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VEGETATIVE GROWTH AND YIELD RESPONSE OF NIGER (*GUIZOTIA ABYSSINICA*) TO LEAF-LITTER DUST OF *LANTANA CAMARA*

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ABSTRACT

Experiments were conducted to identify the allelopathic effects of different concentrations of leaf-litter dust of *Lantana camara* on the vegetative growth parameters (development of total number of leaves per plant, height of the plant, total leaf area, leaf area index) and components of yield (production of number of heads per plant, production of seeds per head, weight of seeds, seed yield per plant) of niger (*Guizotia abyssinica*). The results obtained and data presented in the tables showed the concentration dependent poor vegetative growth and decreased trend of yield of the test crop. This study indicates that the allelochemicals released from the leaf-litter dust into the soil had the potential to inhibit physiological processes of niger plant there by suppressed the above parameters of the test crop.

INTRODUCTION

Allelopathy occurs through the release of one plant species of chemicals which affect other species in its vicinity. Del Moral and Cates, (1971) opined that it is the inhibitory effect on germination, growth and metabolism of one plant due to release of organic chemicals by another plants. Therefore, it is the priority area of multidisciplinary research in developed countries. Hence, currently allelopathy researches are being carried out through out the world.

Chemicals that impose allelopathic influences are called allelochemicals, allelochemics or phytochemicals, which are generally considered as secondary metabolites such as alkaloids, phenoics, flavonoids, terpenoids and glucosinolates Rice, (1984). Allelochemicals virtually present in all plant tissues, including leaves, flowers, fruits, stems, roots, rhizomes, seeds etc. are being released from plants or plant parts (donor)into the environment by means of: volatilization, leaching, root exudation and decomposition of plant residues, which influence the growth and development of other plants (recipient).

Lantana camara becomes a dominant understorey species and thought to be allelopathic *i. e.* able to inhibit or suppress by chemical means the germination and/or growth of at least some competing plant species. Overseas glasshouse studies Swarbrick *et al.* (1995); Day *et al.* (2003) and a substantive Australian field trial Gentle and Duggin (1997b), provide support for this.

Lantana camara is regarded as a cosmopolitan weed and in many countries it has been declared a noxious weed. It colonizes new areas and spreads quickly. It is well known that these plants mount chemical defenses against feeding herbivores. It also encroach agricultural land and is a weed in many agricultural crops.

In some agricultural fields of Rayagada district, plants like *Lantana camara* being grown for fencing. Niger is widely cultivated in Kasipur and other blocks of Rayagada district of Odisha for its high yielding potentials. It was observed by the cultivators that the density of the crop plants decreases near the boundaries of the *Lantana* fencing. Therefore the present study was conducted to determine the influence of leaf litter-dust of *Lantana camara* on vegetative growth parameters, yield and components of yield of Niger (*Guizotia abyssinica).*

MATERIALS AND METHODS

Occupying a total area of 7,073 km^2, Rayagada district of Odisha has a rich floristic heritage. The district generates income mainly through agriculture based activities. paddy, wheat, ragi, green gram, black gram, niger, ground nut, potato, maize are the major crops grown in the area.

In the present piece of investigation, Niger (*Guizotia abyssinica* (L.f.) cass.) cv Deomali seeds were used to study the effect of leaf - litter dust of *Lantana camara* plant on vegetative growth parameters, yield and components of yield per plant of Niger.

The visually selected healthy seeds of Niger of uniform size, shape, colour were surface sterilized with 0.03% formalin solution for 10 minutes separately and then washed thoroughly with tap water followed by distilled water. For studying the vegetative growth, yield and components of yield of the test crop influenced by leaf-litter dust of *Lantana camara*, pot culture method as described below was adopted.

In the morning hour freshly fallen senescent leaves of *Lantana camara* were collected from old plants in field fencing places, washed thoroughly with water, sun dried, mechanically powered and kept in polythene bags for further use.

Experiments were conducted in the open field (19°10′ N 83°25′ E) in the departmental garden. Earthen-ware pots of 13 x 13 cm size containing equal quantity of well mixed sandy soil and cow dung manure in a ratio of 8:1 parts (w / w) were taken. To get different concentrations of leaf-litter dust, in the soil of the pot, 4,8,12 and 20g of dust were added per 100g of soil manure mixture in pots separately prior to the sowing of seeds. The visually selected and surface-sterilized seeds of the test cultivar were directly sown @ 10 seeds per pot. The set which was not provided with dust served as control. After 10 days of germination, the seedlings were thinned to stand 1 healthy seedling per plant. The plants were allowed to grow in pots till harvest.

The vegetative growth parameters such as (a) development of total number of green leaves per plant, (b) height of the plant, (c) total leaf area and (d) leaf area index (LAI) were recorded at interval of one week after 20 days of germination till flowering in both control and treated sets, following the methods adopted by Patnaik, (1998).

The yield and parameters of yield such as (a) number of heads per plant (b) number of seeds per head, (c) weight of 1000 seeds and (d) seed yield per plant at the time of harvest in both control and treated sets, as per the methods adopted by Patnaik, (1998).

The data so obtained were subjected to statistical analysis for calculation of standard error (S.E).

RESULTS

Production of number of green leaves per plant

The production of number of green leaves per plant and their retention till the time of flowering in plants grown in pots provided with 4,8,12 and 16 % of dust showed positive correlations between production of green leaves and advancement of plant age and negative correlations between development of leaves/plant and increase in concentrations of leaf-litter dust were established in this test cultivar (Table 1).

Height of the plant

The mean maximum height was recorded at the time of flowering in plants raised in control was set 29.2 ± 0.26 whereas at the same age, mean minimum height was recorded in plants treated with 16 % concentration of leaf-litter dust of *Lantana camara* was 20.2 ± 0.17 Other concentrations showed intermediate values (Table 1).Positive correlations were marked between increase in the plant height and advancement of growth period and negative correlations between increase in concentrations of leaf-litter dust of *Lantana camara* and plant height were noticed in this piece of investigation.

Total leaf area (TLA)

The Niger plants exhibited reduced leaf areas influenced by all different concentrations of leaf-litter dust of *Lantana camara* supplied in the soil. The TLA exhibited positive correlations in plants of both control and treated sets with advancement of plant age till flowering and negative correlations with increase of dust concentrations applied into the soils (Table 1).

Leaf area index (LAI)

Like TLA, the LAI also considerably decreased by the influence of different concentrations of litter-dust of *Lantana camara*. The LAI of niger plants exhibited positive correlations with advancement of plant age till flowering and negative correlations with increase in the concentrations of dust added into the soil-manure mixture of pots (Table 1).

Development of number of heads / plant

The application of different concentrations of leaf-litter dust of *Lantana camara* considerably caused decreased number of heads per plant. The mean maximum and minimum number of heads developed per plant raised in pots of control set and pots provided with 16 % concentration of leaf-litter dust were20.7± 0.18 and 12.5 ± 0.16 respectively. Plants grown with 4, 8 and 12% leaf-litter dust concentration produced intermediate number of heads per plant. The production of number of heads/plant showed negative correlations with increase in concentrations of dust applied into the pots of this test cultivar (Table 2).

Development of number of seeds per head

From Table 2 it can be observed that the development of number of seeds per head was considerably reduced by the influence of different concentration of dust applied into the soil. Maximum number of seeds developed per head in plants of the control sets was 16.4 ± 0.17 while the value was reduced by the influence of 16% concentration of dust in the soil. Other concentration of the dust exhibited intermediate values. All the concentrations of dust considerably checked the production of seeds/plant as a result of which negative correlation was established between production of number of seeds/plant and increase in concentrations of dust.

Weight of 1000 seeds

The weight of 1000 seeds harvested from control plants was found maximum(2.85± 0.23) whereas the weight of the same number of seeds collected from plants grown in pots provided with 16% dusts was reduced to minimum(1.61± 0.16). Plants grown in soils provided with other concentrations of dust exhibited intermediate weights between the above mentioned values (Table 2).Thus, the weight of 1000 niger seeds exhibited a negative correlation with increase in concentration of dusts applied into the soil.

Seed yield / plant

Maximum seed yield per plant recorded in plants of control set and minimum seed yield per plant grown in 16% concentration of leaf-litter dust of *Lantana camara* were 0.967 ± 0.05 and 0.175 ± 0.06 g respectively. Intermediate values were recorded in plants grown in other concentrations (Table

Table 1: Effect of different concentrations of leaf - litter dust of *Lantana camara* on vegetative growth parameters of niger (*Guizotia abyssinica* (L. f) cass cv Deomali).

Dust Conc.(%)	Age of the plant at the time of recording (days)	Number of green leaves/plant	Height of the plant(cm)	Total leaf area/plant (cm^2)	Leaf area index (%)
C	21	7.8 ± 0.21	17.9 ± 0.23	49.5 ± 0.9	37.3
	28	10.4 ± 0.15	19.4 ± 0.18	65.8 ± 1.3	49.58
	35	14.9 ± 0.19	27.3 ± 0.21	126.4± 3.2	95.25
	F	15.8 ± 0.18	29.2 ± 0.26	190.5 ± 0.7	143.5
4	21	6.9 ± 0.16	18.5 ± 0.21	46.4 ± 1.7	34.96
	28	9.3 ± 0.11	20.9 ± 0.19	60.8 ± 1.3	45.81
	35	12.8 ± 0.15	23.7 ± 0.23	108.3 ± 2.1	81.61
	F	14.9 ± 0.12	28.5 ± 0.20	174.0 ± 0.9	131.1
8	21	5.8 ± 0.11	16.3 ± 0.19	33.7 ± 1.6	25.3
	28	8.7 ± 0.16	19.4 ± 0.21	57.3 ± 1.3	43.18
	35	11.6 ± 0.13	21.9 ± 0.15	101.3 ± 0.8	76.33
	F	13.7 ± 0.15	26.6 ± 0.14	168.3 ± 1.2	126.8
12	21	4.9 ± 0.11	15.2 ± 0.14	25.3 ± 1.1	19
	28	7.6 ± 0.14	18.5 ± 0.16	50.3 ± 1.5	37.9
	35	10.3 ± 0.12	20.4 ± 0.13	96.4 ± 1.2	72.64
	F	12.2 ± 0.08	24.1 ± 0.19	148.2 ± 1.1	111.6
16	21	3.7 ± 0.07	11.5 ± 0.13	10.2 ± 1.8	13.71
	28	6.8 ± 0.05	14.2 ± 0.14	45.3 ± 1.3	34.13
	35	9.4 ± 0.11	18.5 ± 0.11	92.4 ± 1.4	69.63
	F	11.7 ± 0.08	20.2 ± 0.17	138.2 ± 1.3	104.1
20	21	*	*	*	*
	28	*	*	*	*
	35	*	*	*	*
	F	*	*	*	*

* No. seedlings established, F = First flowering stage; Each value is mean of 10 replicates ± SE; Date of sowing 1st Sept. 2010

Table 2:Effect of different concentrations of leaf- litter dust of *Lantana camara* on yield and components of yield of niger (*Guizotia abyssinica* (L. f) cass. cv Deomali)

Dust . Conc(%)	Number of heads/plant	Number of seeds/head	Weight of 1000 seeds (g)	Seed Yield/ plant (g)
C	20.7 ± 0.18	16.4 ± 0.17	2.85 ± 0.23	0.967±0.05
4	18.3 ± 0.22	14.2 ± 0.18	2.61 ± 0.21	0.678±0.04
8	16.8 ± 0.21	12.1 ± 0.16	2.15 ± 0.19	0.437±0.08
12	14.9 ± 0.21	10.2 ± 0.16	1.87 ± 0.17	0.284±0.08
16	12.5 ± 0.16	8.7 ± 0.06	1.61 ± 0.16	0.175±0.06
20	*	*	*	*

* No. seedlings established; Each value is mean of 10 replicates ± SE; Date of sowing 1st Sept. 2010

2). Thus, Negative correlations were noticed between seed yield/plant and increase in concentrations of leaf-litter dust applied into the soil of the pots.

DISCUSSION

Sharma *et al*., (2007) reported that *Lantana* spp. shows hepatoxic actions. The hepatotoxins are pentacyclic triterpenoids called lantadenes. The plant exert allelopathic action on the neighboring vegetation. The allelochemicals have been identified as phenolics, with umbelliferone, methylcoumarin, and salicylic acid being the most phytotoxic. In addition to phenolics, a recent report indicates lantadene A and B as more potent allelochemicals.

Besides the known glycosides, verbascoside and a flavone glycoside, a novel flanonol glycoside named camaraside and a new phenylpropanoid glycoside, lantanaside have been isolated from the leaves of *Lantana camara* and defined as 3,5-dihydroxy-4′,6-dimethoxyflavonol-7-*O*-glucopyranoside and 3,4-dihydroxy-, β-phenylethyl-*O*-α-L-rhamnopyranosyl (1→3)-4-*O*- *cis*- caffeoyl- β -D-glucopyranoside respectively by spectroscopic methods and chemical transformations Mahato *et al.* (2001).

Thus, the release of these phenolic compounds might have adversely affected the growth and yield of test cultivars through their interference in energy metabolism, cell division, biosynthetic processes etc.

Production of number of green leaflets was considerably reduced when treated with different concentrations of leaf-litter dust which might be due to translocation of active ingredients of allelochemics present in the dust from the soil to the leaves.

The inhibitory effect on plant height might be due to checking or inhibition of biosynthesis of gibberellins, which are responsible for cell-elongation and plant height. The present observations corroborate the findings of Jayakumar *et al*., (1990), Igboanugo, (1988b) and Basu *et al*., (1987).

The development of leaf area is very much checked in plants of treated sets compared to the control plants. It is expected that the phenolics might have checked the increase of leaf area by preventing the synthesis of protein, nucleic acid and other metabolites responsible for the synthesis of growth regulators. The present findings agree with the report of Jayakumar *et al*. (1990) and Sahu, (2000).

The decrease in LAI might be due to development of lesser number of leaves / unit area of land where it grows. As the development of green leaves per plant was reduced the LAI also proportionately reduced.

Yield potential of any crop is related to its photosynthetic activity during grain filling Evans and Rawson,(1970). The allelopathic influence of *Lantana camara* leaf-litter dust on yield and components of yield of all the test cultivar is discussed below.

The allelochemicals released from the dust into the soil might have checked the synthesis and translocation and/or accumulation of flowering hormones responsible for production of number of flowers per inflorescence of the plant. The present findings corroborate with the findings of Sahu, (2000).

The development of seeds in heads depends on the photosynthates available in leaves and their translocation to seeds. The allelochemicals might have lowered seed setting per head.

In the present investigation it was marked that all concentrations of leaf-litter dust considerably reduced the seed weight compared with respective control plants. The phenolic compounds leached from the dusts might have interfered in oxidoreduction reactions, nucleotide biosynthesis and other vital functions, controlling and/or preventing gibberellin's biosynthesis, and accumulation of growth regulators in the cells causing inhibitory effect and vegetative growth and grain development during reproductive phase, which ultimately might have reflected on seed weight. Muller and Chou, (1971) reported similar findings influenced by decaying of *Eucalyptus* litter.

In the present investigation, it was also noticed that all the concentrations of dust considerably reduced the yield efficiency of the test crops compared with their respective control plants. This decrease in the yield/plant might be due to reduction in production of number of heads per plant, low rate of seed settings which were controlled by reduction in vegetative growth parameters.

The present findings agree with reports of Acharya, (1994); Narwal, (1994); Patnaik, (1998); Padhy *et al*. (2000) and Gantayet, (2007) in various crops under the influence of different allelochemicals of other plants**.**

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