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PHYTOCHEMICAL PROFILING AND ALLELOPATHIC IMPACT OF *CONOCARPUS ERECTUS* L. ON SELECTED AGRICULTURAL CROPS

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Abstract

The role of phytochemicals in agricultural system is increasingly recognized for its potential to supress or promote plant growth. The study was aimed to screen major phytochemicals and evaluate allelopathic potential of *Conocarpus erectus* plant parts against germination and growth of wheat, barley and spinach. For phytochemical analysis, four different solvent extracts (aqueous, methanol, acetone and petroleum ether) of plant parts (stem, leaf and bark) were used. Tannins, phenols and quinones were present while flavonoids, alkaloids and phlobatannins were absent in all extracts of *C. erectus* L. plant parts. For allelopathic evaluation of plant parts, filter paper method was used to apply different concentrations (0.5%, 1% and 2%) of aqueous extracts. Leaf and bark extracts mostly stimulated the germination of spinach and wheat at all concentrations. However, the hypocotyl and radicle growths of wheat were mostly inhibited by all plant parts. The inhibition was found to be concentration dependent. The maximum inhibition of radicle growth was observed by bark extract. Results from experiments showed that *C. erectus* has some allelopathic effects on crops. It has the potential to cause biochemical and physiological damage to cultivated crops. Therefore, pro-active preventative management of *C. erectus* L. is required around the crops like wheat, spinach and barley. It should be planted carefully as a boarder cover. Further investigations are required for the possible phytochemicals present in *C. erectus*.

Keywords: Allelopathy; acetone; barley; methanol, phytochemicals; spinach; wheat

INTRODUCTION

Combretaceae also known as the white mangroves family, has approximately 500 species in 20 genera and placed with the order myrtales (Khalil *et al*., 2020a). This family is mainly represented by trees and shrubs. The most adapted and flourishing species of Combretaceae is *Conocarpus erectus* L. which is 6 m in length with 20 cm diameter evergreen with scattering crown (Khalil *et al*., 2020a). The common name of *Conocarpus* is botton wood or button mangroves. *Conocarpus* was originating from Florida, Mexico and West Indies. In Saudi Arabia it was introduced as invading species and flourished mostly as roadside specie (Alsharekh *et al*., 2022). It has worldwide distribution from shoreline to tropical and subtropical regions and found in some areas of Pakistan (Hussain and Abbas, 2022). The leaf morphology shows that it has lanceolate leaves with alternate arrangements (Dompreh *et al*., 2024). Inflorescence has greenish flowers present on the cone shaped head at terminal position (Abbas *et al*., 2021). It has great economical and medicinal importance.

Conocarpus is planted as an ornamental hedge tree planted in parks, yards, streets and even in parking lots (Abdul-Sahib *et al.*, 2022). Wood obtained from this tree is used for various purposes like boat construction due to its durable property in water (Abbas *et al.*, 2021). It is extremely heat tolerant and can grow in soil with low fertility. Bark is a source of dye for leather tanning and has ornamental value (Abdul-Sahib *et al*., 2022). The plant species is being utilized for medicinal purposes by different

researchers and scientists against several diseases like catarrh, diabetes, diarrhea, fever, hemorrhage, orchitis, anemia, syphilis and skin ulcer. The extract obtained from this plant has anti-cancerous, antioxidant and hepatoprotective properties (Abbas *et al*., 2021; Khalil *et al*., 2020b).

The plants have different chemicals in them that perform various potential activities. These phytochemicals perform protective and defensive action against different diseases (Mohan *et al*., 2021). Among these chemicals long chain fatty acids, phenolic compounds, alkaloids, terpenoids, steroid, tannins, terpenes, quinones, flavonoids, and many other compounds are secondary chemical compounds (Saadullah *et al*., 2024). These phytochemicals have different properties and can stimulate or inhibit the growth and germination capacity of the neighboring plants, that is why they are also called as allelochemicals (Baraik and Sandya, 2022). The mode of action of allelochemicals varies depending on the plants. They either inhibit germination by changing the cell division process or disrupting the energy transfer process in other plants like respiration etc. (Dhaou *et al.*, 2022). Allelochemicals released by different plants can alter growth, survival, behavior ultimately so, these can change the overall performance of neighboring plants (Pan *et al.,* 2023). Therefore, it is of great importance to check the allelopathic potential of plant species against its surrounding plants. This study was aimed to screen the phytochemicals found in different plant parts of *Conocarpus* and its allelopathic effects on seed germination and seedling growth of selected agricultural crops.

MATERIALS AND METHODS

The experiment was carried out to determine the presence of phytochemicals and to study the allelopathic potential of various parts of *Conocarpus erectus* L. i.e., leaves, bark and stem on seed germination and seedling growth of different test species including *Triticum aestivum* L. (wheat), *Spinacia oleracea* L. (spinach) and *Hordeum vulgare* L. (barley).

Plant collection

Different parts of *C. erectus* were collected separately from the garden of University of Education and Ideal Park, College Road, Lahore, Pakistan.

Drying of plant material

After plant collection various plant parts were separated and washed thoroughly to remove any dust or contamination and air-dried at room temperature for 15-20 days. After that dried samples were smashed into fine powder and stored in sealed plastic bags in dry conditions for future use.

Preparation of aqueous and different solvent extracts

The preparation of aqueous extract was carried out as mentioned by (Popoola *et al*., 2020). Weigh about 20 g of prepared fine powder of each plant part of donor species. Subsequently measured samples were soaked in 100 mL of deionized water and covered with aluminum foil and kept overnight. The extracts were stained by using Whatman filter paper. After that the collected filtrate was preserved in refrigerator for further use. For the preparation of various solvent extracts maceration techniques were used (Syahputra *et al*., 2021; Hassan *et al*., 2024). Measure approximately 20 g of finely ground powder from part of each plant donor species. Weighed samples were immersed in 100 ml of petroleum, methanol, acetone and ether separately and kept overnight in beakers covered with aluminum foil.

After 24 hours, the extracts were initially stained via cheese cloth to eliminate leaf debris and then finally filtered with the assistance of Whatman filter paper. The filtrate was concentrated at room temperature and stored in refrigerator for further use.

Phytochemical Screening of Plant Parts

For phytochemical screening, different extracts of plant parts were subjected to various qualitative tests using standard procedure adopted by Sharma *et al*. (2020).

Tannins

Approximately 0.5 g of plant extract was heated in 10 ml of water within test tube and filtered. A few drops of 0.1% solution of ferric chloride were added and mixture was examined for the appearance of a blue-black or brownish green hue (Alqethami and Aldhebiani, 2021).

Alkaloids

The raw extract was combined with 2 mL of Wagner's reagent. The formation of reddish-brown precipitates confirmed the occurrence of alkaloids.

Phlobatannins

The crude extract from each plant sample was heated with 2% aqueous hydrochloric acid. Subsequently, the formation of red precipitates served as an indication of phlobatannin presence.

Flavonoids

A 5 mL portion of diluted ammonia solution was introduced to raw extract, followed by the adding of concentrated sulfuric acid. The indication of a yellow hue in every sample signified the presence of flavonoids, which gradually faded upon standing.

Saponins

Plant unrefined extract was blended with 5 mL of purified water in a test tube and vigorously agitated. A few drops of olive oil were then added. The development of a persistent spume signified the presence of saponins.

Quinones

A 1 mL portion of the crude extract was treated with diluted sodium hydroxide. The indication of a blue-green or red hue confirmed the presence of quinones.

Coumarin

Raw extract was added with 10% sodium hydroxide and the addition of chloroform. The emergence of a yellow tint indicated the presence of coumarins.

Terpenoids

A portion of 5 mL extract was mixed with 2 mL of chloroform, tracked by careful addition of 3 mL of concentrated sulfuric acid to generate distinct layering. The emergence of a reddish-brown tint at the interface confirmed the presence of terpenoids.

Steroids

To 0.5 mL of plant extract and 2 mL of acetic anhydride were added, followed by 2 mL of sulfuric acid. A color transition from violet to blue or green signified the presence of steroids.

Carbohydrates

Equal portions of Fehling's A and Fehling's B solutions were combined, and 2 mL of mixture was added to crude extract, then gently heated. The

formation of brick-red deposits at the bottom of the test tube confirmed the presence of reducing sugars.

Proteins

When raw extract was combined with 2 mL of Millon's reagent and white precipitate formed which turned red upon mild heating, resulting confirming the presence of proteins.

Phenols

The crude extract was mixed with 2 mL of a 2% ferric chloride solution. The appearance of a blue-green or black hue represented the presence of phenols.

Glycosides

Crude extract was blended with 2 mL each of chloroform and acetic acid and chilled on ice. Concentrated sulfuric acid was carefully introduced. A color alteration from violet to blue to green confirmed the presence of a steroidal nucleus, denoting the glycine component of glycosides (Kebede *et al*., 2021).

Determination of allelopathic potential

The aqueous extract of different parts of donor plant were used to evaluate the allelopathic potential against test species.

Preparation of different concentrations

The stock solution of already prepared aqueous extract of each plant part was diluted to prepare various concentrations i.e., 0.5%, 1% and 2%. The flasks of extracts were covered with aluminum foil and stored in the refrigerator for further use.

Test plants

Three different species including *Triticum aestivum* L. (wheat), *Spinacia oleracea* L. (spinach) and *Hordeum vulgare* L. (barley) were used as test plants to study the allelopathic potentials. The seeds of test plants grew from November to January at the temperature of 12-25˚C.

Preparation of medium for germination

Filter paper was used as a medium for germination of seeds. Before the adjustment of filter paper in petri plates, plates were sterilized to remove any contamination using 70% ethanol dipped cotton. Two layers of filter papers in each plate were soaked with 1 ml of aqueous extract of plant parts while distilled water in case of control. Ten seeds of each test plant were placed in petri dishes at equal distance. The filter papers were soaked again upon drying, with the aqueous extract of various concentrations and distilled water for control experiment. Each treatment was replicated thrice. The experiment was left for a week.

Treatments

C= seeds of test plant grown with distilled water

T1= seeds of test plant grown with 0.5% aqueous extract

T2= seeds of test plant grown with 1% aqueous extract

T3= seeds of test plant grown with 2% aqueous extract

Growth and germination record

The experiment was set at room temperature allowing the germination of seeds. Germination was noted on a daily basis. The growth was determined by measuring the length of hypocotyl and radicle using centimeter (cm) scale.

$$\textbf{\% Germination} = \frac{\text{Number of germinated seeds under various conc.}}{\text{Total number of seeds}} \times 100$$

$$\textbf{\% Inhibition / Stimulation} = 1 - \frac{\text{Root or Shoot length with Treatment}}{\text{Root or Shoot length with control}} \times 100$$

Data analysis

Data was processed by using SPSS software and Microsoft Excel. One-way ANOVA was conducted to assess the statistical significance of the activity (Alizadeh *et al*., 2023), with a significance threshold set at 5%. Germination percentage, mortality rate, and plumule and radicle growth were illustrated using a line graph.

RESULTS

Phytochemical screening of *Conocarpus erectus* plant parts

To examine the phytochemical constituents in different plant parts of donor species various chemical tests were performed. Phytochemical screening was done using aqueous extract and different solvents (methanol, aceton and petroleum ether). From results it was found that the bark extract of donor plant has tannins, saponins, quinones, carbohydrates, proteins, tannins, terpenoids and phenol in aqueous extract of bark (Table 1). Methanol and acetone extract showed the presence of carbohydrates, tannins, quinones and phenols. While steroid was found only in the methanol extract of *C. erectus* bark. In case of leaf extract, the methanol and acetone extracts showed the same secondary compounds (tannins, carbohydrates, phenols and coumarin) but methanol extract of leaves showed additional compound saponin which was not present in the leaf extract of acetone. The water extract showed the presence of carbohydrates, flavonoids, proteins, alkaloids, terpenoids and glycoside. The aqueous, methanol and acetone stem extract of donor plant showed the presence of secondary compounds phenol, quinones and tannins while the absence of alkaloids, phlobatannins, flavonoids, glycosides and coumarin. Carbohydrates were present only in methanol and acetone extract of stem (Table 1).

Effects of *Conocarpus erectus* on germination of test plants

In case of wheat, germination was stimulated by different concentrations of *C. erectus* leaf extract. It was found that the increase in germination was concentration dependent in case of wheat while in barley the germination was inhibited by various concentrations. Spinach showed different patterns of germination at high (2%) and low (0.5%) concentration the germination was stimulated but at 1% concentration of aqueous leaf extract germination was inhibited (Figure 1). Aqueous extract of bark at various concentrations also has different effects on germination of test plants. Highest concentration (2%) of bark extract greatly stimulated the germination of spinach (23%) while lower concentrations inhibited the germination of spinach and barley from control. Bark extract significantly stimulates germination in wheat. Barley showed a variation in germination pattern. Highest suppression of germination was observed in barley (17.8%) at 1% concentration of aqueous bark extract of *C. erectus* (Figure 2). The germination of spinach was inhibited by the aqueous stem extract of donor plant. The suppression of germination was concentration dependent. The highest inhibition was observed in spinach (47%) with aqueous extract of stem of *C. erectus* plant. Wheat

showed the stimulation of germination at high concentration of stem extract. In the case of barley only 1% showed the inhibition of germination (Figure 3).

Effect of *Conocarpus erectus* on growth of test plants

The bark extract of *C. erectus* plant has various effects on the seedling growth of barley. It was also reported that radicle growth was affected more as compared to hypocotyl growth. Bark extract significantly reduced 62% of radicle growth of barley at 2% concentration (Table 2). Hypocotyl growth was also suppressed by bark extract, and it was concentration dependent (Figure 4). The radicle growth of spinach and wheat was also retarded by the bark extract of *C. erectus*. This suppression of radicle growth was concentration dependent. The highest retardation was 57% and 56% (significant) respectively at 2% concentration (Table 2). Similarly, in case of hypocotyl the higher concentration inhibited the hypocotyl growth of both wheat and spinach but lower concentration 0.5% stimulated the hypocotyl growth of wheat and spinach (Figure 5).

The radicle growth of barley was significantly inhibited by the different concentrations of stem extract of *C. erectus* plant (Table 3). The highest suppression (35%) of radicle growth was observed by 2% concentration of stem extract. In case of hypocotyl growth, mild stimulation was observed by 1% of stem extract while other concentrations have negative impact on the hypocotyl growth of barley (Figure 6). In case of spinach seedling growth, the hypocotyl growth was retarded by stem extract of donor plant. The maximum inhibition was 14% observed by 1% concentration. The radicle growth of spinach was stimulated at low concentration. A 10% increase in radical growth was observed at 0.5% concentration. Different concentrations of stem extract have various effects on the hypocotyl growth of wheat. Hypocotyl and radical growth of wheat was significantly inhibited by stem extract. Maximum retardation of hypocotyl growth (21%) was observed at 1% concentration (Figure 7; Table 3).

The radicle and hypocotyl growth of barley was significantly inhibited by *Conocarpus* leaf extract. Retardation was concentration dependent (Table 4). As the concentration was increased the suppression of radicle growth also increased. The highest decline in radicle growth was seen at the (2%) concentration that was 35%. Highest concentration of *Conocarpus* leaf extract (2%) showed 18% inhibition of hypocotyl growth (Figure 8). The radicle and hypocotyl growth of spinach showed different behavior towards the various concentration of leaf extract of *Conocarpus erectus*. The hypocotyl and radical growth of spinach was highly bridled by 2% concentration of *C. erectus* leaf extract but the mild concentration (1%) showed the bracing effect on hypocotyl growth. The inhibition of radical growth was concentration dependent. There was significant elevation of hypocotyl growth of wheat instead of suppression (Table 4). Low concentration (0.5%) showed an increase in hypocotyl growth of wheat by 57%, high concentration also stimulated the hypocotyl growth. The radicle growth of wheat showed the usual pattern of growth retardation by different concentration of *C. erectus* leaf extract. This retardation was concentration dependent (Figure 9).

Discussion

From the present results, it was observed that germination of wheat was stimulated by all plant parts of *C. erectus*. In the case of wheat, germination was

stimulated by different concentrations of *C. erectus* L. leaf extract. It was found that the increase in germination was dependent on the case of wheat. The positive allelopathic effect of *Conocarpus* on germination was observed by (Hussain and Abbas, 2022) who studied the increase in germination of cereal crops. While in barley the germination was inhibited by various concentrations. Similar Inhibition of seed germination of barley was also studied by (Mamude and Asfaw, 2023) they commented that inhibition of germination was due to allelochemicals present in donor plant which act by damaging subcellular structure, metabolism of plant hormone and by disturbing the synthesis of protein and starch.

Aqueous extract of bark at various concentrations also has different effects on germination of test plants. Highest concentration of bark extract greatly stimulated the germination of spinach (23%) while 1% concentration inhibited germination by 11% from control. This finding is following the observation made by (Yurlisa and Sholihah, 2023) that evaluated the allelopathic effect of basil leaf extract on spinach. In case of barley only lower concentrations have inhibitory effects on germination while high concentrations have no effects on germination of barley seeds. This study was consistent with previous results of (Alrawik *et al*., 2021), they studied the effects of alfalfa on germination of barley. Inhibitory effects on germination might be due to allelopathic chemicals like phenol which affect metabolic processes during early growth stages of plants like germination (Naby and Ali, 2020). The germination of spinach was inhibited (47%) by the aqueous stem extract of donor plant. The suppression of germination was concentration dependent higher the concentration higher was the inhibition of germination. These results were like previous study of (Erhatic *et al*., 2023) who found the inhibition of spinach germination by nettle and cumin seed. In the case of barley only 1% showed the inhibition of germination. The inhibition of seed germination might be due to the reduction of water potential during seed germination (Gindri *et al*., 2020).

The retardation of seedling growth may possibly be due to allelochemicals like phenols. The growth suppression of phytochemicals causes oxidative damage. These allopathic metabolites can cause change in the mineral imbalance, permeability of membrane and damage in ion absorption process which leads to enzyme stress and antioxidative stress (Naeem *et al*., 2023). In the present results, the growth of hypocotyl and radicle was also found to be affected by aqueous extracts of various plant parts of *Conocarpus erectus*. The hypocotyl of wheat showed the highest growth retardation by aqueous extract of leaves at highest concentration. Similar results were studied by (Elbouzidi *et al*., 2021) who found that the seedling growth of durum wheat was inhibited by aqueous leaves extract of *Matricaria chamomilla*. This might be related to high concentration of allelochemicals i.e. Flavonoids, alkaloids, in aqueous extract of *Conocarpus lancifolius* (Prajapati and Dodiya, 2021). The similar case was reported by (Chauhan *et al*., 2022) who studied the leaf extracts of *Juglan regia* were found to be toxic and highly influenced the hypocotyl growth wheat and rye. The inhibitory effect of allelochemicals on seed growth might be due to the change in enzyme activities that affected the transport of storage substances.

Present results showed that hypocritical and radicle growth was highly affected by aqueous extract of different concentrations. The bark extract of *C. erectus* caused the highest inhibition of radicle growth (62%) in barley followed by wheat. Similar sensitivity

of radicle growth was observed by (Talhi *et al*., 2020) who studied the effect of *Lantana camara* on seedling growth of barley. The inhibition of radicle growth was concentration dependent. The reason for this allelochemicals suppression may be reduction in water absorption by root, nutrient deficiency which indirectly reduces photosynthesis and respiration in plants (Janusauskaite, 2023). Elongation of radicles was significantly inhibited in aqueous extract of different concentrations. This might be related to high concentration of phytochemicals i.e., phenolic acids terpenes and alkaloids present in the extract (Khalil *et al*., 2020b).

The present results showed that the inhibitory effect of bark, leaves and stem extract of *Conocarpus* on seedling growth of barley and wheat and spinach. These allelopathic effects of *C. erectus* might have some relation with the phytochemicals like phenols, tannins, detected in the respective plant parts (Afifi *et al*., 2021). The stem extract of *C. erectus* also showed effects on the seedling growth of barley, wheat and spinach. As in case of bark extract stem extract also showed highest retardation of hypocotyl and radicle growth on barley seedling. These results agree with many other studies (Talhi *et al*., 2020) where root and shoot growth of barley was highly suppressed by aqueous extract of *Lantana camara*. The retardation of growth was concentration dependent. The present study also showed that the *C. erectus* plant parts like bark had different phytochemicals especially phenols and tannins which showed inhibition of the seed germination and growth of plumule and radicle of test plants. Plants release allelopathic chemicals and production of primary or secondary metabolites by the donor plants over test crops, these chemicals interfering growth properties which in turn either proved toxic or stimulate their growth (La-Hovary *et al*., 2016).

Conclusion

The results showed that the *C. erectus* plant parts have different phytochemicals. Different solvent extracts, i.e. aqueous, methanol, acetone and petroleum ether were used for phytochemical screening. Tannins, quinone and terpenoids were found in all plant parts. While saponin was found to be present only in methanol extract of leaf and stem. Results of allelopathic evaluation indicated that spinach germination was stimulated by leaf and bark aqueous extract while wheat showed increased germination by all plant parts of *C. erectus*. The hypocotyl growth of wheat was greatly inhibited by leaf extract. While in case of radicle growth, barley and wheat showed maximum suppression. So, there is need to inform farmers and gardeners about allelopathic potential of *C. erectus* on associated crops. Further studies are recommended to investigate the possible phytochemicals and physiological mechanism of the allelopathic effect of these chemicals.

Table 1: Phytochemical Analysis of Different Extracts of *Conocarpus erectus* L. Bark, Stem and Leaves

Tests	Different Solvent Extracts of Bark				Different Solvent Extracts of Stem				Different Solvent Extracts of Leaf			
	Aqueous	Methanol	Petroleum Ether	Acetone	Aqueous	Methanol	Petroleum Ether	Acetone	Aqueous	Methanol	Petroleum Ether	Acetone
Tannins	+	+	_	+	+	+	_	+	+	+	_	+
Alkaloids	_	_	_	_	_	_	_	_	_	_	_	_
Phlobatannins	_	_	_	_	_	_	_	_	_	_	_	_
Flavonoids	_	_	_	_	_	_	_	_	_	_	_	_
Saponins	+	+	_	_	+	+	_	_	+	+	_	_
Quinones	+	+	_	+	+	+	_	+	+	+	_	+
Coumarin	_	_	_	_	+	_	_	_	_	_	_	_
Terpenoids	+	+	_	+	_	_	_	_	_	+	_	+
Steroids	_	+	_	_	_	_	_	_	+	+	_	_
Carbohydrates	+	+	_	+	_	+	_	+	_	+	_	+
Proteins	+	_	_	_	_	_	_	_	+	+	_	_
Phenols and Tannins	+	+	_	+	+	+	_	+	+	+	_	+
Glycosides	_	_	_	_	_	_	_	_	_	_	_	_

Table 2: Allelopathic Effects of *Conocarpus erectus* L. Bark Extract on Growth of Test Plants

Test Species	Control		0.5%		1%		2%		F Value		P Value	
	H	R	H	R	H	R	H	R	H	R	H	R
***Triticum aestivum* L.**	4.18	7.83	3.86	7.05	4.4	5.05	4.17	3.42	5.65	38.87	0.02*	0.00*
***Hordeum vulgare* L.**	3.86	6.56	3.77	6.26	3.3	3.18	3.53	2.46	0.61	22.44	0.63**	0.00*
***Spinacia oleracea* L.**	2.07	3.98	2.19	3.74	1.78	3.29	1.73	1.7	0.6	3.05	0.63**	0.09**

Key: H= Hypocotyl, R= Radicle, * Significant Effect, ** Non-Significant Effect, Alpha Value: 0.05

Table 3: Allelopathic Effects of *Conocarpus erectus* L. Stem Extract on Growth of Test Plants

Test Plants	Control		0.5% Extract		1% Extract		2% Extract		F Value		P Value	
	H	R	H	R	H	R	H	R	H	R	H	R
***Triticum aestivum* L.**	5.51	8	4.41	8.01	4.31	7.64	4.69	6.46	26.3	5.1	0.00*	0.03*
***Hordeum vulgare* L.**	5.17	10.43	4.79	8.86	5.22	9.25	4.81	6.72	1.3	21.17	0.34**	0.00*
***Spinacia oleracea* L.**	2.7	4.9	2.55	5.4	2.31	4.13	2.44	4.56	0.29	1.48	0.83**	0.29**

Key: H= Hypocotyl, R= Radicle, * Significant Effect, ** Non-Significant Effect, Alpha Value: 0.05

Table 4: Allelopathic Effects of *Conocarpus erectus* L. Leaves Extract on Growth of Test Plants

Test Plants	Control		0.5% Extract		1% Extract		2% Extract		F Value		P Value	
	H	R	H	R	H	R	H	R	H	R	H	R
***Triticum aestivum* L.**	4.14	6.52	6.52	5.71	4.11	5.55	6.42	3.44	4.8	18.3	0.03*	0.00*
***Hordeum vulgare* L.**	5.72	9.57	5.27	9	5.6	8.57	4.69	6.17	8.46	26.21	0.01*	0.00*
***Spinacia oleracea* L.**	2.2	4.46	1.55	4.26	2.24	4.11	1.47	3.78	1.8	0.47	0.23**	0.71**

Key: H= Hypocotyl, R= Radicle, * Significant Effect, ** Non-Significant Effect, Alpha Value: 0.05

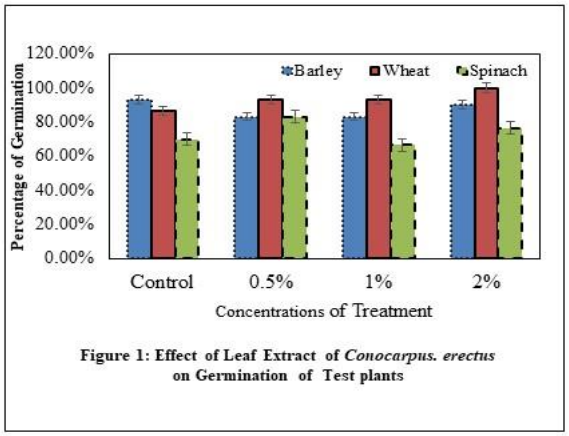

Figure 1: Effect of Leaf Extract of *Conocarpus. erectus* on Germination of Test plants

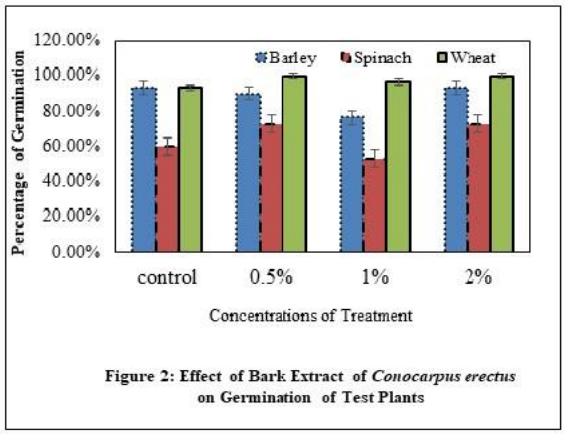

Figure 2: Effect of Bark Extract of *Conocarpus erectus* on Germination of Test Plants

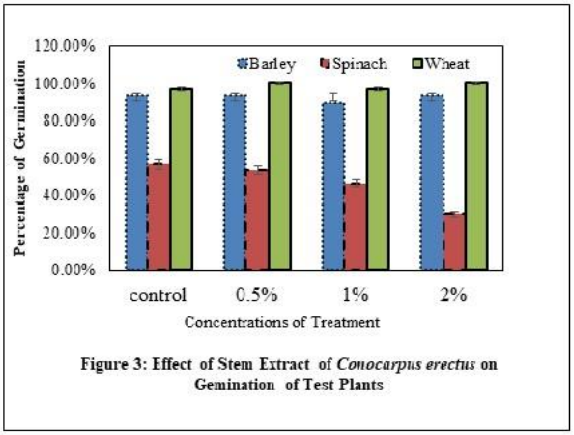

Figure 3: Effect of Stem Extract of *Conocarpus erectus* on Gemination of Test Plants

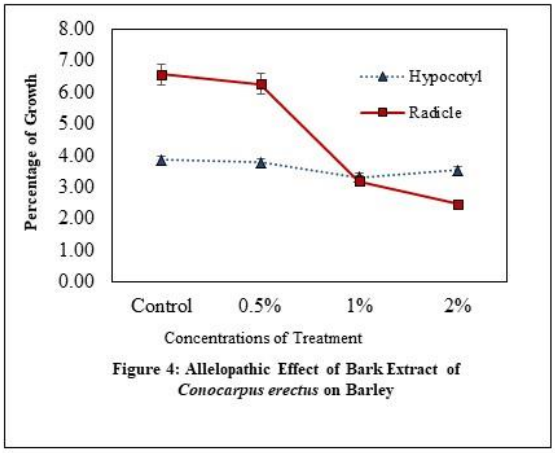

Figure 4: Allelopathic Effect of Bark Extract of *Conocarpus erectus* on Barley

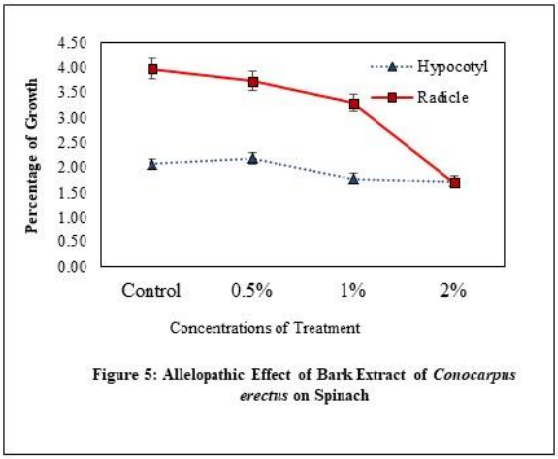

Figure 5: Allelopathic Effect of Bark Extract of *Conocarpus erectus* on Spinach

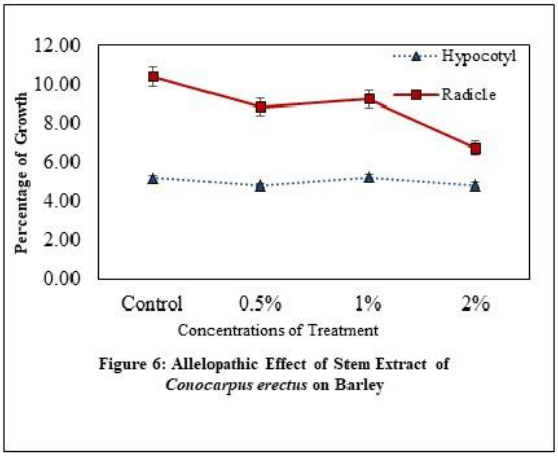

Figure 6: Allelopathic Effect of Stem Extract of *Conocarpus erectus* on Barley

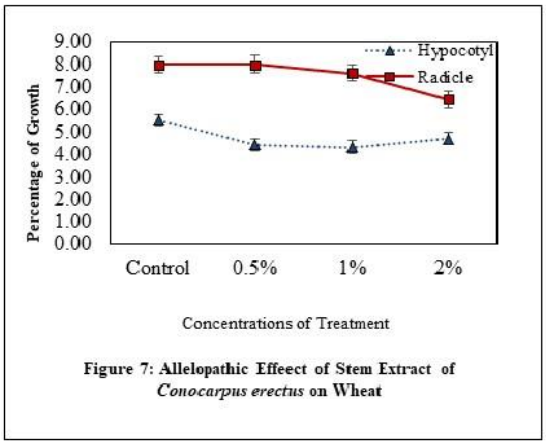

Figure 7: Allelopathic Effeect of Stem Extract of *Conocarpus erectus* on Wheat

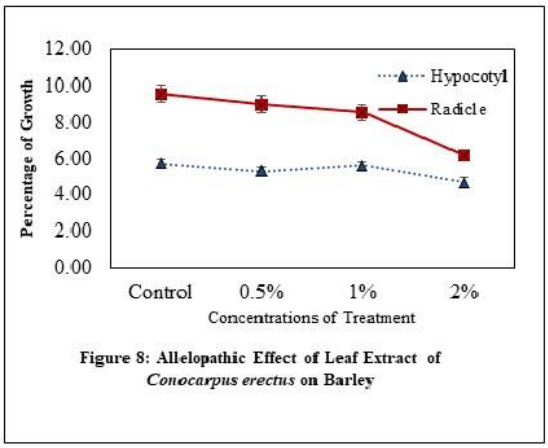

Figure 8: Allelopathic Effect of Leaf Extract of *Conocarpus erectus* on Barley

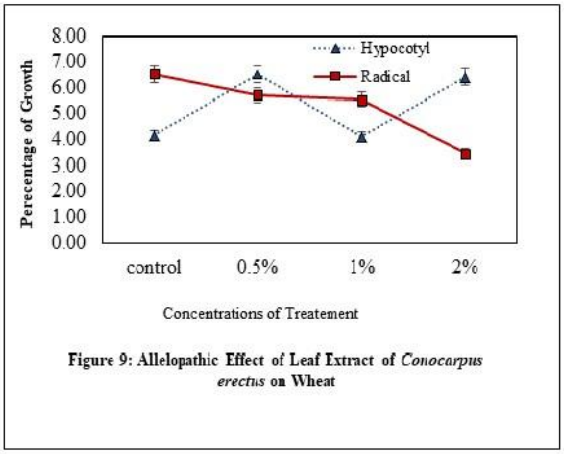

Figure 9: Allelopathic Effect of Leaf Extract of *Conocarpus erectus* on Wheat

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