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Allelopathic Effects of Leaf Extracts of Kalmegh on Seed Germination and Seedling Growth of Wheat (*Triticum aestivum* L.)

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Research Article

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ABSTRACT

Andrographis paniculata Nees is traditionally known as Kalmegh, Allelopathic effect of Kalmegh was examined on seed germination and seedling growth of four (Sonalika, VL-914, Euguanda-6 and Mond's Aids) wheat genotype, the aqueous leaf extracts reduced seed germination and seedling growth of wheat. On the basis of value of per cent reduction in seed germination, germination relative index and vigour index, the inhibitory effect of different leaf extracts was maximum in susceptible genotypes (Euguanda-6 and Mond's Aids) followed by tolerant genotypes (sonalika and VL 914). The root and shoot length, root and shoot fresh weight and root and shoot dry weight declined with increase in the concentration of the leaf extracts of Kalmegh, leaf extracts of Kalmegh showed inhibitory effect of reducing sugar, non-reducing sugar, total sugar and soluble protein and stimulatory effect on total free amino acids contents of wheat seedlings. The results indicated that the allelopathic effect of aqueous leaf extracts of *Andographis paniculata* was maximum in terms of all physiological and biochemical parameters.

INTRODUCTION

Kalmegh was in use in Indian systems of medicine, since time immemorial. Leaves and stem constitute the drug. It is bitter toxic and possesses antityphoid and antibiotic properties. It is used to treat liver and digestion complaints, general weakness, worms, fever, dysentery and excessive gas formation in stomach. Allelopathy is also regarded as a biochemical welfare. Plants inhibit the seed germination and growth of other plants by means of producing toxic chemicals that is alleleochemicals or allelopathins. Allelopathy refers to any process involving secondary metabolites produced by plants, microorganics, viruses and fungi that influence the growth and development of agricultural and biological systems including positive and negative effects. Allelochemicals from plants are released in to the environment by exudation from roots, leaching from stems and leaves or decomposition of plant national [1]. reported that the secondary metabolites (flavonoids, glycosides, steroids and diterpenoids) of some medicinal and aromatic plants accounted for allelopathic activity likewise) studied allelopathic effect of medicinal plants. *Andrographis paniculata* which showed inhibition in germination and seedling growth of *lens culinaris* [2-4].

Hence, the laboratory experiment was undertaken to study the behavior of phytochemicals present in *Andrographis paniculata* extracts in germination and seedling growth of *Triticum aestivum*. Hence, the present study was carried out to determine the allelopathic effects of medicinal plants species on *Triticum aestivum* L. The study was conducted under laboratory conditions.

MATERIAL AND METHODS

The experiment was conducted during Rabi season 2014 in the Department of Botany and Plant physiology laboratory, Faculty of Basic sciences and Humanities, Rajendra Agricultural University, Pusa, Samastipur, Bihar. There were shade dried for 10 days, then powdered in grinders and sieved. For leaf extract, 30 g leaf powder was soaked in 100 ml distilled water for 24 hours to get 30% extract. By dilutions with distilled water 8%, 16%, and 24% concentrations of extracts were prepared. Seeds of *Triticum aestivum* were surface sterilized with 0.1% mercuric chloride for 2.0 minutes and repeatedly washed with

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sterilized distilled water. The seeds were soaked in different concentration of extracts for 24 hours. The experiment was done in 11 cm diameter, petridishes with blotting paper and kept 25 + 2°C in a BOD incubator under controlled conditions with three replications. The germination relative index (GRI) was calculated according to the formula given by Srivastava and Sareen [5]. $\sum$ Xn (h–n), where Xn = number of seeds germination on nth count, h = total number of counts, n = count number. Vigour Index (VI) was worked out by multiplying germination (%) with total seedling length [6]. Seven-day-old wheat seedlings were used for the estimation of soluble sugar, soluble protein and total free amino acid [7-9].

RESULTS AND DISCUSSION

Seed Germination and Seedling Growth

The increasing concentrations of aqueous leaf extracts of *Andrographis paniculata* inhibited the seed germination of sonalika, VL-914, Euguanda- 6 and mond's aids varieties of wheat **(Table 1).** Maximum decline in germination percentage was observed in susceptible varieties (Euguanda -6 and Monds Aids) at 24.0% leaf extract in comparison to control, followed by tolerant varieties (Sonalika and VL-914). The GRI and VI of test varieties decreased with increase in concentration of leaf extracts. The interaction between treatments and varieties was found significant. Decreased germination and growth with increasing aqueous leaf extract have been observed [4,10]. Also found similar trend for germination and seedling growth of various crops, with increase in leaf leachate concentration [11,12]. The effects of leaf leachates on seed germination and seedling growth were due to the presence of nutrients, growth regulators, alkaloids and toxins [13,14]. Further, the phenolic compounds (synthesized in the roots and shoots of plants and released into the soil) inhibits seed germination of surrounding plant species [15].

Table 1. Effect of aqueous leaf extracts of *Andrographis paniculata* Nees on germination, growth and biomass of wheat at 7-day after sowing.

Aqueous extract conc. (%)	Wheat varieties	Germin-ation (%)	GRI	Vigour Index	Shoot length (cm)	Root length (cm)	Root dry weight (mg.)	Shoot dry weight (mg.)
Control	Sonalika	100.0	374.3	2824.0	15.8	12.4	54.0	112.4
	VL-914	98.3	372.7	2654.9	15.0	12.0	53.0	112.0
	Euguanda-6	100.0	362.3	2543.4	14.9	12.0	53.0	109.9
	Monds's Aids	98.3	358.7	2580.9	14.9	11.8	52.0	109.3
	Mean	99.1	367.0	2650.8	15.1	12.0	53.0	110.9
8.0	Sonalika	96.7	342.0	2455.3	14.0	11.0	48.2	106.2
	VL-914	95.0	340.7	2258.2	13.0	10.3	47.6	105.3
	Euguanda-6	93.3	319.6	2149.4	13.0	10.0	45.9	101.8
	Monds's Aids	91.7	313.0	2122.3	12.9	9.9	44.3	99.2
	Mean	94.2	328.8	2246.3	13.2	10.3	46.5	103.1
16.0	Sonalika	88.3	331.3	1952.1	12.6	9.1	44.2	100.7
	VL-914	86.7	334.0	1848.7	12.1	8.8	43.3	99.3
	Euguanda-6	85.0	308.7	1669.9	12.0	8.1	40.8	92.8
	Monds's Aids	83.3	300.3	1635.7	11.8	7.8	39.6	91.8
	Mean	85.8	318.6	1776.6	12.1	8.4	41.9	96.1
24.0	Sonalika	85.0	301.3	1350.4	10.4	6.8	39.8	93.5
	VL-914	83.3	295.7	1252.8	10.0	6.5	38.9	92.9
	Euguanda-6	76.8	262.7	947.7	9.3	4.6	29.1	85.3
	Monds's Aids	73.7	254.3	866.9	9.1	4.0	26.3	82.8
	Mean	79.7	278.5	1104.4	9.1	5.5	33.5	88.6
CD (0.05)	Treatment (T)	0.8	1.2	57.3	0.5	0.5	0.6	0.7
	Variety (V)	0.8	1.2	57.3	0.5	0.5	0.6	0.7
	Interaction (T x v)	1.6	2.5	114.6	0.9	1.0	1.1	1.5

Shoot and root length invariably decreased with increase in aqueous leaf extracts concentration **(Table 1).** Shoot and root lengths were higher in tolerant genotypes (Sonalika and VL-914) than susceptible genotypes (Euguanda - 6 and Mond's Aids). The maximum inhibition in shoot and root length was found at 24% leaf extract. Effects of leaf extract on all four genotypes were found highly significant. The greater inhibition in shoots and root growth observed in this study, was in accordance with findings of [16]. Have also reported such effects of leaf extracts [13,16-18]. The effects on different growth parameters of wheat seedlings were concentration dependent and statistically significant. The dry weight of shoot and root declined with increasing aqueous leaf extracts of all four test genotypes under test **(Table 1).** Dry weight of shoot and root of different varieties was significantly decreased with increase in the concentration of leaf extract. At each leaf extract concentration, maximum value of shoot dry weight was recorded for tolerant genotypes (Sonalika and VL-914) followed by susceptible genotypes (Euguanda-6 and Mond's Aids). The maximum reduction in biomass occurred in susceptible genotypes.

Biochemical Parameters

The lower value of total sugar was recorded in the seedlings of all genotypes, under higher concentration of leaf extract **(Table 2).** The level of reducing and non-reducing sugar was highest in control. The level was highest in tolerant genotypes

(Sonalika and VL-914) as compared to susceptible genotypes (Euguanda-6 and Mond's Aids). Less sugar might be produced due to reduced starch hydrolysis with increasing leaf extraction concentration. Also observed that sugar content of wheat seedlings decreases with increase in leachate concentration of *Dalbergia sissoo, Acacia lenticularis, Bombax cieba* and *Populus deltoids* [14,19]. Protein was also found highest in tolerant genotypes (Sonalika and VL-914) followed by susceptible genotypes (Euguanda-6 and Mond's Aids). The protein content decreased and free amino acids increased leaf extracts concentrations. Similar findings were reported by [14,19]. Decrease in protein might be due to disturbance in protein metabolism. The free amino acid content followed a reverse trend of increase at each leaf extract concentration in the all four varieties. The maximum content was found in tolerant group at 24% leaf extract concentration. The interaction between treatments and varieties for protein and amino acids were highly significant.

Table 2. Effect of aqueous leaf extracts of *Andrographis paniculata* on sugar, protein and free amino acid of wheat at 7-days after sowing.

Aqueous extract conc. (%)	Wheat varieties	Reducing sugar (mg/g d. wt.)	Non-reducing sugar (mg/g d. wt.)	Total sugar (mg./g d. wt.)	Soluble protein (mg./g d. wt.)	Free amino acid (mg./g d. wt.)
0.0	Sonalika	25.8	29.0	54.8	39.8	20.0
	VL-914	25.1	28.9	54.5	39.6	20.0
	Euguanda-6	25.4	29.0	54.4	39.7	20.0
	Monds's Aids	25.5	29.1	54.6	39.5	19.5
	Mean	25.4	29.0	54.6	39.6	19.9
8.0	Sonalika	24.1	27.4	51.5	36.7	23.2
	VL-914	23.9	27.0	50.9	36.4	22.9
	Euguanda-6	22.8	26.2	49.0	34.9	23.7
	Monds's Aids	22.7	26.1	48.8	34.4	23.3
	Mean	23.4	26.7	50.0	35.6	23.3
16.0	Sonalika	22.8	24.8	47.6	34.2	24.6
	VL-914	22.4	24.5	46.9	33.7	24.2
	Euguanda-6	19.9	19.1	41.4	28.9	28.3
	Monds's Aids	19.2	18.8	41.0	27.5	27.9
	Mean	21.1	21.8	44.2	31.1	26.2
24.0	Sonalika	19.6	21.9	41.5	30.4	26.9
	VL-914	19.1	21.5	40.6	29.9	26.5
	Euguanda-6	15.0	12.1	31.7	22.0	31.7
	Monds's Aids	14.3	11.7	31.1	21.6	31.3
	Mean	17.0	16.8	36.2	25.9	29.1
CD (0.05)	Treatment (T)	0.9	1.0	0.7	0.9	0.8
	Variety (V)	0.9	1.0	0.7	0.9	0.8
	Interaction (T x v)	1.8	2.1	1.5	1.9	1.8

CONCLUSIONS

Potentially of different concentrations of aqueous leaf extracts of *Andrographis paniculata* nees was investigated germination and seedling growth of four Wheat (*Triticum aestivum* L.) varieties: Sonalika, VL-914, Euguanda- 6 and Mond's Aids. On the basis of reduction in seed germination, germination relative index (GRI) and Vigour Index (VI), the inhibitory effect of leaf extract was maximum in Sonalika followed by VL-914, Euguanda-6 and Mond's Aids with increase in leaf extract concentration, the shoot and root length and their dry weight decreased. The leaf extract decreased the soluble sugar and protein content, but increased the total free amino acids content. The results indicated that allelopathic effects of leaf extract of *Andographis paniculata* were maximum in Mond's Aids.

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