ORIGINAL RESEARCH

ALLELOPATHIC EFFECT OF MUNGBEAN EXTRACT ON GERMINATION AND SEEDLING GROWTH OF MUNGBEAN, SWEET CORN AND OKRA

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ABSTRACT
The experiment was conducted (from 14th June to 9th October 2015) at the experimental farm and laboratory of Inst. of sustainable Agro technology, University Malaysia Perlis, Padang Besar, Perlis, Malaysia, with the objective of assessing the effect of mungbean extract on germination and seedling growth of mungbean, sweet corn and okra. Aqueous extract (fresh, dry) at vegetative stage were used and water as control. Mungbean plants have taken in different duration namely fresh and after 2 weeks from drying at 40°C. The experiments were randomly distributed and according to Design of Randomized Complete (RCD), with five replicates. The results showed dry extract significantly retarded the germination of all tested plants except sweet corn compared to control, but fresh extract had variable effects. Similarly, dry extract significantly reduced number of roots, total root length and hypocotyl and shoot length of mungbean, sweet corn and okra seedlings. This variation occurred as a result of effect of extract type (fresh, dry) and differential behavior of crops in response to water extract.

KEYWORDS: Dry, Fresh, Inhibition, Seeds

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1. INTRODUCTION

The direct or indirect, stimulatory or inhibitory effects of plants on each other through the release of chemicals into the environment are referred to as allelopathy[1]. The allelochemicals from the donor plants pose inhibitory[2]as well as stimulatory[3]allelopathic effects on germination and growth of recipient plants. Stimulatory and inhibitory allelopathic effect depends upon the concentration of allelochemicals[4]. Higher concentrations of allelochemicals have been observed to have inhibitory effect[5], while lower concentrations exert stimulatory allelopathic effect on seed germination and growth of plant[6]. The allelochemicals were commonly found in living plant exudates, volatile compounds released from leaves, decomposing plant residues and leaf leachates[7]. In field conditions, the allelochemicals are released mostly in the form of leachates from plant residues[8]. Allelopathic interactions are primarily based on the synthesis and release of secondary metabolites by higher plants that initiate a wide array of biochemical reactions, which induce several biological changes. However, many of these are yet to be understood. In nature, many plant species grow together and interact with each other by inhibiting or stimulating the growth and development through allelopathic interactions. In any ecosystem, the dominant plants growing within it are exhibited in the form of pure stands or monothickets. Such ecosystems always show the zones of inhibition around them [9, 10].

Mungbean is important pulse crop having high nutritional values and rich in protein content[11,12]. Mungbean is affected by its own toxic exudates or by phytotoxins produced when crop residues decompose in the soil[13]. Continuous cropping of mungbean can lead to plant growth inhibition. Allelochemicals from mungbean inhibit of as much as 10–25% of crop growth when mungbean is planted following a previous crop of mungbean. Mungbean plants are allelopathic and their surrounding soil is oftentoxic[14]. Seed yields of mungbean and sesame when grown under mixed cropping with variable seeding rates were less than their sole crop yields but the combined yields or equivalent yields of mungbean and sesame from mixed cropping were more than the sole crop yield of either mungbean or sesame[15]. A three-year study in wetland transplanted rice, using a rice-mungbean cropping sequence revealed that the population of lowland weeds, like *Cyperus difformis*, was drastically reduced by the introduction of a relay crop of mungbean in the sequence[16].Mungbeanallelochemicals inhibited germination and reduced the root length and dry matter of lettuce, but seemed to stimulate the seed germination and shoot growth of *Echinochloacrusgalli*[17].The pot experiment indicated that the germination and plant height of the subsequent crops were inhibited.

Justify with use as green manure therefore, the objective of this study was to ascertain the effects of aqueous extracts of mungbean plant on seed germination and seedling growth of mungbean, sweet corn and okra.

2. MATERIALS AND METHODS

The experiment was conducted (from 14th June to 9th October 2015) at the experimental farm and laboratory of Inst. of Sustainable Agrotechnology, University Malaysia Perlis, Padang Besar, Perlis, Malaysia.

2.1 Sample preparation

Plants were dried at 40°C for 2 weeks in the oven. Twenty grams was placed in 250 mL conical flask and added distilled water till the volume became 200 mL (giving concentration of 10%, or 100 g L^{-1}, as recommended by[18]). The mixture was stirred for ten minutes and left in at room temperature for 48 h. The extracts were filtered with two layers of cheese cloth followed by WhatmanNumber1 filter paper. Extracts were kept at 5°C in the refrigerator till use. The filtrates were taken out of the refrigerator 24 h before being used experimentally, in order to achieve room temperature.

2.2 Extracts from fresh plants

Mungbeanplants were harvested at vegetative stage (37 daysafter planting), cut into small pieces. Twenty grams of plant was added to 200 mL of distilled water (giving the ratio of 1:10, w/v).The mixture was

shaken for 10 min and then left at room temperature for 48 h. Filtration was like that of oven dried samples.

2.3 Germination and seedling growth bioassays

Mungbean, sweet corn and okra were used as test crops. Ten seeds per treatment were placed evenly in sterile 9 cm petri dishes lined with two layers of filter papers. Then 8 mL of extract treatments was applied to each petri dish and water was used as control. The experiment was conducted under dark condition with minimum exposure to light during data collection. Four days after treatment application, germination was determined by counting the number of seed germinated in each petri dish and expressed in percentage. The 5th day, number of roots/seedling, total root length and shoot length of sweet corn and hypocotyl length of mungbean and okra was measured from four randomly selected seedlings. The percentage of inhibition was calculated following the formula by[19].

% inhibition = [(control-extract)/control] x100, by which negative sign shows stimulation and positive sign shows inhibition.

2.4 Statistical analysis

The bioassay experiment was designed in factorial CRD (fresh, dry extractand water as control)and replicated five times. The analysis of variance was carried out using SAS program (version 9). Mean values were separated based on Duncan's at 0.05 probability levels.

3. RESULTS

3.1Germination percentage and Inhibition:

Effect of fresh aqueous extract of mungbean on germination of mungbean, sweet corn and okra was highest as compared to control but was not significant with control with mungbean and okra (Table 1). Dry extract showed increase significant for sweet corn but not significant with control. By contrast dry extract gave 62% and 77.5% lower values for mungbean and okra, respectively, and insignificant with control for sweet corn.

For dry extract, it was significantly inhibited, mungbean (32.6%) and okra (13.8%) while it had stimulatory effect to sweet corn (36%) (Table 1).However, fresh extracts was stimulatory to mungbean, sweet corn and okra (6.5%, 48% and 2.22%), respectively (Table1).

Table 1. Effect of mungbean extracts on germination percentage of mungbean, sweet corn and okra

Treatments	Mungbean		Sweet corn		Okra	
	Germination (%)	Inhibition (%)	Germination (%)	Inhibition (%)	Germination (%)	Inhibition (%)
Control	92 a		50 b		90ab	
Fresh	98 a	- 6.5	74 a	-48	92.5 a	-2.22
Dry	62 b	32.6	68a	-36	77.5 b	13.8

*The values of the same letter to each character which are not different significantly to Duncan test of different borders in level (5%)

3.2 Number of roots and total root length: Extract of dry extract indicated the presence of inhibitory substances as indicated by reduced number and total root length of mungbean, sweet corn and okra, respectively (Table 2). But fresh extract and control showed variable effects on mungbean,sweet corn and okra, respectively, that could be due to reduced concentration of the substances.

Table 2. Effect of mungbean extracts on number of roots and total root length

Treatments	Mungbean		Sweet corn		Okra	
	Number of roots/seedling	Total root length/seedling (cm)	Number of roots/seedling	Total root length/seedling (cm)	Number of roots/seedling	Total root length/seedling (cm)
Control	9.6 b	3.5b	5.1 a	8.1 a	11.4 a	3.4a
Fresh	12.2 a	4.9 a	5.2 a	6.7 b	10.5 a	3.9 a
Dry	0c	0 c	5.6 a	4.5 c	0 b	0 b

*The values of the same letter to each character which are not different significantly to Duncan test of different borders in level(5%).

From Table 3, dry extract showed significant reduction of hypocotyl length of mungbean, okra and shoot length of sweet corn. But fresh extract and control significantly increased the hypocotyl length of mungbean, while control significantly increased the shoot length of sweet corn. Fresh extract, however significantly increased the hypocotyl length of okra.

Table **3. Effect of mungbeanextracts on Shoot length of sweet corn and hypocotyl length of mungbean and okra.**

Treatments	Mungbean	Sweet corn	Okra
	Hypocotyl length/ seedling (cm)	Shoot length/ seedling (cm)	Hypocotyl length/ seedling (cm)
Control	8.07 a	6.2 a	4.5b
Fresh	8.7 a	4.5 b	6.3 a
Dry	0b	1.6 c	0c

*The values of the same letter to each character which arenot different significantly to Duncan test of different borders in level (5%)

4. DISCUSSION

4.1 Germination percentage

The dry plant extracts were more phytotoxic in comparison to the fresh extract and this probably was due to synthesis and accumulation of more potential phytochemicals in plants after drying[20]. In this regard[21] reported that dry aqueous extracts of sunflower were more phytotoxic than fresh aqueous extracts on germination of wheat and maize. Similarly[20]fresh extract of *Hyptissu aveolens* leaves was better than extract of dry leaves on germination of *Parthenium hysterophorus* L.

4.2 Number of roots and total root length

Dry extract indicated the presence of inhibitory level of phytochemicals as seen in reduced number and total root length of mungbean and okra. But for number of root of sweet corn, the variable effect could be due to difference in genetics and resistance to extract because dry extract were both inhibitory. The phytochemical effects probably depended upon the freshness and dryness of the material. It was obvious that dried extract were more inhibitor than fresh and that dried extracts were more toxic than fresh[22]. Our findings agree with many other similar studies that have also shown differential toxicity of aqueous extracts from other plants[23,24,25,26].

4.3 Shoot length of sweet corn and hypocotyl length of mungbean and okra

This present study showed that fresh aqueous extract of mungbean may contain phytochemicals that performed stimulatory function. The stimulatory functions of these chemicals were evident in the significant enhancement of the growth parameters (number of root, total root length and shoot height) of older extracts [27].These results were in agreement with published reports on sunflower allelopathy against wheat and maize [21], and a similar growth promoting effect on wheat seedlings was reported where application of senna mulching was the phytochemical source[28].

4.4 Effect of extract on plants:

Water extract of mungbean (Table 1, 2 and 3) affected germination and seedling growth of mungbean, sweet corn and okra. These might be due to differential behavior of crops in response to water extract. It has been observed that different crops respond differently to the same type of allelochemicals[29]. Our results were supported by[30]Differential response of maize, wheat and rice to water extracts of *Ageratum conyzoides* and *Eupatorium adenophorum*were in support of this study. Where germination and seedling growth of wheat and rice was affected more than maize. Similarly, water extract of *Hyptissuaveolens* against *Pennisetum setosum* and *Mimosa invisa* seedlings were assessed, germination and seedling growth of *P. setosum* was more susceptible than *M. invisa*[31]Also were found *Vigna sativa*of differently affect germination percentage, germination index, shoot length and seedling dry weight of mungbean and mashbean[32].

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5. CONCLUSIONS

Results showed that phytochemicals produced from extracts of fresh and dry mungbean plant affected germination and growth of mungbean, sweet corn and okra. Most reduction was on germination and growth of mungbean, sweet corn and okra by extract from dry mungbean plant.

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