

EFFECT OF AQUEOUS EXTRACT OF *Eucalyptus camaldulensis* L. ON GERMINATION AND GROWTH OF MAIZE (*Zea mays* L.).

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ABSTRACT

Effect of aqueous extract of Eucalyptus camaldulensis L. was investigated on the germination and growth of maize (Zea mays L.) at the Faculty of Agriculture G.U.D.I.Khan during, 2006. The soil series used in the experiment were Tikken, Saggi and Ramak which were alkaline with deficient phosphorus. The experimental results revealed that seed germination (%) was reduced as a result of extract application. Regarding the dry wt (g) of both shoot and root, an increase over water applied seedlings was noted. Soil pH was decreased while P₂O₅ content of soil was increased only in Ramak soil series.

Key words: Allelopathy, Eucalyptus, Maize seedling

INTRODUCTION

Maize (*Zea mays* L.) is the second most important cereal crop in world after wheat. The leading maize producing countries of the world are USA, Brazil, South Africa, India, Philippines and Indonesia. In Pakistan, it can be planted successfully throughout the country; however, its cultivation is concentrated in Punjab and NWFP provinces that together contribute 98% of the total production. During 2006, maize area and production were 1017 thousand ha with a production of 3088 thousand tons with a mean yield of 3037 kg ha⁻¹ (Anonymous, 2007).

Allelochemicals compounds had injurious effect on the growth and development of crop plants. Allelochemicals released either from leaves, stem, bark of living or dead trees or plants can be classified into terpenes, glucocides, coumanines, aldehyds and phenolic compounds. The leaves of Eucalyptus are main releasing source of toxic compounds. The volatile compounds are also considered a threat to the environment (Alam and Islam, 2002). The *Eucalyptus camaldulensis* L. has been planted in the command area of Chashma Right Bank Canal, D.I.Khan, NWFP, Pakistan, in farm forestry. The tree is considered of having allelochemicals and volatile

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compounds in its all parts. These chemicals 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 (Ghafar *et al.*, 2000).

Rahim (1998) studied nine soil series of D.I.Khan including Tikken, Saggi and Ramak. He reported that soil texture class ranged from sandy to clay and clay loam, soil reaction in all series was alkaline, deficient in nitrogen, phosphorus and organic matter.

Khan *et al.* (2004) stated that aqueous extracts of Eucalyptus leaves significantly reduced seed germination, root and shoot length, fresh and dry weight of maize compared to control treatment. Similarly Blaise, *et al.* (1997) reported a significantly decreased germination of maize seeds in fields surrounded by Eucalyptus trees. Moreover Thaukur and Bhardwaj (1992) noted significantly reduced maize seed germination. Allolli and Narayanareddy (2000) studied the allelopathic effects of various concentrations of plant extracts (1.0, 2.5, 5.0 and 10.0%) isolated from leaves, barks and roots of Eucalyptus on the germination and seedling growth of cucumber seeds. Treatment with 10% leaf extract resulted in 41% less germination and decreased shoot and root growth. Therefore, it was imperative to determine the ill effects of aqueous extract of *E. commaldulensis* L. on the germination and growth of maize seed in different soil series of D.I.Khan, NWFP, Pakistan. The other reason of this study was to generate awareness among the farmers of this region about the allelopathic effect of *E. camaldulensis* on maize crop.

MATERIALS AND METHODS

A pot experiment was conducted at the agronomic research area of Gomal University (City Campus) during, 2006. The fresh green leaves of Eucalyptus were collected and washed with water. These were chopped manually with help of a sickle and again thoroughly mixed. The chopped material was soaked in water using plastic tubs in the ratio of 1:5 (Leaves: water) for 72 hours. The soaked material was stirred frequently after every 8 hours to maintain the oxygen level and to avoid the anaerobic condition.

The soils samples were collected from 3 soil series (Tikken, Saggi and Ramak) from a depth of 15-30 cm, from the different areas of D.I.Khan. The soil samples of each soil series were thoroughly mixed. Five pots were filled from each soil series. The pot size was 150 square centimeters. The aqueous extract was applied to 4 pots and one control pot was irrigated with tap water. Ten seeds of maize hybrid 4208 were sown in each pot. The sowing was done on 10 September, 2006. The soil in the pots was kept moist throughout the duration of experiment by applying aqueous extract and water to the respective pots. The pH was determined by using sample of 5g in 25ml

of distilled water with the help of pH meter before and after application of Eucalyptus extract. The available phosphorus was determined by using method of Black (1965). Germination % was recorded after 15 days of sowing. The plants were harvested after 17 days. The shoot and root were packed in a paper bag and put in an oven at 80°C. After 72 hours, shoots and roots were taken out of oven and were weighed on the scientific electrical balance separately and data were recorded. Paired T-test was applied to the means of treatment by using computer software MSTATC (Bricker, 1991).

Table-1. Textural class of different soil series

Soil Series	pH	P ₂ O ₅ mgkg ⁻¹	Sand (%)	Silt (%)	Clay (%)	Remarks
Tikken	8.1	08.1	60	20	20	Sandy loam
Saggu	8.2	10.0	11	25	64	Silty Clay
Ramak	8.0	07.2	01	18	81	Clay

RESULTS AND DISCUSSION

Germination (%)

The results revealed that aqueous extract application significantly reduced the seed germination over water applied treatment (Table-2). The decrease in germination % was found from 12-18%. More decrease was recorded in Tikken than Saggu and Ramak soil series. The inhibition in germination could be due to imbibed allelochemicals. These results are in agreement with those reported by Lisanework and Michelson (1993) who noted a decrease in germination and radical growth of maize due to applied Eucalyptus extract. These results suggested that if maize has to be cultivated in a land surrounded by Eucalyptus trees or having Eucalyptus in agrforestry, then seed rate must be increased upto 18% over the normal seed rate to obtain the desired plant population per unit area. Ghaffar *et al.* (2000) also reported that allelochemicals reduce and delay germination. While Allolli and Narayanareddy (2000) observed that treatment with 10% aqueous leaf extract of Eucalyptus resulted in 41% lesser germination in cucumber.

Root and shoot dry weight

The effect of aqueous extract was found to be stimulatory regarding the root and shoot dry weight of maize seedlings (Table-2). The increase in dry weight (g) as compared to that obtained in water treated check plants was highly significant. The interesting point to note was that increase in dry weight (g) in all soil series was higher than control. The stimulatory effect

might be due to 1:5 (water: aqueous extract). Slightly neutral solutions increase the process of transportation (osmosis and diffusion) than an alkali solution. Alkali solutions inhibit germination, growth and increase the mortality rate of seedlings (Zeng and Shannon, 2000). 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. It could be inhibitory if different aqueous extract prepared in different ratios and applied to the maize seedlings.

Soil pH

The pH of aqueous extract and water was 7.7 and 8.1, respectively. It lowered the pH of soil of all three series filled in the pots. The data in Table-2 clearly indicated that extract applications to all soil series lowered the pH. It seems to be the beneficial effect to the soil with high pH. The pH of Tikken soil reduced upto 0.2. This reduction in pH is minimum as compared to other soil series. This might be due to its coarse texture of sandy loam texture. Since the coarse textured soils can not hold the allelochemicals as much as fine textured soils do. So, the applied litter of Eucalyptus could be used for soil pH correction especially in alkaline soils if residual effect is degraded after a passage of time. Then it will not be injurious to seed germination and growth. Putnam (1984) reported that Eucalyptus species release volatile compound such as benzoic, cinamic and phenolic acids, which inhibit growth of crops and also reduce the soil pH. Similar results were quoted by Tomer *et al.* (1992).

Available Phosphorus

Significant reduction in P₂O₅ content was observed in water applied soil. It could be due to the absence of restriction caused by extract application. The other probable reason could be easy leaching of available phosphorus in water application as compared to the aqueous extract application where possibly the allelochemical compounds hindered in its release and leaching. As the clay particles were more in soils, these soil had good holding ability and so these soil held up aqueous extract more, so their P-level remained high even after harvest of crop. This result is in an agreement with the findings reported by Khitran (1996).

Table-2. Effect of aqueous extract on germination and growth of maize hybrid 4208.

Soil Series	Germination (%)			Shoot Dry wt.(g)		Root dry wt.(g)		pH		P ₂ O ₅ mg kg ⁻¹	
	Control	Extract	Decrease	Control	Extract	Control	Extract	Control	Extract	Control	Extract
Tikken	100	82	18.0	0.11	0.15	0.12	0.13	8.1	7.9	08.3	7.5
Saggu	100	88	12.0	0.08	0.13	0.07	0.10	8.2	7.4	10.0	8.1
Ramak	100	87	13.0	0.15	0.20	0.12	0.14	8.0	7.7	07.1	8.6
Mean	100	85.7	14.3	0.11	0.16	0.10	0.12	8.1	7.7	08.5	8.1
Variance	-	33	-	0.01	0.00	0.20	0.00	0.01	0.01	0.91	0.76

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