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Allelopathic Effect of *Prosopis chilensis* (Molina) Stunz. on Seed Germination and Seedling Growth of *Acacia tortilis* (Forsk.) Hyne in Arid Region of Rajasthan

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ABSTRACT

The present study was carried out to assess the effect of aqueous extract different parts of Prosopis chilensis tree on Acacia tortilis to understand the suitability of tree-tree combination in arid region forestry. Different concentrations of root, stem, leaf and bark (1%, 5% and 10%) aqueous extract of Prosopis chilensis were used to study the seed germination, radicle and plumule growth of Acacia tortilis.

KEYWORDS : Aqueous Extract; Radicle and Plumule; Growth; Seed Germination

Introduction

Allelopathy is an important mechanism of plant interference induced by the addition of plant produced phytotoxins to the plant environment (Alam *et al.,* 2001). Rice defined allelopathy as any direct or indirect competition, harmful or beneficial effect by plants (including microorganisms) on another plant through production of chemical compounds that escape into the environment (Halbrendt, 1996; Rice, 1984). Bais *et al.* (2003) noted that in spite of classic opinion in which allelopathy refers to the chemical inhibition by another, modern research suggested that allelopathic effects can be both positive and negative, depending upon the dose and organism (Niakan and Saberi, 2009).

Allelochemicals are plant metabolites or their products that are released into the environment and may affect neighbouring organisms by reducing cell membrane permeability, disrupting mineral uptake or damaging genetic material (Mattner, 2001; Rizvi and Rizvi, 1992; Halbrent, 1996). All compounds or phytotoxins, escape into the environment by volatilization, decay of plant material and by exudation from roots (Alam *et al.,* 2001). All plant parts including leaves, stems, pollen, flowers, roots, buds, rhizomes, seeds and fruits have been shown to contain allelochemicals, but leaves and roots are the most important source (Aldrich, 1984; Rizvi and Rizvi, 1992; Alam *et al.,* 2001).

Commonly cited effects of allelpathy include reduced seed germination and seedling growth. Also delayed or inhibited germination and the stimulation or inhibition of root and shoot growth are often reported (Rizvi and Rizvi, 1992). Most of the growth and germination inhibitors produced by perennial angiosperms identified by Rice (1984) were derivatives of cinnamic acid or phenolic compounds. Also other authors found the inhibitory compounds including coumarins, flvonoids, alkaloids, cynoglycosides, proteins and amino acids (Friedman and Waller, 1983; Waller, 1989; Dudai, 1999).

Every tree manages the environment on its surroundings by physical and chemical means. Naturally the chemical influences appear stronger in tree species than the herbaceous species because greater biomass in trees and longer consecutive inflows from trees composed by herbs (Ito and Ito, 2007).

The germination and seedling growth studies are unsatisfactory under field condition as the results cannot be repeated with reliability. Bioassays under laboratory condition where external conditions are controlled, give regular and reliable results with complete germination and seedling growth of test species. *Prosopis chilensis* is the major trees of the arid region of Rajasthan and have been widely planted along road, canal, around the margin of cultivated field, on sand dunes, wasteland and gravel lands. Different plant parts of the *Prosopis chilensis* were tested for allelopathic effect on the seed germination and seedlings growth of *Acacia tortilis.*

Material and Methods:

For the bioassay study, plants materials were collected from different localities in Bikaner district in bulk. Collected plant material were brought to laboratory and washed to remove soil particles and other contaminants. Root, leaves, flowers and fruits were detached. The full matured fruits were kept separately at laboratory conditions for collection of seeds, The remaining fresh parts of the plant were dried in oven having exhaust fan at 60°C till constant weight obtained (Martin et al., 1987; Anderson and Chapman, 1987). The dried plant parts were powdered separately and stored in polythene bags for preparation of extracts. Seeds of Acacia tortilis were obtained from Forest Department.

Preparation of aqueous extracts:

The aqueous extracts of different parts of plants were prepared as per method of Narwal (1996). 10 gm of powdered plant material was dissolved in 100ml water to prepared extract of 10% concentration. The extract of 1% and 5% concentration were prepared from 10% extract by dilution. The extracts of different concentration were stored in refrigerator during the experimental period as per requirement.

Effect of aqueous extract of different plant parts on seed germination and seedling growth of *Prosopis chilensis* were performed in sterilized petriplates (15 cm. diameters) lined with a single layer of filter paper. Twenty seeds were placed on each petriplate and treated with 10 ml of filtrate. Each experiment was repeated thrice. Adequate moisture was maintained in petriplate by supplying the extracts at intervals for normal growth. Percentage of seed germination and seedling growth were observed every day upto 10 days. Root and shoot lengths were recorded at 10 days after showing. The data presented for seedling growth were based on the randomly selected 20 seedling from replicates of each treatment. The data presented in the form of mean with standard deviation.

Results and discussion

Fresh seeds of *Acacia tortilis* were not germinated under control condition. Mechanical scarification was done by rubbing of seeds on sand paper and 90% germination was observed. Mechanical scarified seeds were used as control in the present experiment. Effect of different concentration of aqueous extract of root, stem, bark, leaves, fruit wall (Pericarp) and seeds of *Prosopis chilensis* on seed germination and seedling growth of *Acacia tortilis* have been shown and percentage of inhibition or stimulation over control.

The aqueous extract of leaves was proved more inhibitory on seed germination and seedling growth of *Acacia tortilis* than any other parts of *Prosopis chilensis*. The stem extracts stimulated shoot growth at lower concentration (1% and 5%) whereas inhibited at higher concentration. Seed germination and root growth were inhibited at all concentration of the aqueous extract of stem. Fruit wall extract of this tree was more inhibitory at all concentration on both seed germination and seedling growth of *Acacia tortilis*. Aqueous extract of seed had inhibitory effect at all concentration on seed germination and seedling growth except shoot at 11% aqueous extract. The aqueous extract of *Prosopis chilensis* bark had more inhibitory effect on seed germination and seedling growth of *Acacia tortilis*. The lower concentration of bark slightly stimulated the shoot growth but higher concentration inhibited.

Trees influences the other tree growing in the vicinity by releasing allelochemical substances from their seeds, pericarp, fallen leaves, decomposing residues, leachates exudates and volatiles. Most of the tree species have inhibitory effect on crops, yet some also exhibited stimulatory effects.

Table- 1. Effect of the aqueous extract of different part of *Prosopis chilensis* on seed germination and seed germination and seedling growth of *Acacia tortilis*

Plant part	Extract concentration (%)	Seedling growth at 10 days		
		Germination (%) 240 hrs.	Shoot Length (cm)	Root Length (cm)
	Control	90±2.02	35±1.12	5.6±3.02
	1	75±0.98	3.6±1.73	5.2±1.16
Root	5	47±3.16	35±0.81	4.8±1.20
	10	28±3.74	2.6±1.56	3.2±1.01
	1	70±0	4.0±0.20	5.3±1.01
Stem	5	62±0.70	4.0±0.54	4.5±0.73
	10	50±0.29	3.0±0.26	4.0±0.17
	1	65±7.48	4.0±0.73	5.2±2.26
Bark	5	52±3.74	3.7±0.86	4.7±1.56
	10	41±3.16	2.6±0.92	3.5±0.89
	1	42±3.14	3.5±0.73	5.0±0.50
Leaves	5	28±5.09	3.0±0.86	42±1.06
	10	22±7.48	1.5±0.92	3.0±0.50
	1	57±2.44	3.5±0.86	5.2±1.13
Fruit wall	5	52±5.09	3.0±0.86	4.8±1.15
	10	42±6.78	3.0±0.97	3.5±0.38
	1	52±1.18	3.6±0.92	5.2±2.43
Seeds	5	42±0.86	3.3±0.86	5.6±1.74
	10	38±7.48	2.3±0.73	3.2±1.28

Mean±Standard deviation

Rice (1984) suggested that allelochemicals may be present in any part of plant but leaves are the major source. Sundramoorthy *et al.* (1995) observed the allelopathic effect of *Prosopis juliflora*. Provenance Israel on seed germination and seedling growth of pearlmillet and sesame crops and found that leaf leachates had more inhibitory effect as compare with stem, litter and soil leachates.

Swaminathan *et al.* (1989) observed that the aqueous and extract of bark and leaves of *Acacia nilotica* trees significantly inhibited the seed germination, radical and plumule growth of some crops and he inhibition from bark extract was greater than that from leaf extract. Similar trend of effect was observed in the percent investigation from the bark extract of *A. nilotica*.

Puri and Bhangarwa (1992) observed adverse effect of *A. tortilis* and *A. nilotica* on crops. Sundramoorthy and Kalra (1991) studied the allelopathic effects of *A. tortilis* plantation in the Indian desert at Jodhpur and found that the properties of soil beneath *A. tortilis* and *Prosopis cineraria* did not differ significantly and concluded that the growth of understorey plant is inhibited not due to change in natural status of the substratum but because of some chemical inhibition. They also observed that soil extracts of *A. tortilis* exhibited inhibitory effect on germination and seedling growth of some arid zone crops in which sesame was most adversely affected and leaves and stem leachates showed maximum inhibitory effect. In the present study, it was observed that bark and leaves extracts of *A. tortilis* showed maximum inhibition on seed germination whereas the fruit wall and seed extract showed maximum inhibition on seedling growth and stem extract at lower concentration (1% and 5%) stimulated shoot growth.

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