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ALLELOPATHIC EFFECTS OF EUCALYPTUS *(EUCALYPTUS CAMALDULENSIS* DEHNH*.)* AQUEOUS LEAF LITTER EXTRACT ON THE GROWTH OF WHEAT (*TRITICUM AESTIVUM* L.) AND REGULATION BY FARMYARD MANURE.

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Abstract

Eucalyptus camaldulensis leaf litter generally has inhibitory effects on crop growth due release of allelochemicals. This influence was studied by examining seed germination and seedling growth of wheat (*Triticum aestivum* L.). Allelopathic effect of *E. camaldulensis* was subjected by the application of different concentrations of aqueous leachate of Eucalyptus leaf litter. The given research also evaluates the biocontrol of *Eucalyptus camaldulensis* allelopathic effect by combining the litter leachate with different concentrations of farmyard manure (FYM).

It was found that *E.camaldulensis* leaf litter extract (leachate) significantly reduced shoot length and shoot and root fresh and dry weight of wheat. However, a combined effect of litter and FYM extract markedly reduced the inhibitory effects of leachate and thus increased the growth of wheat. These results suggested that if the studied crop has to be cultivated in an agricultural land surrounded by *E. camaldulensis* tree, the possible growth rate could be supported by the application of farmyard manure. But in the absence of this support, the plant growth was significantly arrested due to allelopathic effect of *E. camaldulensis* leaf litter.

Introduction

Although eucalyptus has been the choice tree species in most of the social forestry project in the Asia pacific regions, it has registered pronounced deleterious effects on the environment. The Eucalyptus species are considered the most notorious of allelopathic trees causing understory suppression specially in dry climates and scarcity of water (rainfall< 400mm) (May and Ash, 1990). Allelopathy has direct or indirect deleterious effect of one plant upon another through the release of chemical inhibitors (phytotoxins) and it may be the main reason of failure or poor crop growth in the different environmental systems.

Eucalyptus species has a high potential of allelochemicals in the form of phenols and essential oils. Iqbal *et al* (2003) found 16 components in the essential oil of *E.camaldulensis* out of which 5 compounds (alpha pinene, 3-carene, beta-phellandrene, 1-8 cineole and p-cymene) were identified. Ghafar *et al* (2000) found that these allelochemicals and volatile compounds present in all parts of *E.camaldulensis* have harmful effect on the crops in the ecosystem resulting in the reduction and delaying of germination mortality of seedling and reduction in growth and yield. Putnam (1984) reported that eucalyptus species released volatile compounds such as benzoic, cinamic and phenolic acids which inhibit growth of crops and also reduce the soil pH. Khan *et al*, (2004) stated that aqueous extract of Eucalyptus leaves significantly reduced seed germination, root and shoot length, fresh and dry weight of maize as compare to control treatment. The release of phenolic compounds adversely affect plant growth through their interference with energy metabolism, cell division, mineral uptake and other biosynthesis processes (Rice, 1984). Different researchers found that the eucalyptus leachate had varying degree of inhibitory and stimulatory effects on germination percentage (Phlomina and Srivasuki, 1996) and plant growth (Sidhu and Hans, 1998) considerably at higher concentration (Jayakumar *et al.*, 1990). Therefore, *Eucalyptus*, though a potential industrial crop, is not being recommended as an inter crop in an agro-foresty system (Bansal, 1988; Suresh and Rai, 1987), presumably due to the release of allele-chemicals and phyto-chemical compounds from the tree (Lisanework and Michelson, 1993).

It is reported that the eucalyptus tree is a fast producer of biomass because of the large amount of water and nutrient uptake as compare to all local plants and trees. There is also very little return of humus to the soil because of slow decomposition of leaves. There is a rapid loss of nutrient reserves from the soil due to short rotation cropping of eucalyptus tree, therefore to maintain soil fertility and enhance their productivity, the use of other alternative option of soil fertility replenishment is indispensable. Farmyard manure is the potential source of nutrients which maintains soil fertility, improve crop yield and sustain productivity. This organic source of nutrient has potential to control plant growth growing under *Eucalyptus camaldulensis* leaf litter that generally has inhibitory effects on crop growth due to allelochemicals release. Several studies reported the efficiency and effectiveness of FYM as an organic nutrient source in maintaining soil fertility, improving crop yield and sustaining productivity.

Thus, it is suggested that, in case of agroforestry, the allelopathic inhibitory effect of *E.camaldulensis* can be effectively suppressed by supplying the organic fertilizer (i.e. farm yard manure) to prevent the yield drop.

Hence, the instant study was initiated to determine the allelopathic effect of *E.camaldulensis* on the growth parameters of wheat and its suppression by the addition of farmyard manure.

Materials and Methods

Sampling of leaf litter and farm yard manure: Naturally decomposed *E.camaldulensis* leaf litter was collected from a garden surrounded by rows of *E.camaldulensis* tree. The farm yard manure used for the experiment was well decomposed under shade.

Preparation of aqueous extract of E. leaf litter and farmyard manure: The aqueous extract of leaf litter and farm yard manure were prepared by soaking *E. camaldulensis* leaf litter and farm yard manure separately in the ratio of 1:100 and 5:100 for 24 hour. The mixtures were filtered through filter paper to obtain 1% and 5% (w/v) extract of leaf litter and farmyard manure in order to make six treatments i.e. 1% leachate, 5% leachate, 1% FYM extract, 5% FYM extract along with two combined mixtures,1% leachate +FYM extract and 5% leachate +FYM extract.

Experiment: In this experiment, Petri dish method was applied to check the allelopathic effects of aqueous litter extract on wheat along with farm yard manure (FYM) extract. Ten healthy chemically sterilized seed of wheat (*Triticum aestivum* L.) were in Petri dishes with one disc of filter paper under normal laboratory condition at 21-25 ^{o}C. Five ml of each treatment were added to 3 replicate of each treatment plate. Distilled water was applied to the control level. the growth parameters including germination rate, shoot length, root length, shoot fresh and dry weight and root fresh and dry weight were recorded after 5th day of germination.

Inhibitory Percentage (I): The percentage of inhibitory effect on shoot and root growth (length, fresh weight and dry weight) in comparison to control was calculated in accordance with Surendra and Pota (1978) formula;

$$I = \frac{100 - T}{C} x100$$

Where, I is the parentage of inhibition t is treatment reading and C is control plant reading.

Data Analysis: The data were subjected to analysis of variance to evaluate the treatment effects Duncan's multiple range test (DMRT) was performed as a post-hoc test.

Table 1. Effect of aqueous extract of *Eucalyptus camaldulensis* leaf litter and farm yard manure on wheat (*Triticum aestivum*).

Treatments	Shoot length (cm)	Root length (cm)	Shoot fr.wt. (g)	Shoot dry.wt. (g)	Root fr.wt (g)	Root dry.wt (g)
Control	5.3a	5.67f	0.22c	0.027c	0.24a	0.024b
	(0)	(0)	(0)	(0)	(0)	(0)
1%Leachate	4d	7.96b	0.16e	0.02f	0.11e	0.018e
	(-24.53)	(+40.38)	(-27.27)	(-25.93)	(-54.16)	(-25.0)
1% FYM extract	5.1c	8.64a	0.24a	0.028a	0.23b	0.024b
	(-3.77)	(+52.38)	(+9.09)	(+3.70)	(-4.17)	(0)
1%Leachate +FYM	5.2b	6.82c	0.22b	0.027b	0.14c	0.026a
	(-1.89)	(+20.28)	(0)	(0)	(-41.67)	(+8.33)
5%Leachate	2.1g	3.62g	0.09g	0.013g	0.08f	0.015f
	(-60.38)	(-36.16)	(-59.09)	(-62.96)	(-66.67)	(-37.50)
5% FYM extract	3.9e	5.8e	0.19d	0.024d	0.14c	0.019d
	(-26.42)	(+2.29)	(-13.64)	(-11.11)	(-41.67)	(-20.83)
5%Leachate +FYM	2.9f	6.2d	0.16f	0.021e	0.13d	0.02c
	(-45.28)	(+9.35)	(-27.27)	(-22.22)	(-58.33)	(-16.67)

Values in parentheses indicate percent increase (+) or decrease (-) over control.
Different letters indicate a significant difference at 0.05 level of probability ($p<0.05$) according to Duncan Multiple Range Test (DMRT)

Results and Discussion

Table 1 showed that the aqueous extracts of Eucalyptus leaf litter (leachate) have inhibitory effects on all the growth parameters of wheat plant. These negative effects were significantly controlled by farm yard manure treatment along with leachate (L+FYM). Khan *et al*, (1999) also reported the similar negative effect of Eucalyptus extract on growth and germination on different crops.

Shoot length: Table-1 revealed that eucalyptus litter extracts inhibits wheat shoot length. With increasing leachate concentration, the inhibitions of wheat shoot length increased by the range of 24% to 60%. It was controlled by the parallel application of farm yard manure extract which reduced the inhibitory effect from 24% to 1 % and 60% to 45% over control.

Root length: Table-1 showed that leachate had positive effect on wheat plant root length (40.38% increases in low leachate conc). Although, the high conc. of leachate had inhibitory effect on wheat root length (i.e 36% over control plant) but it was controlled by farm yard manure application that reduce 36% inhibition to 9.35% increase oven control (Fig.1). Tariq *et al*. (2006) and Dawar *et al*. (2007) reported that Eucalyptus essential oil is considered to have marked antiseptic action against infectious bacteria, viruses and fungi, which help in root length increase.

Shoot fresh weight: Table-1 showed that leachate application significantly reduced shoot fresh weight in wheat at both conc. especially at high conc. (i.e. 59% over control). Farm yard manure remarkably supported shoot fr. wt. inhibition (i.e. 59% reduced to 27.27) when applied along with eucalyptus extract.

Shoot dry weight: *E. camaldulensis* leachate application has high inhibitory effect on wheat shoot dry weight at both conc. (Fig.2) Significant reduction found with high conc. i.e. -62.96% but this reduction in shoot dry weight was supported by farm yard manure extract supply which reduced the inhibitory percentage from 62.96% to 22.22% over control.

Fig. 1. Effect of aqueous extract of *Eucalyptus camaldulensis* leaf litter and farm yard manure on wheat (*Triticum aestivum*) shoot and root length.

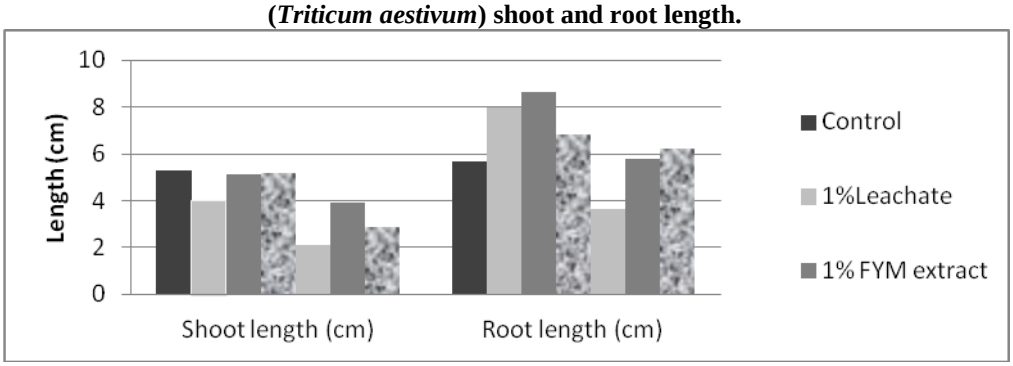
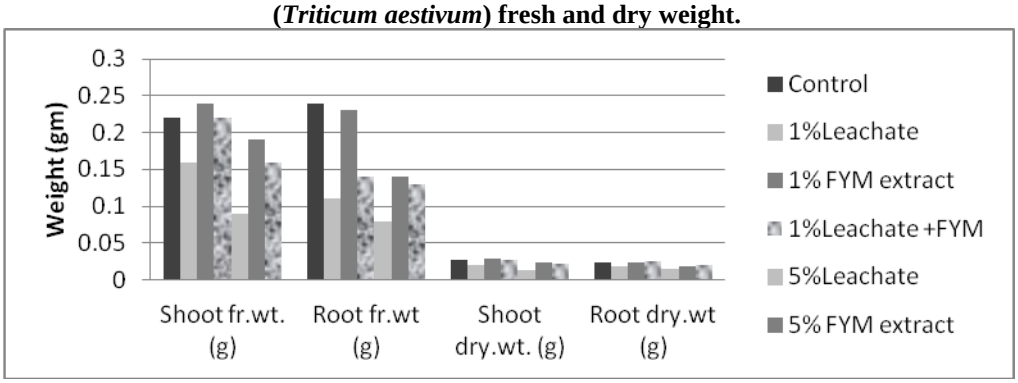


Fig. 2. Effect of aqueous extract of *Eucalyptus camaldulensis* leaf litter and farm yard manure on wheat (*Triticum aestivum*) fresh and dry weight.



Root fresh weight: Leachate has inhibitory effect on root fresh weight of wheat both at low and high conc. i.e. 54.16% 66.67% respectively. These inhibition markedly reduced by supplying farm yard manure extract i.e. 54% to 41% and 66% to 58% over control (Fig. 2).

Root dry weight: Table-1 showed that the inhibitory effect of leachate was significantly controlled by FYM application. The rate of FYM support for wheat root dry weight was 8% at low conc. and the inhibition of 37.50 % drops to 16.67% at high concentration when compared to control plant.

Conclusion

In the present study, shoot length, root length, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight of wheat are markedly affected by the application of *E.camaldulensis* leaf litter extract. The phenolic compounds released from the E. *camaldulensis* leaf litter due to its allelopathic interference caused an inhibition of a number of interacting physiological processes as respiration, net photosynthesis and enzymatic activities which was the main factor which suppressed growth rate and dry matter production. The study indicated that the phyto-toxicity of phenolic compounds is present in *E. camaldulensis* leaf litter as allele-chemicals are highly significant but could be overcome by the application of farm yard manure as a neutralizing agent.

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