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ALLELOPATHIC EFFECT OF *FICUS BENGHALENSIS* L. LEAVES EXTRACT ON GERMINATION AND EARLY SEEDLING GROWTH OF MAIZE, MUNGBEAN AND SUNFLOWER

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ABSTRACT

The allelopathic effect of the aqueous leaves extracts of *Ficus benghalensis* L. was investigated on seed germination of maize (*Zea mays* L.), mung bean (*Vigna radiata* (L.) R. Wilczek) and sunflower (*Helianthus annuus* L.) at different application rate (0, 25, 50 and 100%). Germinated seeds were daily counted or until the last seed germinated. Different parameters, including germination percentage, germination rate, coefficient of germination velocity, mean germination time and germination index were recorded. Seedlings growth parameters include shoot length, root length and seedling weights were also determined. Germination of maize and sunflower was inhibited by *F. benghalensis*. However, tested concentrations of aqueous extract did not cause any inhibitory effect on mung bean. Germination rate affected in maize and sunflower but not in mung bean. Shoot length, root length and seedling weight altered by increase concentration of aqueous extracts of *F. benghalensis*.

KEY WORDS: Germination indices, *Ficus benghalensis*, leaves extract, seed treatment, allelopathic effect.

INTRODUCTION

Allelopathy is a phenomenon where one plant suppresses the growth of another plant by the release of biochemicals known as allelechemicals. Allelopathy has beneficial or harmful effects on plants due to release of allelechemicals which are secondary metabolites, released into the environment through root exudates and leachates during litter decomposition. Allelopathic plants store allelochemicals within their leaves and as the leaves drop to the ground and decompose, the toxins release in the soil and effect nearby plants. Roots are also the house of storage of toxins which when release absorbed by other trees and plants (Phipps, 2016).

Ficus genus contains about 850 species of woody trees, shrubs, vines, epiphytes and hemiepiphytes in the family Moraceae. *Ficus benghalensis* L., also called banyan which is native to India and Pakistan. It is the world's largest tree in terms of its spread with other old trees over an acre of ground (Riffle, 1998; Nadkarni, 2006; Kirtikar and Basu, 2005; Chew, 1989). This tree possesses variety of medicinal uses. Its leaves are used to cure ulcers, aerial roots for gonorrhea, obstinate vomiting, its bark used as tonic and astrigent also in diarrhea, dysentery and diabetes. Its milky juice from stem and bark is useful in treatment of rheumatism and other inflammatory diseases (Nadkarni, 2006; Nadkarni and Nadkarni, 1982; Dev, 2006; Patil and Pimprikar, 2009).Chemically *F. benghalensis* stem and bark contain anthocyanidin derivatives, beta-sitosterolglucoside and mesoinsitol and aliphatic long chain ketones (Sankar and Nair, 2001; Vishnu and Anupama, 2010; Manoj and Urmila, 2008). Besides this, leaves contain crude protein, crude fibres, calcium oxalate, phosphorous, sterols, flavanoids, phenol, tannins and saponins in large amount. However, aromatic acids, carbohydrates, triterpenoids, gums and volatile oils were totally absent in this plant. Number of researchers observed its anti-inflammatory, anthelminitin, antihistaminic, immunomodulatory, antimicrobial, allelopathic, antidiabetic, antioxidant, antifungal and antibacterial activities (Vishnu and Anupama, 2010; Manoj and Urmila, 2008; Taur and Patil, 2009; Uma and Prabhakar, 2009; Jayakumar *et al*., 1998; Sharma *et al.*, 2009; Sharma *et al.*, 2007;Suryanarayanan and Vijaykrishna, 2001; Parekh *et al.*, 2005).

Little researches have been conducted on the allelopathic effect of *F. benghalensis* so far. Therefore, present work was conducted to explore the allelopathic effects of leaves extract of *F. benghalensis* L., on germination of maize (*Zea mays*), mung bean (*Vigna radiata*) and sunflower (*Helianthus annuus*).

MATERIALS AND METHODS

Plant samples and preparation of leaves extract: Fully grown healthy leaves of *Ficus benghalensis* L., were collected from University of Karachi campus; leaves were washed thoroughly with distilled water and dried under shade for 14 days. The dried samples were ground into fine powder and stored dry until used. Aqueous leaves extract was prepared by soaking 10 g of powdered leaves material in 100 ml distilled water for 24 hours. Extract was filtered using Whatman No. 1, filter paper and the extract was collected into conical flask designated as stock solution or 100% extract. Then final concentrations of 25% and 50% were prepared by adding requisite amount of sterilized distilled water.

Seed treatment: Seeds of maize (*Zea mays* L.), mung bean (*Vigna radiata* (L.) R. Wilczek) and sunflower (*Helianthus annuus* L.) were taken from local market. Crop seeds were soaked in respective concentration (25, 50, 100 % w/v) of aqueous extract for atleast half hour. Then seeds were placed on Petri plates (10 seeds/plate of each crop) contained moistened filter paper irrigated with respective aqueous extract concentration. Seeds soaked in sterilized distilled water were served as control. Each treatment was replicated thrice. The Petri dishes were watered once in every 2-3 days with either different concentrations of aqueous solution of leaves extract or distilled water for the control, if necessary. The Petri plates were incubated at room temperature (25 ± 2°C) and different germination parameters were counted daily upto 6 days or until the last seed germination. Different germination indices including germination percentage, germination rate, coefficient of velocity (Maguire, 1962), mean germination time (Ellis and Roberts, 1981) and germination index (AOSA, 1983) were calculated. Besides germination parameters, seedling growth parameters were also observed which includes shoot length, root length and seedling weight.

Analysis of data: Data were subjected to analysis of variance (ANOVA), followed by calculation of Fisher's least significant difference and Duncan multiple range test (Gomez and Gomez, 1984).

RESULTS

Germination percentage: Highest germination percentage was observed in control plants. Seed germination declined with increase in concentration (Fig. 1A). In case of mung bean, 100% germination was observed at 25 and 100% concentration and 80% germination was observed at 0% concentration (Fig. 1B). No germination of sunflower was recorded on day1 while on day 2 seeds are germinated at all concentrations except at 100% concentration. Highest decline in germination percentage was observed at 100% concentration (Fig. 1C).

Germination rate: There was no germination of maize seeds on day 1 while, on day 2 and 3 germination was constant at 50% concentration. After which it start declining at all concentrations (Fig. 2A). In case of mung bean, germination rate was 0 on day1 while germination rate was constant from day 2 to day 4. Then it started declining at all concentrations (Fig. 2B). Sunflower seeds were not germinated on day 1. Germination was observed on day2 at all concentrations except 50% concentration. Then it started declining from day3 in all concentrations (Fig. 2C).

Germination velocity: Germination velocity of maize seeds showed constant result at 0, 25 and 50% concentration of *F. benghalensis* while, 100% gave less germination velocity compared to other concentrations. In case of mung bean, maximum germination velocity was recorded with 100 and 25% concentrations followed by 50%. However, 25 and 100% concentration showed improved germination velocity in sunflower seeds (Table 1).

Mean germination time: Minor difference in mean germination time of maize, sunflower and mung bean was recorded where 100% gave comparatively highest result followed by 50% concentration on maize and sunflower seeds. However, 50% concentration gave better result in case of mung bean seeds (Table 1).

Germination index: Germination index of maize showed not much improved by the use of *F. benghalensis* extract but comparative to other concentrations 100% gave maximum result. 25 and 100% concentration showed greater germination index in mung bean seeds followed by 50 % concentration. However, in case of sunflower, 25% gave better results compared to other concentrations (Table 1).

Shoot and root length: In maize seeds, shoot length was not increased by soaking in *F. benghalensis* extract while in mung bean little bit better results were recorded with 100 and 50% concentrations. 50 and 100% concentrations improved shoot length in sunflower seeds (Table 2). Root length was maximum when maize seeds were treated with 100 % concentration of *F. benghalensis* extract when compared with control. 50% and 100% concentration gave maximum shoot length in mung bean seeds. However, in sunflower root length decreased by the seed treatment with *F. benghalensis* extract (Table 2).

Seedling weight: Seedling weight declined when plants treated with *F. benghalensis* aqueous extracts as compared to controls in maize plant. However, mung bean showed improved seedling weight with *F. benghalensis* aqueous extracts at different concentrations. Sunflower seedling weight was highest with 25% concentration compared to control. However, 50 and 100% concentration showed reduced seedling weight (Table 2).

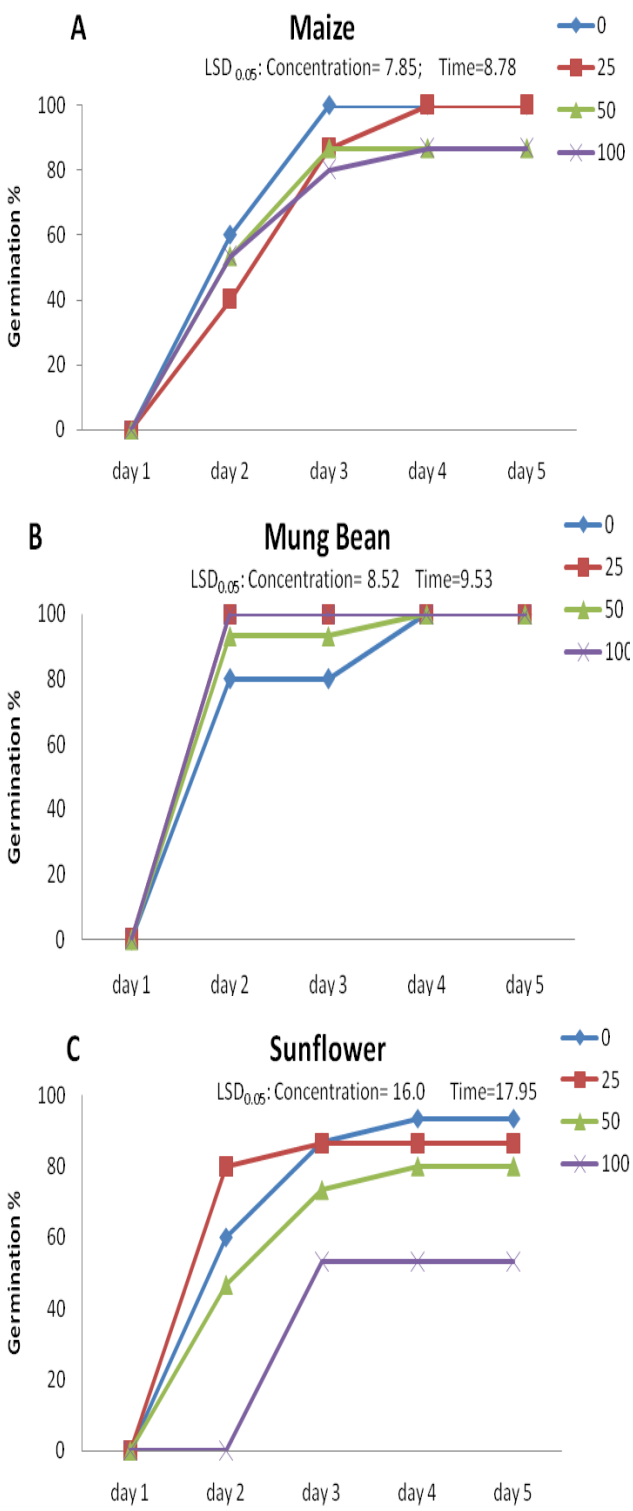

Fig. 1. Effect of *Ficus benghalensis* leaves extracts on germination percentage of Maize, Mung bean and Sunflower.

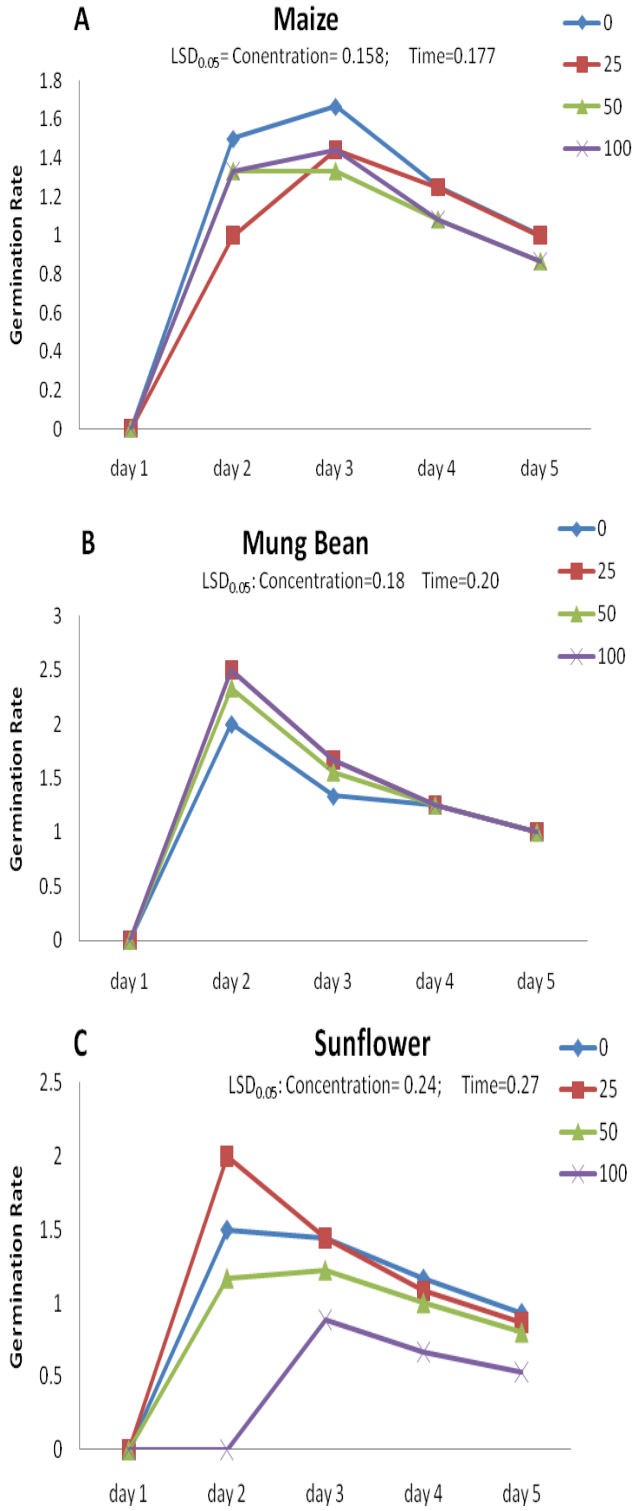

Fig. 2. Effect of *Ficus benghalensis* leaves extracts on germination rate of Maize, Mung bean and Sunflower.

DISCUSSION

Biochemical changes during seed germination provide basic frame work for subsequent growth and development. Abugre *et al.* (2011) used *Eucalyptus grandis* leaves extract for seed germination of *Vigna ungiculata* and observed that germination was promoted but radicle and plumule development were inhibited by root extracts of all the trees. Previously, it is reported that aqueous extract of leaves and bark of *Ficus benghalensis* inhibited seed germination in *Vigna radiata* (Jayakumar *et al.*, 1998). Different weeds extracts like *Glycyrhiza glabra*, *Sorghum halepense* and *Reseda lutea* enhanced seed germination of chickpea by 95, 94 and 93 %, respectively (Kadioglu *et al.*, 2005). Seed germination is dependent on concentration of aqueous extracts, higher concentration exhibited greater allelopathic potential than the

lower concentrations (Siddiqui *et al*., 2009). Researchers observed that allelopathy is a kind of stress which may be increased the amount of chlorophyll content resulting in increasing efficiency of photosynthesis (Salisbury and Ross, 1991). The best indicator of allelopathic effects of plant extracts was root length due to the reason they are more sensitive to phytotoxic compounds as compared to hypocotyl. Nishida *et al.* (2005) observed that the permeability of allelochemicals to root tissues was greater than shoot tissues. Dhole *et al.* (2013) observed that the leaves extract of *Euphorbia hirta* gave stimulatory effect on seed germination, seedling emergence, root length and shoot length followed by *Portulaca oleracea.* Allelochemicals from *Ficus* species reported to inhibit the growth by altering biochemical changes in bloom-forming algae *Chlorella pyrenoidosa*, including, change in reactive oxygen, species, reduction in photosynthetic ability and cell membrane penetrability (Jiang *et al*., 2014). In this study, *Ficus benghalensis* aqueous extract gave inhibitory response on seed germination, root elongation and seedling weight of maize, mung bean and sunflower. However, further investigation should be carried out to investigate the mechanism of inhibition on these economically important crops. Isolation and identification of allelochemicals present in *Ficus benghalensis* should be investigated which can be used as natural herbicide in controlling weeds.

Table 1. Effect of *Ficus benghalensis* leaves extracts on germination indices in Maize, Mung bean and Sunflower.

	Treatments	Germination velocity	Mean germination time	Germination index
Maize	0	0.419 ± 0.02	2.400 ± 0.11	2.167 ± 0.1
	25	0.420 ± 0.01	2.733 ± 0.07	1.889 ± 0.15
	50	0.416 ± 0.04	2.450 ± 0.23	1.861 ± 0.14
	100	0.366 ± 0.01	2.383 ± 0.07	1.944 ± 0.03
	$LSD_{0.05}$	0.08	0.448	0.368
Mung bean	0	0.437 ± 0.06	2.400 ± 0.40	2.250 ± 0.25
	25	0.500 ± 0.00	2.000 ± 0.00	2.500 ± 0.00
	50	0.472 ± 0.03	2.133 ± 0.13	2.417 ± 0.08
	100	0.500 ± 0.00	2.000 ± 0.00	2.500 ± 0.00
	$LSD_{0.05}$	0.111	0.687	0.43
Sun flower	0	0.425 ± 0.04	2.400 ± 0.23	2.028 ± 0.07
	25	0.485 ± 0.02	2.067 ± 0.07	2.111 ± 0.11
	50	0.417 ± 0.05	2.467 ± 0.29	1.694 ± 0.23
	100	0.222 ± 0.11	2.000 ± 1.00	0.889 ± 0.44
	$LSD_{0.05}$	0.21	1.74	0.85

Table 2. Effect of *Ficus benghalensis* leaves extracts on seedling growth of Maize, Mung bean and Sunflower.

	%	Shoot length (cm)	Root length (cm)	Seedling weight (g)
Maize	0	6.167 ± 0.66	6.867 ± 0.29	0.229 ± 0.05
	25	4.167 ± 0.69	4.340 ± 0.71	0.077 ± 0.02
	50	3.167 ± 0.09	3.833 ± 1.29	0.058 ± 0.02
	100	4.867 ± 0.64	7.007 ± 1.91	0.131 ± 0.04
	$LSD_{0.05}$	1.88	3.96	0.11
Mung bean	0	5.113 ± 0.39	7.067 ± 0.33	0.136 ± 0.02
	25	5.200 ± 0.2	7.047 ± 1.22	0.122 ± 0.01
	50	5.607 ± 0.16	11.180 ± 0.81	0.194 ± 0.01
	100	5.720 ± 0.46	10.253 ± 2.25	0.158 ± 0.02
	$LSD_{0.05}$	2.38	4.42	0.05
Sun flower	0	3.667 ± 0.40	4.347 ± 0.25	0.136 ± 0.03
	25	3.253 ± 0.35	3.653 ± 0.61	0.151 ± 0.03
	50	2.107 ± 1.05	2.913 ± 0.25	0.098 ± 0.02
	100	3.353 ± 0.71	1.760 ± 0.93	0.067 ± 0.03
	$LSD_{0.05}$	2.24	1.9	0.09

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