ALLELOPATHIC EFFECT OF LANTANA CAMARA

Sonam Bamania
Assistant Professor in Botany
Govt.PG College, Karauli Rajasthan

ABSTRACT

Lantana camara is regarded both as a notorious weed and a popular ornamental garden plant. Allelopathy involves both inhibitory and stimulatory biochemical interactions between plants. Lantana allelopathic effect studies have been done with many crops, trees, shrub and weeds under both laboratory and field conditions to determine their allelopathic potential and its use. Allelochemicals of Lantana inhibited the germination, growth and metabolism of crops, weeds and bryophytes and vegetables. An experiment was conducted to understand the allelopathic effects of different concentrations derived from leaf-litter dust of Lantana camara on the vegetative growth parameters such as - development of total number of leaves per plant, height of the plant, total leaf area, leaf area index and components of yield such as - production of number of heads per plant, production of seeds per head, weight of seeds, seed yield per plant of green gram (Phaseolus radiatus).Results showed different concentrations of leaf-litter dust caused significant inhibitory effect on vegetative growth and yield of the test crop. The study indicates that the allelochemicals released from the leaf-litter dust into the soil suppressed the above parameters of the of the green gram plant.

In this article we are going to discover Effect of Lantana Camara on Seed and Vegetative Growth behavior and Evaluation of Allelopathic Potential of Lantana Camara.

KEYWORDS: Allelopathy, crops, germination, growth, Lantana camara, weeds seeds.

INTRODUCTION:

The term allelopathy is used to refer to the impact of secondary metabolites produced by plants including micro-organisms that influences the growth and development of agricultural and biological systems. To describe this phenomenon, Mulish, (1937) coined the word allelopathy as encompassing the chemical interaction among all plants and microbes involving stimulatory as well as inhibitory effect. Under field conditions weed infestation is one of the major factors responsible for yield reductions in crops. With the help of allelopathy, weed-crop interactions can easily be explained. In most of the scientific research, allelopathic interactions between them were not considered. Hence, the present investigation is aimed at to find out the allelopathic impact of Lantana camara on vegetative growth parameters, yield and components of yield of green gram crops. The replacement of one species by another is by biochemical inhibition of germination and growth of existing species by the intruder species. The major requisite of allelopathy are organic substances, allelochemicals, allelochemics or phytochemicals, that are produced by plants as secondary metabolites such as alkaloids, phenoics, flavonoids, terpenoids and glycosylates. Substances passing out from the leaves and other plant parts after they have been shed are known to inhibit the seed germination, growth and development of other species Rice, reported that allelochemicals as non-nutritional chemicals produced by one organism which affect germination growth, health and behavior/population biology of other crops. It is believed that adverse effects of plant residues on crop yields are usually due to phytotoxic compounds leached from them due to decomposition, volatilization, leaf leachates and root exudates.

Weed are undesirable plants which compete with main crops in the growth media for nutrients, moisture, space, light and hamper the healthy growth ultimately reducing the growth and yield both qualitatively and quantitatively. Lantana is among top ten invasive weed on the earth. Lantana has allelopathic effects against agronomic crops. It contains 50 species among them Lantana camara contain more harmful allelochemicals L. camara is a native plant in tropical America and widely distributed throughout the world and is now major weed in coastal areas, roadsides, fence-lines, river bank, forestry and barren areas and it infests millions of hectares of grazing and agricultural land in more than 50 countries Lantana plant also grows well on nutrient rich and on nutrient deficient barren soils and in good light availability. Reduced performance due to weed is fact but one of the most effective ways of increasing yield potential is the scientific management of weeds However, it may produce and releases different phenolic acids, flavonoids, terpenes and terpenoids. Among these secondary metabolites, some are known allelochemicals inhibiting the germination and growth of other organisms of allelopathy all L.camara may be to cause shifting community distribution and composition when it invades in ecosystem. Keeping in view above fact, present investigation was carried out to study the allelopathic effect on seeds and vegetables.

Lantana camara L. (Verbenaceae), a fast-growing woody thicket-forming shrub, is native to tropical and sub-tropical South and Central America and currently widely distributed in many countries. It is among the top ten invasive weeds on earth (Sharma et al., 2005). The species may reach 3 m in height within 3 to 4 years and often forms dense thicket. It can aggressively establish in open forest lands, plantations, farmlands and wastelands. Lantana camara (hereafter referred to as lantana) grows under a wide range of climate conditions and occurs on a variety of soil types reflecting its wide ecological tolerance. The different parts of lantana contain allelochemicals mainly aromatic alkaloids and phenolic compounds which can interfere with seed germination and early growth of many plant species. Lantana can also interfere growth of nearby plants by outcompeting for soil nutrients and altering microenvironment (e.g., light, temperature) by forming dense thickets. Despite its recognition as among the worst invasive alien species in the world information on the ecological interference of lantana on the growth and establishment of native plants, especially on agronomic crops, is scanty in Ethiopia. In the present study, the allelopathic potential of lantana was therefore evaluated on three agricultural crops commonly grown in Ethiopia to identify whether lantana invasion in agricultural lands might interfere with agricultural crop production by reducing crop growth and establishment. The agricultural crops were maize (Zea mays), tef (Eragrostis tef) and finger millet (Eleusine coracana). Aqueous extracts of lantana leaf were used for testing the allelopathic potential of lantana on the agricultural crops. It is hypothesized that germination and early growth of the three agricultural crops is lower under the various concentrations of lantana leaf extracts.

OBJECTIVES OF PROPOSED WORK:

1) Effect of Lantana Camara on Seed Growth behavior.
2) Evaluation of Allelopathic Potential of Lantana Camara.

REVIEW OF LITERATURE:

Allelopathy of Lantana camara as an Invasive Plant

Hisashi Kato-Noguchi and Denny Kurniadie

Lantana camara L. (Verbenaceae) is native to tropical America and has been introduced into many other countries as an ornamental and hedge plant. The species has been spreading quickly and has naturalized in more than 60 countries as an invasive noxious weed. It is considered to be one of the world's 100 worst alien species. *L. camara* often forms dense monospaces stands through the interruption of the regeneration process of indigenous plant species. Allelopathy of *L. camara* has been reported to play a crucial role in its invasiveness. The extracts, essential oil, leachates, residues, and rhizosphere soil of *L. camara* suppressed the germination and growth of other plant species. Several allelochemicals, such as phenolic compounds, sesquiterpenes, triterpenes, and a flavonoid, were identified in the extracts, essential oil, residues, and rhizosphere soil of *L. camara*. The evidence also suggests that some of those allelochemicals in *L. camara* are probably released into the rhizosphere soil under the canopy and neighboring environments during the decomposition process of the residues and as leachates and volatile compounds from living plant parts of *L. camara*. The released allelochemicals may suppress the regeneration process of indigenous plant species by decreasing their germination and seedling growth and increasing their mortality. Therefore, the allelopathic property of *L. camara* may support its invasive potential and formation of dense monospaces stands.

ALLELOPATHIC POTENTIAL OF CALLUS EXTRACT OF LANTANA CAMARA Manjula K. Saxena, Jyoti Gupta and Neerja Singh Department of Botany, University of Rajasthan, Jaipur 302004, India

Callus cultures of Lantana camara L. (family Verbenaceae) were induced from leaf and stem explants on Morishige and Skoog medium supplemented with α naphthalene acetic acid (NAA), Indole3-acetic acid (IAA) and 2,4 dichloro-phenoxy acetic acid (2,4-D). Callus cultures (4.04 g dry weight) developed from young leaf and shoot tips on medium containing 2, 4-D (0.02 mg/liter) after 25 days in vitro. Callus extract (1% conc.) showed toxicity to the growth of Salvinia molest Mitchell after 7 days. The leaves and flowers of this species serve as for a source of allelopathic compounds, both exhibited high potential to act as strong biopesticide and suppressed a number of organisms including bacteria, fungi, aquatic and terrestrial weeds in its aqueous leachate/extract in earlier studies. This study high lights the ability of callus of L.camara to produce allelochemicals under in air-conditions that also exhibited phytotoxicity.

Development of mean concentration stimulation point for fermented Lantana Camara Phyto nematicide on tomato production
Malatji, Kgashane Philip

Root-knot nematodes (Meloidogyne species) are the major soil-borne pests of tomato (Solanum Lycopersicon) plants. Due to the global withdrawal of effective chemical nematicides from the agrochemical markets, nematodes are difficult to control under the production systems. Currently, botanicals are being researched and developed as alternative to chemical nematicides with promising results, although they have challenge of phytotoxicity. The objective of this study was to determine the Mean Concentration Stimulation Point (MCSP) of Tickberry (Lantana camara) extracts for tomato plant-infected with M. javanica. Treatments consisted of six levels of L. camara extracts, namely, 0, 2, 4, 6, 8 and 10% per pot, which were arranged in a randomised complete block design, with ten replicates. Tomato seedlings were inoculated with 2500 second-stage juveniles (J2S) of M. javanica at five days after transplanting, with treatments applied at seven days after inoculation. At 56 days after inoculation, L. camara extracts had positive effects on plant height, stem diameter, number of leaves, number of fruits and fruit mass, contributing 65, 74, 61, 25 and 61% in total treatment variation (TTV), respectively, under greenhouse conditions. Under microplot conditions, treatments contributed 55, 85, 61, 36 and 85% in TTV of the respective plant variables. Under greenhouse it contributed 60, 35 and 77% and 29, 79 and 70% under microplot on dry shoot mass, dry root mass and galling index respectively. Treatments did not have any effects on soil pH and electrical conductivity (EC). Under greenhouse conditions, treatments contributed 88, 94 and 92% in TTV of nematode in roots, soil and final population, respectively, whereas under microplot conditions 94, 97 and 95% in xvii TTV of the respective nematode stages. The derived mean concentration of L. camara extracts for tomato was 5.76 and 5.31% under microplot and greenhouse conditions, respectively. The overall sensitivity of tomato plants to L. camara extracts under microplot and greenhouse were 3 and 0, respectively. In conclusion Meloidogyne species can be managed using L. camara extracts 5.31 and 5.76% under glasshouse production and field production system respectively.

Allelopathic Effects of Lantana (*Lantana camara*) on Milkweed vine (*Morrenia odorata*)

Achhireddy, Nagi Reddy and Megh Singh

Allelopathic effects of lantana (*Lantana camara*) residues (root, shoot), foliar leachates, and the soil (where lantana was grown) on milkweed vine (Morena *odorata* Lindl. 3 MONOD) seed germination and growth over a 30-day period were examined. Foliar leachates or the soil collected from the field where lantana had been growing had no effect on the final germination percentage or the seedling growth of milkweed vine. Incorporation of dried lantana shoot or root material into soil had no effect on the final percentage germination but caused significant reductions in milkweed vine growth over a 30-day test period. Roots were inhibitory than shoots. Fifty percent of milkweed vine seedlings died within 15 days after germination at 1% (w/w) dried lantana root incorporation into the soil, and higher concentrations increased seedling death. Lantana roots incorporated into the soil produced foliar symptoms such as wilting and desiccation, whereas lantana shoots incorporated into the soil produced yellowing of the foliage of milkweed vine. Allelopathic activity of lantana residues was still strong even after decomposition of lantana residues for 4 weeks prior to the planting of milkweed vine seeds.

Effect of lantana camara on plant structure and diversity in Bumanya sub County

Emmanuel, Mwoleka, Metadata

Invasive species are among the world's greatest threat to biodiversity and native species in protected areas. Invasions by introduced species are the third biggest threat to biodiversity in Uganda today after habitat loss and unsustainable utilization of natural resources. Invasive plants can transform ecosystems by establishing populations with high growth rates that displace the native biota, or thereby potentially transforming ecosystem structure and functionality. The vegetation of the northern, central and southern parts of Queen Elizabeth National Park (QENP) has, since the mid 1970's, been progressively invaded by the invasive shrub Lantana camara. The study was carried out in the three villages of Bumanya, Bulimia and Wampee, found in Bumanya Sub- County. The main objective of this study was to assess the effect of Lantana camara invasion on the floral diversity and structure. This was conducted to compare plant species richness and diversity between Lantana camara invaded and un-invaded sites and assessing the impact of invasion on cover of trees, shrubs and forbs, by plot sampling at both Lantana camara infested and un-infested sites larger numbers of species were registered for the non-invaded sites as compared to the L.camara invaded sites. Species percentage cover at the un-invaded site was higher than at the invaded. Similarly, diversity was higher in L. camara infested than the non-infested sites. Results therefore indicate that the weed (Lantana camara) affects negatively the floral structure and diversity by smothering native plants. More research is needed into the management of this invasive species as well as restoration of degraded habitats in order to avoid irrevocable degradation of habitats and wildlife and decline in livestock production.

Allelopathic Effects of Lantana (*Lantana camara* L.) Leaf Extracts on Germination and Early Growth of three Agricultural Crops in Ethiopia

D Tadele

Allelopathic potential of aqueous extracts of lantana (*Lantana camara L.*) leaf on germination and growth of three agricultural crops: Maize, Finger millet and Tef, commonly cultivated in Ethiopia were studied under laboratory condition. The aqueous extracts were assayed at 5, 10, 25, 50 and 75% and their allelopathic effects were compared with distilled water (control). All the aqueous extracts did not significantly influence germination of the agricultural crops except 75% extract which significantly reduced germination of tef. All the leaf extracts stimulated root growth of maize and finger millet plants with the effect being declined with rise of concentration. In contrast, tef plants had reduced root growth in various leaf extracts with the highest reduction occurring at higher concentrations (25, 50 and 75%). The shoots of maize plants were also stimulated by all extract concentrations; whereas shoot growth of both tef and finger millet were not significantly affected by the leaf extracts. The results generally showed that lantana leaf extracts had stimulatory effects on early growth of maize and finger millet and inhibitory effects on tef growth.

MATERIAL AND METHODOLOGY:

Extract Preparation

Mature leaves were collected from shrubs of lantana established in Abay Millennium Park, northwestern Ethiopia, where the species has aggressively invaded forest edges and grasslands of the park and adjacent farmlands and grazing lands (Solomon, 2010). Aqueous leaf extracts were prepared by soaking 100g fresh leaves of lantana with 500 ml distilled water using 1000 ml container. Each container was shaken and kept at room temperature for 24 hours. The resulting aqueous extracts were filtered through two layers of Whitman No. 1 filter paper and then some extracts were diluted to generate concentrations of 5, 10, 25, 50 and 75% and stored in conical flasks until required.

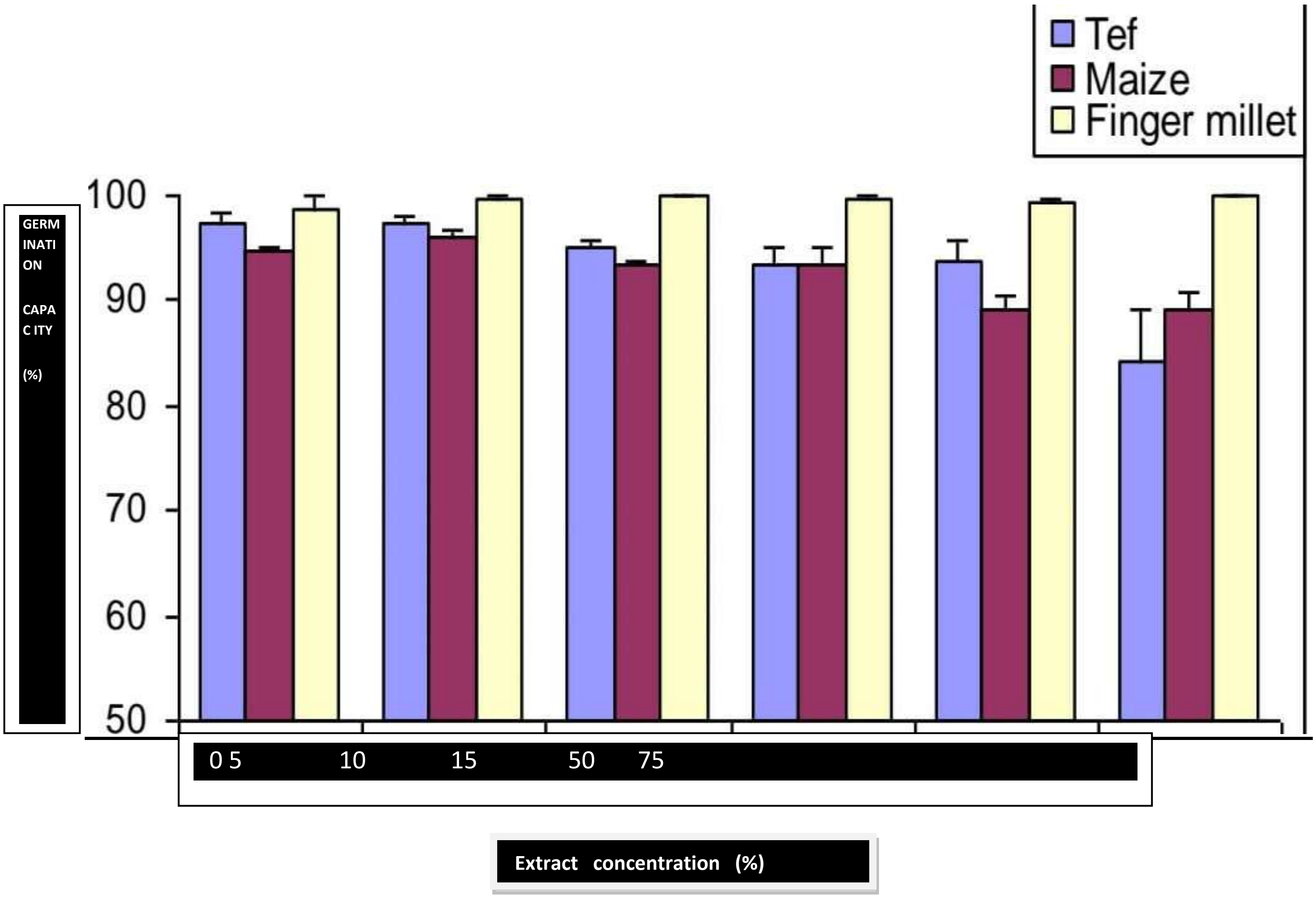
Germination test:

Seeds of maize, finger millet and tef, after washed with distilled water, were surface sterilized with 15% sodium hypochlorite for 20 min (Tinnin and Kirkpatrick, 1985). The seeds were then rinsed with distilled water. Three replicates in a completely randomized design, each containing 25 seeds of maize, 50 seeds finger millet and 50 seeds of tef, were prepared for each extract concentration using sterile petri dishes (9 cm diameter) lined with sterile Whitman No. 1 filter paper. Seeds were evenly distributed on the filter paper and 5 ml of each extract solution was added to each petri dish. The seeds used as controls were treated with only distilled water of same amount. Moisture in the Petri dishes was maintained by adding 2 ml of aqueous extract or distilled water every 2 days. The experiment was carried out for two weeks. The seeds were considered germinated upon the emergence of the radicle. Germinated seeds were counted daily and the lengths of the roots and shoots were measured at the end of the experiment.

In order to study 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. Freshly fallen senescent leaves of Lantana camara were collected from old plants in the morning hours in field fencing places adjacent to college campus randomly. Theleaves collected were washed thoroughly with water, sun dried, mechanically powered in willey mill and kept in polythene bags for further use.

RESULT:

The effects of aqueous extracts of lantana leaf on seed germination of the three agricultural crops are shown in Figure 1. As compared to the control, lantana leaf extracts had no significant effects (P > 0.07) on seed germination of the agricultural crops except at 75% extract concentration where seed germination of tef was significantly reduced (P < 0.01) by 13.5%.



Germination capacity (%) of three agricultural crops in response to different concentrations of lantana leaf extracts. Bars indicate ± SE.

Root and shoot growths of the agricultural crops grown under various concentrations of aqueous extracts of lantana leaf are presented in table 1. Both maize and finger millet plants developed significantly longer roots (P < 0.001) at all extract concentrations as compared to the control, with the stimulatory effect being decreased at higher concentrations. In tef plants, however, the various leaf extracts generally reduced root growth, with the highest reduction (P < 0.001) occurring at higher concentrations (25, 50 and 75%). The shoots of maize plants were also longer at all extract concentrations as compared to those treated with water alone; whereas shoot growth of both tef and finger millet were not significantly affected by lantana leaf extracts (P > 0.06)

Table 1. Root and shoot elongation (mm) of three agricultural crops in response to different concentrations of lantana leaf extracts (mean ± SE).

Agricultural crops	Extract conc. (%)	Root length Shoot	Length
Tef	0	33.4 + 5.48	16.1 + 0.57
	5	33.5 + 5.48	16.1 + 0.61
	10	32.3 + 5.48	16.0 + 0.47
	25	27.7 + 5.31*	16.4 + 0.45
	50	24.5 + 4.91*	15.9 + 0.47
	75	20.8 + 4.42*	16.2 + 0.57
Maize	0	72.5 + 2.57*	40.9 + 1.61
	5	109 + 5.17*	47.4 + 2.00*
	10	122 + 5.22*	57.6 + 2.04*
	25	110.9 + 4.25*	57.1 + 2.36*
	50	102.2 + 3.04*	56.9 + 1.87*
	75	95.3 + 2.70	* 53.3 + 1.89
Finger millet	0	33 + 1.91	22.4 + 0.54

	5	45 + 2.63*	23.6 + 0.61
	10	52.1 + 1.07*	23.8 + 0.54
	25	49.1 + 1.89*	25 + 0.46
	50	41.8 + 1.75*	23.3 + 0.72
	75	41.3 + 1.71*	22.1 + 0.72

*Significantly different from the control at $P < 0.05$ according to Tukey's HSD Test.

DISCUSSION:

Growth of both shoots and roots of maize and roots of finger millet were stimulated by all extract concentrations with magnitude of stimulation become lowered at higher concentrations. In contrast, the various leaf extracts generally had inhibitory effects on root growth of tef with increasing reduction towards higher extract concentrations. In all agricultural crops, shoot growth was less affected by the leaf extracts than root growth. The results indicated that the effects of lantana leaf extracts on root and shoot growth were both species specific (stimulatory effect on maize and finger millet and suppressive effect on tef) and concentration dependent and they were generally more pronounced on the roots than shoots of the agricultural crops. Previous studies on allelopathic effects of lantana showed its potential interference with seed germination and growth of many plant species including agricultural crops.Allelopathy is one of the important mechanisms in agro-ecosystems which affect crop performance (Rice, 1984; Kohli et al., 1998). High germination capacity and stimulated early growth of maize and finger millet indicates that lantana leaf extracts exerted a positive action affecting germination capacity of the seeds and growth of roots and shoots of these crops. The results, thus, indicate the possibility to cultivate maize and finger millet in agricultural lands invaded by lantana after its removal or growth of these crops close to lantana thickets. Growing tef, however, may not be promising in areas where lantana invasion occurs due to allelopathic interference though the allelochemicals causing reduction in growth of tef may not cause the same effect in the field since the concentration of these substances is probably greater in aqueous extracts than under natural conditions in the field (Rice, 1984) or they may be bound and made unavailable by soil particles (Dalton et al., 1983) or decay may reduce the allelopathic effects of leaf litter (May and Ash, 1990). The report from Hussain et al. (2011), for example, showed strong allelopathic effects of aqueous extracts of all parts of lantana on the test species while the soil collected underneath lantana thickets had no allelopathic effects.

CONCLUSION:

The finding of the study indicates that L. camara have high allelopathic potential toward seeds. Seed germination and seedling growth suffered more in higher concentration (6%, 8%) than lower concentration (2%, 4%). Mostly all the cases in higher concentration showed inhibitory effects in different parameters. Inhibition and reduction may be due to the change in activities of enzymes that effect on transition of reserved compounds and energy system during germination. Study also indicates that allelopathic and overspreading nature of Lantana near agricultural area can make the serious problem for production. The plant can prevent soil compaction and erosion and is a source of organic matter for pasture renovation. Lantana compost at 4t/ha gave significantly higher grain yield of rice over the control due to more tillers/hill and higher growth rate. Lantana leaves for improving yield and chemical constituents of sunflower plants. The natural compounds (allelochemicals) of Lantana camara can be beneficial or detrimental. The beneficial allelopathic effect of any weed or crop on another weed can be exploited to ecofriendly, cheap and effective green herbicides. Many plants and their root residues have been reported to have allelopathic effect on agricultural crops. Studies have been carried out on the effects of allelochemicals released by root, leaves, stem, fruits and other parts. The present study revealed that aqueous extracts of the selected weed specie L. camara contained water soluble allelochemicals which cause inhibitory effects on germination and on germination attributes. The aqueous leaf extracts showed higher inhibitory effect on the seed germination with increase in concentration. Effects of leaf extracts could be due to the large amount of allelochemicals present in the leaf. Inhibitory effects increased with increase in concentrations. This study shows that the leaf extracts of L. camara showed significant inhibition of maize seed compared to the control treatment at all concentrations. This is a confirmation of observation of on allelopathic effects of L.camara on some agricultural crops. Results obtained from this work are similar to that of other researchers, in relation to inhibitory effects of leaf extracts of Ageratum conyzoids on seed germination of rice reported that Chromolaena odorata allelochemicals inhibit the growth of many plants in nurseries and plantations have demonstrated that aqueous extracts of leaf and shoot extract of T. diversifolia was inhibitory to the germination and growth of Amaranthus cruentus. However, results suggest that reduction in germination, radicle and plumule length was more pronounced in the leaf extracts from L. camara than stem and root aqueous extracts. Similar observations were made by on wheat. Based on the result obtained from this research on the allelopathic potential of the selected weed specie, Lantana camara leaf extract showed higher allelopathic potency, even at low concentrations and should be carefully removed during land preparation and cultivation, to avoid high deposit of residues of various vegetative parts. It is therefore required to control the growth of this weed so as to protect the diversity. Further studies shall be carried out to search the probable methods for control of this weed.

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