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ALLELOPATHIC EFFECTS OF EUCALYPTUS LEAF EXTRACTS ON GERMINATION AND GROWTH OF COTTON (*Gossypium hirsutum* L.)

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ABSTRACT

The allelopathic effect of Eucalyptus camaldulensis leaf extracts, soaked, crushed and boiled in tape water and simple tap water as a check, were evaluated on the seed germination and growth of cotton variety MNH-93 at the Department of Agronomy, Faculty of Agriculture, Gomal University, Dera Ismail Khan during 2001. Analysis of variance revealed that all the extracts significantly reduced seed germination, root and shoot length, fresh and dry weight compared to control where no extract was used. The eucalyptus boiled extract decreased seed germination to 57% as compared to 97% in the check. It also caused the highest decrease in the root length. The highest decrease in the cotton fresh and dry weight was obtained in the crushed extract. The soaked extract produced the highest decrease in cotton shoot length and shoot fresh and dry weight. The suppression of cottonseed germination and other growth parameters depicted an allelopathic effect. It is suggested that planting cotton close to eucalyptus trees should be avoided due to likely adverse effects on its germination and growth parameters.

Key words: Allelopathy Eucalyptus extract germination cotton growth.

INTRODUCTION

Forest trees produce allelo-chemicals that affect the growth of other crops and weeds growing near to it. Putnam (1984) reported that eucalyptus species released volatile compounds such as benzoic, cinnamic and phenolic acids, which inhibit growth of crops and weeds growing near it. Pawar and Chawan (1999) reported that some forest trees including *Eucalyptus globolus* reduced uptake of Ca, Zn and Mg in sorghum resulting in reduced growth. Schumann et al. (1995) reported that water extracts of *E. grandis* significantly reduced weed establishment. However, Blaise et al., 1997 reported that soils from eucalyptus forests increased germination of wheat and cowpeas and decreased that of maize. Devasagayam and Ebenezar (1996) and Thakur and Bhardwaj (1992) reported that leachates from *E. globulus* leaves significantly reduced maize germination but were statistically ineffective on wheat germination.

Eucalyptus has been advocated by the Foresters to be an integral part of our agro-forestry system in Pakistan. It has been established in the irrigated area of Dera Ismail Khan because of its fast growing nature. It is expanding in the command area of Chashma Right Bank Canal (CRBC). But, the adverse effects of eucalyptus have been realized by the farming community, which need to be explored on scientific footings.

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Cotton crop plays a pivotal role in the economy of Pakistan. It is grown on more than 2.5 million hectares and it feeds about 319 units of spinning mills with about 8.1million spindles, 1035 ginning factories and about 5000 oil expellers. The textile industry in the country is employing about 35% of the industrial labour force. The export earning from cotton and its value added goods were 68% of the total export (Ahmad, 1994). Dera Ismail Khan is the only district in NWFP where cotton is cultivated and has an immense scope for increased production. Hence, this study was initiated to determine the allelo-pathic effect of *E. camaldulensis* on the growth parameters of cotton crop so that recommendations could be furnished for growing this crop close to eucalyptus trees or not?

Materials and Methods

Experiments was conducted to determine the allelo-pathic effect of aqueous leaf extracts of *E. camaldulensis* on some of the growth parameters of cotton in the laboratory of the Department of Agronomy, Faculty of Agriculture, Gomal University Dera Ismail Khan during the year 2001. The different leaf extracts were made according to the following procedures.

T-1. 10 L tap water in a bucket at room temperature for 72 hours.

T-2. 1 kg Eucalyptus leaves soaked in 10 L tape water for 72 hours at room temperature

T-3. 1 kg crushed Eucalyptus leaves in 10 L tap water.

T-4. 1 kg Eucalyptus leaves boiled in 10 L tap water for one hour.

The experiment was carried out in randomized complete block design with four replications. Sixteen plastic pots (6x6x15 cm^3) were filled with sand. Four pots each were soaked with tap water (check), soaked extract, crushed extract and boiled extract. The pots were placed on the laboratory table in a random procedure laid down by Steel and Torrie (1980). Ten seed of commercial cotton variety MNH-93 were sown in each pot. The pots were kept moistened with their respective extracts throughout the duration of study. The experiment was run for three weeks.

Data were recorded on seed germination (%), shoot length (cm), root length (cm), shoot fresh weight (g) and root fresh weight (g), shoot dry weight (g), root dry weight (g) according to the standard procedures. The data for the individual parameters were subjected to ANOVA technique appropriate to the design. The treatment means were separated using Fisher's protected least significant difference test as outlined by Steel and Torrie (1980).

Results And Discussion

Seed Germination (%)

All the extracts significantly decreased cotton seed germination as compared to control (Table I). The highest decrease in seed germination was registered in the boiled extract, which significantly differed from the soaked and crushed extract in affecting the cotton seed germination. The decrease in percent seed germination in the Eucalyptus extract treatments ranged between 29 to 41% (70-57% germination) compared to 97% germination in the control. The highest reduction (41%) in the seed germination of cotton in the boiled extract was likely due to the higher concentration of the allelo-chemicals liberated into the extract due to boiling. The results validate findings of Ibrahim et al (1999), who reported that leaf and litter extracts of *E. camaldulensis* and *E. microthecia* delayed and inhibited germination of cotton.

Root length (cm)

The data in Table-I exhibit that the Eucalyptus extracts significantly reduced the cotton root length as compared to the control. The highest root length of 8.45cm was recorded in the control whereas the lowest root length of 4.04cm was shown in the boiled extract The reduction in root length of cotton in the Eucalyptus extract ranged between 33% and 52% (4.04-5.65 cm root length), compared to 8.5cm root length in the untreated control. The maximum (52%) retardation in the cotton root length in the boiled Eucalyptus extract was believed to be due the higher amount of allelo-chemicals. Similar findings were reported by Khan *et al.*, (1999) and Sangina and Swift (1992) who reported that Eucalyptus extracts reduced maize root growth.

Root fresh weight (g)

Means for root fresh weight in Table-1 revealed that all the eucalyptus extracts significantly reduced cotton root fresh weight as compared to check. The highest (6.11g) reduction in cotton root fresh weight was registered in the crushed extract, which significantly differed from the soaked and boiled extract in affecting the root fresh weight. The lowest reduction in the cotton root fresh weight was obtained in the boiled extract. The reduction in the cotton root fresh weight in the eucalyptus extracts ranged between 49% (22.64 g) and 84% (6.1g). The maximum decrease in cotton root fresh weight in the crushed extract may be due to presence of higher amount of allelo-chemicals. The crushing of leaves might have helped in release of more allelo-chemicals. Similar findings were reported by Sanginga and Swift (1992) and Lisanework and Michelson (1993), who found that sunflower extracts reduced cotton root fresh weight.

Root dry weight (g)

Eucalyptus extracts significantly decreased cotton root dry weight as compared to check (Table-1). The lowest dry root weight of 0.16 g was achieved in crushed extract compared to 0.94 g root dry weight in control. The decrease in cotton root dry weight in the eucalyptus extract ranged between 40% (0.56g) and 83%(0.16g). The highest decrease in the crushed extract might be due to the presence of higher amount of allelo-chemical. Similar findings were reported by Lisanework and Michelson (1993).

Shoot length (cm)

The Eucalyptus extracts significantly reduced cotton shoot length as compared to check (Table-2). The smallest shoot length of 5.40 cm was recoded in the soaked extract, which however, was statistically at par with the boiled extract (6.09 cm). The decrease in shoot length of cotton in the Eucalyptus extracts treatment ranged between 21% and 52% (8.89-5.04 cm) as compared to 11.33 cm cotton shoot length in the untreated check. The highest (52%) decrease in the shoot length of cotton in the soaked extract was presumably due to the elevated amount of allelochemicals extracted in this treatment. Khan et al. (1999) reported maize shoot length reduction by Eucalyptus extract. These findings are also in agreement with the work of Khan et al. (2004a&b) who found inhibitory role of Eucalyptus on wheat and some of its associated weeds.

Shoot fresh weight (g)

Means in Table-2 depicted that Eucalyptus extracts significantly differed in affecting the cotton shoot fresh weight compared to the check. The least shoot fresh weight of 5.84 g was demonstrated in the soaked extract. The crushed Eucalyptus extract stimulated cotton growth and produced the highest shoot fresh weight of 9.42 g compared to 7.49 g in the check. The decrease in shoot weight in the soaked and the boiled extracts ranged between 11% and 22% (5.84-6.64 g), as compared to 7.6 g shoot fresh weight in the check. Similarly

James *et al.* (1982) reported that soaked extracts caused more reduction in weed seed germination. Khan *et al.* (2004a&b) have also demonstrated the inhibition due to leaf extracts of Eucalyptus and some other forest species.

Shoot dry weight (g)

The data given in Table-2 revealed that soaked eucalyptus extract significantly reduced cotton shoot dry weight as compared to control. However, the crushed extract significantly increased cotton shoot dry weight. The increase may be the result of growth hormones in the extract. The reduction in cotton shoot dry weight in the eucalyptus extracts ranged between 12% (0.66g) and 25% (0.56 g). The highest decrease in the cotton shoot dry weight in the soaked extract may be the result of presence of allelo-chemicals reducing shoot growth. These results corroborate to those of Sanginga and Swift (1992) and Khan *et al.* (1999) who reported reduction in maize shoot dry weight by eucalyptus extracts.

Table-1. Cotton germination, root length, fresh and dry weight response to leaf extracts of Eucalyptus

Treatments	Germination (%)	Root Length (cm)	Root Fresh Weight (g)	Root Dry Weight (g)
Check (simple tap water)	97a	8.45a	9.57a	0.94a
Eucalyptus leaves soaked in water	70c	4.79cd	3.66d	0.35c
Eucalyptus leaves crushed in water	76b	5.65b	1.53c	0.16d
Eucalyptus leaves boiled in water	57d	4.04d	5.66b	0.56b
$LSD_{0.05}$	5.72	1.05	0.04	0.03

Means sharing a common letter in the respective column are not significantly different by LSD test at P=0.05.

Table-2. Cotton shoot length, fresh weight and dry weight response to leaf extracts of Eucalyptus

Treatments	Shoot Length (cm)	Shoot Fresh Weight (g)	Shoot Dry Weight (g)
Check (simple tap water)	11.73a	7.49b	0.75b
Eucalyptus leaves soaked in water	5.40c	5.84d	0.56c
Eucalyptus leaves crushed in water	8.89b	9.42a	0.90a
Eucalyptus leaves boiled in water	6.09c	6.64c	0.66bc
$LSD_{0.05}$	1.70	0.75	0.106

Means sharing a common letter in the respective column are not significantly different by lsd test at p=0.05.

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