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Allelopathic potential of *Sesbania grandiflora* Pers. on germination of *Cajanus cajan* Millsp. (Redgram) varieties

Chinnappan Alagesaboopathi*, Mahalingam Deivanai

Department of Botany, Government Arts College (Autonomous), Salem-636 007, Tamilnadu, India

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Abstract

In the present study, the leaf extracts of *Sesbania grandiflora* Pers. showed inhibitory effects on seed germination, plumule length, radicle length, fresh and dry weight in redgram (*Cajanus cajan* Millsp. var. *Vamban* 2 and *Cajanus cajan* var. *Vamban* 3). The allelopathic effect of leaf extracts of *S. grandiflora* decreased the seed germination of *Cajanus cajan* var. *Vamban* 2 and var.*Vamban* 3 with increase of extracts concentration. The extracts also inhibited the plumule and radicle length of *Cajanus cajan* var. *Vamban* 2 and var. *Vamban* 3 seedlings with increase of *S. grandiflora* extracts concentration. The result revealed that the inhibitory and stimulatory effect may be due to the presence of these allelochemicals like sterols, saponins, phenols and tannins etc., in the aqueous leaf extracts of *S. grandiflora* from the present investigation.

*Corresponding Author: Chinnappan Alagesaboopathi ✉ alagesaboopathi@rediffmail.com

Introduction

Allelopathy refers to the chemical inhibition of one plant by another. Allelopathic chemicals can be present in any part of the plant. They can be found in roots, stems, leaves, pollen, flowers, fruits seeds or sometimes found in just one or two parts (Zeng *et al.,* 2008). The toxic chemicals may inhibit shoot/root growth, they may inhibit nutrient uptake, or they may attack a naturally occurring symbiotic relationship thereby destroying the plants usable source of a nutrient (Conn, 1980).

Mathela (1994) reported that the secondary metabolites (glycosides, steroids, flavonoids and diterpenoids) of some medicinal and aromatic plants accounted for allelopathic activity (Mathela, 1994). Sidhu and Hans (1988) observed that as the concentration of extracts of *Eucalyptus* increased, the growth of the plant decreased. Phlomina and Srivasuki (1996) reported that leaf leachates of five multipurpose tree species (*Sesbania grandiflora, Derris indica, Casia siamea, Eucalyptus camaldulensis* and *Acacia nilotica*) had varying degrees of inhibitory and stimulatory effects on germination percentage. Hunshal *et al.,* (2000) observed the allelopathic studied and chemical composition of tree species. Alagesaboopathi (2011) reported that leaves, stem and root extracts of *Andrographis paniculata* significantly decreased germination and seedling growth in *Sesamum indicum*. There are various reports allelochemicals from this plant negatively concern plants like *Allium cepa*, *Helianthus annus* and some vegetables (Rashedmohasel and Mousavi, 2007).

Sesbania grandiflora Pers. is a soft wooded tree belonging to the family Paplionaceae commonly known as Sesbania is often planted for its edible flowers and pods in tropical countries. It is supposed to have originated either in India or Southeast Asia and grows primarily in hot and humid areas of the world. It was certainly introduced into the Philippines. This tree occurs also in India to the Mascarene Islands, through Malaya to tropical Australia, and is planted in other tropical countries (Anonymous, 1980; Kirtikar and Basu, 1995). Locally it is known as agathi (Tamil). *Sesbania grandiflora* is cultivated in gardens and betel-vine plantations. The leaves are used as cooling, tonic and diuretic. (Narayan Das Prajapati *et al.,* 2004). Flowers are luxuriant in nutrients and are used as vegetables. The juice from the flower is used to manage headache. A decoction of this bark is used to cure small pox, tonic, febrifuge and astringent. Various parts of this plant are used in Siddha system of Indian traditional medicine for the remedy of a broad spectrum of diseases including fever, anemia, nasal catarh, bronchitis, inflammation, rheumatism and leprosy. The different parts of *Sesbania grandiflora* are used as medication for several ailments and sickness. Hence, in this investigation was carried out to determine the allelopathic effects of *Sesbania grandiflora* aqueous leaf extracts on the seed germination and seedling growth of *Cajanus cajan* var. *Vamban* 2 and *Cajanaus cajan* var. *Vamban* 3. This study was conducted under laboratory conditions.

Materials and methods

Mature fresh healthy leaves of *Sesbania grandiflora* were collected in December 2010 from Harur, Dharmpauri district of Tamilnadu. The freshly collected leaves were washed thoroughly in tap water, shade dried at root temperature (28^{o}C) for 10 days, then powdered in grinders and sieved. For leaf extract, 25 g leaf powder was soaked in 150 ml double distilled water for 24 h to get 25% extract. By dilutions with double distilled water 5, 10, 15, 20 and 25% concentrations of extracts were prepared.

The seeds of *Cajanus cajan* Millsp (var. *Vamban* 2 and var. *Vamban* 3) selected for the present study were procured from Tamilnadu Agricultural University, Coimbatore, Tamilnadu, India. The seeds of *Cajanus cajan* (Redgram) var. *Vamban* 2 and *Cajanus cajan* var. *Vamban* 3 were surface sterilized with 0.1% mercuric chloride for 1 min to remove the fungal

spores on the seeds. Then the seeds were washed with double distilled water for many times to remove the mercuric chloride. The seeds were soaked in various concentrations of extracts for 24 h. The experiment was done in 11 cm dia petriplates line with sterile cotton. Each petriplate contained 10 uniform sized seeds, while seeds double distilled water were maintained as control separately, which were irrigated with 20 ml distilled water on alternative days. The experimental design was a randomized complete block with three replicates for each treatment and control. The growth parameters germination percentage, radicle and plumule length, fresh weight and dry weight were determined on 12th day after germination. Each treatment of this experiment was carried out with three replications and repeated twice. Data obtained were subjected to analysis of variance (ANOVA).

Results and discussion

In the present investigation leaf aqueous extract of *Sesbania grandiflora* on *Cajanus cajan* var. *Vamban* 2 and *C. cajan* var. *Vamban* 3 seeds showed a gradual reduction in all parameters. The decrease in percent *C. cajan* var. *Vamban* 2 seed germination in the *S. grandiflora* extract treatments ranged between 21 to 81% compared to 92% germination in the control. The decrease in germination percentage of *C. cajan* var. *Vamban* 3 was found from 28 to 92% compared to 90% germination in the control. The seed germination, plumule length and radicle length was inhibited in all concentrations (Tables 1-2). The inhibitory effect was increased with increasing concentrations of the extracts and inhibition of the radicles was greater than that of the plumules. The inhibitory effect was concentration dependent. At the maximum concentration studied, a highest of 32% and 41% of reduction in seed germination was observed in leaf extracts on *Cajanus cajan* var. *Vamban* 2. At the higher concentration studied, a maximum of 30% and 39% of reduction in seed germination was noticed in leaf extracts on *Cajanus cajan* var. *Vamban* 3. Comparable trend was followed in plumule and radicle length. *C. cajan* var. *Vamban* 2 a highest of 50% and 33% reduction was recorded in plumule and radicle respectively. In *C. cajan* var. *Vamban* 3 a maximum of 55% and 32% reduction was noticed in plumule and radicle individually. The degree of retardation also increased with the raise in the concentrations of the extracts. Statistical analysis at five percent level (t-test) revealed that, apart from comparison between 5 and 25 g extract concentrations, there were no indicative differences in the growth length of radicle in the varying extract concentration as well as those of the control.

Table 1. Effects of *Sesbania grandiflora* aqueous extracts of leaf on germination and seedling growth of *Cajanus cajan* var. *Vamban* 2. Values are mean ± SE of 10 samples.

Extracts conc. (%)	Germination (%)	Radicle length (cm)	Plumule length (cm)	Fresh weight (g)	Dry weight (g)
Control	92 ± 9.5	5.8 ± 0.5	6.1 ± 0.4	0 ± 0.671	0 ± 0.28
5	81 ± 8.1	5.0 ± 0.1	5.3 ± 0.5	0 ± 0.086	0 ± 0.03
10	66 ± 8.6	4.3 ± 0.6	4.9 ± 0.2	0 ± 0.61	0 ± 0.03
15	48 ± 9.3	4.1 ± 0.2	4.5 ± 0.1	0 ± 0.65	0 ± 0.02
20	36 ± 8.4	2.6 ± 0.3	3.0 ± 0.2	0 ± 0.51	0 ± 0.02
25	21 ± 8.8	1.3 ± 0.1	1.6 ± 0.3	0 ± 0.47	0 ± 0.02

The leaf extracts of *S. grandiflora* also caused significant reduction in seedling growth of *C. cajan* var. *Vamban* 2 and *C. cajan* var. *Vamban* 3. The extracts not only reduced the plumule and radicle length of *C. cajan* var. *Vamban* 2 and *C. Cajan* var. *Vamban* 3 seedlings but also reduced the fresh and dry weight. The reduction of biomass was correlated with reduction in seedling growth. The reduction in the fresh and dry weight may be due to stunted and meagre vegetative growth of *C. cajan* var. *Vamban* 2 and *C. cajan* var. *Vamban* 3. The reduction may be to

phytotoxic property of phytochemicals presence in leaf aqueous extracts of *S. grandiflora* (Narwal, 1994).

The results of present study showed that the leaf extracts of *S. grandiflora* was inhibitory in both *C. cajan* var. *Vamban* 2 and *C. cajan* var. *Vamban* 3. Alagesaboopathi and Thamilazhagan (2010) reported that leaves and stem extracts of *Andrographis lineata* significantly decreased germination and seedling growth in balckgram (*Vigna mungo* var. T 9) and greengram (*Vigna radiata* var. CO 6) Similar results have been reported by Alagesaboopathi (2011).

Table 2. Effects of *Sesbania grandiflora* aqueous extracts of leaf on germination and seedling growth of *Cajanus cajan* var. *Vamban* 3. Values are mean ± SE of 10 samples.

Extracts conc. (%)	Germination (%)	Radicle length (cm)	Plumule length (cm)	Fresh weight (g)	Dry weight (g)
Control	90 ± 7.3	6.4 ± 0.1	6.0 ± 0.3	0 ± 0.653	0 ± 0.25
5	82 ± 6.2	5.1 ± 0.4	5.3 ± 0.1	0 ± 0.082	0 ± 0.03
10	73 ± 6.7	4.3 ± 0.4	4.8 ± 0.4	0 ± 0.66	0 ± 0.02
15	54 ± 3.5	4.1 ± 0.2	4.0 ± 0.1	0 ± 0.61	0 ± 0.02
20	42 ± 8.1	2.8 ± 0.7	2.4 ± 0.2	0 ± 0.48	0 ± 0.03
25	28 ± 8.3	1.4 ± 0.3	1.8 ± 0.4	0 ± 0.31	0 ± 0.02

Allelopathy has been implicated to be trustworthy in various cases for no germination, stunted growth and sometimes out right destroy of plants (Inderjit and Duke, 2003). Palani and Dasthagir (1998) reported a significant yield reduction in sesame, cowpea, horsegram and sorghum by of yield in many other crops, by aqueous leaf extract was reported only by few researchers. Sundaramoorthy and Katra (1991) observed a reduction in yield of cluster bean, Pearl Millet and Sesame by the aqueous leaf extracts of *Acacia tortilis*. Allelochemical activity of plants is measured by the sensitivity of roots in the biosassy (Heisey, 1990). The results are in alliance with previous studies reporting that effectiveness of receiver plants to allelochemicals was concentration dependent of inhibitory essences with a response threshold (Lovett *et al.,* 1989; An *et al.,* 2005. Ashrafi *et al.,* 2009). Salam and Noguchi (2010) reported that the extracts of allelopathic plants had more inhibitory effect on root growth than on hypocotyl growth because root is the first organ to absorb allelochemical from the environment. Furthermore, the permeability of allelochemicals to root tissue was reported to be greater than that to shoot tissue (Nishida *et al.,* 2005).

The aqueous leaf extracts of *S. grandiflora* showed inhibitory effects on seed germination, plumule length, radicle length, fresh weight and dry weight of *C. cajan* var. *Vamban* 2 and *C. cajan* var. *Vamban* 3. The *S. grandiflora* leaf extracts inhibited the germination and growth of *C. cajan* var. *Vamban* 2 and *C. cajan* var. *Vamban* 3 in the present investigation. Hence, they must have been responsible for the inhibition of seed germination, growth and dry matter accumulation of radicle and plumule of both the plants were progressively decreased with the increase in the concentration of the extract. Further studies are required to isolate and characterize the putative allelochemicals in *S. grandiflora* and the interaction that could be indicative for the observed inhibition of seed germination and plant growth.

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