ALLELOPATHIC EFFECT OF *EUCALYPTUS CAMALDULENSIS* ON WHEAT (*TRITICUM AESTIVUM*) CROP

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ABSTRACT

Allelopathic effects of different parts of *Eucalyptus camaldulensis* were studied in this experiment. Wheat variety Faisalabad 83 and Faisalabad 85 were irrigated with 5% solution of fresh leaves, dry leaves, fresh bark, dry bark, fruits and flowers of *Eucalyptus camaldulensis* whereas pure water was used for woodlot soil treatment and control. Effects of 5% solution of different parts of *Eucalyptus camaldulensis* on the pH of soil, germination percentage, number of tillers per plant, height of crop and yield, (straw and grains) of wheat crop were studied which were statistically insignificant.

INTRODUCTION

Plants live in association, communities and various groups depending upon their ecological requirements. Where two or more plants associate in nature, they interfere with each other for various reasons like competition for resources and allelopathy.

Allelopathic effects depend upon various environmental factors such as temperature, light, soil, precipitation and nutrient status of habitat. Various chemical substances for instance, organic acids, unsaturated lactones, fatty acids, terpenoids, phenolica, benzoic acids, cimmamic coumaric, ferulic acids and their derivatives are released from plants body through either leaching from alive and/ or dead parts, root exudates and volatization by air, rain, fog, dew or even irrigated water. These toxic products may have adverse effects on crop in the eco-system resulting in reduction and delaying of germination, mortality of seedling, reduced absorption of water and nutrients, increased susceptibility of pathogens and parasitic attack, reduction in regeneration of orchards, forests and range lands etc. On the other hand allelopathy may be beneficial as it may help in controlling weeds, pathogens and parasites.

Agroforestry, which involves combining woody plants with annual or perennial crops or livestock, increases the biophysical and/or socio-economic productivity of an agricultural enterprise. However, farmers hesitate to grow trees with agricultural crops due to some illusions in their minds as they think that trees decrease the yield of agricultural crops. But this controversy needs to be investigated.

Many tree species are part of our agroforestry systems. *Eucalyptus camaldulensis* is one of them. Eucalyptus were introduced in Pakistan nearly hundred years ago. Now-a-days *Eucalyptus camaldulensis* is commonly cultivated throughout the country along road sides, avenues, in gardens, irrigated plantations and agricultural fields due to its raped growth, adaptation and lofty height, having handsome canopy. The tree sheds its mature leaves and flower buds regularly during winter. Outer bark naturally peeling off into pieces, is added to the soil environment. These plants parts become a component of soil as litter where they are decomposed as a result of natural decaying process. Suppression of many species especially agricultural crops by *Eucalyptus camaldulensis* lead to the hypothesis that the tree species is potentially allelopathic. In the present study an effort has, therefore, been made to explore the allelopathic effect of different parts of *Eucalyptus camaldulensis* on wheat crop affecting its germination, tillering capacity, grain and straw yield, root and shoot growth, biomass production.

REVIEW OF LITERATURE

The direct and indirect harmful effects of

one plant on another by a way of competition for light, moisture and nutrients have been much investigated in the past. However, the harmful effects of forest trees on agricultural crops through production of chemical compounds known as allelochemicals have assumed a great importance in the recent past with the recognition of agroforestry as an independent discipline.

Moral (1967) studied the allelopathic effects of Eucalyptus upon herbs. *Eucalyptus globulus* and *Eucalyptus camaldulensis* were shown to produce large quantities of readily leachable, water soluble phenolic and non phenolic compounds as well as several terpenes, which were toxic to seed germination and herb growth. Del Mormal and Mullar (1970) reported that *Eucalyptus camaldulensis* was inhibitory to annual herbs on California soils but it failed to inhibit these plants on sand. Hussain, et. al. (1979) revealed in their laboratory experiments that tobacco litter showed allelopathic effects on maize and mustard. Ahmad, et. al. (1982) reported the allelopathic potential of *Eucalyptus tereticornis* Sm. against *Sorghum vulgare var.* Dale, *Sorghum vulgare* var. Wing, *Phaseolus mungo, Brassica chinensis, Brassica compestris, Sisymbrium irio,* Nigella sativa, Raphanus sativus and *Setaria italica* using aqueous extracts from leaves, flowers, buds and bark. Rao and Reddy (1984) carried out investigation that leaf extracts of *Eucalyptus tereticornis* inhibit germination of crop seeds to a certain extent. Hussain, et. al (1985) in a study observed that *Azadirachta indica* exhibited phyto-toxicity against wheat, millet, maize, lettuce, and mustard. Reid and Wilson (1985) found that some species of Eucalyptus, such as *Eucalyptus globulus* appear to inhibit grass growth around the tree base. Hussain et. al. (1987) investigated in their study that aqueous extracts from leaves and fruits epicorps of *Melia azedarch* linn. invariably inhibited germination and reduced growth of *Pennisetum americanum, Trifolium respinatum, Lactuca sativa* and *Brassica compestris*. Aakram et. al. (1990) in his studies noted allelopathic potential of *Ficus bengalensis* L., *F. racemosa L., F. religiosa L., F. Palmate Forssk.* against nine crops.

MATERIALS AND METHODS

An experiment was laid in Punjab Forestry Research Institute, Faisalabad in Rabi 1990-91 in randomized complete block design in five replications. Seeds of two varieties (Faisalabad 83 and Faisalabad 85) of wheat were sown in polythene bags after proper treatment. There were 20 seeds per experimental unit making a total of 100 seeds in five replications for one treatment and 700 seeds in the experiment for 7 treatments of one variety of wheat. Similarly there were 700 seeds for the second variety of wheat. Treatments applied in the experiment were as under:

A. Fresh bark of *Eucalyptus camaldulensis* (5% solution).
B. Dry bark of *Eucalyptus camaldulensis* (5% solution).
C. Fresh leaves of *Eucalyptus camaldulensis* (5% solution).
D. Dry leaves of *Eucalyptus camaldulensis* (5% solution).
E. Fruits and Flowers of *Eucalyptus camaldulensis* (5% solution).
F. Soil collected from three years old woodlot of *Eucalyptus camaldulensis* (Irrigation of wheat plants with ordinary water)
G. Control (Irrigation of wheat plants with ordinary water).

Fresh leaves, fresh bark, dry leaves, dry bark, fruits and flowers of *Eucalyptus camaldulensis* were collected and dried in shade. After drying the material was ground thoroughly. Five percent solution (100 cc water and 5 gm ground material) was made separately for each treatment and filtered after 24 hours. Seeds of wheat variety Faisalabad 83 & Faisalabad 85 were soaked in filtered solution for 24 hours and then sown in polythene bags (4.5" x 9") filled with ordinary field soil. For one treatment (F) soil collected from three years old plantation of *Eucalyptus camaldulensis* was used. All the irrigations till maturity of crops were done with solution as prepared above except for treatment F and G which were irrigated with ordinary water.

FIG. 1 EFFECT ON WHEAT GERMINATION
(ALLELOPATHIC EFFECT OF EUCALYPTUS)

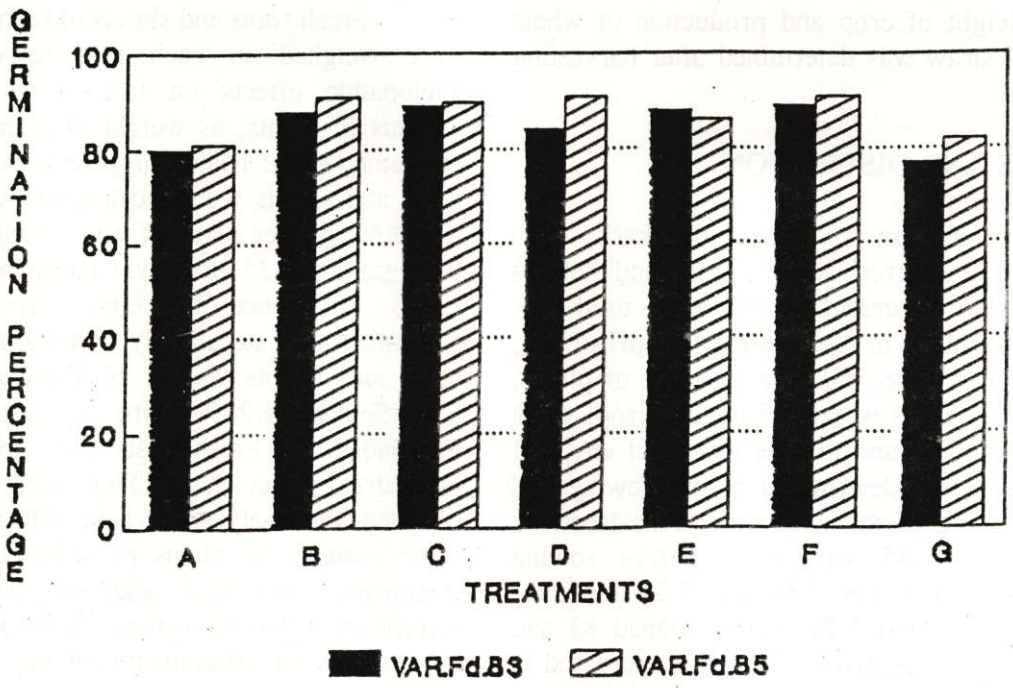
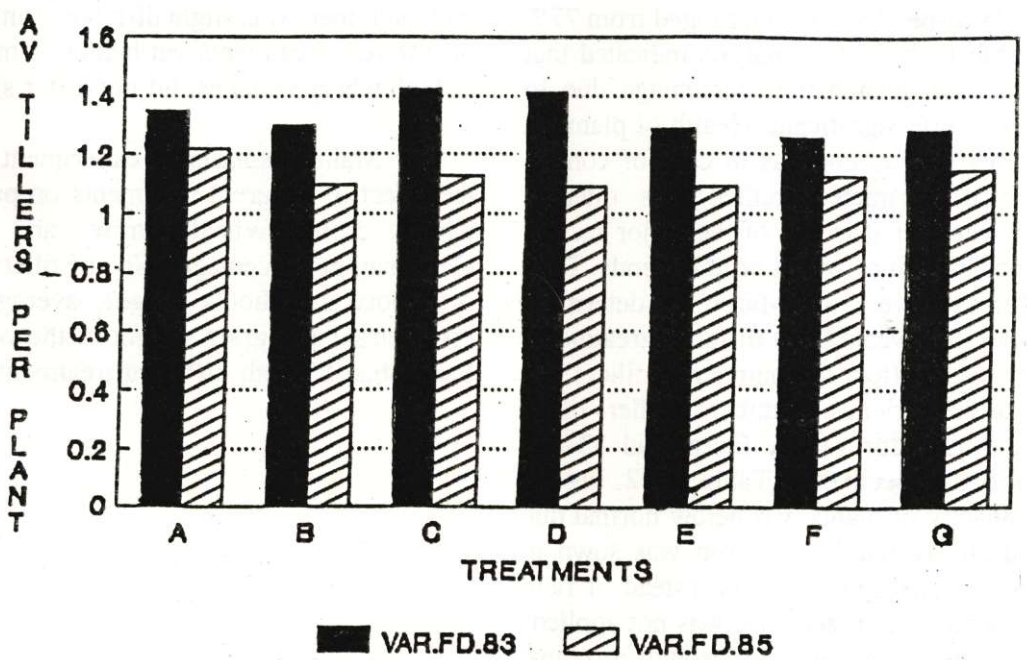


FIG. 2 EFFECT ON WHEAT TILLERING CAPACITY
(ALLELOPATHIC EFFECT OF EUCALYPTUS)



Soil pH was determined before sowing and after harvesting of crop. Germination percentage was recorded after three weeks of sowing of crop. Number of tillers were counted in last week of March, Height of crop and production of wheat grains and straw was determined after harvesting of crop.

RESULTS AND DISCUSSION

Five percent solution of dry bark, fresh bark, dry leaves, fresh leaves, fruits and flowers of *Eucalyptus camaldulensis* was used for irrigation purposes to see its effects on pH of soil, germination of crop, tillering capacity of plants, fresh and dry roots weight of mature crop, grain yield, straw yield and disease attack, if any. pH value of soil was determined before sowing and after harvesting of the wheat var. Faisalabad 83 and Faisalabad 85 separately. Before sowing average pH value was 7.58 and 7.24 and after harvesting 7.98 and 7.21 for Faisalabad 83 and Faisalabad 85 respectively. It slightly increased in var. Faisalabad 83 but no significant change was observed in pH values for different treatments and varieties.

Average germination recorded was 85.00 and 87.41 percent for var. Faisalabad 83 and var. Faisalabad 85 respectively which ranged from 77% to 91% (Table 1, 2 Fig 1). Analysis indicated that variation in seed germination percentage due to treatments was non-significant. Health of plants in different plots was as good as in case of control (Tr.G). Third parameter studied was tillering capacity of wheat as it is one of the major factors on which production of wheat crop depends. Data collected in last week of March to determine tillering capacity revealed that different treatments did not adversely affect the number of tillers per plant in both the varieties. Number of tillers came out 1.33 and 1.13 for variety Faisalabad 83 and Faisalabad 85 respectively (Table 1, 2 Fig.2). Tillering capacity of plants was below normal due to less nutrient availability as crop was sown in plastic bags in nursery conditions instead of field and recommended fertilizer dose was not applied. Plastic bags intercepted the root growth of plants which resulted in poor crop. Var. Faisalabad 83 produced 17.60% more tillers per plant as compared to var. Faisalabad 85.

Fresh roots and shoots of both the varieties were weighed in each plot to examine the allelopathic effects on fresh roots and shoots weights of plants, as weight of plant is also and indicator of the health of plants. Average fresh roots and shoots weight calculated was 0.20 gm and 0.40 gm per plant of var. Faisalabad 83 and 0.13 gm and 0.35 gm of var Faisalabad 85 (Table 1, 2). Difference in weights among different treatments was statistically non significant. Fresh roots and shoots weight of Faisalabad 83 was 53.85% and 14.28% more as compared to var. Faisalabad 85. Fresh roots and shoots collected were dried under shade. That dried material was weighed and analyzed to have information about water contents in plants provided with different treatments. Statistical analysis did not show significant difference among roots and shoots of dried plants for different treatments.

Average height of matured crop calculated came out 64.9 cm and 53.5 cm for var. Faisalabad 83 and var. Faisalabad 85 respectively. (Table 1, 2 Fig. 3) var. Faisalabad 83 gained 21.30% more height as compared to var. Faisalabad 85. Although there was slight difference among heights of different treatments yet height of matured crop in both wheat varieties did not differ significantly.

Main emphasis in experiment was to see the effect of different treatments on production of wheat crop. Wheat straw and Table 1. Germination percentage, No. of tillers, fresh and dry roots and shoots weight, average height of crop, straw and grain weight of the wheat variety Faisalabad 83 with different treatments.

Treatments	Germination % age	Tillers/ plant (No.)	Fresh Shoots wt./ plant (gm)	Fresh Roots wt./ plant (gm)	Dry Shoots wt./plant (gm)	Dry Roots wt./plant (gm)	Av. Ht. of Crop (cm)	Straw wt./ plot (gm)	Grain wt. /Plot (gm)
A. Dry Bark	80.00	1.35	0.32	0.18	0.11	0.09	70.00	29.00	23.40
B. Fresh Bark	88.00	1.30	0.34	0.20	0.12	0.11	65.80	26.60	21.00
C. Dry Leaves	89.00	1.42	0.44	0.18	0.13	0.10	68.60	34.40	24.40
D. Fresh Leaves	84.00	1.41	0.34	0.17	0.11	0.09	62.60	27.60	23.00
E. Fruits/Flowers	88.00	1.29	0.44	0.24	0.14	0.10	59.40	26.40	20.40
F. Plantation Soil	89.00	1.26	0.46	0.21	0.12	0.11	60.80	27.80	20.80
G. Control	77.00	1.28	0.40	0.24	0.12	0.10	67.20	27.00	22.80
Average	85.00	1.33	0.40	0.20	0.12	0.10	64.90	28.40	22.26

Table 2. Germination percentage, No. of tillers, fresh and dry roots and shoots weight, average height of crop, straw and grain weight of the wheat variety Faisalabad 85 with different treatments.

Treatments	Germination % age	Tillers/plant (No.)	Fresh Shoots wt./plant (gm)	Fresh Roots wt./ plant (gm)	Dry Shoots wt./plant (gm)	Dry Roots wt./plant (gm)	Av. Ht. of Crop (cm)	Straw wt./ plot (gm)	Grain wt./ Plot (gm)
A. Dry Bark	81.00	1.22	0.34	0.13	0.09	0.07	56.20	17.60	12.40
B. Fresh Bark	91.00	1.10	0.36	0.12	0.10	0.09	51.60	14.20	10.80
C. Dry Leaves	90.00	1.13	0.38	0.14	0.12	0.09	59.40	17.80	13.60
D. Fresh Leaves	91.00	1.09	0.32	0.14	0.10	0.10	44.20	15.80	10.80
E. Fruits/Flowers	85.00	1.09	0.40	0.13	0.11	0.11	54.00	16.00	11.40
F. Plantation Soil	91.00	1.13	0.28	0.12	0.08	0.08	55.80	17.20	12.20
G. Control	82.00	1.15	0.34	0.12	0.08	0.09	54.00	19.20	12.00
Average	87.41	1.33	0.35	0.13	0.10	0.09	53.50	16.83	11.97

FIG. 3 EFFECT ON WHEAT PRODUCTION
(ALLELOPATHIC EFFECT OF EUCALYPTUS)

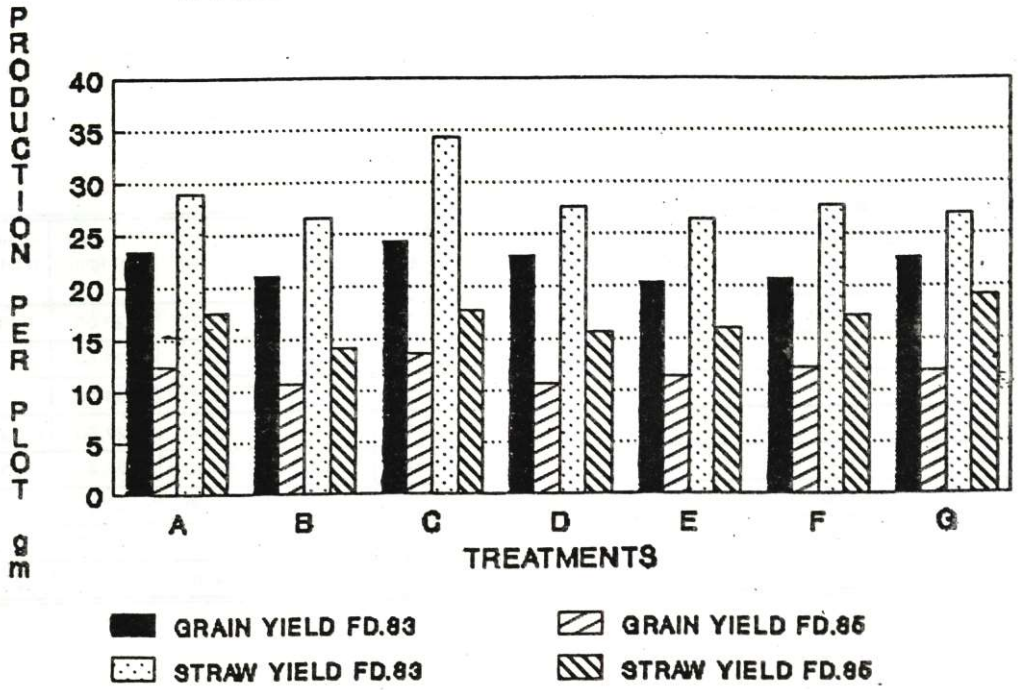
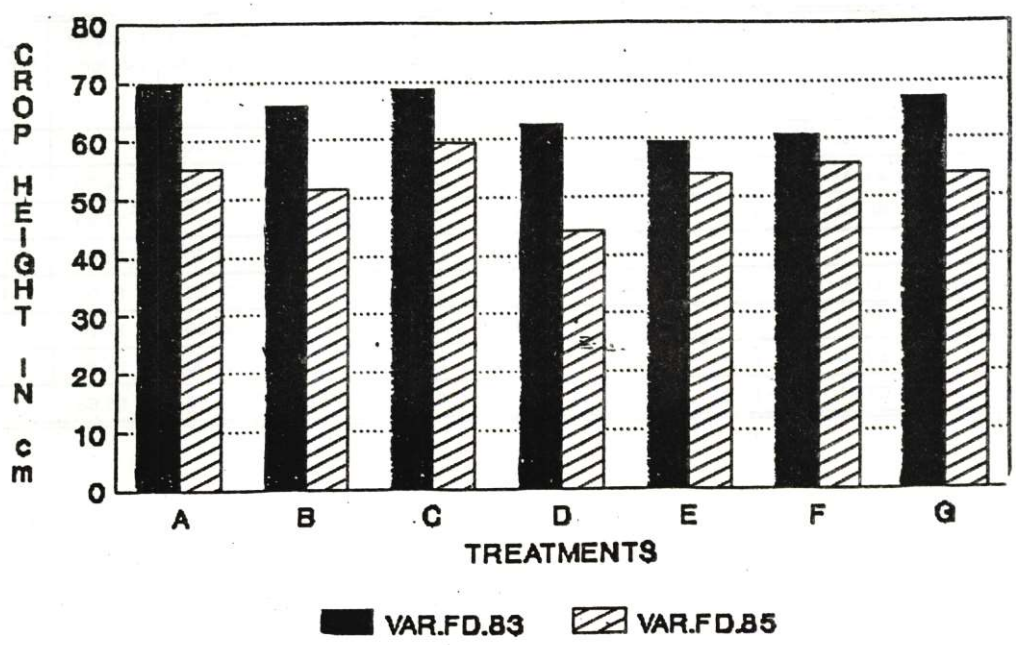


FIG.4 EFFECT ON WHEAT HEIGHT
(ALLELOPATHIC EFFECT OF EUCALYPTUS)



grains were weighed separately on per plot basis. Average grain yield per plot came out 22.26 gm and 11.97 gm where as straw yield per plot was 28.4 gm and 16.83 gm for variety Faisalabad 83 and Faisalabad 85 respectively. Grain yield per plot with treatment C (dry leaves) was higher than other treatments in both wheat varieties (Table 1, 2 Fig.4). Statistical analysis did not show any significant difference in yield of grains and wheat straw in both varieties. During the study period observations were carried out to see any disease effect on wheat plants at different stages of plant growth. There were no symptoms of any wheat disease. Since there was no significant allelopathic effect of various parts of *Eucalyptus camaldulensis* on wheat (*Triticum aestivum*) crop, it is not possible to ascertain how it was related to the disease of wheat crop.

CONCLUSION

The result of the study revealed that 5% solution of *Eucalyptus camaldulensis* do not have adverse effects on wheat (*Triticum aestivum*) due to production of allelochemicals from its leaves, bark, floral buds etc. The reasons for decrease in germination growth, yield and other aspects may, therefore, be attributed to ecological competition for space, light, moisture, nutrients etc. This study was confined to six months. So it is possible that continuous application of 5% concentrated solution for more than six months duration may have adverse effects on soil and as a result on crop production. Higher concentration than 5% may also have allelopathic effects. It is therefore, suggested that further field trials should be carried out to study different aspects regarding interaction of *Eucalyptus camaldulensis* and wheat in different localities to reconfirm results.

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