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In vitro Allelopathic interference of aqueous extracts of *Cardiospermum halicacabum* L. root on seed germination and seedling growth of wheat crop.

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Abstract

The current investigation into the allopathic effects of ballon vine (*Cardiospermum halicacabum* L.) on wheat (*Triticum aestivum* L.) was carried out in a laboratory. The most significant cereal is wheat, which is also a food. Although wheat can be grown in many different types of soils and varied temperatures, it does best in tropical areas with 25-80 cm of rainfall annually. *Cardiospermum halicacabum* L. is a weed that is growing quickly and is a major allelochemical competitor in wheat. One of the main factors reducing crop productivity is weeds. Five concentrations with varying ratios were acquired in order to show the germination of seeds from two wheat varieties that are grown nearby, Sharabati and Lokwan. To evaluate *Cardiospermum halicacabum* L.'s allelopathic potential in Triticum aestivum L. seed germination, a bioassay using a petridish was conducted. The treatment involved the use of water-based weed root extracts. It was found that the *Cardiospermum helicacabum* L. had a different inhibitory effect on the wheat varieties Lokwan and Sharbati.

Key words : Allelochemicals, *Cardiospermum halicacabum* L., bioassay in Petridish, Seedling growth,Seed germination.

Chemical exchanges between plants, comprising those intermediated by microbes, are referred to as allelopathy[10]. Secondary metabolites are not always existing in plants but do present irregularly, make up the majority of allelochemicals, or plant toxic substances, that are suspected of preventing seed germination and growth in plant tissues[20].

Allelopathy is an unusual occurrence in biology in which a plant produces biochemicals called allelochemicals that hinder the growth of other plants[1,4]. Agricultural weeds are thought to be unwanted plants that contest with developed field crops for resources such as sunlight, fertilizer, minerals, and water, and they also impact the rate at which developed crops develop and regenerate[14].

Hence, crops field unwanted plants

have significance in crop creation for their unfavorable consequences for crops. Allelopathy is a type of obstruction in which the giving plants impede the other plant by introducing a synthetic inhibitor from decaying or living tissues. Allelochemicals which are water-soluble primarily affect plant development at early stages of growth are delivered by various weeds, demonstrating allelopathic effects[18]. Several plants got affected by biochemical release by weeds. Allelochemicals are substances that plants produce as byproducts, outcomes, or metabolites and which can be obtained from whole plant parts such as leaf, root, shoot etc. Still, the leaves and roots seemed to have capability of producing the most dependable allelochemical[16].

These collections of artificial substances could be administered collectively and could have detrimental effects in addition to one another or work in concert. Allelochemical release from various plant parts affects beneficiary crop plants' seed germination and seedling development immediately, either by stimulating or inhibiting these processes. Lokwan and Shrabati varieties of wheat (*Triticum aestivum* L., family Poaceae) are perfect for the agro-climatic conditions of Maharashtra and Madhya Pradesh. Wheat is the most widely grown commercial crop in the world today and the main source of grain used for human consumption. The cereal crop *Triticum aestivum* L. is grown annually. The harvest is primarily designed for seeds that contain a high amount of carbohydrates.

Cardiospermum halicacabum L. is a deciduous, woody, perennial to annual vine that grows naturally in tropical America. The square stems have a rapid growth rate. The plants can climb because of their forked tendrils. a weed of disturbed ground, especially in riparian corridors and wetland areas[12].

Weeds are thought to significantly reduce harvest yields. Plants are primarily affected by allelopathy when there is less seed germination and development 18. After that, allelopathy is important in a lot of agro-ecosystems[3]. The allelopathic interference on seed germination are interconnected to the allelochemicals, benefit plant type, and ecological factors[8]. Allelopathy is a distinctive and environmentally friendly technique that may be used as a viable weed-control strategy for workable rural practices[5]. It is clear from the information given that the weeds listed above contain allelochemicals that may prevent seeds from germinating.

Cardiospermum halicacabum L. specimens were collected from a wheat field near Ramtek, Nagpur, Maharashtra. Roots of collected plant material were thoroughly cleaned with water, chopped into tiny pieces, and dried in shade. The shade dried plant materials were stored in airtight glass bottles after being separately ground in a grinder and sieved.

The shade dried plant materials were used to prepare aqueous root extract. The 10 grams of root powder were mixed with 100ml distilled water to produce 10% stock solution and kept for overnight, then filtrate were obtained from mixture, Volume were make up to 100 ml by adding distilled water to filtrate. These stock solution were used to prepare serial concentration of 10% to 50% [2]. These solution of different concentration were stored in labelled airtight bottles for further experiment.

Water is widely used as the natural solvent extraction medium, which is why aqueous extracts are preferred. The seeds of Lokwan and Sharbati varieties of wheat were procured from agriculture department of Ramtek Tahsil. The seeds were sterilized by treating with 1% $HgCl_2$ for 10-15 minutes and utilized for additional bioassay investigations. The Petri Dish Bioassay Experiment was used to conduct the study[6]. Twenty-five sound, evenly spaced, and surface-sterilized seeds were set aside for germination research in double-blotting paper-lined, sterile Petri dishes that were moistened with 10 millilitres of various aqueous root extract concentrations (50%, 40%, 30%, 20%, & 10%). Each treatment was repeated 5 times using distilled water as the control. For a week, the couple petri dishes were stored in the experiment room at 25°C, (room temperature) in midday and low light. After a week, a count of the germinated seeds was used to determine the percentage of seeds that had germinated. After that, on the fifteenth day, a slide calliper was used to measure a number of parameters, including the plumule and radical length. Five observations were made over the course of two days off [2].

Data Analysis :

One-way ANOVA was used to compare data on the allelopathic interferences of *Cardiospermum halicacabum* L. on germination and growth of seedling (Plumule and Radical length) of *Triticum aestivum* L. The FLSD (Fishers LSD) test was used to look at any significant differences of means among the group. SPSS (Statistical Package for Social Sciences) statistics with a significance threshold of 5% were used for all tests.

Agreeing to the experimental results, the recipient variety of wheat crop's percentage of seed germination and seedling development were lower in the sets provided with root extracts from *Cardiospermum halicacabum* L. than in the control group. Higher inhibition was noted in the extract at 50% concentration. When compared to the control, the results show that the *Cardiospermum halicacabum* L. aqueous whole plant extracts significantly decreased seed germination, root length, and shoot length. The calculations were statistically evaluated using the F test, which is calculated using a one-way ANOVA. All tests were conducted using SPSS, a statistical program, with a significance level of 5%.

Impact on germination of seed- Seed germination is the time interval between water absorbance and the onset of meristematic activity, during which physiological processes in seeds begin, resulting in cell elongation and the formation of new tissues, organs, and cells [11]. The high percentage of seed germination for both wheat varieties (100±SE00) were observed in the 10% concentration and control group, while the lowest seed germination for the Lokwan and Sharbati varieties (75.2± SE4.496) and (76±SE1.264) were observed in the 50% concentration repectively. It was significantly (P 0.001) less than all other concentrations treatments. At concentration ranges of 20% to 40%, the germination percentages were, respectively, 92.1±SE1.264, 86.8±SE1.319, 84.8±SE1.496, 84±SE1.378, and 76.6 ±SE1.326, 79.2±SE1.496.

Impact on root length- The seedling root length of the wheat varieties Lokwan

Table-1. Mean of seed germination (±SE) after one week

Sr.no.	Aqueous Root Extract Concentration	Varieties of Wheat	
		Sharbati	Lokwan
1	Control	100 (±0)	100 (±0)
2	10	100 (±0)	100 (±0)
3	20	92.1(±1.264)	86.8(±1.319)
4	30	84.8(±1.496)	84(±1.378)
5	40	76.6(±1.326)	79.2(±1.496)
6	50	75.2(±4.496)	76(±1.264)
F Statistic at p=0.05, P<0.001.		93	84

and Sharbati was considerably (P<0.001) impacted by the root aqueous extracts of *Cardiospermum halicacabum* L. Root length (4.60±0.24cm and 5±0.44cm) was most inhibited by 50% concentration, then 40% (7±0.44cm and 7.2±0.37cm), 30% (8±0.2cm and 9±0.31cm), 20% (11.4±0.24cm and 10.8±0.37cm), 10% (14.4±0.24cm and 14.6±0.2cm) over control (15.4±0.50 and 14.8±0.37cm).A statistical assessment between the groups also revealed that, when compared to one another, the treatment groups differed in a way that was not statistically significant. Thus, it definitely said that observable changes in root length were significantly dependent on variations in test sample concentration (P<0.001).

Table-2. Mean of seedling root length (±SE) after fifteen days (in cm)

Sr.no.	Aqueous Root Extract Concentration	Varieties of Wheat	
		Sharbati	Lokwan
1	Control	14.8(±0.37)	15.2(±0.37)
2	10	14.6(±0.2)	14.4(±0.24)
3	20	10.8(±0.37)	11.4(±0.4)
4	30	9(±0.31)	8.2(±0.37)
5	40	7.2(±0.37)	7(±0.44)
6	50	5(±0.44)	4.6(±0.24)
F Statistic at p=0.05, P<0.001.		142	167

Influence on seedling shoot length: the statistical analysis results showed that the shoot length of the wheat varieties Sharbati and Lokwan was significantly (P<0.001) affected by the a number of water base root extracts of *Cardiospermum herlicabum* L.The control seeds that received distilled water had maximum shoot lengths of 12.6±0.24cm and 13±0.31cm, respectively, which was significantly (P<0.001) higher than all other treatments.

Conversely, for Wheat Varieties Sharbati and Lokwan, the minimum (5.6±0.24cm and 5.2±0.2cm) shoot lengths were noted in 50% concentration. correspondingly. The shoot lengths were (12.2±0.37cm and 12.6±0.24cm), (11.6±0.24cm and 11.8±0.37cm), (10.8± 0.37cm and 9.6±0.4cm), and (8.2±0.37cm and 7.8±0.66cm) respectively, at concentration ranges of 10% to 40%. When groups were compared to one another, a multiple comparison revealed a statistically insignificant alteration between experimental treatment groups (control to 50%).

Table-3. Mean seedling shoot length (±SE) after fifteen days (in cm)

Sr.no.	Aqueous Root Extract Concentration	Varieties of Wheat	
		Sharbati	Lokwan
1	Control	12.6(±0.24)	13(±0.31)
2	10	12.2(±0.37)	12.6(±0.24)
3	20	11.6(±0.24)	11.8(±0.37)
4	30	10.8(±0.37)	9.6(±0.4)
5	40	8.2(±0.37)	7.8(±0.66)
6	50	5.6(±0.24)	5.2(±0.2)

From the above experiments it is surely put forth that the weed might have water-soluble biochemical released by root, which might have inhibitory impact on the two varieties of wheat crop, as the aqueous extract of *Cardiospermum halicacabum* L. root significantly reduced the incubation of Wheat seeds. These findings are in accordance with a study on the allelopathic interferences of different weeds on wheat seed germination by Siyar *et al.*(2018)[18] and Rao *et al.*(1994)[15]. Additionally, at higher concentrations (30%, 40%, and 50%), the water soluble root extracts of *Cardiospermum halicacabum* L. demonstrated the greatest inhibition of Wheat germination. Wheat seed germination may have been inhibited by the allelopathic stress of different concentrations of water base plant extract brought on by innumerable anomalies in plant metabolic processes initiated by the influence of allelochemicals[9].

The study's findings also reveal that the Sharabati and Lokwan varieties' of Wheat, root and shoot lengths were significantly reduced by the *Cardiospermum halicacabum* L. aqueous extracts of root. Seedlings roots and shoots of the Lokwan variety were more susceptible to the allelopathic stress than those of the Sharbati variety; at 50% concentrations of *Cardiospermum halicacabum* L. water soluble root extracts, Wheat seedlings root and shoot length were considerably affected[7]. Despite the fact that the interferences showed by weed varied between the two kinds (Sharbati and Lokwan), they were dependent on concentration of water soluble root extracts. They showed that leaf extracts from the weed *Cardiospermum halicacabum* L. had strong inhibitory impacts, reducing seed germination by 63% and the length of the lettuce root and stem by 0.77 cm and 1.10 cm, respectively. This study's findings about smaller roots and

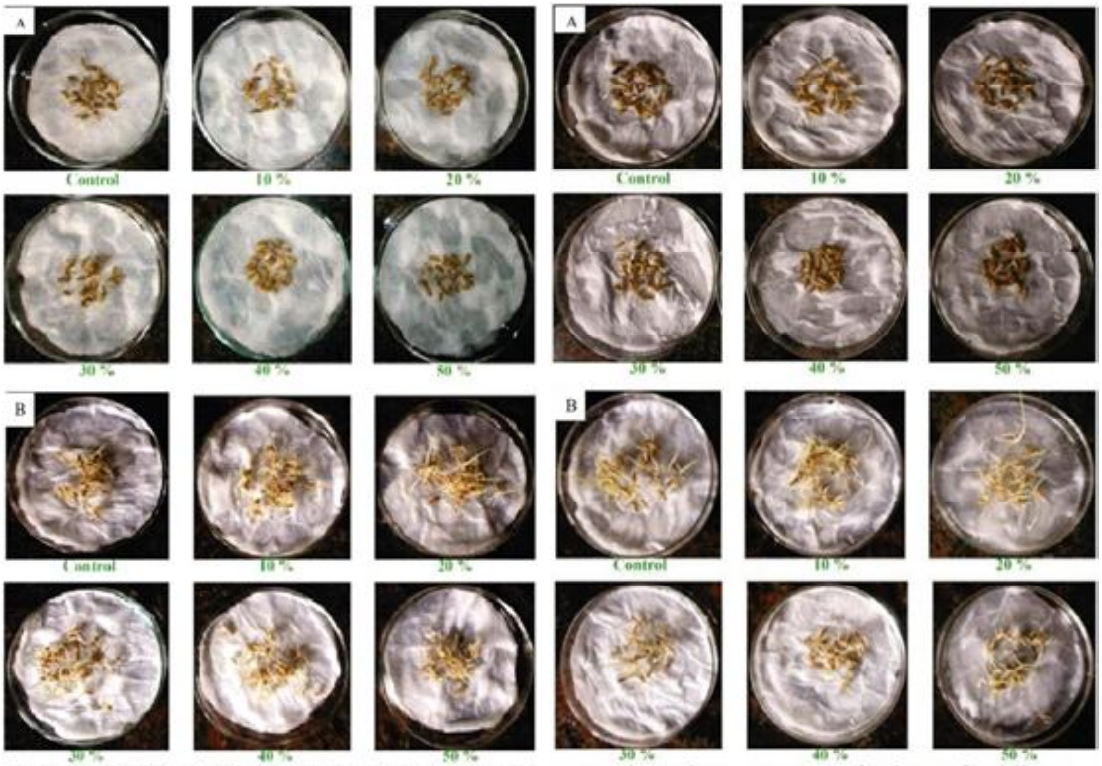

Fig:A 2 day germination stage from control to different concentration root extract,B: After 7 day seed germination,Variety Sharbati

Fig.2 A: 2 day seed germination treated with control to different concentration of root extract, B: 7 day seed germination Variety Lokwan

Source: Picture by D.N. Watakhere

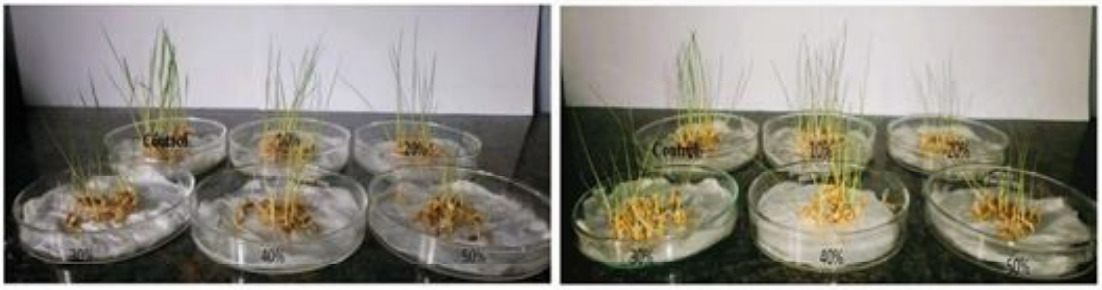

Figure 3: Seed Germination after 12th day Var. Sharbati

Figure 4: Seed germination after 12th day Var. Lokwan

Source: Picture by D.N. Watakhere

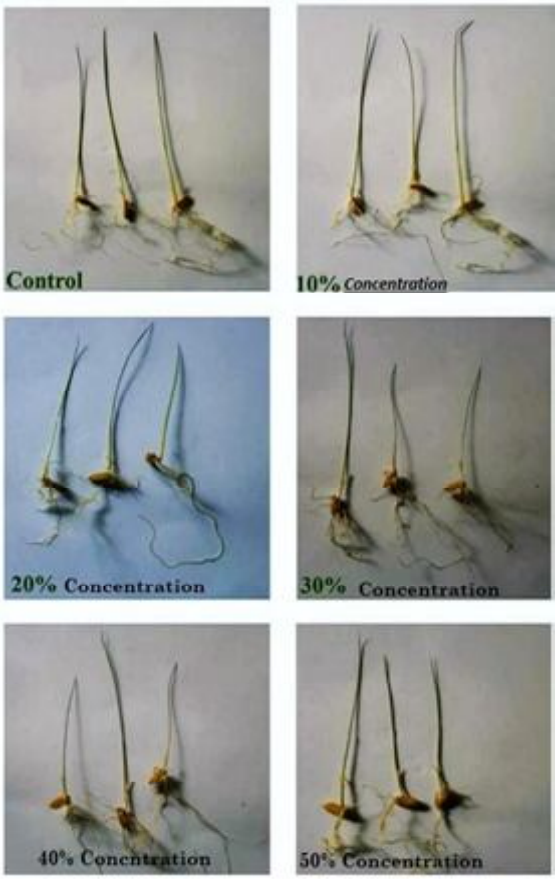

Figure 5: Root shoot length Var. Sharbati,

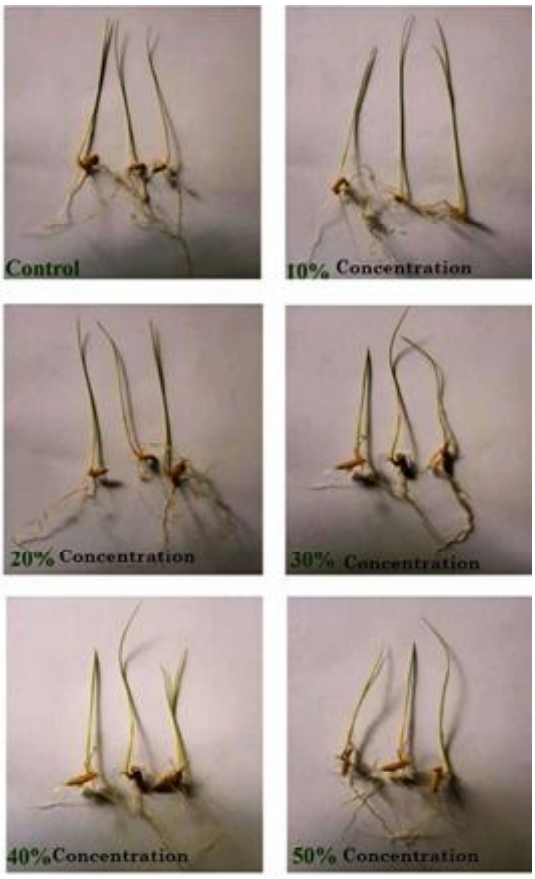

Figure 6: B- Root shoot length Var.Lokwan

Source: Picture by D.N. Watakhere

shoots could have a negative impact on crop productivity, particularly in smallholder farming systems. Because they are crucial for minerals uptake and the soil support of the plant, seedlings root and shoot lengths are significant factors that affect the god development of plants[19]. According to Subudhi *et al*.(2018)[20], plants with shorter roots have a harder time to obtain water and nutrients from the ground. Conversely, a plant's susceptibility to ecological pressures like water scarcity has been associated with shorter shoots[17]. Furthermore, plants with shorter shoots have a harder time competing for the air, sunlight, needed for photosynthesis; these resources are scarce and can hinder plant growth[13].

The water based root extracts of *Cardiospermum halicacabum* L. contained allelochemicals that significantly inhibited the seed germination of the wheat (Lokwan and Sharbati varieties) seeds, also growth of seedling which includes root and shoot length. The outcomes are some of the earliest to show

how root extracts from *Cardiospermum halicacabum* L. affect Wheat seed germination and growth. Higher concentrations (30%, 40%, and 50%) of the *Cardiospermum halicacabum* L. aqueous root extract negatively affected Triticum aestivum L. seed germination and seedling growth when related to lower doses (20%) and the control (0%). The water-soluble allelochemicals in root extracts of *Cardiospermum halicacabum* L. may be responsible for these effects; future research is needed to know the main cause and identification of inhibitory biochemical.

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Conflict of Interest

Research paper writers have no conflict of interest.

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