3	8.3	8
No. of roots	3.1	2.3	2.2	2.1
Length of Hypocotyl	0.75	0.39	0.36	0.3

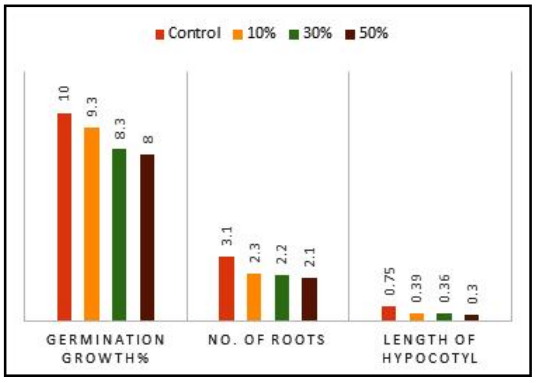

Fig. 3. Effect of shoot extracts on Maize seeds

The differential degree of inhibitory (10, 30 and 50%) effect on thegermination growth percentage and seedling growthmay be due to the presence of allelochemicals at different concentration of both components extracts. The result of Drost and Doll[5] supports the present findings, where the plant residues and tuber extracts of yellow nutsedge (*Cyperus esculentus* L.) inhibited the germination and growth of corn (*Zea mays* L.) and soybeans (*Glycine max* L.). Our results are lined with the previous study of Channappagoudar *et al.*[4] on Glycine max, Triticum aestivum and Vigna radiata. They observed that *C. rotundus* and *C. bengalensis* had inhibitory effect on seed germination and seedling length of the above plants. The higher concentration of leaf, new shoot and old shoot extracts of *T. cordifolia* inhibited the germination of *S. orientala* and *E. coacana*[3]. Asif Tanveer *et al.*, recorded the weed *Euphorbia helioscopia* caused an inhibition on growth and development of three crops *i.e.,* wheat, chickpea and lentil[1]. The allelopathic effect could happen because of some secondary metabolites, which reacted with one another, there is some reports which supporting the idea that the allelochemicals could be synthesized by either the shikimic acid or acetate pathways[13,19,20,21]. Some of the allelochemical are belonging to ferulic acid and phenolic acids family, including o-hydroxy-phenyl acetic acid[6]. The increased inhibitory effect on germination characteristics at higher concentration of weed extract may be due to an increase in the concentration of allelochemicals, coming from phenolic acids compounds like, P-hydroxy benzoic acid, p-coumaric acid, cafeic acid, o-coumaric acid and ferulic acid, Similar results were reported in previous published studies[2,10,24,26]. Sa´nchez-Moreiras[23] suggested that allelopathy in cereals of the *Gramineae* family was attributed mostly to hydroxamic acids. Sorgoleone is responsible for allelochemical agent from sorghum roots and heliannuols, annuolides, tambulin, and

heliannones were identified as allelochemicals from sunflower[27].

In the present investigation, it was observed that both the root and the shoot extracts of *C. viscosa* show inhibitory effect on germination growth percentage of maize seeds. The root number and length of hypocotyl of Maize plant was also decreased with the increase in the concentrations of root and shoot extracts of *C. viscosa* weed. This indicates that certain type of allelochemicals is present and they might be the reason for its decreasing effects. To find out the allelochemicals which hampering the growth of crop plants need to investigate in future studies.

Authors are thankful to the Head, Botany Section, School of Sciences, Maulana Azad National Urdu University, Hyderabad, for providing necessary equipments and other facility in the lab.

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