SUPPRESSING EFFECT OF *CONOCARPUS LANCIFOLIUS* AQUEOUS EXTRACT ON CEREAL GERMINATION PHYSIOLOGY

Abstract:

An experiment was designed to evaluate the effect of *Conocarpus lancifolius* on cereal germination physiology in vitro environment at agronomic post graduate laboratory, faculty of Agriculture, Gomal University, D.I.Khan, KPK., Pakistan during the session 2021. The experimental design used was CRD with three replications. A control treatment was also included. By applying the water extract of *C. lancifolius* to cereal crops, namely wheat, oat, rice, millet, maize, and sorghum @ 25% (w/v) to check its allelopathic potential. The leaf water extract was applied at interval of 3 days for each treatment. The data obtained after 20 days showed that the aqueous extract of C. lancifolius effected differently for different crops. The effect of aqueous extract of C. lancifolius significantly enhance the germination count for all the cereal as compared to control. Similarly, the data recorded for plant tallness (cm) by the application of aqueous extract of C. lancifolius, the tallest plants were observed in oat, millet, and sorghum (14.6, 7.85 and 11.50 grams) respectively. Meanwhile, the aqueous extract of C. lancifolius reduced the plant height (cm) of all other cereals. Moreover, the data collected for shoot length (cm) indicated that the aqueous extract of C. lancifolius responded positively for improving the shoot length of oat as compared to control, while all other crops showed negative effect. The results further described that the aqueous extract of C. lancifolius proved to be effective in improving the root length of oat and sorghum. However, the data recorded for root length of maize were found like the control treatment and remain unaffected. Similarly, the regarded epicotyl length (cm) indicated that the application of aqueous extract of C. lancifolius responded positively in uplifting the epicotyl length (cm) of sorghum followed millet and oat having their epicotyl length 1.31, 1.16 and 1.1 (cm) respectively. However, the application of C. lancifolius aqueous extract adversely affected the count of leaves per plant, fresh and dry wight (gm) and chlorophyll content of all the crops studied.

Introduction

Conocarpus lancifolius (buttonwood) is an evergreen shrub or tree that belongs to family Combretaceae and native to Florida's mangrove forest ecosystem in North America. Its native habitat is moist and mostly grows on shorelines in tropical and subtropical areas around the world (Hegazy et al., 2008). Since the nutrient status of C. lancifolius is very low so it grows very well in the soils that have very low fertility (El-Mahrouk et al., 2010). Mostly, it is planted in parks, streets and yards as ornamental and the potted plants are used to make bonsai (Abohassan et al., 2010). Trees release some phytochemicals in the soil which adversely affect the germination and yield of crops (Hierro & Callaway, 2003). Cereals also called grain crops are generally defined as grasses grown for their edible seeds. The ancient Roman Goddess for agriculture was called 'Ceres'. Hence the common food grains at that time were also recognized with Her name. The word 'Ceres' is now changed to cereals. The well-known cereals crops are wheat, maize, rice, barley, sorghum, oat, rye, and pearl millet (Bajra). They belong to the family Gramineae, also known as Poaceae. (Khalil & Jan 2010).

Cereals dominate the world food trade; their stocks and prices reflect the major trends in the fluctuating world food situation. They are the economic source of protein and starch, contributing about 60% of the calories in human diet. Wheat and barley are the important rabi (winter) cereals, while rice and maize are the major kharif (summer) cereals. In some regions of Pakistan millet (bajra and ragi) are also grown. The important crops wheat, rice, barley, maize and sorghum account 23.60 percent in the value addition of agriculture sector and 4.45 percent in the GDP (GOP., 2020). Any process involving secondary metabolites produced by plants, algae, bacteria and fungi that influence the growth and development of agricultural and biological system is known as Allelopathy. Allelopathy is an important mechanism of plant interference mediated by the addition of plant–produced phytotoxins to the plant environment and competitive strategy of plants.

Allelochemicals related to various groups of secondary compounds are phenols, benzoic and flavonoids, tannis, coumarines, cinnamic acid derivatives, terpenoids, alkaloids and polyaccetones (Duke et al., 2000). Allelochemicals are released into environment by all plant parts i.e. roots, stem, leaves and fruits. In a specific environment, the Allelochemicals have enough strength to affect the neighboring plants. Interference may occur when one plant species fails to germinate, grows more slowly, shows symptoms of damage, or does not survive in the presence of another plant species. Allelopathy is an important mechanism of plant interference mediated by the addition of plant–produced phytotoxins to the plant environment and competitive strategy of plants. Most of the allelochemicals are water soluble and water is the best medium and carrier for such chemicals. Water extracts use to promote growth at low concentration and reduced the growth and development at high concentration (Farooq et al., 2011). Considering the allelopathic potential of *Conocarpus lancifolius*, this study was designed for determining its impact on cereal crops germination physiology (Farooq et al., 2013).

Material and methods

Study area

A laboratory-based study was carried out at Post-graduate Agronomy Lab., Faculty of Agriculture, Gomal University, Dera Ismail Khan, KPK., Pakistan.

Collection of C. lancifolius leaves

3 kg fresh leaves of c. carpus were collected from Faculty of Agriculture, Gomal University, Dera Ismail Khan. The collected leaves were kept drying at ambient temperature for 15 days. After drying, the leaves were grinded with the help of electric blender and powder was made.

Preparation of *C. lancifolius* aqueous extract

The water extract of *C. lancifolius* was made by adding 25 g powder of *C. lancifolius* leaves in to 1000 ml of distilled water in 1.5-liter plastic bottles at a ratio of 1:25 w/v. The bottles were then kept at room temperature for 72 hours. The extract was then filtered through a double layer muslin cloth (Fikreyesus et al., 2011).

Experimental design and material used

The experimental design to carry out research was CRD with four replications and a check/control treatment was also included for the comparison of treatments mean. The crops studied including (wheat, oat, rice, maize, millet and sorghum). Thirty disposable glasses were taken, and each was filled with 250 gram of sandy loam soil. 6 seeds of each crop were sown in each disposable glass at a depth of 2 cm.

Method of *C. lancifolius* extract application

The first dose of *C. lancifolius* aqueous extract was applied to each glass except control after sowing and the remaining at three days interval.

Observations to be studied

1. Number of plants emerged.
2. Epicotyl length (cm).
3. Number of leaves plant^{-1}.
4. Plant height (cm).
5. Shoot length (cm).
6. Chlorophyll content (SPAD meter).
7. Fresh weight (gm).
8. Dry weight (gm).
9. Root length (cm).

Statistical test to be used

The data computed was compared by using ANOVA technique and then least significance difference was applied for the comparison of treatments mean, by a software "STATISTIX ver. 8.1".

Results and discussion

1. Effect of *Conocarpus lancifolius* on germination and growth of Cereal.

The effect of aqueous extract of *C. lancifolius* on germination and growth are presented in Table.1. shows that the aqueous extract of *C. lancifolius* significantly affected the germination count of all the cereal crops as compared to control. Moreover, maximum positive effect was noted in T2 (maize) followed by T1, T3 and T6, while minimum significant effect was recorded in T5 and T4. Similar findings were reported by (Afzal et al. 2012). They found that seed priming done with herbal leaf extract (*Moringa olifera L.*) significantly increased the germination and growth of maize. Likewise, Phytochemical are bioactive compounds derived from plant parts containing acids. They possess different bio chemicals functions in other plants species like germination, growth development and microbiological control (Kuppusamy, 2018). Positive allelopathy was determined by Xaxa et al. (2018) that allelochemicals exuded from herbal extract (*P. deltoides)* may have beneficial in case of germination in some crops.

Table 1. Allelopathic effect of Conocarpus lancifolius on number of plants emerged.

Treatments	Control	Extract	Difference
T1: Oat	3 b	4.5 a	+1.5
T2: Maize	1 d	4.66 a	+3.66
T3: Rice	2 c	3.5 b	+1.5
T4: Millet	2 c	2.66 c	+0.66
T5: Wheat	3 b	4 a	+1
T6: Sorghum	2 c	3.5 b	+1.5
$LSD_{0.05}$		**1.18**	

Means followed by different letter in the respective column are significant at 5% level of probability.

2. Effect of *Conocarpus lancifolius* on number of leaves.

The data recorded in Table. 2 on number of leaves represents that aqueous extract of *C. lancifolius* have negative impact on number of leaves count for each treatment except T6: sorghum (+1.05). the maximum inhibitory effect was noted in T1 followed by T2, T3,T4 and T5. This may be due to allelopathic (Phytochemicals) potential of *C. lancifolius*. Earlier finding depicted that herbal aqueous extract (*Acacia cyanophylla*) have maximum inhibitory effect on the germination, shoot and root length of lettuce and harmal (Ayeb et al. 2013).

Table 2. Allelopathic effect of Conocarpus lancifolius on number of leaves per plant.

Treatments	Control	Extract	Difference
T1: Oat	1.1 c	1 c	-0.1
T2: Maize	3 a	2.15 ab	-0.85
T3: Rice	2 b	1.04 c	-0.96
T4: Millet	1.38 b	1.2 c	-0.18
T5: Wheat	1.63 b	1.33 b	-0.33
T6: Sorghum	0.4 d	1.45 b	+1.05
$LSD_{0.05}$		**0.87**	

Means followed by different letter in the respective column are significant at 5% level of probability.

3. Effect of *Conocarpus lancifolius* on fresh weight (gm).

The effect of *C. lancifolius* adversely affected the fresh weight of all the cereal crop as compared to the control as shown in Table. 3. The maximum reduction in fresh weight was noted in T2 (-2.1) followed by T5 and T1 having mean difference (-0.5 and -0.50) respectively. Whereas the minimum reduction in fresh weight was recorded in T3 (-0.115) followed by T6 and T4. Similar results were declared by (Shah et al. 2018) they reported that osmopriming done with herbal aqueous extract (*Prosopis juliflora*) reduced all the agronomic, morpho-physiological and yield attributing parameters. Allelochemicals released from *C. lancifolius* extract may be the cause of reduction in fresh weight due to low photosynthesis.

Table 3. Allelopathic effect of Conocarpus lancifolius on fresh weight (gm).

Treatments	Control	Extract	Difference
T1: Oat	0.75 bc	0.25 c	-0.50
T2: Maize	3 a	0.9 bc	-2.1
T3: Rice	0.444 bc	0.329 c	-0.115
T4: Millet	0.42 bc	0.2 c	-0.22
T5: Wheat	1 b	0.5 bc	-0.5
T6: Sorghum	0.86 bc	0.6 bc	-0.26
$LSD_{0.05}$		**1.05**	

Means followed by different letter in the respective column are significant at 5% level of probability.

4. Effect of *Conocarpus lancifolius* on dry weight (gm).

The data regarding dry weight showed that the effect of aqueous extract of *C. lancifolius* negatively affected the dry weight of all the treatment studied as shown in Table 4. The maximum reduction in dry weight was recorded in T2 (-0.73) followed by T3, T6 and T1, while minimum dry weight was reduced in T4 and T5 having difference in their mean value -0.093 and -0.084 respectively. Similar trend of negative impact on fresh weight and dry weight was due to the presence of allelochemicals in aqueous extract of *C. lancifolius*.

Table 4. Allelopathic effect of Conocarpus lancifolius on dry weight (gm).

Treatments	Control	Extract	Difference
T1: Oat	0.30 b	0.12 c	-0.18
T2: Maize	0.87 a	0.14 c	-0.73
T3: Rice	0.18 c	0.08 d	-0.1
T4: Millet	0.01 d	0.11 c	-0.093
T5: Wheat	0.22 b	0.13 c	-0.084
T6: Sorghum	0.16 c	0.01 c	-0.144
$LSD_{0.05}$		**0.35**	

Means followed by different letter in the respective column are significant at 5% level of probability.

5. Effect of *Conocarpus lancifolius* on plant height (cm).

The data in Table 5. depicted that the effect of aqueous extract of *C. lancifolius* on plant height responded significantly in increasing the plant height of several treatments while some treatments showed non-significant effect with each other. The maximum plant height was recorded in T6 having significant difference in their mean value +3.885 followed by T1 and T4 having difference of +4.06 and +2.75 respectively, whereas as minimum plant height was recorded in T5 (-2.07) followed by T2 and T3 having significant differences in their mean values -4.97 and -7.53 respectively. Tallness of plant may be their genetic character of species which are also affected latterly by allelochemicals present in aqueous extract of *C. lancifolius.* Mengal et al. (2015) observed reduction in plant height of wheat by applying weeds extract (*Chenopodium album*) to it.

Table 5. Allelopathic effect of Conocarpus lancifolius on plant height (cm).

Treatments	Control	Extract	Difference
T1: Oat	10.1 d	14.16 bc	+4.06
T2: Maize	24 a	19.03 b	-4.97
T3: Rice	16 ab	8.47 d	-7.53
T4: Millet	5.1 e	7.85 d	+2.75
T5: Wheat	18.17 b	16.1 ab	-2.07
T6: Sorghum	6.61 e	11.50 c	+4.885
$LSD_{0.05}$		**5.78**	

Means followed by different letter in the respective column are significant at 5% level of probability.

6. Effect of *Conocarpus lancifolius* on shoot length (cm).

Table 6. described that the influence of *C. lancifolius* aqueous extract significantly affected the shoot length of some of the cereal as compared to control. Moreover, the aqueous extract of *C.*

lancifolius also showed non-significant differences in some treatments. The maximum positive effect of aqueous extract was recorded in T6 (+4.33) followed by T1 and T4 having significant difference in their mean value +3.09 and +2.272 respectively. Oat, millet, and sorghum are self-allelopathic, drought and salt resistant crops. So, they take the advantage of allelochemicals presence and remaining crops are adversely affected. However, the maximum suppressing effect of aqueous extract of *C. lancifolius* was recorded in T2 (-4.07) followed by T3 which was -2.967, while minimum inhibitory effect was noted in T5 (wheat) having significant difference was -2.272.

Table 6. Allelopathic effect of Conocarpus lancifolius on shoot length (cm).

Treatments	Control	Extract	Difference
T1: Oat	6.1 d	9.19 c	+3.09
T2: Maize	17.3 a	13.23 b	-4.07
T3: Rice	8 c	5.033 d	-2.967
T4: Millet	3.1 e	5.822 d	+2.722
T5: Wheat	12.472 b	10.2 c	-2.272
T6: Sorghum	1.3 e	5.63 d	+4.33
$LSD_{0.05}$		**4.19**	

Means followed by different letter in the respective column are significant at 5% level of probability.

7. Effect of *Conocarpus lancifolius* on root length (cm).

The data presented in table. 7 revealed that the application of water extract of *C. lancifolius* on root length. It showed non-significant differences in most of the treatments except T1 (oat +1.87) while T2 showed no difference as compared to control. Moreover, the aqueous extract of *C. lancifolius* showed maximum inhibitory effect in T3 (-4) followed by T6 and T4 (-1.38 and -0.92) respectively, while minimum root suppressing effect were noted in T5 (-0.21). Oat and maize have the property to adjust themselves in case of salinity and chemicals present in their ecology. Correspondingly, the past studies carried by Carvalho et al. (2015) and Hussain et al. (2019) examined that the root length of maize was suppressed by using aqueous extracts of eucalyptus, neem and poplar.

Table 7. Allelopathic effect of Conocarpus lancifolius on root length (cm).

Treatments	Control	Extract	Difference
T1: Oat	3.1 c	4.97 ab	+1.87
T2: Maize	6.7 b	6.7 a	0
T3: Rice	7 b	3 b	-4
T4: Millet	1.1 d	1.02 cd	-0.92
T5: Wheat	3.01 c	2.8 b	-0.21
T6: Sorghum	5.1 b	6.48 a	-1.38
$LSD_{0.05}$		**3.05**	

Means followed by different letter in the respective column are significant at 5% level of probability.

8. Effect of *Conocarpus lancifolius* on epicotyl length (cm).

The data recorded in table. 8 depicted that the effect of aqueous extract of *C. lancifolius* have both the significant and non-significant effect on epicotyl length of cereals. The findings of the study showed that the maximum significant differences were found in T2 (+1.0335) followed by T4 and T6 (+0.45 and +0.24) respectively. Whereas the maximum allelopathic effect of *C. lancifolius* was noted in T2 (-1.06) followed by T3 which was -0.85, while minimum inhibitory effect was noted in T5 which was -0.6. Oat, millet, and sorghum are salt and chemicals resistant crops, they can acclimate themselves in hard environment like allelochemicals present in their surroundings. Farooq et al. (2013) reported allelopathy helped in abiotic stresses and helps the plants to grow vigorously under such conditions.

Table 8. Allelopathic effect of Conocarpus lancifolius on epicotyl length (cm).

Treatments	Control	Extract	Difference
T1: Oat	0.06 d	1.1 c	+1.035
T2: Maize	2.5 a	1.44 b	-1.06
T3: Rice	2 ab	1.15 bc	-0.85
T4: Millet	0.71 c	1.16 bc	+0.45
T5: Wheat	2.8 a	2.2 a	-0.6
T6: Sorghum	1.1 c	1.34 bc	+0.24
$LSD_{0.05}$		**0.88**	

Means followed by different letter in the respective column are significant at 5% level of probability.

9. Effect of *Conocarpus lancifolius* on chlorophyll content (SPAD Unit).

The data presented in table. 9 showed the effect of aqueous extract of *C. lancifolius* on chlorophyll content of cereal crops. The findings of the study depicted that water extract of *C. lancifolius* leaf leachates adversely influenced the chlorophyll content of all the treatments studied as compared to control. The maximum inhibitory effect was recorded in T5 (-22) followed by T4, T2, T1 and T3 (-18, -7.5, -5 and -5) respectively, however, the minimum allelopathic effect was recorded in T5 (wheat) which was -4. Chlorophyll is the pigment responsible for capturing of light energy and assimilate the Co_2 into carbohydrates and growth. So, *C. lancifolius* significantly reduced its value ranged from (-2 to -5). Similar findings were reported by Sikolia et al. (2018). Additionally, similar findings were reported by Hussain et al. (2019) explained that chlorophyll formation and photosynthesis are adversely disturbed by phytotoxic, allelochemicals.

Table 9. Allelopathic effect of Conocarpus lancifolius on chlorophyll content (SPAD Unit).

Treatments	Control	Extract	Difference

T1: Oat	15.00 de	10.00 f	-5
T2: Maize	32.5 b	25.00 c	-7.5
T3: Rice	18.00 d	13.00 e	-5
T4: Millet	40.00 a	22.00 c	-18
T5: Wheat	16.00 e	12.00 e	-4
T6: Sorghum	36.00 a	14.00 e	-22
$LSD_{0.05}$		**6.5**	

Means followed by different letter in the respective column are significant at 5% level of probability.

Conclusion

Allelopathic potential of C. lancifolius have been known since ages and lot of work has been done on the chemical nature of allelochemicals and their detrimental effects on the neighboring plants. However, it was left imperative to study phytotoxic effects of this allelopathic plant on the field crops. On the basis of results obtained, it is concluded that different crops behavior also different from each other towards aqueous extract. However, the application of aqueous extract of C. lancifolius significantly improved the count of germination, plant tallness (cm) soot length (cm), root length (cm) and epicotyl length (cm) of oat, sorghum, and millet. The positive response of aqueous extract of C. lancifolius for oat, millet and sorghum may be due to the same (allelopathic) nature of the crops. Meanwhile, the other crops (wheat, rice, and maize) treated with same concentration were adversely affected. Furthermore, the application of aqueous extract of Conocarpus lancifolius negatively affected the number of leaves per plant, fresh weight (gm), dry wight (gm) and chlorophyll content of all the crops studied.

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