



Original Research Article

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Screening of Allelopathic Activity of *Strychnos nux-vomica* L. on the Germination and Seedling Survival of *Solanum trilobatum* L. in Tamil Nadu, India

C. Alagesaboopathi*

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

*Corresponding author.

Abstract

The allelopathic effects of *Strychnos nux-vomica* L. on seed germination and seedling growth of medicinal plant *Solanum trilobatum* L. Leaf and bark aqueous extracts of *Strychnos nux-vomica* at 5, 10, 15, 20 and 25% concentrations were applied to effect their determine on seed germination and seedling growth of test plant under laboratory conditions. Germination and seedling growth tests were performed as CRD (Completely Randomized Design) with 3 replications. The aqueous extracts from leaf and bark had inhibitory effect on seed germination of *Solanum trilobatum*. The results showed that the extracts brought about considerable inhibition in the germination of *Solanum trilobatum* seeds and in the growth of its root length and shoot length. The allelopathic effect of leaf and bark extracts of *Strychnos nux-vomica* decreased the seed germination of *Solanum trilobatum* with increase in the extracts concentration. The extracts also inhibited the root length, shoot length and dry weight of *Solanum trilobatum* seedlings with increase in the extracts concentration compared with control treatments. Aqueous extract of leaves shows the higher inhibition while bark shows the minimum effect on *Solanum trilobatum*. These result revealed that the inhibitory effect potency be due to the presence of the allelochemicals in the extract of *Strychnos nux-vomica* from the present investigation. *Strychnos nux-vomica* leaf extracts were more detrimental than stem bark extracts. The evidence obtained could be used in the progress of bioherbicide for future in the field.

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Introduction

The term “allelopathy” coined by Molish (1937) popularly refers to any direct or indirect effect of the plant on the germination, growth or development of other plants, through the production of chemicals that avoid into the environment (Rice, 1984). Allelopathy is known as the effects of plant(s) on other plant(s) through the discharge of chemical compounds into the environment via leaching, evaporation, spread out from roots and

decomposition of plant residues; which has synergic or antagonistic effects such as auto toxicity and isolation (Rice, 1987; Weih et al., 2008).

Allelochemicals are plant secondary metabolites chiefly produced from medicinal and aromatic plants (Delabys et al., 1998); have been indentified, including the alkaloids, glycosides, phenolic acids, flavonoids, terpenoids, glucosinolates and coumarins. These chemical essences (Phytotoxic) are known to be exuded

by plants to decrease emergence or growth of the other plants; allelopathic effects of these compounds are often noted to occur early in the life cycle, causing inhibition of seed germination and seedling development. These compounds present a extensive extent of mechanisms of activity and interpretations of mechanisms of performance are complicated by the fact that particular compounds can have multiple phytotoxic effects (Einhellig, 2002).

Allelopathic effect of medicinal species is of particular attention in modern years (Han et al., 2008). Fujii et al. (2003) evaluated the allelopathic activities of 239 medicinal species using the "Plant Box Method" and 223 species of them were found to suppress tested plant development, whereas 17 species were enhancing lettuce radicle development. Gilani et al. (2010) also surveyed allelopathic effects of 81 Japanese medicinal plants to find out possible candidates as natural herbicides. Aziz and Fujii (2005) allelopathic potentialities of 14 medicinal plant species grown in plain areas of Pakistan with semi-arid conditions on growth of lettuce (*Lactuca sativa*).

Medicinal plants have inhibitory effects (Lin et al., 2003) on selected weeds and its allelochemicals inhibiting weed development. Therefore, it was easier to screen allelopathic plants from medicinal ones than other plants possibly because they have the efficiency to assemble particular metabolic compounds treating numerous disorders of mankind (Qasem and Hassan, 2003).

Some plants may suppress germination, emergence and subsequent development of other plants by exuding toxic essences. These essences are called allelopathic chemicals or allelochemicals and the method is called allelopathy (Rice, 1984). Allelopathic chemicals may be distributed widely among organs such as leaves, stems, barks, roots inflorescence, pollen, flowers, fruits and seeds sometimes found in just one or two of such organs (Zeng et al., 2008). Alagesaboopathi (2014) reported that as the concentration of extracts of *Erythroxylum monogynum* increased, the growth of the plant decreased, Mahmood Dejam et al. (2014) observed that leaves extracts of *Eucalyptus globulus* significantly decreased germination and seedling growth in egg plant (*Solanum melongena* L.).

There are many reports allelochemicals from this plant negatively concern plants like *Ampelocissus latifolia*, *Lantana camara*, *Leucaena leucocephala*, *Artemisia annua*, *Rosmarinus officinalis* and *Lavandula vera*

(Chaudhuri et al., 2015; Enyew and Raja, 2015, Kalpana and Navin, 2015, Rahim et al., 2015). *Strychnos nux-vomica* L. belongs to the family of Loganiaceae, is found predominantly distributed in India, Sri Lanka, Southeast Asia and Northern America. It is cultivated throughout India. The plant is popularly known as snake wood or Nux-vomica in English (Chitra et al., 2010) and Yetti or Kanjaram in Tamil (Matthew, 1983). In the Indian system of medicine, the medicinal properties of this species have been known for long time.

The seeds of *Strychnos nux-vomica* are utilized as stimulant, stomachic, purgative, febrifuge, aphrodisiac and antihelmentic (Warrier et al., 1996) and also in curing diabetes, skin disorders, paralysis, nervous disorders asthma, anaemia and constipation (Jain and Defilippis, 1991). The leaves are used for curing ulcers chronic wounds and the root bark in manage of cholera. The entire plant is used for treating eilepsy and digestive disorders. The plant possesses antitumour, anti-inflammatory, analgesic and also used as an antidote for snake poison (Grieve, 2007).

Solanum trilobatum is belongs to the family of Solanaceae. It is an important medicinal plant. *Solanum trilobatum* is a thorny shrub widely distributed in South India. *Solanum trilobatum* is an extensively used Indian traditional medicine to treat various diseases like bronchial asthma, tuberculosis and respiratory problems (Chopra et al., 1958; Govindhan et al., 2004). This plant is well known in Ayurveda and Siddha systems. The roots, berries and flowers are used to manage cough (Swathy et al., 2010). The leaf and bark are used to treat antibacterial and antifungal activities (Akshara et al., 2016).

To the best of my knowledge there is scarce information about the effects of allelochemicals on the seed germination dynamics and subsequent seedling growth of *Solanum trilobatum* L. (Thuthuvalai in Tamil). The aim of this study was to evaluate for the first time the possible effects of the *Strychnos nux-vomica* L. leaves and bark aqueous extract on the seed germination and seedling growth of *Solanum trilobatum* plants. Hence, the present research was carried out to determine the allelopathic effects *Strychnos nux-vomica* extracts on *Solanum trilobatum*. This study was conducted under laboratory conditions.

Materials and methods

Preparation of aqueous extract *Strychnos nux-vomica* plants which grew naturally in Pethampatti, Salem

district of Tamil Nadu, India. Leaf and stem bark were collected at their matured stage on January 20 and February 7, 2015, for the experiment. The parts were brought into the laboratory and each part of the fresh plant was cut into small pieces, shade dried and then ground separately with the help of electronic grinder and made to fine powder. For leaf and stem bark extract, 20 g. leaf and stem bark powder was soaked in 150 ml double distilled water for 48 hrs to get 24% extract, by dilutions with double distilled water 5, 10, 15, 20 and 25% concentrations of extracts were prepared.

Treatments and experimental design

Fresh seeds of *Solanum trilobatum* were collected from the Kanjamalai Hills and road sides of the Pethampatti. The seeds of *Solanum trilobatum* (Tamil – Thuthuvilai, English – Climbing Brinjal, Purple fruited Pea egg plant) were surface sterilized with 0.2% mercuric chloride for 1 min. to eliminate the pathogens on the seeds. Then the seeds were to remove the mercuric chloride. The seeds were soaked in various concentrations (5, 10, 15, 20 and 25%) of extracts for 24 hrs. The trial was done in 9 cm diameter lined with sterile cotton were used for germination trial. Each Petri dish contained 10 uniform sized seeds, while distilled water was added to the untreated control (0%). The treatments were arranged in a Completely Randomized Design (CRD) with three replicates kept at room temperature on laboratory bench. The whole experiment was repeated once.

Physical parameters

Seed germination counts were noted daily for fifteen

days. After fifteen days, the seedling root length (cm), shoot length (cm), fresh weight and dry weight were determined (mg). The root and shoot length were determined manually while the fresh weight and dry weight with the help of 4 digital balance of Shimadzu Corporation (Japan).

Statistical analysis

After twenty days, the seedling root length, shoot length, fresh weight and dry weight were determined. The data obtained were analysed by factorial analysis of variance (ANOVA) to conclude significant ($p < 0.05$).

Results and discussion

In the present study, leaf and stem bark aqueous extracts of *Strychnos nux-vomica* inhibited the seed germination of *Solanum trilobatum*. The inhibitory effect was increased with increasing concentration of the extracts. Maximum inhibitory effect was notable with concentrated leaf extracts. Highest inhibition (80%) was accounted with concentrated leaf extract. Leaf and stem bark aqueous extracts of *Strychnos nux-vomica* on *Solanum trilobatum* noted a moderate reduction in all parameters. The decrease in percent *Solanum trilobatum* seed germination in the *Strychnos nux-vomica* leaf aqueous extract treatments ranged between 20 to 35% compared to 86% germination in the control. The decrease in germination percentage of *Solanum trilobatum* seed germination in the *Strychnos nux-vomica* stem bark aqueous extract treatments ranged between 25 to 40% compared to 90% germination in the control (Tables 1 and 2).

Table 1. The effects of *Strychnos nux-vomica* L. aqueous extracts of leaf on germination and growth of *Solanum trilobatum* L.

Treatment with plant Extract	Germination (%)	Root length (cm)	Shoot length (cm)	Fresh weight (g)	Dry weight (g)
Control	86 ± 4.7	2.5 ± 0.4	3.6 ± 0.5	0 ± 0.15	0 ± 0.029
5%	35 ± 1.4	1.1 ± 0.6	2.9 ± 0.2	0 ± 0.13	0 ± 0.020
10%	30 ± 5.3	1.4 ± 0.3	3.0 ± 0.8	0 ± 0.14	0 ± 0.019
15%	30 ± 6.1	1.8 ± 0.5	2.1 ± 0.4	0 ± 0.12	0 ± 0.015
20%	25 ± 3.5	1.9 ± 0.2	2.3 ± 0.5	0 ± 0.13	0 ± 0.11
25%	20 ± 6.2	1.4 ± 0.8	2.6 ± 0.3	0 ± 0.10	0 ± 0.008

The seed germination, root and shoot length was inhibited in entire concentrations (Tables 1-2). The decrease was concentration dependent. The aqueous extracts of two extracts also delayed the shoot lengths of *Solanum trilobatum* (Tables 1-2). The degree of retardation also increased with raise in the concentrations of the extracts. Statistical analysis at

5% level (t-test) revealed that apart from comparison between 5 and 25 g extract concentrations, there were no significant differences in the growth length of root in the varying extract concentrations as well as those of the control in leaf and stem bark extracts. The extracts of *Strychnos nux-vomica* also caused significant reduction in seedling development of

Solanum trilobatum. The extracts not only decreased the shoot and root length of *Solanum trilobatum* seedlings but also reduced the fresh and dry weight. The reduction in the fresh and dry weight may be due

to stunted scanty vegetative development of *Solanum trilobatum* seedling. This reduction may be due to phytotoxic activity of phytochemical constituents present in aqueous extracts of *Strychnos nux-vomica*.

Table 2. The effects of *Strychnos nux-vomica* L. aqueous extracts of stem bark on germination and growth of *Solanum trilobatum* L.

Treatment with plant Extract	Germination (%)	Root length (cm)	Shoot length (cm)	Fresh weight (g)	Dry weight (g)
Control	90 ± 2.4	2.7 ± 0.6	3.8 ± 0.2	0 ± 0.17	0 ± 0.029
5%	40 ± 3.7	1.6 ± 0.5	3.1 ± 0.4	0 ± 0.15	0 ± 0.025
10%	35 ± 2.1	1.5 ± 0.3	2.5 ± 0.6	0 ± 0.14	0 ± 0.021
15%	33 ± 1.5	1.6 ± 0.7	2.4 ± 0.8	0 ± 0.13	0 ± 0.019
20%	30 ± 2.3	1.9 ± 0.3	2.3 ± 0.4	0 ± 0.12	0 ± 0.015
25%	25 ± 4.2	1.6 ± 0.5	2.5 ± 0.5	0 ± 0.11	0 ± 0.010

The result of present study proved that the leaf and stem bark extracts of *Strychnos nux-vomica* was inhibitory in *Solanum trilobatum*. Alagesaboopathi (2014) reported that leaves and stem extracts of *Erythroxylum monogynum* significantly decreased germination and seedling development of *Solanum lycopersicum* Mill. var. PKM-1. Similar results have been noted by Namkeleja et al. (2014). Some current studies indicating the allelopathic effect of aqueous extracts of medicinal plants include. *Artemisia annua*, *Rosmarinus officinalis* and *Lavandula vera* (Rahim et al., 2015), *Ricinus communis* (Saadaoui et al., 2015), *Eruca sativa*, *Mentha peperina*, and *Coriandrum sativum* (Ali Baeshen, 2014), and *Andrographis paniculata* (Alagesaboopathi, 2011).

Phytotoxic substances in plants can be released into soil, either as exudates from living plant tissues or by decomposition of plant residues and act as allelopathic substances which inhibit seed germination, seedling establishment and plant development (Belz, 2007). All these investigations indicated the release of phytotoxic chemicals during the preparation of aqueous extracts. Based on this studies were further extended to research the impact of *Strychnos nux-vomica* leaves and stem bark, as they possessed larger phytotoxicity on the emergence and development of *Solanum trilobatum*.

Allelopathy has been implicated to be capable in various cases for no germination, stunted progress and sometimes out correct remove of plants (Inderjit and Duke, 2003). Allelochemical play of plants is measures by the sensitivity of roots in the bioassay (Heisey, 1990).

The results are in similarity with previous studies reporting that effectiveness of receiver plants to allelochemicals was concentration dependent of inhibitory essences with a confirmation threshold

(An et al., 2005). The results appeared to be in agreement with that of Swaminathan et al. (1989) who noted that the potential compounds, which are responsible to influence inhibitory determine on germination, are identified a phenolic acids. The release of phenolic compounds adversely affects the germination and development of plants through their interference in energy metabolism, cell division, mineral uptake and biosynthetic processes (Rice, 1984).

The studies of Dias et al. (2005) appeared that the extracts of some plants inhibit the growth of others. With notice to allelopathic effects of plant secondary metabolites, it is now usually recognised that some terpenoids, chiefly monoterpenes and sesquiterpenes present in the volatile fraction (Fischer, 1991) and phenolic compounds are the chief responsible for growth inhibition of competing plants (Harborne, 1993).

Polyphenol compounds such as flavonoids, tannins, and phenolic acids were the highest notable compounds of the crude extracts investigated and could contribute to the germination and growth inhibitory action of the *Hypericum* species extracts (Dall' Agnol et al., 2003). Various flavonoids such as rutin, quercetin, isoquercitrin and quercetrin among several others have shown effects on plant growth (Iqbal et al., 2005).

The aqueous leaf and stem bark extracts of *S. nux-vomica* showed inhibitory effects on seeds germination, shoot length, root length, fresh weight and dry weight of *S. trilobatum*. The *S. nux-vomica* leaf and stem bark extracts inhibited the germination and growth of *S. trilobatum* in the present investigation. Hence, they must have been responsible for the inhibition of seed germination, growth and dry matter collection of root and shoot of the plant were progressively decreased with

the heighten in the concentration of the extract. Further studies are essential to isolate and characterize the supposed allelochemicals in *S. nux-vomica* and the interaction that could be pointing out for the observed inhibition of seed germination and plant progress.

Conclusion

In conclusion, the concentration dependent inhibitory properties of the aqueous leaf and stem bark extracts of *S. nux-vomica* on the germination and seedling survival of *Solanum trilobatum* suggest that the plant has allelopathic activity and receive allelochemicals. These allelochemicals could be the vital purpose for the restricted development of other plant species near their colony. Isolation and characterization of those allelochemicals from *Strychnos nux-vomica* could be show as manage for the progress of biodegradable environment amicable invention authentic herbicides and equivalent it for chemical herbicides for sustainable weed manage. However, vast research is needed to further promise the allelopathic potential of *Strychnos nux-vomica* and laboratory and filed experiments. This investigation revealed that the aqueous leaf and stem bark extract of *Strychnos nux-vomica* has significantly inhibited the seed germination, seedling growth, dry and fresh weight of *Solanum trilobatum*.

Conflict of interest statement

Author declares that there is no conflict of interest.

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