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SUPPRESSIVE EFFECTS OF *LANTANA CAMARA* LEAF EXTRACTS ON THE GROWTH OF RED CHILLI (*CAPSICUM ANNUUM*)

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ABSTRACT

Lantana camara L. which is called tembelekan by Indonesian people, is a shrub plant having wide ecological tolerances that can be found in varied habitats and shows a strong suppressive effect on a variety of crop species. In order to determine whether the chilli plants resistant to *L.camara* allelopathy, the tembelekan leaf extract was tested against the growth of red chilli (*Capsicum annuum*). By using completely randomized design, 25 red chilli plants were grouped into five consist of 5 plants each. Each plant was grown individually in a poly bag containing mixture of soil and compost in a ratio of 2:1. Group 1 is the chillies given 0% (v/v) *L.camara* leaf extract as the control. Group 2, 3, 4 and 5 are the plants treated with extract at the concentration of 25%, 50%, 75% and 100% respectively. After treatment for one week the chillies are harvested and all the study parameters namely plant height, fresh and dry weight, and concentration of chlorophyll were assessed. The results showed, plant height and fresh weight of chillies significantly decreased by the extract of 100%. Likewise, the content of chlorophyll b and total chlorophyll lowered significantly by aqueous leaf extract of tembelekan. In conclussion it can be suggested that aqueous extract of *L.camara* possess suppressive effects against the growth of red chilli.

KEYWORDS: *Lantana camara*, Tembelekan, Allelopathy, Allelopathic Effect**,** Red chili, *Capsicum annuum.*

1. INTRODUCTION

Lantana camara L. (Verbenaceae), which in Indonesia is called tembelekan, is a shrub plant having wide ecological tolerances that can be found in varied habitats ranging from open wastelands, beachfronts, rainforest edges and forests disturbed by activities such as fire or logging.[1] This plant is even tolerant of climatic warming and shows a strong suppressive effect on a variety of crop species.[2]

Suppressive properties of tembelekan has shown by numerous research reports. The aqueous extract of *L. camara* showed allelopathic effect on germination of kodo plant *(Paspalum scrobiculatunn* L.)[3] and inhibitory effect on seed germination, shoot and root elongation of *Phaseolus mungo, Brassica juncea*, *Zea mays* and *Mimosa pudica.*[4] Leaf powder of *L. camara* significantly inhibits seed germination, speed of germination, shoot and root length, stem thickness and biomass of wheat and maize.[5] (On *Leucaena leucocephala*, leaf extract of *L.camara* also found to inhibit the elongation of roots and shoots.[6]

A genotoxicity study revealed that aqueous extracts of *L.camara* and *L.alba* reduced the mitotic index, induced chromosome aberrations and cellular death in roots cells of lettuce (*L. sativa*).[7] In addition to have suppressive effect on plant growth and development, bioactives content of *L.camara* leaf residues can be used as natural materials for controlling *Chorchorus olitorius* and *Echinochloa colonum* and root knot nematode, *Meloidogyne incognita.*[8] *(*El-Nagdi et al., 2016).

If *L. camara* indeed very invasive and suppressive then the question is, are there crop plants resistant to this weed? Chillies (*Capsicum* spp.) are among the crop plants that have known to have inhibitory effects against other plants. Capsicum leachate from *Capsicum annuum,* for example, inhibited the seed germination, root and shoot growths and reduced acummulation of the chlorophyll and porphyrin contents of *Vigna radiata.*[9] Another study showed that *C. annuum* has competitive advantage over *Amaranthus lividus* weeds when both plant planted together.[10]

Beside its suppressive effects, lantana leaf extracts had stimulatory effects on early growth of maize (*Zea mays*) and finger millet (*Eleusine coracana*) and inhibitory effects on tef (*Eragrostis tef*) growth.[11] Thus, the study has a double interest, besides can be used to determine whether chili can withstand the suppressive properties of L. camara, it also can be

used to see if the leaf extract of tembelekan possess stimulatory properties on the growth of chillies.

2. MATERIALS AND METHODS

2.1. Lantana Leaf Samples

The Lantana plant leaves was collected from shrubs around the city of Bandar Lampung, the capital of Lampung Province, Indonesia.

2.2. Plant Extracts

Aqueous extracts of *L.camara* leaf were prepared by grinding 500 g fresh leaves which were then soaked in 500ml distilled water for 24 hours at room temperature.The samples then filtered using Whatman No.1 filter paper. Filtrate collected in erlenmeyer flask and is noted as a stock solution. The stock solution was diluted in accordance with the treatment concentrations designed for the experiment.

2.3. Plant Seedlings

The crop plant designed as the allelochemical recipient in this study is red chili (*Capsicum anuum* L). The chili seeds used are produced by East West Indonesia Ltd. The seeds were sown on a mixture media in the poly bags consisted of soil and compost in a ratio of 1:2. The compost applied in the study are the product of Trubus Mitra Swadaya Ltd.The chillies were allowed to grow for three weeks before being transferred to test media.

2.4. Experimental Design and Treatments

By using completely randomized design, 25 chilli seedlings were grouped into five consist of 5 plants each. Each chili seedling was grown individually in a poly bag containing freshly mixture of soil and compost in a ratio of 2:1.Group 1 is the chillies given 0% (v/v) tembelekan extract as the control. Group 2, 3, 4 and 5 are the plants treated with tembelekan leaf extracts at a concentration of 25%, 50%, 75% and 100% respectively. Application of L.camara leaf extract on tested plants is done by watering the growing medium with 20 ml of the extract. After being allowed to grow for one week the chillies are harvested and all the study parameters were assessed.

2.5. Study Parameters

The suppressive effects of crude extract of L.camara leaves on red chili plants were based on the parameters assessed one week after extract application. The study parameters are: plant height, fresh weight, dry weight, and concentration of chlorophyll a dan b.

a. Plant height is the total length of the plant measured (using ruler meter) from soil surface level to highest peak of the crop
b. Fresh weight was assessed by weighing the whole plant imediately after the plants were removed from the planting medium, washed and wind dried.
c. Plant dry weight was determined by measuring plant weigth after the samples were dried in an oven at 60^{o}C.
d. Concentration of chlorophyll a dan b.

The concentration of chlorophyll a and b was determined by following Miazek[12] protocol as follows. The fresh leaves of red chilli with a weigh of 0.1g milled in a mortar and then disolved in 95% ethanol. After filtration the chlorophyll contained in the filtrate measured spectrophotometrically using a UV-1800 UV-VIS Spectrophotometer from Shimadzu. The concentration of chlorophyll a and chlorophyll b in the ethanolic extract of chili leaves calculated using equations below:

Chla = 13.36.A664 – 5.19.A648..... (1)

Chlb = 27.43.A648 – 8.12.A664..... (2)

In the equation (1) and equation (2), A664 mean absorbance at wavelength 664 nm, while A648 mean absorbance at wavelength 648 nm. By multiplying the absorbance values by [v/(w x1000)], where v is the volume of solvent and w is the weight of plant tissue, the concentration of chlorophylls (in mg/g plant tissue) are obtained.

2.6. Statistical Analysis

Study results were reported as mean±standard error (SE) and One-way analysis of variance (ANOVA) with LSD test was used to determine the significant differences between the means at the 5% level.

3. RESULTS AND DISCUSSION

Effect of aqueous leaf extract of *L. camara* on the plant height of red chillies are presented in Table 1. Based on the results of analysis of variance (ANOVA) and the LSD test at α=5% it is found that leaf extract of tembelekan with a concentration of 100% markedly suppressed the growth of red chillies. Fresh and dry weight of of the whole plant of *C. annuum* after given the crude extract of leaf extract of *L.camara* are presented respectively in Table 2 and Table 3. The results of ANOVA and the LSD test at α=5%, only aqueous extract of

tembelekan in a concentration of 100% that significantly decrease the fresh, but not dry, weight parameters of red chilli plants.

The possible effects of aqueous leaf extract of tembelekan against the chlorophyll content of red chilli plant has also determined and the results are presented in Table 4. Refers to the F-values of ANOVA against chlorophyll a (2.24), chlorophyll b (5.43) and total chlorophyll (4.51) it is clear that aqueous extract of tembelekan significantly affects chlorophyll b and total chlorophyll content, but not the chlorophyll a, of red chilli. On chlorophyll b, the inhibitory effects shown by extract 25% or higher, while on total chlorophyll only extract 75% or higher that was effective.

Table 1: Effect of aqueous leaf extract of *Lantana camara L.* on the plant height of red chillies (*Capsicum annuum* L.)

Concentration of Extract	Plant Height (cm)					Mean ± SD
	1	2	3	4	5	
0%	2,4	3,2	2,7	3,2	2,8	2,86±0,34^{ab}
25%	3,6	5,4	2,6	4,2	3,2	3,80±1,07^{a}
50%	2,3	2,9	1,2	3,8	3,4	2,72±1,02^{b}
75%	1,7	1,5	2,5	3,7	2,68	2,42±0,88^{bc}
100%	1	1,5	1,5	1,8	1,5	1,46±0,29^{c}

ANOVA of the data are as follows: F=**5,64**, P-value =0.00329, Fcrit.= 2.87

LSD test results: The values of Mean ± SD followed by the same superscript are not significantly different at α = 5%

Table 2: Effect of aqeueous leaf extract of *Lantana camara* L. on the plant fresh weight of red chillies (*Capsicum annuum* L.)

Concentration of Extract	Fresh Weight (mg)					Mean ± SD
	1	2	3	4	5	
0%	11,3	18,5	15,7	11,1	18,7	15,07 ± 3.72^{a}
25%	20,7	24	16,1	24,3	11,1	19,24 ± 5,62^{a}
50%	11,8	21,7	12,1	18,3	9,3	14,64 ± 5,15^{a}
75%	9,9	13,8	13,3	19,2	13,8	14,00 ± 7,06^{a}
100%	6,3	11,3	6	9,2	8,3	8,22 ± 2,18^{b}

ANOVA results of the data are as follows: F=**4,22**, P-value =0.0101, Fcrit.= 2.87

LSD test results: The values of Mean ± SE followed by the same superscript are not significantly different at α = 5%

Table 3: Effect of aqeueous leaf extract of *Lantana camara* L. on the plant dry weight of red chillies (*Capsicum annuum* L.)

Concentration of Extract	Fresh Weight (mg)					Mean ± SD
	1	2	3	4	5	
0%	1,6	3	2,9	3	4,8	3,06 ± 1,14
25%	2	4,3	3,7	4,2	1,7	3,18 ± 1,24
50%	3	4,5	2,9	2,8	4	3,44 ± 0,76
75%	3,5	3,5	2,1	4	4,8	3,58 ± 0,98
100%	3,1	2	1,8	2,6	2,3	2,36± 0,51

ANOVA results of the data are as follows: F=1,21, P-value =0.338, Fcrit.= 2.87

Table 4: Effect of aqueous leaf extract of *Lantana camara* L. on the chlorophyll content of red chillies (*Capsicum annuum* L.)

Concentration of Extract	Concentration of Chlorophyll (mg/g plant tissue)		
	Chl a	Chl b	Total
0%	2,34±0.24	2,82±0,36^{a}	2,62±0,33^{a}
25%	2,23±0.42	2,39±0,18^{b}	2,241±0,2^{ab}
50%	2,15±0.53	2,35±0,30^{bc}	2,19±0,31^{ab}
75%	1,68±0.16	2,16±0,10^{bc}	1,96±0,05^{bc}
100%	1,77±0.73	2,00±0,42^{c}	1,70±0,63^{c}
F	2,24	5,43	4,51
P-value	0.1305	0,0039	0,0093
F-criterion	2,87	2,87	2,87

LSD test results: The values of Mean ± SE followed by the same superscript are not significantly different at α = 5%

Based on the data presented in Tables 1, 2, 3 and 4, it is suggested that the aqueous leaf extract of *L. camara* is potential to inhibit the growth and development of red chilli plants. These findings confirm similar allelopathic studies which use the same parameters that allelochemical compound may inhibit the growth and decrease the chlorophyll content of plant.[13] Inhibitory effects of *L.camara* likely due to the presence allelopathic substances such as p-OH-benzoic acid, p-coumaric acid, caffeic acid, vanillic acid, ferulic acid, syringic acid and gentisic acid, which was known to have inhibitory activity against many species.[14] There are at least 41 substances extracted from tembelekan plants, among others: β-pinene, β-sitosterol, betulonic acid, betulinic acid, caffeic acid, calceolarioside, camaraside, camarinic

acid, camaric acid, campesterol, 1,8-cineole, cinnamic acid, dipentene, geniposide, myristic acid, palmitic acid, ρ-coumaric acid. Some of the materials mentioned above was known to show inhibitory effect on germination and growth of certain plants namely, β-pinene, ρ-coumaric acid, cinnamic acid, dipentene, myristic acid, palmitic acid and 1,8-cineole. In addition to inhibiting cell growth such as process of seed germination there is also substances which effectively reduced chlorophyll contents in soybean leaf, i.e. ferulic acid.[15]

In a more limited study, phytochemical analysis of *L.camara* plant resulted substances namely: terpenes, fixed oils, flavones, and alkaloids[16]; phenols, tannins condensed, tannins pyrogallates, flavones, flavonols, flavononols, flavonones, chalcones, aurones, proanthocyanidins, catechins, alkaloids, triterpenoids, saponinas[17] As has been reported, phenolic acids, tannins, flavonoids and alkaloids were proven to allelopathic against tomato plants[18] and maize.[19] Other studies which strongly indicated that phenolic compounds possess strong allelopathic properties was reported by Li et al.[20]

4. CONCLUSION

Given red chillies treated with tembelekan leaf extracts showed plant height and fresh plant weight, content of chlorophyll b and total chlorophyll lower than that of control, it can be suggested that aqueous extract of L.camara is suppressive against the growth of red chilli.

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