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Phytotoxicity of Chir Pine (*Pinus Roxburghii*) Needle Litter Towards *Cassia Occidentalis*

KEYWORDS: Allelopathy, Phytotoxicity, *Pinus roxburghii*, weed management.

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ABSTRACT *The decomposing litter on the forest floors influences the germination and growth of sensitive understorey species by releasing allelochemicals. Effect of chir pine needle litter collected from the forest floor was studied on Cassia occidentalis, a common weed. Aqueous extracts of litter powder reduced the growth of Cassia occidentalis under laboratory conditions. A significant reduction in root and shoot length and biomass of target species was also observed in soil medium in dose dependent manner. The chlorophyll contents were found to be reduced in the treated plants compared with control. The litter powder mixed soils were found to be rich in phenolics which are known for allelopathic effects. The study indicates the potential of utilizing the Chir pine needle litter for management of weeds.*

Introduction:

Allelopathy is a phenomenon of chemical interference among plants. It is mediated through release of chemicals by volatilization, leaching, as root exudates, or as a result of decomposition of plant residues (Rice, 1984). It is an important ecological phenomenon and governs plant-plant interaction (Kim *et al.*1997). It is cause of failure of regeneration in forests (Fisher, 1980). Many species of Pine has been shown to possess allelochemicals and show phytotoxicity towards other species (Lodhi, and Killingbeck, 1982; Kil et *al.*; 1991, Singh *et al* 1999; Kato *et al* 2009). Chir Pine (*Pinus roxburghii Sargent*) forest floor is characterized by a carpet of fallen pine needles. The understorey of chir pine forests is characterized by sparse vegetation, which could possibly be due to allelopathic effect of the needle litter. This paper describes the allelopathic effect of Chir Pine needle (leaves) litter on early growth of a common weed, *Cassia occidentalis* (commonly called coffee senna, coffee weed)

Materials and Method:

Plant material

Needle Litter of Chir Pine was collected from a Chir Pine forest of Himachal Pradesh, shade dried and powdered. The seeds of C*assia occidentalis* were collected from plants growing in wild.

Lab Bioassay Experiment

Aqueous extracts of concentration 0.5%, 1%, 2% and 4% were prepared from litter powder of Chir Pine. Pure distilled water served as control. Seeds of *Cassia occidentalis* were given acid treatment for 50 seconds followed by repeated washings with distilled water. Seeds were put in distilled water for imbibition. 10 seeds of *Cassia occidentalis* were placed in 15 cm diameter Petri dish, lined with filter paper and moistened with 10 ml of respective solution or distilled water (control). For each treatment, 3 replicates were maintained. Root, shoot length, biomass of seedlings at the end of 5 days were recorded.

Pot experiments

Powder of *Pinus roxburghii* needles and soil were mixed in the ratio of 0, 0.5, 1, 2, 4 grams of powder per 100 grams of soil in pots. 4 replicates were maintained for each treatment. 10 seeds of *Cassia occidentalis* were sown in each pot. Pots were watered regularly. Growth of test plant was recorded after 15 days as well as after one month. Powder amended soil was analyzed for presence of phenolics as per Swain and Hillis (1959). Chlorophyll contents in leaves of plants grown were estimated as per Hiscox and Israelstem, 1979; Rani and Kohli 1991).

Minimum three replicates were maintained for each treatment. The replicates were kept in completely randomized manner. Data was analyzed by one- way ANOVA.

Results and Discussion:

Plant litter can alter the physical and chemical environment of a community and affect the establishment of plants (Facelli and Pickett, 1991). The results show the phytotoxic effect of Pinus roxburghii litter on seedling growth of the *Cassia occidentalis*.

Table 1. Effect of *Pinus roxburghii* litter extracts on early growth of *Cassia occidentalis* seedlings grown in petri dish in laboratory measured after 5 days.

Concentration of extract	Root length (cm mean±S.E.)	Shoot length (cm mean±S.E.)	Biomass (mg)
0 (control)	3.18±0.08	5.22±0.14	9.62
0.5	3.01±0.11	4.74±0.16	8.67
1.0	2.77±0.07	4.18±0.12	9.58
2.0	2.43±0.10	3.95±0.17	8.65
4.0	2.24±0.09	3.29±0.22	7.13

Table 2: Effect of *Pinus roxburghii* litter amended soil on growth of *Cassia occidentalis* plants after 15 days

Concentration (%w/w)	Root length (cm±S.E)	Shoot length (cm ±S.E)	Biomass (mg)
Control	8.15±0.63	7.58±0.21	74.13
0.5	7.91±0.43	6.10±0.39	33.53
1.0	6.58±0.76	5.33±0.33	28.88
2.0	6.83±0.91	5.66±0.24	29.90
4.0	4.35±0.72	4.53±0.33	21.18

Table 3: Effect of *Pinus roxburghii* litter powder amended soil on growth of *Cassia occidentalis* measured after 1 month.

Concentration (%w/w)	Root length (cm mean±S.E)	Shoot length (cm mean±S.E)	Biomass (mg)
Control (0)	32.43±1.49	13.41±0.48	178.9
0.5	15.32±0.64	7.31±0.30	47.52
1.0	12.05±0.41	6.78±0.36	41.31
2.0	11.27±0.27	6.71±0.21	43.85
4.0	8.71±0.71	6.02±0.45	40.46

The root and shoot length of *Cassia occidentalis* was retarded in general, both laboratory as well as experimental dome conditions. The growth inhibition corresponds to concentration of extract or amended powder. Even the lowest concentration showed significant phytotoxicity towards test plant. A trend of reduction was also noticed for seedling biomass. 26% reduction at highest concentration (4%) as compared to control has been observed for biomass accumulation by seedlings grown in petri dish. The reduction at the end of 15 days was noticed to be 71% whereas after one month a reduction of 77% was recorded as compared to control, indicating that the plants exposed to allelochemicals at the emerging stage were unable to overcome the phytotoxic effect. Allelochemicals affect the photosynthesis (Kim *et al*

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1997), so the chlorophyll contents in leaf tissue of *Cassia occidentalis* were determined. Total chlorophyll of *Cassia occidentalis* was reduced in plants grown in Litter amended soil. In general, the decrease was corresponding to the amount of powder added. Reduction in chlorophyll contents will affect the photosynthetic yield, and thus growth. Litter decomposition is an important source of allelochemicals (Reigosa *et al.* 1996). Soil analysis revealed the presence of phenolics, the known potent allelochemicals, in powder amended soil. The amount of phenolics increased with increase in the dose of pine leaf powder. The amount of phenolics was more than 4 times higher at 4% (w/w) compared to control. The total phenolic contents detection is relevant as phenolics act synergistically (Williams and Hoagland, 1982). These compounds affect plant growth directly or by altering the other properties of soil including electrical conductivity (Blum *et al.*, 1999). In the present experiment electrical conductivity of Chir Pine needle amended soil increased. The development of resistance towards synthetic herbicides by certain weeds and environmental concerns have led to attention of researchers towards allelopathic plants (Bhadoria 2011). The present investigation points out towards the possibility of utilizing litter of Chir Pine for management of weeds.

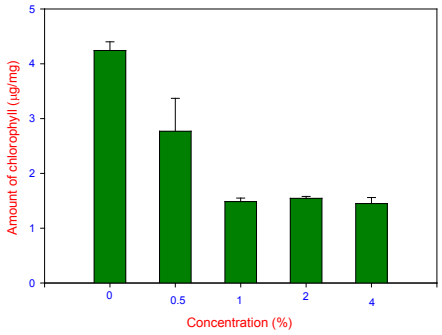

Fig 1. Amount of Chlorophyll in leaves of *Cassia occidentalis* grown in soil amended with *Pinus roxburghii* needle litter powder.

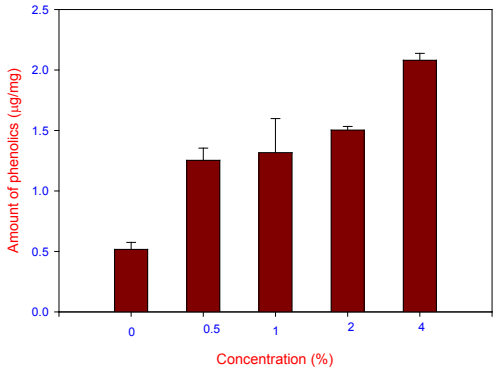

Fig.2. Change in the amount of water soluble phenolics in soil amended with *Pinus roxburghii* litter powder

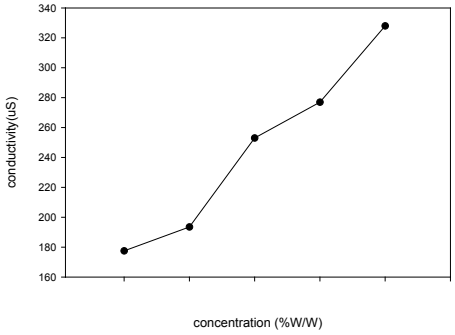

Fig. 3. Effect of *Pinus roxburghii* litter powder amended in soil on conductivity of soil

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