

EFFECTS OF *EUCALYPTUS CAMALDULENSIS* DEHNH. AQUEOUS LEAF LITTER EXTRACT ON THE GROWTH OF GREEN GRAM (*VIGNA RADIATA* (L.) WILCZEK)

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ABSTRACT

The allelopathic effects of *Eucalyptus camaldulensis* Dehnh. and its control by farmyard manure was subjected by the application of different concentration of aqueous leachate of leaf litter and with the combined effects of *E.camaldulensis* litter leachate and farmyard manure through different dilutions. The experiment was carried on by the examined seed germination, seedling growth of green gram (*Vigna radiata*) (L.) Wilczek growing in plate culture. Different concentrations of aqueous leachate of *Eucalyptus* (*Eucalyptus camaldulensis*) litter affect differently along with different concentrations of farmyard manure (FYM). The investigations showed that *E.camaldulensis* leaf litter extract (leachate) had inhibitory effects on the growth of different parameters of *vigna radiata*. It was also observed that the combined effects of litter and farmyard manure markedly reduced the inhibitory effects of leachate and thus increased the growth of gram. The results suggested that if *Vigna radiata* L. is to be cultivated in an agricultural land surrounded by *E. camaldulensis* trees, its growth rate may be enhanced by the application of FYM. In the absence of FYM, *Vigna* growth is significantly arrested due to allelopathic effect of *E. camaldulensis* leaf litter.

Keywords: Green gram (*Vigna radiata* L.), Farm yard manure (FYM), *Eucalyptus*, Litter, Allelopathy.

INTRODUCTION

In Pakistan, *Eucalyptus camaldulensis* Dehnh. is an integral part of agroforestry system because of its fast growing nature. The species grows under a variety of ecological conditions associated with water courses. The best growth in Pakistan is observed on exposed and disturbed sites. Although eucalyptus has been the choice tree species in most of the social forestry project in the Asia pacific regions, it has been registered as pronounced deleterious effects on the environment. The eucalypts species are considered the most notorious allelopathic trees causing understory suppression especially in dry climates (rainfall < 400mm) (May and Ash, 1990). *Eucalyptus* species has a high potential of allelochemicals in the form of phenols and essential oils. Iqbal *et al.* (2003) found nearly 16 components in the essential oil of *E.camaldulensis* out of which five compounds (alpha pinene, 3-carene, beta-phellandrene, 1-8 cineole and p-cymene) were identified. Ghafar *et al.* (2000) found that these allelochemicals and other volatile compounds present in all parts of *E.camaldulensis* have harmful effects 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, cinnamic 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 compared 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 intercrop in an agro-forestry system (Bansal, 1988; Suresh and Rai, 1987), presumably due to the release of allelochemicals and phytochemical compounds from the tree (Lisanework and Michelson, 1993). *Eucalyptus* tree belt had more adverse effects on wheat than legume crops. Similar effects have been reported by Huang *et al.* (1997), who studied the effects of leaf extracts of *Eucalyptus* spp. on wheat and mung bean.

It was observed that the eucalyptus tree is a fast producer of biomass because of the large amount of water and nutrient uptake as compared 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 released. Several studies have 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 effects of *E.camaldulensis*

can be effectively suppressed by supplying the organic fertilizer (i.e. farm yard manure) to cure the yield drop. Hence, the instant study was initiated to determine the allelopathic effects 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 decomposing *E.camaldulensis* leaf litter was collected from a garden surrounded by rows of *E.camaldulensis* trees. The farm yard manure used for the experiment was well decomposed under shade.

Preparation of aqueous extract of leaf litter and farmyard manure:

The aqueous extracts of leaf litter and FYM were prepared by soaking *E. camaldulensis* leaf litter and FYM separately in the ratio of 1:100 and 5:100 for 24 hours. The mixtures were fine filtered through filter paper to obtain 1% and 5% (w/v) extract of leaf litter and FYM in order to make six treatments i.e. 1% leachate, 5% leachate, 1% FYM extract, 5% FYM extract along with two mixtures, 1% leachate +FYM extract and 5% leachate+FYM extract making a total of six treatments.

Experimental Design (Plate Culture)

The experiments was conducted to determine the allelopathic effects of *E.camaldulensis* leaf litter on gram growing under different concentrations of litter leachate and farm yard manure. In this experiment, Petridish method was used to study the allelopathic effects of aqueous litter extract on gram along with farm yard manure (FYM) extract. Ten healthy chemically sterilized seed of green gram (*Vigna radiata*) were placed in Petri dishes with one disc of filter paper under normal laboratory conditions with temperature ranging from 21-25°C. Five ml of each treatment was added daily to 3 replicates of each treatment plate. Distilled water was applied to the controls. The growth parameters including shoot length, root length, shoot fresh and dry weights and root fresh and dry weights were recorded after 4th day of germination.

Inhibitory Percentage (I)

The percentages of inhibitory effect on shoot and root growth in comparison to control was calculated by formula (Surendra and Pota, 1978):

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

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

Data Analysis

The data were subjected to analysis of variance and means were compared through Duncan's multiple range test (DMRT).

RESULTS AND DISCUSION

Table 1 showed that the aqueous extracts of Eucalyptus leaf litter (leachate) significantly supported the green gram (*Vigna radiata*) growth at low concentrations. Inouye *et al.* (2001), 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 early growth parameters like increase in root, shoot length and root, shoot weight. At the higher concentration, only root length and shoot dry weight showed positive response, but all other growth parameters were inhibited.

Shoot length: Table 1 revealed that litter extract has positive effect on shoot length of green gram at low conc. (+11.3%) over than control, but overall effect was inhibitory on gram shoot length on both type of planting. This negative effect was also reduced by farm yard manure application (up to -2.9%).

Root length: Table 1 showed that both concentrations of leachate have positive effect on gram root length i.e. 190% to 101% increase at low and high concentration, respectively. Addition of FYM in separate plating enhanced the positive effect of litter up to 173% over control.

Shoot fresh weight: Table 1 showed that leachate application significantly reduced gram shoot fresh weight at both conc. mainly at high conc.

Table 1. Effect of aqueous extract of *Eucalyptus camaldulensis* Dehnh. leaf litter and farm yard manure on green gram (*Vigna radiata* (L.) Wilczek) growth.

Treatments		Shoot length (cm)	Root length (cm)	Shoot Fresh wt (g)	Root Fresh wt (g)	Shoot dry.wt (g)	Root dry.wt (g)
T0	Control (no leachate no FYM)	9.11e	3.83g	1.063d	0.151c	0.043f	0.023
T1	1% Leachate	8.47f (-7.03)	11.12a (+190.34)	1.056f (-0.94)	0.134e (-11.26)	0.048e (+11.63)	0.018 (-21.74)
T2	1% FYM extract	10.12c (+11.09)	5.67e (+48.04)	1.127a (+6.02)	0.258a (+70.86)	0.106d (+146.51)	0.024 (+4.35)
T3	1% Leachate +1% FYM	11.2a (+22.94)	8.5c (+121.93)	1.058e (-0.47)	0.215b (+42.38)	0.041g (-4.65)	0.022 (-4.35)
T4	5% Leachate	10.14b (+11.31)	7.73d (+101.82)	1.083b (+1.88)	0.112f (-25.82)	0.109c (+153.49)	0.018 (-21.74)
T5	5% FYM extract	7.39g (-18.88)	4.11f (+7.31)	0.92g (-13.45)	0.109g (-27.81)	0.113b (+162.79)	0.016 (-30.43)
T6	5% Leachate +5% FYM	9.4d (+3.18)	10.48b (+173.63)	1.076c (+1.22)	0.146d (-3.31)	0.114a (+165.12)	0.025 (+8.70)

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

Shoot dry weight: Gram showed a positive response with both concentration of leachate and increased the shoot dry weight 11.63% and 153.49% at 1% and 5% leachate concentration, respectively. This positive effect enhanced with FYM (165.12%) as compared to control.

Root Fresh Weight: Leachate has inhibitory effect on root fresh weight mainly at high conc. i.e 25.82% in gram. Low concentration inhibition markedly reduced by supplying FYM extract i.e. -11.26 % of root fr. wt inhibition shifts to +42.38% increase.

Root dry weight: Table showed that the inhibitory effect of leachate significantly controlled by FYM application. In gram, 21% reduction fell to 4.35% at low concentration The negative effect of high concentration (5% Leachate) on gram root dry weight (-21.74% reduction) was converted to +8.70% with FYM.

Conclusion: Our studies indicated that *Eucalyptus camaldulensis* leaf litter is phytotoxic but it could be over come by the application of farmyard manure as biocontrol agent.

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