Research Article

Allelopathic effect of *Morus alba*, *Populus nigra* and *Euphorbia helioscopia* on *Brassica campestris*

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Abstract

The current research work investigates the allelopathic potential of leaves of most common plants found in Brassica farms i.e. *Morus alba*, *Populus nigra* and *Euphorbia helioscopia* on seed germination and seedling growth of *Brassica campestris*. Fresh and dry leaves of *M. alba*, *P. nigra* and *E. Helioscopia* was prepared by soaking fresh chopped leaves and dry leaves in powder form (5g, 10g and 15g) were soaked in 100ml of distilled water for 48hrs and were filtered after 24hrs. The extract of *M. alba*, *P. nigra* and *E. helioscopia* was applied on *B. campestris* seeds to study its effect on germination percentage, radicle length and plumule length. The data was recorded in triplicates after 72hrs of the incubation period at 26°C. Extracts of *M. alba* and *P. nigra* significantly reduced the germination percentage while *E. helioscopia* enhanced the germination percentage of *B. campestris*. The results revealed that the most effective treatment was 10g fresh leaves extract of *P. nigra* which reduced the germination to 67% and showed no germination in 15g fresh leaves extract. The fresh and dry leaves extract of *M. alba*, *P. nigra* and *E. helioscopia* reduced the radicle and plumule length. Maximum reduction in the radicle length was recorded 95.41% in 10g fresh leaves extract of *Populus nigra* and maximum reduction in plumule length was recorded 95.49% in 15g dry leaves extract of *Euphorbia helioscopia*. The effect of dry leaves extract was more inhibitory effect than the fresh leaves extract. From the results it was concluded that the fresh and dry leaves extract of *M. alba*, *P. nigra* and *E. helioscopia* negatively affected the germination and seedling growth of *Brassica campestris* which indicates that some allelochemicals might be present in these plants.

Keywords: Allelopathic effect, *Brassica campestris*; *Euphorbia helioscopia*; Germination percentage; Inhibitory effect; *Morus alba*, *Populus nigra*; Plumule length; Radicle length

Introduction

The term allelopathy was originated from two Greek words, allelo means each other and pathy means to suffer. The term

allelopathy was first used by the Austrian Professor Hans Molisch in his book. He used this term to describe biochemical interaction that inhibits the growth of neighboring plants

by another plant. The biological phenomenon by which an organism produces one or more biochemicals that influence the growth, germination and survival of another organism is known as Allelopathy [1]. Rice [2] used the term allelopathy as “any direct or indirect harmful or beneficial effect by one plant on another through the production of chemical compounds that escape into the environment”. These chemical compounds produced by an organism may have positive, negative or both positive and negative effect. Allelochemicals are those chemicals which can cause allelopathy. These chemicals are secondary plant compounds that are released into the surrounding. Allelochemicals are a wide class of compounds that ranges from simple hydrocarbon to complex polycyclic compounds. Allelochemicals can lead to a different mechanism of action in plants. An allelopathic effect is mainly referred to as a type of negative interaction [3, 4] but positive interaction has also been reported depending on the allelochemicals considered the target plant and the concentration tested [5]. *Morus alba* L. is known as white mulberry is a fast growing small to medium sized tree belonging to the family Moraceae. It grows up to 10-20m tall. The leaves of *Morus alba* are simple, alternate, serrate or dentate and 2-7 inches long. The life span of white mulberry is long-life. In Greece, there are records of 150-year-old white mulberry trees [6]. *Populus nigra* commonly known as safeda is a dioecious tree. It grows at a faster rate and matures in 10-15 years. It is a tree and belongs to the family Salicaceae having a height up to 35 meters with dull grey bark. The plant has a good quality of regeneration due to its rapid growth. Dispersal of seeds occurs by wind and water. It grows and regenerates well in moist conditions [7]. *Brassica campestris* commonly known as mustard and belongs to family Brassicaceae (Cruciferae). It is an annual herb and there are 40 species of *B. campestris* that is distributed

in the Mediterranean region. There are 7 species of *B. campestris* in Pakistan. Between these species only two are wild and the other is cultivated [8]. Hussain [9] studied the allelopathic suppression of wheat and mustard by *Rumex dentatus* with aqueous extracts of rain leachates, litter from fresh and dried shoots and roots. The aqueous extracts of *Rumex dentatus* were highly inhibitory to the germination and seedling growth of both the crops. Lopez [10] investigated that *Tagetes minuta* contains some chemicals in its leaves due to which they show the allelopathic effect. They showed that pure ocimenones delayed and caused inhibition in the seed germination of coexistence species.

Materials and Methods

The present study investigates the allelopathic potential of *M. alba*, *P. nigra* and *E. helioscopia* extract on germination percentage, plumule and radicle length of *B. campestris*. Leaves of *M. alba*, *P. nigra* and *E. helioscopia* were collected. From the collected leaves, half leaves were crushed directly with the help of mortar and pestle and half were dried in the shade.

Relative toxicity of plant

Aqueous extracts of fresh and dried leaves of *M. alba*, *P. nigra* and *E. helioscopia* were prepared by soaking 5g, 10g and 15g of fresh and dry leaves separately in 100ml of distilled water for 48 hours at room temperature. The extract was then filtered after 24hrs and was stored in a refrigerator for future use. Distilled water was used as a control treatment. Petri dishes were lined with doubly folded Whatman No.1 filter paper. The viability of seeds *B. campestris* was checked. Each Petri dish was provided with 5 healthy seeds and was placed at an equal distance on the filter paper. The seedbed was moistened with 4-5 drops of plant extract and in case of control plant was moistened with distilled. These petri dishes were placed in an incubator at 26° C for 72 hours. Each treatment and control had 3

replicates. After 72 hours of incubation germination percentage, radicle and plumule length, were recorded.

Statistical analysis

The experiment was performed in triplicates. The data obtained was statistically analyzed by using one-way ANOVA followed by LSD test at $P=0.05$.

Results

Germination percentage (%)

The germination percentage of *B. campestris* was significantly decreased by *M. alba* and *P. nigra* extracts and was significantly increased by *E. helioscopia* extract, as shown in (Fig. 1). The results showed that the maximum decline in germination percentage was recorded 40% in 15g dry leaves extract of *M. alba* whereas minimum inhibition was recorded 11.15% in 5g fresh leaves extract. *P. nigra* 15g fresh leaves extract showed no germination while showed maximum germination (67%) in 10g fresh leaves extract and minimum germination (14%) in 5g fresh and 10g dry leaves extract whereas no change was observed in 5g and 15g dry leaves extract. The extract of *E. helioscopia* enhanced the germination percentage and was recorded maximum (33.33%) in 15g fresh leaves extract and minimum (22.21%) in 15g dry leaves extract, while inhibited the germination percentage up to 11.16% in 5g fresh and 15g dry leaves extract.

Radicle length (cm)

The extract of *M. alba*, *P. nigra* and *E. helioscopia* significantly reduced the radicle length of *B. campestris* is shown in (Fig. 2). The graph showed that maximum reduction

in the radicle length was recorded 75.57% in 5g fresh leaves extract and minimum reduction in radicle length was recorded 61.41% in 10g fresh leaves extract of *M. alba*. Maximum reduction in the radicle length by *P. nigra* extract was recorded 91.41% in 10g fresh leaves extract, and a minimum reduction was observed 14% in 15g dry leaves extract, whereas 15g fresh leaves extract showed no germination. The data recorded from *E. helioscopia* extract showed that maximum reduction in the radicle length was observed 63.21% in 10g dry leaves extract, and a minimum depletion in radicle length was observed in 42.14% in 15g fresh leaves extract.

Plumule length (cm)

In (Fig. 3) it shows that the plumule length of *B. campestris* was reduced significantly by the aqueous extract of *M. alba*, *P. nigra* and *E. helioscopia* in all treatments except 15g dry leaves extract of *P. nigra* which increased the plumule length (28.34%). The graph revealed that maximum inhibition in plumule length was recorded 91.75% in 15g dry leaves extract and minimum inhibition was recorded 59.45% in 5g fresh leaves extract of *M. alba*. The extract of *P. nigra* reduced plumule length and was recorded a maximum of 91.90% in 10g fresh leaves extract and a minimum of 2.42% in 5g dry leaves extract. Maximum decreased in plumule length of *B. campestris* by *E. helioscopia* extract was observed 95.49% in 15g dry leaves extract, and a minimum decrease of 66.21% was observed in 5g fresh leaves extract.

Figure 1. Effect of *Morus alba*, *Populus nigra* and *Euphorbia helioscopia* on germination percentage of *Brassica campestris*. T0= Control, T1= 5g fresh leaves extract, T2= 10g fresh leaves extract, T3= 15g fresh leaves extract, T4= 5g dry leaves extract, T5= 10g dry leaves extract, T6= 15g dry leaves extract. Bars with different letters represent significant difference at P= 0.05

Figure 2. Effect of *Morus alba*, *Populus nigra* and *Euphorbia helioscopia* on radicle length of *Brassica campestris*. T0= Control, T1= 5g fresh leaves extract, T2= 10g fresh leaves extract, T3= 15g fresh leaves extract, T4= 5g dry leaves extract, T5= 10g dry leaves extract, T6= 15g dry leaves extract. Bars with different letters represent significant difference at P= 0.05

Figure 3. Effect of *Morus alba*, *Populus nigra* and *Euphorbia helioscopia* on plumule length of *Brassica campestris*. T0= Control, T1= 5g fresh leaves extract, T2= 10g fresh leaves extract, T3= 15g fresh leaves extract, T4= 5g dry leaves extract, T5= 10g dry leaves extract, T6= 15g dry leaves extract. Bars with different letters represent significant difference at P= 0.05

Discussion

The present research work was performed to find out allelopathic effect of *M. alba*, *P. nigra* and *E. helioscopia* on *Brassica campestris*. It was found that both fresh and dry leaves extract increase the inhibitory effect. Maximum inhibition was recorded in 15g followed by 10g and 5g. Dry leaves extract had a more inhibitory effect than fresh leaves extract. The allelopathic effect of *M. alba* extract was more as compared to the effect of *P. nigra* and *E. helioscopia* extracts on *Brassica campestris*. The effect was more pronounced at high concentrations. The germination percentage of *Brassica campestris* was significantly effected by *M. alba* followed by *P. nigra* whereas, *E. helioscopia* extract showed less effect on germination percentage. The results showed similarity with the results of Wu [11], they concluded that the aqueous extract of *Citrus reticulata* Banco., *Coronilla varia* L., *Eriobotrya japonica* Thunb., *Gynura bicolor* DC., *Hemerocallis citrine* Baroni., *Medicago sativa* L., *Morus alba* L., *Toona sinensis* Roem., *Zanthoxylum schinifolium* Sieb

significantly inhibited the seed germination and seedling growth of wheat. Similar results were found by Madany [12], they studied the Phytotoxicity of *Euphorbia helioscopia* L. on *Triticum aestivum* L. and *Pisum sativum* L. and found that *E. helioscopia* aqueous extract severely affected the germination in a concentration dependent manner. Our results also showed similarity with the results of Khan [13], they studied the Allelopathic Effect of *Populus Nigra* Bark on *Zea Mays* agroforestry ecosystems and found that the *Populus nigra* bark exhibits more effect on the germination percentage as compared to control. Similar results were also found by Khan [14] and Inayat [15]. The radicle and plumule length of *Brassica campestris* was significantly inhibited by *M. alba*, *P. nigra* and *E. helioscopia* extracts. Similar results were found by Wu [11]. The results are also in comparisons with the findings of Inayat [16], they studied Herbicidal Evaluation of the Aqueous Extract of *Populus nigra* L. Leaves on Six Weed Species and found Germination and growth of all six weeds species were reduced with increasing

concentration of the leaves. Our findings were also in comparison with the results of Ning [17], they performed experiment on allelopathic effects of water extracts from stem and leaf of *Euphorbia helioscopia* on seed germination and seedling growth of three turfgrass species and found that water extract from *E. helioscopia* has the certain effect on tested lawn species. The germination rate, germination index, seedling height and root length of three lawn plant species show a gradual decline trend with increase of water extract compared with CK.

Conclusion and Recommendations

The present research work revealed that *M. alba*, *P. nigra* and *E. helioscopia* leaves may contain some allelochemicals that puts negative effect on the growth and germination of *Brassica campestris* and inhibited the germination, radicle and plumule length of *Brassica campestris*. It is recommended that *Brassica campestris* should not be grown in the fields containing *M. alba*, *P. nigra* and *E. helioscopia*. Fields that have *M. alba*, *P. nigra* and *E. helioscopia* their leaves should be removed before the sowing of *Brassica campestris*. Leaves should also be regularly removed during the fall season to avoid the crop from their allelopathic effects. People especially the farmers must be educated and informed about the negative effects of these plants. Resistant varieties are also a good tool for toleration of the allelopathic effects of plants so such varieties should be sown, that are resistant to the allelopathic effects of *M. alba*, *P. nigra* and *E. helioscopia* in the field containing *M. alba*, *P. nigra* and *E. helioscopia*. The allelopathic compatibility of crops with plants should be checked before introducing them in the field.

Authors' contributions

Conceived and designed the experiments: S Khalid, Amreen & S Bibi, Performed the experiments: Amreen, S Bibi, SA Taskeen & H Shumail, Analyzed the data: S Khalid &

SIU Haq, Contributed reagents/ materials/ analysis tools: Amreen, S Bibi, SA Taskeen & H Shumail, Wrote the paper: S Khalid & SIU Haq.

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