ALLELOPATHIC EFFECT OF *Eucalyptus camaldulensis* L. ON SEED GERMINATION AND SEEDLING GROWTH OF mungbean *Vigna radiata* (L.) Wilczek.

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ABSTRACT

The present study entitled "Allelopathic effect of leaves extract of Eucalyptus camaldulensis L. on the seed germination and seedling growth of mungbean Vigna radiata (L.) Wilczek" was carried in the Phytoecology Lab., Department of Botany, University of Peshawar, Pakistan. The leaves extract was made of 5g, 10g and 15g of powder which were soaked in 100ml distilled water from 24, 48 and 96 hrs. The germination % was found more in the control and 5g/100ml extract as compared to 10g/100 ml and 15g/100 ml concentrations. As the concentrations were increased, the inhibitory effects of the leaves extract on seed germination were found to be increased. The length of radical and plumule were also measured more in the control followed by 5g (24 hrs) treatment and low at 15g (96hrs) treatment. These findings suggest that Vigna radiata and other closely related crops should not be planted close to the Eucalyptus camaldulensis L. which causes inhibitory effects on the seed germination and growth of neighbouring species. It is suggested that the allelopathy of Eucalyptus camaldulensis may be exploited in management of weeds in different crops after ascertaining the required tolerance and susceptibility of crops and weeds.

Keywords*:* Allelopathic effect, germination, plumule, radical, seedling.

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INTRODUCTION

Eucalyptus camaldulensis L. is a perennial woody tree belonging to family Myrtaceae and is indigenous to Australia (May and Ash, 1990). It has been introduced into the other countries of the world (Turnbull, 1999). Eucalyptus is a prominent species of forestry in Australia as well as elsewhere in the world including Pakistan, due to its rapid growth and adaptation to all types of environmental conditions and its use as firewood (Oliveira *et al*., 2010) in addition to its industrial uses. It is also planted in dry and saline areas (Ziaebrahim *et al*., 2007). It is one of the potential allelopathic plants having a number of allelochemicals (El- Darier 2002). It has been observed that the species Eucalyptus has strong allelopathic activity (Gliessman, 2007). Allelopathy is the production of secondary metabolites by plants, algae, fungi and bacteria that influence the agricultural plant growth and development, and also on the biological system (Torres *et al*., 1996).

It has been examined that the eucalyptus produces several types of terpenes and phenolic compound in the environment (Sasikumar *et al*., 2002; Florentine and Fox 2003; Djanaguiraman *et al*., 2005; Setia *et al*., 2007). Allelochemical compounds have injurious effect on the growth and development of crop plants. Allelochemicals may be present in the leaves, bark, roots, flowers and fruits. It has been found that the leaf extract has more powerful inhibitory allelopathic impact compared to the other vegetative parts (Maharjan *et al*., 2007). These allelochemicals are posing a serious threat to the environment (Alam and Islam, 2002). These compounds can also affect phytohormones equilibrium, germination of pollen tube, nutrient absorption, stomatal movement, photosynthesis, respiration, synthesis of proteins, pigments and change in structure of DNA and RNA (Glass, 1974). *Eucalyptus* species release volatile compounds such as benzoic, cinnamic and phenolic acids, which inhibit growth of crops and weeds growing near to it (Putnam, 1984). The investigation of allelopathaic potential of plants through aqueous extract is a simple, rapid and intensive method which can be used for a suspected donor species (Morsi, *et al*., 2016). Seed germination and seedling growth has been widely accepted as main variables to monitor growth responses (Anjum and Bajwa, 2005). The inhibitory effects of *Eucalyptus* on seeds germination and growth of various plants have been studied by different workers (Gliessman, 2007; Fikreyesus *et al*., 2011; Rinez *et al*., 201; Dejam *et al*., 2014; Torres *et al.*, 2016).

Vigna radiata plant is locally known as mungbean or simply mung. This plant is mostly cultivated with *Zea mays* in the field as an intercrop. The mung plant may be short and erect in growth or submerged with slightly twine having length from 1- 1.5 m. The seeds of mung are used as food because they are good source of protein, vitamins and minerals. The leaves and shoots are used as fodder for cattle. Thus, keeping in mind the importance of mungbean to human and cattle consumption, the present study was conducted in the Phytoecology laboratory at the Department of Botany, University of Peshawar, Pakistan to determine the allelopathic effect of leaves extract of *Eucalyptus camaldulensis* L. on germination and growth of *Vigna radiata* seeds.

MATERIALS AND METHODS

Experimental place

This experiment was conducted at the Phytoecology lab. of Department of Botany, University of Peshawar, Pakistan. In this experiment aqueous extracts were used to investigate its allelopatthic effect on seeds germination and seedling growth of *Vigna radiata*.

Collection of *Eucalyptus* leaves and preparation of aqueous extract

Fresh leaves from the *Eucalyptus camaldulensis* were collected and then shade dried at room temperature. The dried leaves were ground to make its powder. 5g/100 ml, 10g/100 ml and 15g/ 100ml extracts were soaked for 24 hrs,

48hrs and 96 hrs with distilled water. The extract was filtered (Whatman 1) and filtrates were collected in flasks.

Experimental design and treatment

The seeds of *Vigna radiata* were surface sterilized with 5% bleach solution for 10 minutes and sundried. The germination test was performed in the sterilized petri dishes in which three replicates for each concentration along with a control were designed. Ten healthy and viable seeds of *Vigna radiata* were put in each replicate including control. The treatments were replicated thrice for each concentration and control. 10 ml of distilled water was added on the first day and then 3ml for next three days soaking. Then the aqueous extracts of 10ml of each concentration were added after 24 hours to the respective replicates. The germination of each seed in each replicate was checked every day.

Data collection and analysis

The germination percentage was calculated through the method (Bewley and Black, 1994) as under:.

Germination % (GP) =(Number of germinated seeds (G) / Total Number of sown seeds (N)) X 100

Where, 'GP' is the germination percentage, 'G' for germinated seeds and 'N' for the number of seeds used for germination.

The length of radical and plumule were determined with measuring scale after seven day treatment. The statistical analysis for mean values of seedling growth in terms of plumule and radical were then calculated and subjected to slandered analysis for t-test using SPSS software version 16.0.

RESULTS AND DISCUSSION

Seed germination and seedling growth are the screening criteria used for the investigation of allelopathic effect. The extract of different concentrations such as 5g/100ml, 10g/100ml and 15g/100ml were prepared from the dry powder of *Eucalyptus camaldulensis* leaves and used for the seed germination of *Vigna radiata* in the respective replicates. The highest percent germination was observed in the control followed by 5 g for 24 hrs, and 10 g for 24hrs (Figure 1). When the concentration was increased the rates of germination were decreased because of the allelopathic effect of the extract. Thus, there has been inverse relationship between the rates of extract germination of mungbean seeds.

The length of radical and plumule were also studied at various concentrations. The control of each concentration showed more length of both radical and plumule (Table-1). When the concentrations was increased, the the growth of radical was found less affected than the plumule. The mean value for the growth of radical was (1.04 to 2.9cm) in comparison to plumule (1.30 to 2.47 cm) at various concentrations. Statistical analysis for t- test has been used to compare the value of various treatments on the plumule and radical. The values were found $P<05$ which indicated that the extract of *Eucalyptus* had negatively affected the growth (Tables 1 and 2). These results indicated that the leaves extract of *Eucalyptus camaldulensis* has allelopathic effect on the seed germination and also on the growth of radical and plumule of *Vigna radiata.*

Allelopathy is the release of chemicals into the environment (Babu and Kandasamy 1997). *Eucalyptus* has been reported to contain phenolic acids, tannins, and flavonoids and these chemicals have inhibited the growth of some plants tested (Espinosa-Garcia, 1996). Many researchers worked on the Allelopathic effect of *Eucalyptus* on various plants from germination to the vegetative growth till to the formation of fruits and seeds. Blake (1985) reported the inhibitory effect of *Eucalyptus* on the growth of its associated species by reducing their germination, photosynthesis and yield. Leaf extract of *Eucalyptus camaldulensis* L. and *Eucalyptus microthecia* L. delayed and inhibited germination of maize (Ebrahim *et al*., 1999, Khan *et al*., 1999, Khan *et al*., 2007). The aqueous extract of

Eucalyptus leaves at high concentrations (50% and 100%) strongly inhibited the germination, vigour and seedling growth (Carvalho *et al*., 2015). *Eucalyptus* plant extract also inhibit seed germination and seedling growth of weed and cultivated crop (Ben Ghnaya *et al.*, 2016). The effect of different concentrations of aqueous leaf extract of *Eucalyptus globulus* on growth and cytogenetic behaviour of barley (*Hordeum vulgare*) was investigated by Morsi and Abdelmigid (2016). They observed the inhibitory effect of the aqueous extract on seed germination and seedling growth of barley plant. De Sousa *et al*. (2018) observed that the allelopathic effects of young and mature leaf extract of *Eucalyptus* on the physiological performance of millet seeds. These results are in agreement with our current finding that the leaves extract of *Eucalyptus* have allelochemicals which caused potential phytotoxic, cytotoxic and genotoxic effects on the seed germination and growth of seedling.

Table-1. Length of plumule of the *Vigna radiata* at various concentrations.

S#	Treatment	Mean length (cm)	Std. Deviation	Std. Error Mean	P
1	5g (24hrs)	1.9525	0.47745	0.23872	0.004
2	10g (24hrs)	2.475	0.95939	0.4797	0.014
3	15g (24hrs)	2.405	1.76804	0.88402	0.073
4	5g (48hrs)	1.7875	0.82399	0.41199	0.023
5	10g (48hrs)	1.81	0.63272	0.31636	0.011
6	15g (48hrs)	1.305	0.85192	0.42596	0.055
7	5g (96hrs)	2.2675	0.73866	0.36933	0.009
8	10g (96hrs)	1.3525	0.37986	0.18993	0.006
9	15g (96hrs)	1.3225	0.87492	0.43746	0.057

Significant at P ≤0.05

Table-2. Length of Radical of the *Vigna radiata* at various concentrations.

S#	Treatment	Mean length (cm)	Std. Deviation	Std. Error Mean	P
1	5g (24hrs)	2.79	0.98	0.49	0.01*
2	10g (24hrs)	3.15	1.44	0.72	0.02
3	15g (24hrs)	2.84	1.63	0.82	0.04
4	5g (48hrs)	1.87	0.83	0.42	0.02
5	10g (48hrs)	2.31	0.67	0.34	0.01
6	15g (48hrs)	1.79	0.52	0.26	0.01
7	5g (96hrs)	2.04	0.61	0.31	0.01
8	10g (96hrs)	1.66	0.98	0.14	0.00
9	15g (96hrs)	1.92	1.44	0.44	0.02

Significant at P ≤0.05

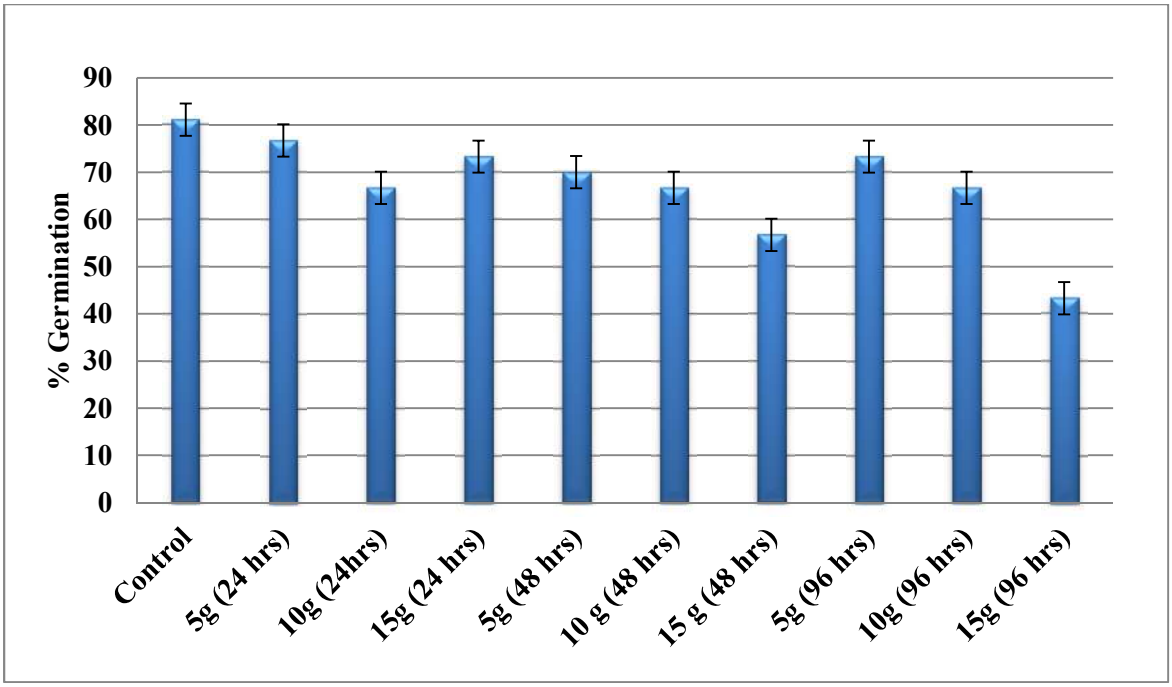

Figure 1- % germination of the seeds of *Vigna radiata* at various concentrations of *Eucalyptus* leaves extract.

CONCLUSIONS

We conclude form our data that high concentration of the aqueous extract of *Eucalyptus camaldulensis* inhibits the seed germination and reduce the growth of seedling of *Vigna radiata*. The plumule and radical length showed significant decrease in higher concentration in response of the allelopathic effect of *Eucalyptus* extract. This experiment indicated that the leaf litter of *Eucalyptus* in the field of *Vigna radiata* and other related genera could causes allelopathic effect on its seed germination, seedling growth and plant development which would result in reduction of the growth and ultimately yield of the test species. Hence, it is suggested that *Vigna* species should be cultivate away from the canopy of *Eucalyptus* trees.

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