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ALLELOPATHIC POTENTIAL OF *SAPINDUS MUKOROSSI* GAERTN TESTED AGAINST *PENNISETUM AMERICANUM* (L.) LEEKE, *SETARIA ITALICA* (L.) BEAUV. AND *LACTUCA SATIVA* L.

BARKATULLAH[1*], IMTIAZ AHMAD[3*], MUHAMMAD IBRAR[2] AND GHULAM JELANI[2]

[1]*Department of Botany, Islamia College Peshawar, Pakistan*
[2]*Department of Botany, University of Peshawar, Pakistan*
[3]*Department of Botany, Bacha Khan University, Charsadda, Pakistan*
**Corresponding author e-mail: bu_barq@yahoo.com; imtiazahmad9310@yahoo.com*

Abstract

Sapindus mukorossi Gaertn, locally named as soap nut tree is a deciduous plant reaching up to the 20 m height. Present study is designed to investigate allelopathic potential of *S. mukorusii* through its aqueous extracts against *Pennisetum americanum* (L.) K. Schum., *Setaria italica* (L.) P. Beauv. and *Lactuca sativa* L. The effect of aqueous extracts of leaves and fruits in different concentration (5%, 10%), hot water extracts, soil intoxication and litter was observed on germination, fresh and dry weight, moisture content and overall growth of test species. Plant extracts significantly inhibit germination rate and overall growth of all the test species. Activity of extract were found dependent on concentration and soaking duration of extract, thus highest activities were recorded for extracts with 10% concentration with 72 hours soaking duration. *L. sativa* was found most susceptible in regard of germination. Plumule length of *S. italica* was most inhibited. The effect of both cold and hot water extracts showed maximum activities against the radicle lengths of *S. italiccertaina* and *P. americanum* while L. sativa was found least susceptible. Soil intoxication and letter showed maximum inhibitory activity against the *L. sativa.* The study thus reveals that the S. *mukorusii* is significantly allelopathic to towards the test species and inhibits both their germination and overall growth.

Key words: Allelopathic potential, Inhibition, *Sapindus mukorusii*, *Penasatum*, *Setarea*, *Latuca*.

Introduction

Allelopathy is an ecological phenomenon which affects directly or indirectly the normal activities of neighbouring plants through the release of allelochemicals in environment. The effects of these allelochemicals on other plants may be detrimental or beneficial (Rice, 1979; Peneva, 2007; Zeng *et al.,* 2008). The detrimental potential of allelopathic substances can be utilized for weeds and pest management. Another important role of these substances is the management of certain ecological processes and distribution of plants (Samreen *et al.,* 2009; Hussain & Ilahi, 2009). Allelopathic suppression is a complex phenomenon and may be due to the interaction of various groups of chemical compounds like flavonoids, alkaloids, phenolic compounds and other secondary metabolites. Usually the allelopathic suppression of a plant is due to the synergetic effects of different compounds. Environmental conditions also modify the allelopathic effect of plants. These allelochemical may inhibit germination rate, overall growth and nutrients uptake of susceptible species (Rizvi *et al.,* 1999; Marwat & Khan, 2006).

Weeds reduce production of many crops in almost every agricultural system due to their higher frequency. Mechanical procedures and various synthetic herbicides are used to control their growth. Both these methods have shortcomings. Mechanical procedures are laborious and the extensive use of herbicides is responsible for many environmental hazards. Moreover, the development of resistance by weeds and the cost of synthetic herbicides are other important issues (Oerke *et al.,* 1995; Batish *et al.,* 2007; Kordali, 2009).

Many plant species such as *Terminalia bellirica, T. chebula, Aeglem armelos* (Thapaliyal *et al.,* 2008), *Cenchrus ciliaris* and *Bothriochloa pertusa* (Hussain *et al.,* 2010), *Dodonaea viscosa* (Barkatullah *et al.,* 2010); *Juniperus ashei* (Young & Bush, 2009), *Cassia angustifolia* (Hussain *et al.,* 2007), *Cenchrus ciliaris* and *Bothriochloa pertusa* (Hussain & Ilahi, 2009), Celtis australis (Ahmad *et al.,* 2014), *Mallotus philippinensis* (Sher *et al.,* 2014) posses potential allelpathic effects on weeds and other plants and can be used as bioherbicides.

The present work is intended to evaluate the allelopathic potential of *Sapindus mukorossi* Gaertin against three test species for their possible use as bio herbicide.

Materials and Methods

Mature leaves and fruit of *Sapindus mukorossi* Gaertin were collected from University campus Peshawar, shade dried at room temperature (25˚C-30˚C) and powdered. Clean and Sterilized glassware were used for experiments. All the results were statistically analyzed through one way ANOVA using SPSS.

i. Effect of aqueous extracts: Five and 10 gm of plant parts were separately soaked in 100 ml distilled water at 25˚C for 24, 48 and 72 hours and filtered to get aqueous extracts. pH of extracts were adjusted to 6.5. These extracts were tested against *P. americanum, S. italica* and *L. sativa* used as the test species on double layers of filter paper in Petri dishes following standard filter paper bioassay (Hussain *et al.,* 2010). The filter papers were separately moistened with leaves and fruit extracts, while distilled water was used as control. For each treatment, five replicates, each with 10 seeds were selected. The Petri dishes were incubated at 25˚C. After 72 hours, the percentage germination, length of plumule and radicle were recorded.

ii. Effect of hot water extracts: Five gm dried leaves and fruit of *S. mukorossi* were separately boiled in 100 ml water for 5 minutes and filtered. The room cooled extracts were tested against *P. americanum, S. italica* and *L. sativa.*

iii. Effect of litter: Five gm litter of plant containing leaves and fruits were placed over a single sheet of filter paper in a Petri dish and moistened with sufficient distilled water. In control treatment fine pieces of filter paper were used.

iv. Effect of soil intoxication: Five gm crushed dried leaves and fruit materials were placed separately in plastic glasses which were half filled with sterilized moist sand. For each treatment five replicates, each with 10 seeds were used. The plastic glasses were incubated at 25˚C and observed for germination. After 7 days growth of plumule and radical were measured.

Results and Discussion

Effect of aqueous extracts: Aqueous extracts of *Sapindus mukorossi* significantly reduced the germination rate and overall growth of all the three test species at both concentrations (5% and 10%) and soaking durations (24 hr, 48 hr and 72 hr) though extracts with higher concentration (10%) and longer soaking durations (72 hr) were found more inhibitory (Table. 1). Highest inhibition of germination was recorded for *L. sativa*, while *P. americanum* was found least susceptible species regarding germination rate (Fig. 1). Highest reduction in plumule length was observed for *S. italica* followed by *P. americanum* (Fig. 2). Varied effects of aqueous extracts on radicle length were observed for the three test species. At low concentration (5%), extracts were found to be more inhibitory towards *L. sativa*, while at higher concentration (10%), *S. italica* was found more susceptible (Fig. 3). Aqueous extracts of *L. camara* also have the potential to inhibit the germination and overall growth of these test species (Hussain *et al.,* 2011). Inhibition of radicle is likely due to the presence of saponin which was reported by Pelegrini *et al.* (2008) in genus *Sapindus*. Root growth inhibition is one of the prominent effects of allelochemicals exposure which is normally associated with deposition of lignin in premature cell walls (Suzuki *et al.,* 2008). The effects of *S. mukorossi* on test species are just like synthetic herbicides that clearly demonstrate the efficiency of plant as bio herbicide. Moreover, the results indicate that by increasing the soaking duration, increase in the efficiency of extracts was noted. Such trends were also found in *Azadirachta indica* (Xuan *et al.*, 2004; Ashrafi *et al.,* 2008) and *Tamarindus indica* (Parvez *et al.*, 2003).

Effects of Hot water extracts: Hot water extracts of both leaves and fruits significantly reduced the germination rate, radicle and plumule lengths of all the three test species (Table.1). Highest % inhibitions were recorded for germination rate, plumule and radicle lengths of *S. italica* followed by *P. americanum* and *L. sativa* was least affected (Figs. 1, 2, 3). Hot water procedure reduces the time required for extraction (Barkatullah *et al*., 2010). The present work suggests that hot water extracts are more inhibitory than cold water extracts. This phenomenon was also observed by Chung *et al*. (2007) Peneva (2007), Hussain *et al*. (2004) and Hussain & Ilahi (2009) while working on allelopathic potentials of *Coffea arabica* L., *Xanthium strumarium* L., *Broussonetia papyrifera* Vent., *Cenchrus ciliaris* Linn., *Bothriochloa pertusa* (L.) A. Camus.

Effects of soil intoxication and litter: Soil intoxicated separately with fruits and leaves significantly inhibited the germination rate and plumule and radicle lengths of all the three test species (Table. 2). Effects of soil intoxications were found more severe as compared to letter (Fig. 4). Highest % inhibitions for germination rate, plumule and radicle lengths were recorded for *L. sativa* (Fig. 4).

Table 1. Effect of aqueous extracts of *Sapindus mukorossi* on germination, plumule and radical length of *P. americanum, S. italica* and *L. sativa.*

Treatments	Test species								
	Pennisetum americanum			*Setaria italica*			*Lactuca sativa*		
	% Ger	PL	RL	% Ger	PL	RL	% Ger	PL	RL
Leaves 05% with 24 hr S.D	36.0*	10.96*	13.10*	36*	2.48*	2.02*	18*	3.06*	0.12*
Leaves 05% with 48 hr S.D	32.0*	05.36*	04.68*	30*	3.28*	1.52*	16*	3.58*	0.20*
Leaves 05% with 72 hr S.D	36.0*	04.38*	03.10*	30*	3.48*	1.34*	16*	3.86*	0.28*
Leaves 10% with 24 hr S.D	42.0*	10.86*	12.36*	30*	2.12*	1.98*	36*	4.22*	1.60*
Leaves 10% with 48 hr S.D	32.0*	05.12*	04.16*	30*	3.26*	1.50*	32*	5.20*	2.16*
Leaves 10% with 72 hr S.D	32.0*	04.42*	03.80*	26*	3.44*	1.30*	20*	2.32*	1.70*
Fruit 05% with 24 hr S.D	48.0*	09.98*	12.20*	32*	2.48*	1.24*	20*	2.77*	0.04*
Fruit 05% with 48 hr S.D	40.0*	05.00*	03.90*	34*	2.86*	0.90*	16*	3.52*	0.12*
Fruit 05% with 72 hr S.D	34.0*	03.12*	02.98*	34*	2.78*	0.78*	16*	3.64*	0.20*
Fruit 10% with 24 hr S.D	42.0*	08.18*	10.48*	32*	2.48*	1.24*	28*	3.80*	0.80*
Fruit 10% with 48 hr S.D	36.0*	04.68*	03.68*	32*	2.48*	0.86*	34*	4.40*	1.76*
Fruit 10% with 72 hr S.D	34.0*	03.12*	03.16*	28*	2.78*	0.78*	26*	2.80*	0.70*
Hot water leaves ext	33.0*	07.96*	10.89*	29*	2.18*	0.47*	56*	14.02*	10.60*
Hot water fruit ext	38.0*	09.42*	11.84*	31*	1.65*	0.64*	32*	9.42*	8.14*
Control (distilled water)	93.9	50.40	47.86	98.33	61.54	47.87	100	25.25	15.18

* = Significant at significance level $\alpha < 0.01$ (99%), S.D= Soaking duration, ext= extract, Ger= germination, PL= plumule length, RL= Radical length. Each value in table is grand mean of 5 replicates, each having 10 seeds

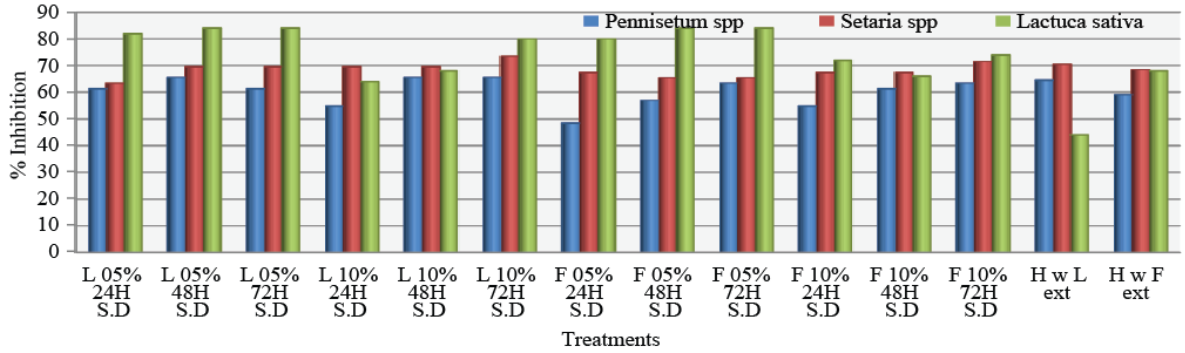

Fig. 1. Effect of aqueous extracts of *S. mukorossi* on germinatin of *P. americanum, S. italica* and *L. sativa*
S.D = Soaking duration, L = Leaf extract, F = Fruit extract, H = Hours

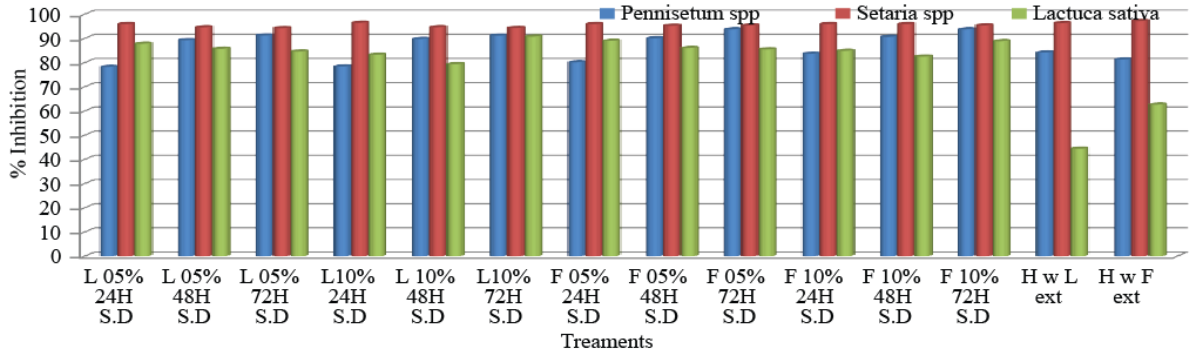

Fig. 2. Effect of aqueous extracts of *S. mukorossi* on Plumule length of *P. americanum, S. italica* and *L. sativa* L.
S.D = Soaking duration, L = Leaf extract, F = Fruit extract, H = Hours

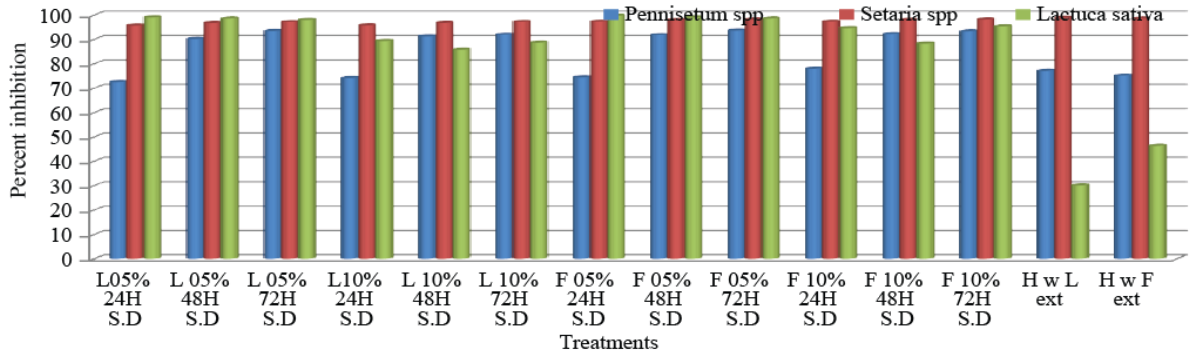

Fig. 3. Effect of aqueous extracts of *S. mukorossi* on radicle length of *P. americanum, S. italica* and *L. sativa.*
S.D = Soaking duration, L = Leaf extract, F = Fruit extract, H = Hours, Hw= hot water extract

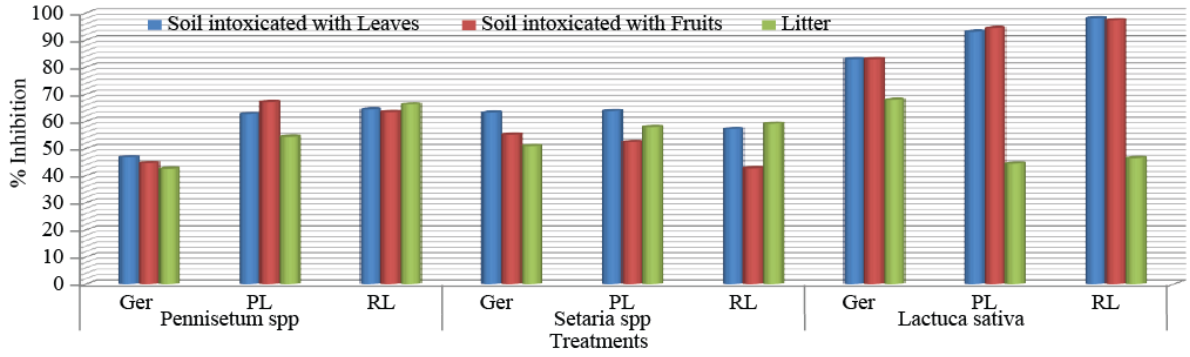

Fig. 4. Effects Soil intoxication and litter of *S. mukorossi* on germination, plumule and radical length of *P. americanum, S. italica* and *L. sativa.*

Table. 2. Effects Soil intoxication and litter of *Sapindus mukorossi* on germination, plumule and radical length of *P. americanum, S. italica* and *L. sativa*.

Treatments	Test species								
	Pennisetum americanum			*Setaria italica*			*Lactuca sativa*		
	% Ger	PL	RL	% Ger	PL	RL	% Ger	PL	RL
Soil intoxicated with leaves	50.00*	18.75*	22.28*	36.00*	21.40*	20.46*	17.00*	1.74*	0.29*
Soil intoxicated with fruits	52.00*	16.48*	22.90*	44.00*	28.20*	27.42*	17.00*	1.40*	0.40*
Litter	54.00*	22.92*	21.12*	48.00*	24.88*	19.54*	32.00*	14.02*	8.14*
Control	93.99	50.26	62.74	97.99	59.28	47.88	100	25.26	15.22

* = Significant at significance level $\alpha < 0.01$ (99%), S.D= Soaking duration, ext= extract, Ger= germination, PL= plumule length, RL= Radical length. Each value in table is grand mean of 5 replicates, each having 10 seeds

Conclusion

Aqueous extracts and soil intoxicated with litter of *S. mukorossi* possess strong allelopathic potential towards the test species. The present results recommend their use as bioherbicides against these weeds on commercial scale and also suggest isolating and characterizing the active constituents of the plant responsible for inhibitory effects.

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