

## Research Article

# A comparative study of the allelopathic effects of *Albizia lebeck* L. and *Ficus virens* on growth and germination of *Brassica campestris* L.

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### Abstract

Aqueous extract of *Albizia lebeck* L. and *Ficus virens* were studied for their effect on growth (Radicle and plumule length) and seed germination of *Brassica campestris*. Plant material (leaves) were collected from *F. Virens* and *A. lebeck* tree in 5, 10 and 15g weight, powdered and was soaked separately in 100 ml of distilled water. Prepared materials were filtered after 24 hours of soaking time. These exudates were applied to *B. Campestris* seeds to investigate its allelopathic (positive or detrimental) impact on radicle and plumule length and germination percentage, after 24, 48 and 72 hours of incubation period at 26°C. With increase in extract concentration from 5 to 15g, a gradual decrease in growth of *B. campestris* occurred. Mean values for percent germination showed that both fresh and dry leaves extract have negative impact on *B. campestris*. Dry leaves extract obtained from *A. lebeck* and *F. virens* have more inhibitory effect on germination percentage (82%) at 72 hours than fresh leaves extract (91%) with same soaking time as compared to control (100%). Plumule is found more affected than radicle for both *A. lebeck* and *F. virens*. Dry leaves extract of *F. virens* was found more inhibitory for radicle length (0.97cm) than *A. lebeck* (1.20cm) as compared to control(4.38cm) while fresh leaves extract of *F. virens* were found less inhibitory (1.41cm) for radicle than *A. lebeck* (1.02cm), when compared to control (4.38cm). Moreover, fresh extract of *A. lebeck* were observed more inhibitory (0.41cm) for plumule length in comparison with *F. virens* (0.80cm), while for dry extract *F. Virens* were found more inhibitory(0.79cm) on test species than *A. lebeck* (1.27cm). Result of the study revealed that radicle was more affected negatively by *A. lebeck* than *F. virens* while plumule was more inhibited by *Ficus* than *Albizia*. However inhibitory effect of both *Albizia* and *Ficus* was same on germination percentage of *Brassica Campestris*, at 72 hours of soaking time. Overall., *A. lebeck* was observed more inhibitory than *F. Virens* on test species. The result suggested that *F. virens* and *A. lebeck* have overall negative effect on *Brassica campestris*, reducing germination percentage and seedling growth of test species.

**Keywords:** Allelopathy; *Albizia lebeck*; *Ficus virens*; *Brassica campestris*; Extra

## Introduction

Any process involving secondary metabolites produced by fungi, bacteria, algae and plants that influence the development and growth of any biological system is termed as Allelopathy [1]. “The process of inhibition of one plant or (other organisms) by another, due to the release of chemicals into the environment, acting as germination and growth stimulators or inhibitors”. It is the characteristic feature of certain fungi, algae, bacteria, coral and certain plants. The biochemicals that are produced by plants that effect the germination and various vital processes of other plants are called Allelochemicals.”. These Allelochemicals are a subset of secondary metabolites [2] which are not needed for metabolism (reproduction, development and growth) of the allelopathic organisms. Allelopathic chemicals are contributed to soil and environment by volatilization leaching, decomposition of plant residues, and root exudation [3]. Rice [4] classified allelochemicals into fifteen classes, Straight chain alcohols, Aliphatic aldehydes and ketones, Long-chain fatty acids, Simple unsaturated ketones Naphthoquinones, Anthraquinones and complex quinines, Terpenoids and Steroids, Simple Phenols, Benzoic acids and their derivatives, Cinnamic acid and derivatives, Coumarins, Flavonoids, Tannins, Amino acids and polypeptides, Alkaloids and Cyanohydrins, Sulfides and Mustard oil glycosides, Purines and Nucleosides, Miscellaneous, Simple water soluble organic acids. Allelopathy is actually the direct or indirect beneficial or harmful effect of one plant, microorganism or fungus on another by production of allelochemicals. Sometimes the receiver species is referred as “indicator” because it indicates the allelopathic interaction [5]. Allelopathic substances are found in all the generative and vegetative organ of plants

[4]. Allelopathy influences the forestation, succession, forest regeneration, and the metabolites of woody plants, affect the pattern of understory species. Species that are considered to have high percentage of allelopathic effect are Alien species [6]. *Ficus virens* is a tree belonging to the group of trees called Strangler figs, this is because its seeds can germinate on other trees, grow to strangle and eventually kill the host tree. The *Ficus virens* has become famous as an avenue tree in New Delhi and around the cities of Noida. It is a very massive tree, in which sometime the size of the crown can exceed the height of the trees. The most massive and oldest Pilkhan trees can be seen inside the complex of Humayun’s tomb in Delhi. Young leaves and young shoots are cooked or raw used. They are sometime used in the preparations of curries [7, 8]. The fruits of figs are edible. Birds, bears and tortoise has been observed feeding on the *Ficus virens* fruits. A bark decoction is used as a gargle in salivation and wash of ulcers [9]. The wood including the aerial root is used locally in tool making. The wood is used for fuel. The wood and roots are used locally in light constructions [10]. The latex of *Ficus virens* is used for water proofing and caulking boat. The light colored wood is porous and soft [11]. Leaves are acuminate, alternate, distichous, simple, entire, lanceolate, elliptic or Ovate-elliptic to Ovate oblong. The flower is an axillary, paired, fig, cream colored, globose and thick walled. *Ficus* produces three types of flowers; male flower, a long-styled female flower, short-styled female flower (often called gall flower). Branches have few to many aerial roots. Aerial roots are one of the most unique and wonderful feature of figs [12]. *Albizia lebbek* L. is large, erect, fast growing, unarmed deciduous tree, having spreading umbrella shaped crown of thin foliage finely fissured, graying brown bark

and having mimosoid legume. Tree is planted as a shade tree in coffee and tea plantations to suppress weed growth, to reduce soil desiccation and to protect plants from rain storms and hail. *Albizzia lebbeck* is a great nitrogen fixer, also it produces wood and provide fodder for livestock [13]. *Albizzia lebbeck* (L) is found in deciduous forests in tropical and sub-tropical countries of Asia, such as Cambodia, Indonesia, Vietnam, Laos Malaysia, Africa, India and is also found in Australia. This tree can tolerate acidity, alkalinity, water logged soils, sodic, drought, lateritic sites, heavy and eroded soils [14, 15]. *Albizzia lebbeck* contain the following compounds such as Tannins, Glycosides, Flavonoids, Carbohydrates, Alkaloids Proteins and Amino Acids. Through methanolic successive extracts, tannins, saponins, and flavonoid alkaloids were also reported from the plant [16]. Brassica is the genus of plants in the mustard family (Brassicaceae). The members of the genus are informally known as Cruciferous vegetables, Cabbages, or mustard plants. Sometimes the crops of this genus are called cole crops-derived from latin caulis, denoting the stem or stalk of a plant. Brassica campestris has a particular varieties of oil seed known as canola but usually it has some related species *Brassica napus* (rap seed) and *Brassica juncea* (mustard greens and mizuna). *Brassica campestris* is cultivated for oil production [17].

### Materials and Methods

#### Collection, drying, crushing and soaking of plant material

The leaves of the *Ficus virens* and *Albizzia lebbeck* tree were collected and washed properly with distilled water. Half of the leaves were allowed to dry in a room and half were chopped fresh using mortar and pestle. Dried leaves were grinded in a food processor to obtain the powder for the extraction purpose.

#### Processing of fresh and dried leaves

Solution was prepared from fresh leaves (chopped) in sterilized beakers using different concentrations i.e. 5, 10 and 15g in 100 ml of distilled water. Similarly, solution was prepared from dried leaves powder in sterilized beakers using different concentrations i.e. 5, 10 and 15g in 100 ml of distilled water. All the solutions were kept undisturbed for 24 hours at room temperature in the laboratory of ICP.

#### Preparation of fresh and dried leaves extract

All the solutions were filtered, and filtrate were obtained after 24 hours to obtain the respective extracts. Hence aqueous extract of fresh and dry leaves with three concentrations that is 5%, 10% and 15% w/v were prepared. Extract were collected and stored as stock solution in refrigerator. Overall, twelve extracts were prepared for its use in germination experiment.

#### Sterilized equipment's and usage of standard filter paper

Petri dishes, Filter paper, Beakers, Incubator, Refrigerator, stirrer, Digital balance, Funnels, Titration flasks, Iron stand, and Mortar and pestle were used, and all these equipment's were sterilized at 160C for few hours. Whatman.1 filter paper and cotton were used as the seed beds in the experiment.

#### Test species

*B. campestris* was used as test species to check the allelopathic potential of *Ficus virens* and *Albizzia lebbeck* (fresh+ dry leaves extract) on it. All the petri dishes that were to be used for the experiment were provided with double folded filter paper and thin layer of cotton beneath. 5 seeds of *B. campestris* were put in each petri dish and was soaked with the respective extracts. Different concentrations of leaves extract were provided after each 24th hours to the petri dishes having seeds placed at equal distance. A control series of 3 sterilized

petri dishes, soaked double folded filter paper with distilled water was also taken. The petri dishes were placed in an incubator at 24 degree centigrade. After three days of incubation period (72hours), germination percentage, radicle length and plumule length were recorded.

#### **Standard method of Measuring data**

Readings from the Petri dishes was taken after 72 hours of incubation period in the incubator, the seeds that germinated were counted in each Petri dish. With the help of scale, the plumule and the radicle length of the germinated seeds were measured in centimeters. Based on recorded data, mean values were derived. Germination percentage of the Brassica Campestris seeds were recorded by following the method of Scot [18].

(Germination Percent = no of germinated seeds / total no of seeds x 100)

#### **Results and Discussion**

Inhibition was observed in case of germination percentage in Brassica campestris seeds in all cases that is when both fresh and dry leaves extract of *Albizia lebbek* and *Fiscus virens* were applied separately.

#### **Effect of 24, 48 and 72 hours of fresh and dry leaves extract of *Albizia lebbek* on germination percentage of *Brassica campestris* seeds**

Mean values for different soaking duration shows that highest germination percentage (91%) of *Brassica Campestris* seeds is found in 72 hrs of soaking duration when fresh leaves extract were applied and 82 % when dry leaves extract were applied, followed by (55%) at 48hrs and (36% and 27%) at 24hrs by using fresh and dry leaves extract. Moreover, extract with all different concentrations (5g, 10g and 15g) were found to have inhibitory effect on test species that have decreased germination percentage when compared to control (100%). 5g, and 15g (dry leaves) reduced

germination percentage to (73.3%) while (5g and 10g) fresh leaves have inhibited Radicle length to 87% at 72hours when compared to control. Dry leaves extract affected germination more than fresh leaves extract. However, in all the three treatments, varied values of inhibition were found at different soaking time (Table 1; Fig. 1).

#### **Effect of 24, 48 and 72 hours of fresh and dry leaves extract of *Ficus virens* on germination percentage of *Brassica campestris* seeds**

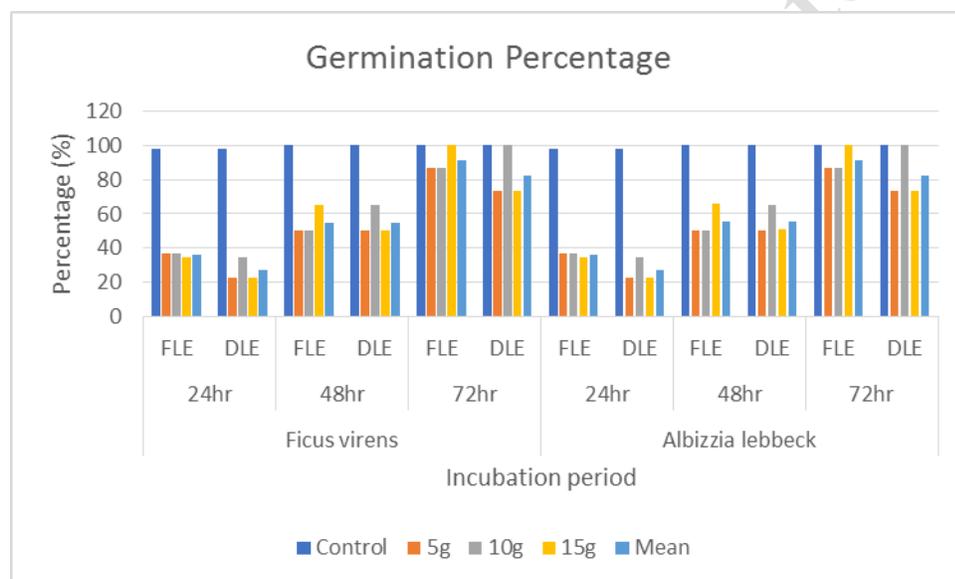
According to mean values, percent germination is observed for dry and fresh leaves extract of *Ficus virens* which reduced percent germination of test species to 91% and 82% at 72 hours, followed by 55% at 48 hours and 27 and 36% at 24hours of soaking duration. Moreover Table 1 showed that in 5g, 10g and 15g treatment, *Ficus virens* leaves extract, percent germination was decreased as compared to control (100%). In (5g, 10g and 15g) treatments, 5g and 15g (dry leaves) reduced germination percentage to (73.3%). However, 5g and 10g fresh leaves also have the potential to inhibit seed germination to 87% at 72hours when compared to control (100%). At 24hours, 15gdry and fresh leaves extract reduced germination percentage to (23 %) and (35%) followed by 10g and 5g, reducing germination percentage to (23%, 37%) and (35%, 37%) respectively. Dry leaves extract affected germination more than fresh leaves extract just like *Albizia lebbek*. However in all the three treatments, varied values of inhibition were found (Table 1; Fig. 1). Barkatullah [19], Hussain [20], Samreen [21] have been reported that aqueous extract of leaves of *Diospyros kaki* L. reduced germination percentage of *Brassica campestris* which greatly support the present findings. Antony [22] also concluded that effect of aqueous extract of leaves of the edible plant

and Flourita is inhibitory on seed germination of *B. campestris*. Same result was also reported by Maharajan [23] that

seed germination was greatly inhibited by *Parthenium hysterophorus* leaves extract.

**Table 1. Effect of 24, 48- and 72-hours soaking duration extract of *Ficus virens* and *Albizia lebbek* at 5g, 10g and 15g fresh and dry leaves on Germination percentage of *Brassica campestris* L. FLE= Fresh leaves extract, DLE= Dry leaves extract**

Species	<i>Ficus virens</i>						<i>Albizia lebbek</i>					
	24hr		48hr		72hr		24hr		48hr		72hr	
Incubation period												
Treatments	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE
Control	98	98	100	100	100	100	98	98	100	100	100	100
5g	37	23	50	50	87	73	37	23	50	50	87	73.3
10g	37	35	50	65	87	100	37	35	50	65	87	100
15g	35	23	65	50	100	73	35	23	66	51	100	73.3
Mean	36	27	55	55	91	82	36	27	55	55	91	82



**Figure 1. Effect of 24, 48 and 72 hours soaking duration extract of *Ficus virens* and *Albizia lebbek* at 5g, 10g and 15g fresh and dry leaves on Germination percentage of *Brassica campestris* L. FLE= Fresh leaves extract, DLE= Dry leaves extract. Bars represents significance difference at P=0.05**

**Effect of 24, 48 and 72 hours of fresh and dry leaves extract of *Albizia lebbek* on Radicle length of *Brassica campestris* seeds**

According to mean values, the maximum radicle length (1.20, 1.02) cm was observed by using both fresh and dry leaves extract

separately on *Brassica campestris* seeds at 72 hours of soaking period followed by (0.89, 0.69) cm at 48hours of soaking duration and the minimum radicle length was recorded at 24 hours of soaking duration (0.72, 0.42) cm by using dry and fresh extract. More significant inhibitory

effect was shown by the extract obtained from 10g fresh and dry leaves that reduced radicle length to (0.11cm) and (0.17cm) at 24hrs of soaking time, followed by 10g fresh and 10g dry as well as 15g dry leaves extract (0.29cm), (0.3cm), (0.37cm) at 48hrs duration. Furthermore it was found out that 5g dry and fresh leaves extract have least inhibitory effect i.e. (2.45cm) and (1.04cm) at 72hours, (2.0) and (0.86cm) at 48 hours, (1.1cm) and (0.54) at 24 hours of soaking time as compared to control. So, from the recorded values it is clear that, by increasing extract concentration, inhibitory effect increases (Table 2; Fig. 2).

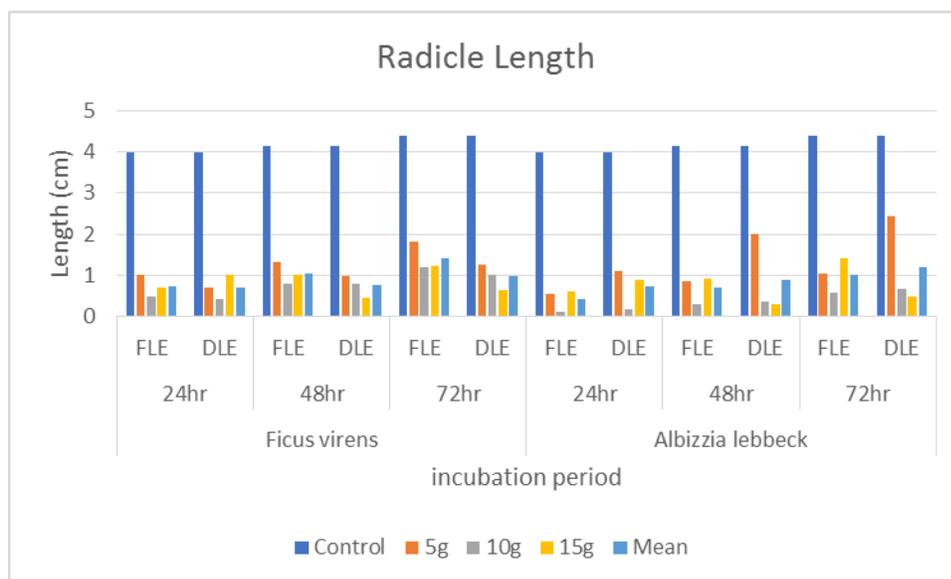
#### Effect of 24, 48 and 72 hours of fresh and dry leaves extract of *Ficus virens* on Radicle length of *Brassica campestris* seeds

Effect of aqueous extract of *Ficus virens* L were observed for *Brassica campestris* seeds and It was found from the mean value of soaking duration that *B. Campestris* have maximum radicle length(1.41cm) and (0.97cm) at 72 hours followed by (1.04cm) and (0.75cm) at 48 hours, (0.73cm) and (0.70cm) at 24 hours by using fresh and dry extract respectively. Inhibitory effect was observed to increase by increasing the

concentration ie extract obtained from 15g stands out to be more inhibitory (0.65cm) and (1.23cm) at 72 hours, (0.45) and (1.0cm) at 48 hours, (0.7cm) and (1.0cm) at 72 hours of soaking duration by using dry and fresh leaves extract separately. At low concentration (5g) extract were found to be least inhibitory (1.25cm) and (1.81cm), followed by 10g dry and fresh leaves extract (0.65cm) and (1.23cm) at 72 hours of soaking duration (Table 2; Fig. 2). The present results are also in line with those of Gulzar [24] observed effect of aqueous extract of *Calotropis procera* on the growth of *Brassica campestris*. Their result showed that higher concentration of extract significantly reduced Radicle length and plumule length as compared to control. Same result was also reported by Uniyal and Sachin [25], Hussain and Ilahi [20] also observed allelopathic inhibition of radicle growth of *B. campestris* when different concentration of extracts was applied on its seeds. Similarly, Bahuguna [26] have also revealed that aqueous extract of leaves of walnut significantly reduced Radicle length of *B. campestris* when compared to water control.

**Table 2. Effect of 24, 48 and 72 hours soaking duration extract of *Ficus virens* and *Albizzia lebbek* at 5g, 10g and 15g fresh and dry leaves on Radicle length of *Brassica campestris* L. FLE= Fresh leaves extract, DLE= Dry leaves extract**

Species	<i>Ficus virens</i>						<i>Albizzia lebbek</i>					
	24hr		48hr		72hr		24hr		48hr		72hr	
Incubation period	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE
Treatments	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE
Control	3.98	3.98	4.15	4.15	4.38	4.38	3.98	3.98	4.15	4.15	4.38	4.38
5g	1	0.69	1.31	0.99	1.81	1.25	0.54	1.1	0.86	2	1.04	2.45
10g	0.5	0.41	0.8	0.81	1.19	1.02	0.11	0.17	0.29	0.37	0.59	0.67
15g	0.7	1	1	0.45	1.23	0.65	0.62	0.9	0.93	0.3	1.42	0.49
Mean	0.73	0.70	1.04	0.75	1.41	0.97	0.42	0.72	0.69	0.89	1.02	1.20



**Figure 2.** Effect of 24, 48 and 72 hours soaking duration extract of *Ficus virens* and *Albizzia lebbeck* at 5g, 10g and 15g fresh and dry leaves on Radicle length of *Brassica campestris* L. FLE= Fresh leaves extract, DLE= Dry leaves extract. Bars represents significance difference at P=0.05.

#### Effect of 24, 48 and 72 hours of fresh and dry leaves extract of *Albizzia lebbeck* on Plumule length of *Brassica campestris* seeds

After statistical analysis, plumule length showed varied lengths at different soaking duration. At 24, 48 and 72 hours, 0.50cm, 0.91cm, and 1.27cm plumule lengths were observed by using dry leaves extract. However, for fresh leaves extract at 24, 48 and 72 hours soaking duration (0.40cm), (0.28cm) and (0.41cm) were found. Moreover, extract obtained from 5g have least inhibitory effect than 10g and 15g. extract obtained from 5g (dry leaves) reduced plumule length to 2.53cm while 10g and 15g reduced plumule length to 0.57cm and 0.72cm at 72 hours of soaking time. Similarly, 5g fresh leaves extract were found to be more inhibitory than 10g and 15g fresh, 5g fresh reduced plumule length to 0.25cm while 10g and 15g reduced plumule length to 0.37cm and 0.62ccm at 72hrs respectively. Thus, from the result it

is clear that with increasing concentration of leaves extract of *Albizzia lebbeck* L., inhibitory effect was increased (Table 3; Fig. 3).

#### Effect of 24, 48 and 72 hours of fresh and dry leaves extract of *Ficus virens* on Plumule length of *Brassica campestris* seeds

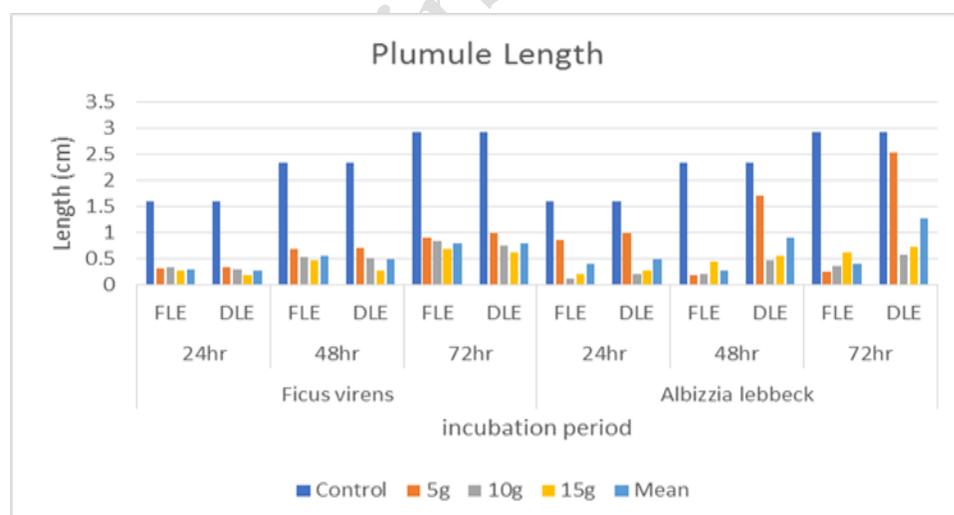
In case of *Ficus virens*, inhibitory effect was shown by all the extracts for test species with different duration and concentration. At 24, 48 and 72 hours, 0.28cm, 0.50cm, and 0.79cm plumule lengths were observed by using dry leaves extract. However, for fresh leaves extract at 24, 48 and 72 hours soaking duration (0.31cm), (0.57cm) and (0.80cm) were observed. Furthermore, extract obtained from 5g have least inhibitory effect than 10g and 15g. 5g (dry leaves) reduced plumule length to (1.0cm) while 10g and 15g reduced plumule length to 0.76cm and 0.62cm at 72 hours of soaking time. Similarly, 5g fresh reduced plumule length

to 0.9cm while 10g and 15g reduced plumule length to 0.83cm and 0.68ccm at 72hrs respectively. Same with the case of *Albizzia lebeck* L., increasing concentration of leaves extract of *Ficus virens*, inhibitory effect on test species were increased (Table 3; Fig. 3). These findings correlated with the report of Indergit [27] who found that aqueous extract of leaves of *Pluchea lanceolata* have inhibitory effect on *Brassica Campestris* in terms of growth percentage. In such experiment significant reduction in plumule length was observed. Significant reduction in plumule length of

*Brassica campestris* was also reported by Naveed [28] by studying allelopathic effect of aqueous extract of leaves of *Forsskaolea tenacissima* on *B. campestris*. Present results are also in line with those of Ali [29] who concluded that plumule length of *Brassica campestris* was significantly reduced by aqueous extract of leaves of *Diospyros kaki* (L.) similarly Gosh [30] have also reported significant reduction of plumule length of *B. Campestris* when leaves extract of *Albizzia saman* were applied on its seeds.

**Table 3. Effect of 24, 48 and 72 hours soaking duration extract of *Ficus virens* and *Albizzia lebeck* at 5g, 10g and 15g fresh and dry leaves on Plumule length of *Brassica campestris* L. FLE= Fresh leaves extract, DLE= Dry leaves extract**

Species	<i>Ficus virens</i>						<i>Albizzia lebeck</i>					
	24hr		48hr		72hr		24hr		48hr		72hr	
Incubation period	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE
Treatments	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE	FLE	DLE
Control	1.6	1.6	2.33	2.33	2.91	2.91	1.6	1.6	2.33	2.33	2.91	2.91
5g	0.31	0.35	0.69	0.71	0.9	1	0.86	1	0.18	1.7	0.25	2.53
10g	0.33	0.29	0.54	0.51	0.83	0.76	0.12	0.22	0.21	0.46	0.37	0.57
15g	0.28	0.19	0.47	0.28	0.68	0.62	0.22	0.27	0.44	0.56	0.62	0.72
Mean	0.31	0.28	0.57	0.50	0.80	0.79	0.40	0.50	0.28	0.91	0.41	1.27



**Figure 3. Effect of 24, 48 and 72 hours soaking duration extract of *Ficus virens* and *Albizzia lebeck* at 5g, 10g and 15g fresh and dry leaves on Plumule length of *Brassica campestris* L. FLE= Fresh leaves extract, DLE= Dry leaves extract. Bars represents significance difference at P=0.05.**

## Conclusion and Recommendations

The result of the study concluded that *Albizia lebbbeck* and *Ficus virens* have some kinds of allelochemicals that could inhibit the germination and seedling growth of mustard crop. Study also indicated that dry leaves extract is more inhibitory on test species than fresh leaves extract, however inhibitory effect of dry leaves extract of *Ficus virens* is more pronounced on *Brassica Campestris* than *Albizia lebbbeck*. Plumule length was observed more affected than radicle length, while inhibitory effect of both species on germination percentage of test species was same, at 72 hours of soaking time. It is also investigated that inhibitory effect is concentration and soaking time dependent. The negative effect on test species was increased from 5 to 15g treatment, when compared to control. From the observations and the results, it is concluded that *Albizia lebbbeck* and *Ficus virens* as significant allelopathic potential reduced the radicle and plumule growth as well as the germination percentage of *Brassica campestris* as compared to control. The current data provided evidences that allelochemicals might be present in leaves extract of *F. virens* and *A. lebbbeck* that are involved in the suppression of *B. campestris* germination and growth. Therefore *A. lebbbeck* and *F. Virens* should not be cultivated near the *B. campestris* field. It is also recommended that *Albizia lebbbeck* and *Ficus virens* can be utilized in weed management in future, if properly studied for its chemicals that are responsible for suppression of *Brassica campestris*. As *Brassica campestris* is economically very important, therefore further studies should be done in order to find out in which environment and habitat it can grow best and not affect other plants and vice versa.

## Authors' contributions

Conceived and designed the experiments: S Khalid & U Ibrahim, Performed the experiments: U Ibrahim, S Riaz, WM Khan and R Kausar, Analyzed the data: M Naseem, R Kausar, SIU Haq & M Sajjad, Contributed

materials/analysis/ tools: S Khalid, WM Khan, Wrote the paper: S Khalid, U Ibrahim, S Riaz, SIU Haq.

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