Allelopathic Effect of Aqueous Extracts of Neem (*Azadiracta indica*) and Eucalyptus (*Eucalyptus citroides*) on the Growth and Germination of Wheat (*Triticum aestivum var-desi*)

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Abstract: Allelopathic effects of the neem and eucalyptus were analyzed on the growth and germination of wheat (Triticum aestivum var. Desi) in a laboratory of IGAEERE, Jiwaji University, Gwalior. The aqueous extract concentrations of neem and eucalyptus used in the experiment were 25%, 50% and 100% w/v prepared by dissolving the leaf powder of 25 g, 50 g and 100 g of the neem and eucalyptus plants in 500 ml distilled water. The aqueous extracts of various concentrations of both these plants showed a remarkable allelopathic effect on the growth and germination of the wheat. The inhibitory allelopathic effect of both these plants directly increases as the concentration of the extract increases. However, the allelopathic effect of eucalyptus extract was found more than neem on the growth and germination of wheat. The present study has very important implications as the eucalyptus and the neem has been used extensively as a part of Agroforestry in various parts of India.

Keywords: Allelopathy, agroforestry, germination, aqueous Extracts, Triticum aestivum var. Desi.

INTRODUCTION

Eucalyptus and Neem has been used in India as a part of agroforestry for a long time. The plantation of various exotic plant species such as the one like eucalyptus is increasing and in the recent years, creating competition between native and exotic species has gained momentum [1]. Direct or indirect stimulatory or inhibitory effects of one plant on another through release of chemical compounds into the environment are referred to as allelopathy. Root exudation, leaching by dews and rains, and volatilization or decaying plant tissue from allelopathic plants results in release of compounds into the environment [2]. These allelopathic plants became a cause of great concern when these are present along with the crop plants.

Wheat (*Triticum aestivum*, family poaceae) is one of the first domesticated food crops and is a basic staple food of the majority of the population not only in India but also in many regions of the world. Today, wheat is grown on more land than any crop and continues to be the most important food grain source for humans. So improvement of both crop quality and yield is the need of the hour [3]. But sometimes the crop plants such as wheat are grown in close proximity with certain allelopathic plants. In this way the process of allelopathy can cause a deleterious effect on the crop productivity as well as the income of the farmers. The present study was conducted to find the possible effect of neem and eucalyptus on the growth and germination of wheat with which they are usually grown in close proximity in various areas of our country.

MATERIALS AND METHODS

Preparation of Aqueous Extracts from the Leaves of Neem and Eucalyptus

Fresh samples of leaves and upper parts of shoot from various neem and eucalyptus plants were collected from the field (University campus). The leaves were shed, dried and then ground, using leaf particulator to pass through 2 mm mesh sieve. 25 g, 50 g and 100 g of the sieved leaf material of both the plants was dissolved into 500 ml of distilled water and kept on a heating mantle at a temperature of 45-55^{o}C for 24 hours. The resulting brownish and dark extracts were filtered through a cotton cloth and after that with whartman No.1 filter paper [1]. The different aqueous concentrations of the leachate of neem and eucalyptus 25%w/v, 50%w/v and 100%w/v were designated as A, B and C respectively. The extract obtained was stored in a refrigerator in a dark place in conical flasks until required.

Collection and Sterilization of Test Seeds

Healthy uniform seed grains of wheat (*Triticum aestivum)* were obtained from a registered seed store. The seeds were surface sterilized before conducting the tests with 1% sodium hypochlorite for about 30 minutes, then rinsed with the distilled water for several times to remove excess of chemical [4].

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SEED GERMINATION TEST

This test was performed for the aqueous extracts of neem and eucalyptus to show their effect on the germination (radicle length) of wheat seeds. For this test, healthy and uniform sized seeds were selected and presoaked in different aqueous concentration (25%w/v, 50%w/v and 100%w/v) of neem and eucalyptus for about 4 hours [3]. The seeds were then evenly placed on two layers of filter papers and kept in sterilized petridishes. Three petridishes were used to contain the seeds treated with different concentrations of neem extract and other three contain the seeds treated with different concentrations of eucalyptus extract. The seventh petridish was kept as control containing the seeds treated with distilled water. About 10-15 seeds were put in each petridish. The petridishes were then placed in an incubator set at 25^0C temperature. Seeds were considered germinated upon radicle emergence. To reveal the effect of different extracts, the radicle lengths were measured with a measuring scale at 24 hour intervals over a 4-day period.

GROWTH TEST

Growth test was conducted to study the effect of aqueous extracts of neem and eucalyptus having different concentrations on the growth of the wheat plants. About seven pots were selected and filled with soil that was collected from same field and uniform size seeds were selected and same procedure of extract treatment was followed as in germination test. The seeds were sown in different pots after the treatment, three pots containing the seeds treated with neem extracts and three pots contain the seeds treated with eucalyptus extracts. The seventh pot contains the seeds treated with distilled water (control). The seeds in the pots were sown at equal depths. The pots were kept in a green house under suitable condition of temperature (30-35 ^{o}C) and humidity and the plants in the pots were treated with aqueous extracts of various concentrations at regular intervals. Meanwhile, the plants in the control pot were treated with distilled water. Only five plants were kept in each pot and the others were eliminated in order to avoid intraspecific competition between the plants for limited supply of nutrients. When the plants in the pots attain the suitable heights, their heights were measured with help of a ruler over a 20-day period at an interval of 5-days, in order to assess the effect of various aqueous extracts of different concentrations on the growth of the plants grown in the pots.

STATISTICAL ANALYSIS

Statistical analysis was performed by using ezANOVA software. To detect the significance of differences of variables, all values have been expressed as mean± SDs.

RESULTS AND DISCUSSIONS

The chemical exudates from allelopathic plants are proposed to play a major role in the allopathic mode of action [5]. Evidences showed that higher plants release a diversity of allelochemicals into the environment, which includes phenols, alkaloids, long-chain fatty acids, terpenoids and flavanoids [2]. The allelopathic effect of neem and eucalyptus on the germination and growth of wheat is shown in Tables **1** and **2**, respectively. It is quite clear that an aqueous leaf extract of neem and eucalyptus inhibited the germination and growth of the wheat. The maximum radicle growth was seen in control where no extract was used which was 0.84±0.05cm at 24h, 0.98±0.08cm

Table 1: Average Radical Length (Germination) of Wheat Seeds Treated with Aqueous Extract of Neem and Eucalyptus (cm)

Concentration of aqueous extract		Time duration			
		After 24 hours	After 48 hours	After 72 hours	After 96 hours
Control		0.84±0.05	0.98±0.08	1.11±0.05	1.26±0.05
Neem extract	A	0.32±0.05	0.4±0.07	0.5±0.10	0.62±0.13
	B	0.24±0.05	0.32±0.04	0.4±0.07	0.52±0.08
	C	0.14±0.05	0.24±0.05	0.36±0.08	0.45±0.11
Eucalyptus extract	A	0.2±0.07	0.3±0.07	0.44±0.11	0.56±0.11
	B	0.14±0.05	0.28±0.08	0.38±0.08	0.48±0.08
	C	0.12±0.04	0.22±0.04	0.34±0.05	0.40±0.05

*remember; A=25g/500ml distilled water, B=50g/500ml , C=100g/500ml , Control=distilled water.

Table 2: Average Length of Wheat Plants Treated with Aqueous Extract of Neem and Eucalyptus (cm)

Concentration of aqueous extract		Time duration			
		After 5 days	After 10 days	After 15 days	After 20 days
Control		9.58±1.54	14.65±1.81	20.05±6.07	26.4±1.52
Neem extract	A	6.4±2.00	11.92±0.42	18.8±2.63	23.16±2.24
	B	5.4±1.39	9.1±0.70	15.22±3.94	18.72±2.90
	C	5.08±0.68	8.62±0.69	14.04±4.59	17.94±4.06
Eucalyptus extract	A	5.24±2.11	9.55±1.34	14.26±3.16	18.72±2.90
	B	4.96±1.14	8.03±1.24	12.88±3.27	16.27±5.20
	C	4.52±0.49	7.64±0.94	10.36±2.16	13.04±1.24

at 48h, 1.11±0.05cm at 72h and 1.26±0.05cm at 96h. The highest inhibitory effect on radicle growth was found that of eucalyptus extract (C) having a concentration of 100%w/v which was 0.12±0.04cm at 24h, 0.22±0.04cm at 48h, 0.34±0.05cm at 72h and 0.40±0.05cm at 96h. The highest plant growth was shown in the control (Distilled water) which was 9.58±1.54cm at 5 days, 14.65±1.81cm at 10 days, 20.05±60.7cm at 15 days and 26.4±1.52cm at 20 days (Table **2**). The highest inhibitory effect on plant growth was found in wheat plants treated with C (100%w/v) concentration of eucalyptus extract which was 4.52±0.49cm at 5 days, 7.64±0.94cm at 10 days, 10.36±2.16cm at 15 days and 13.04±1.24cm at 20 days. From the above results it may be concluded that the inhibitory effect of the extract increases with the increasing concentration of the extract. The highest inhibitory effect on germination and plant growth of wheat was shown by the C (100%w/v) extract concentration of the eucalyptus extract in all time intervals revealing the greater concentration of allelochemicals in the aqueous extract. It is quite clear from our study that both the neem and eucalyptus plants possess remarkable allelopathic effects on the growth and the germination of the wheat. It may be due to the phytotoxic chemicals released by the leaves of neem [6]. The study also reveals that the allelopathic effect of the extract increases with the increase in the concentration of the extract. So 100%w/v concentration of eucalyptus extract has the greatest effect among all the extract concentrations. The present findings corroborate the earliest report by Bora *et al.* [7], who found that the inhibitory effect of leaf extracts of Acacia auriculiformis on germination of some agricultural crops was proportional to the concentration of the extract. Also noted by Jadhar and Gayanar [8] that the percentage of germination, plumule and radicle length of rice and cowpea decreases with the increasing concentration of *acacia auriculiformis* leaf leachates. It is argued that the allelopathic effect might be due to synergistic effect rather than single one [9]. The allelochemicals responsible for allelopathic effect have been shown to be toxic to germination and plant growth [10].

CONCLUSION

The present study concluded that both the name and eucalyptus extracts have allelopathic effects. The 100%w/v concentration of the eucalyptus extract has the greatest effect among all the extract concentrations. Similar findings were also reported by [3, 11-15] in leaf extracts of different agroforestry and weed plants on common agricultural crops. So this can be recommended that these both plant species neem and eucalyptus shouldn't be grown near agricultural fields in order to alleviate their effects on crop productivity. Not using these plants species as a part of agroforestry would substantially avoid the possible allelopathic effect of these plants on various agricultural crops.

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