

Allelopathy Trial Of Clove Leaf Litter (*Eugenia Caryophyllata* Thunb.) On Vegetative Growth Of Maize (*Zea Mays* L.) And Mungbean (*Phaseolus Radiatus* L)

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Abstract: Objective of this study was to determine the effect of clove-leaf litter on the vegetative growth of maize and mungbean. The experiment was held from 12th of April to 14th of May 2012 in Plant Ecology Laboratory Faculty of Agriculture and Light-house of Agriculture Faculty, Brawijaya University, Malang. The experiment consist of four treatments with three replications. Each treatments employed different dosages of clove leaf-litter extract is 0 gram, 10 grams, 20 grams and 30 grams. The experiment was conducted both in the laboratory by using Completely Randomized Design and in the glasshouse by using Randomized Block Design. Plant variables observed were germination percentage and root length in laboratory test while in glasshouse test were plant height, number of leaves, leaf area and total dry weight. The result showed that the germination percentage and the root length of maize (var. BISI-1) and mungbean (var. Kutilang) seeds were significantly reduced by clove leaf-litter extract, while the glasshouse test showed that the treatments did not significantly affect maize and mungbean in all the parameters observed.

Keywords: clove-leaf litter, allelopathy, maize, and mungbean.

I. Introduction

Increasing income of farmer's families is one of many kinds advance and it obtained when using the land by planting crops in diversity on the agroforestry system. For example, many people in Banaran, Blitar Distric using Garden and Clove Plantation in Blitar, where the people life by side this Clove Plantation or clove forest have cultivated maize and mungbean as an intercropping plants. The problem of this site came from clove tree which produce many litters in each year. The litters is plant residues as a source for producing fertilizer (Kusnadi dan Santoso, 1996). The chemical compounds of clove-leaf litter have been reported to have an allelopathic potential. The litters covers on the soil surface and this covering make inhibit on light intercept on the soil surface, and it makes the soil humidity increase, where this condition favourable for growth of phatogen's fungi which could attact to seeds (Brearley et al., 2003). Beside of this reason that's clove leaf-litter have been produce and contain some compounds as name as allelopath (Nugroho, 2009).

Allelopath is as a poison chemical compound that released by plant, it can affect the other plant growth. Allelopath of the plant can release into the rhizosphere or it can reach to the other plant by volatisation, root exudate, leaching and decomposition. After plant or it's organs die, some soluble chemical compound can leaching fastly (Sastroutomo, 1992). Every allelopath was released with certain mechanism depends on it's organs formation and structure or chemical characteristics. Phenol is one of some chemical compounds have been known. Phenol is an allelochemic has released during the litters decomposition, can inhibit on seeds germination, radical growth and it's effect can cause plant die (Nugroho, 2009).

Based on this reasons, it's important to study the effect allelopathy of clove leaves litter (*Eugenia caryophyllata*) on vegetative growth of maize (*Zea mays* L.) and mungbean (*Phaseolus radiatus* L.).

II. Methods

The experiment was held from 12th of April to 14th of May 2012 in Plant Ecology Laboratory and Glasshouse of Agriculture Faculty, University of Brawijaya, Malang. The experiment consisted of four treatments with three replications. Each treatments employed different dosages of clove leaf litter are 0 grams; 10 grams; 20 grams and 30 grams. The experiment was conducted both in the laboratory by using Completely Randomized Design and in the glasshouse by using Randomized Block Design. Plant variables observed were germination percentage and root length in laboratory test while in glasshouse test were plant height, number of leaves, leaf area and dry weight. Each material according the treatment is 10 grams, 20 grams and 30 grams, and than they was cut in small sized before adding into beaker glass which was filled by 200 ml alcohol 70%. And than this mixture incubated until 24 hours in condition with cap closing. After 24 hours these mixture (in the morning) was put by using paper whatman number 42 for passing extract and make solution freely dropping and accumulated into the beaker glass, it's depend on each treatments. Before using these extracts added by aquades

until 1 L in volume (Nugroho, 2007). Research have been conducted on two steps ie: 1) Experiment in the Laboratory of Plant Ecology and 2) In Glasshouse, Faculty of Agriculture, University of Brawijaya Malang, 505 asl. Tools used are cutter, ruler, balance analytic, baker glass, oven, oven, petridish, Paper Whatman no 42, Erlenmeyer, beaker glass, Leaf Area Meter (LAM), hand sprayer, digital camera, pipet dan polybag. Using maize seed variety BISI-2, and mungbean var Kutilang, clove leaf-litter, alcohol 70%, aquades dan soil's type is Regosol.

Experiment in the Laboratory.

Put in on 3 papers whatman into the Petridish (9 cm of diameter), setting 10 seeds of maize and mungbean into petridish with paper have been saturated by aquades and add by 10 ml clove leaf-litter according each treatments. By using Randomize Block Design with 3 replications. Observations of this file was done (ie: percentage of seed germination and radical lengths germination until 7 days after planting)

Experiment in the Glasshouse

Experiment continue under glasshouse condition in order to more approach land field. The method how to make or preparing the menu is the same with preparing extract to experiment in the laboratory. Experiment was used Randomize Block Design with 3 replications. Application of extract clove leaf litter 100 ml to plant at 11 DAP (Day After Planting); 16 DAP; 21 DAP dan 26 DAP. Characteristic of plant growth is plant high, leaf number, leaf area, dan total plant dry weight was measured at 10; 15; 20; 25 and 30 DAP.

III. Result And Discussion

3.1 Experiment in the Laboratory

There is significantly different between dosage of extract clove leaf litter effect on percentage of germination and root lenght both of maize and mungbean (Table 1).

Table 1. Average percentage of germination and root length on maize and mungbean affected by clove leaf litter extract

Treatment	Germination (%)		Root lenght (cm)	
	Maize	Mungbean	Maize	Mungbean
0 g	100,00 c	100,00 c	8,06 b	3,29 b
10 g	57,67 b	81,67 b	0,67 a	0,86 a
20 g	0,00 a	0,00 a	0,00 a	0,00 a
30 g	0,00 a	0,00 a	0,00 a	0,00 a
LSD 5%	12,58*	9,21*	1,67*	0,48*

Note: * number which is followed by different letter is significantly different (p = 0.05).

Percentage of seed germination both of maize and mungbean without clove leaf litter extract higher significantly different than 10 g. But, using with dosage 20 g there is no significantly different to treatment at 30 g.

3.2 Experimant under Glass House

Plant Height

The analysis indicated that there is no significantly different on the plant height both maize (Table 2) and Mungbean (Table 3)

Tabel 2. Average plant height on maize affected by clove leaf litter extract at different times of observation

Treatment	Plant high (cm) at defferent times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	9,21	16,01	22,43	31,12	37,27
10 g	9,46	16,09	22,87	31,07	36,46
20 g	9,32	16,08	21,57	30,57	36,33
30 g	9,31	16,15	21,08	29,95	36,38
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Tabel 3. Average plant height on mungbean at the times of observation as affected by clove leaf litter extract at different times of observation

Treatment	Plant high (cm) at defferent times of observation				
	10 hst	15 hst	20 hst	25 hst	30 hst
0 g	18,62	23,15	24,32	24,85	26,27
10 g	18,52	23,03	23,97	24,73	26,52
20 g	19,10	23,33	23,68	24,43	26,38

30 g	19,10	22,32	22,98	23,58	25,63
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Leaf Number

There is no significant different causing by application of extract clove leaf-litter on leaf- number of both maize (Tabel 4) and mungbean (Tabel 5).

Table 4. Average leaf number of maize after application of clove leaf litter extract at different times of observation

Treatment	Leaf-number at different times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	2,00	3,00	4,00	4,83	5,83
10 g	2,00	3,00	3,67	4,50	5,50
20 g	2,00	3,00	3,50	4,33	5,33
30 g	2,00	3,00	3,33	4,17	5,17
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Table 5. Average leaf number of mungbean after application of clove leaf litter extract at different times of observation

Treatment	Leaf-number at different times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	2,00	5,00	5,50	8,00	10,50
10 g	2,00	5,00	7,00	8,00	10,00
20 g	2,00	5,00	6,50	7,50	9,50
30 g	2,00	5,00	6,00	7,50	9,00
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Leaf Area

There is no significant different causing by application extract of clove leaf-litter on leaf area of both maize (Tabel 6) and mungbean (Tabel 7). Leaf-area of maize or mungbean which growing in media without adjuding extract of clove leaf-litter as same as in media with adding this extract.

Table 6. Average leaf area of maize after application of clove leaf litter extract at different times of observation

Teratment	Leaf-area (cm ²) at different times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	5,15	12,30	22,07	35,45	52,25
10 g	5,29	12,28	22,27	34,03	51,27
20 g	5,21	12,32	21,19	32,38	51,77
30 g	5,23	11,95	20,37	30,58	51,23
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Table 7. Average leaf area of mungbean after application of clove leaf litter extract at different times of observation

Teratment	Leaf-area (cm ²) at different times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	2,96	5,80	8,12	9,88	12,09
10 g	2,98	5,77	8,08	9,90	12,29
20 g	2,98	5,75	8,03	9,54	12,24
30 g	2,97	5,79	8,01	9,51	12,22
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Total Plant Dry Weight

There is no significantly different between the treatments of extract clove leaf-litter on both maize (Table 8) and mungbean (Table 9) total dry-weight. It indicates that application of extract clove leaf-litter not affected to the growth both of plant (maize and mungbean) until 30 DAP (days after planting).

Table 8. Average of Total Plant dry-weight of maize caused by extract clove leaf-litter at different times of observation

Treatment	Total plant dry-weight (g tan ⁻¹) at different times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	0,20	0,24	0,94	2,20	6,11
10 g	0,21	0,27	1,25	2,19	5,25
20 g	0,20	0,27	0,93	1,99	4,93
30 g	0,21	0,25	0,90	1,76	4,64
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Table 9. Average of Total Plant dry-weight of mungbean caused by extract clove leaf-litter at different times of observation

Treatment	Total plant dry-weight (g plant ⁻¹) at different times of observation				
	10 dap	15 dap	20 dap	25 dap	30 dap
0 g	0,08	0,13	0,29	0,58	0,94
10 g	0,09	0,14	0,34	0,60	1,09
20 g	0,09	0,13	0,32	0,55	0,92
30 g	0,09	0,12	0,31	0,52	0,89
LSD 5%	ns	ns	ns	ns	ns

Note: ns is not significantly different (p = 0.05)

Process of maize and mungbean seed germination was affected by some environment factors, where application of clove leaf-litter with several dosages have significantly affects on percentage germination and root length. Using with 0 g clove leaf-litter extract (as a control) indicates that germination of seed are normal and percentage of germination on maize and mungbean is 100 % respectively. This environment (rhizosphere) is favourable for seeds germination if there is no limiting factors as like as water stress or the chemical inhibits factors as like as phenol or chemical compound (allelopath) which was contained in the clove leaf-litter extract.

In this favorable condition occur water imbibition through the membran for activity of enzyme like giberaline and ATP-ase for converting food storage as like as carbohydrate, protein and fat to the simple molecule like glucose, amino acids and fatty acid will required as an energy to young organs development as like as radical and stem (Nugroho, 2009). Application of 10 g clove leaf-litter can decrease on percentage of germination and root length both of maize and mungbean. Decreasing of these variables was caused by compound of allelopath from clove leaf-litter extract as like as phenol. Phenol can inhibit to activity enzyme which is convert food storage to nutritional available but non-adequat for root and stem development, while if application of extract clove leaf-litter with 20 g an 30 g shows that ercentage of seeds germination of both maize and mungbean are 0% or there is no seed germination. If increasing on dosage application of clove leaf-litter extract can increase the contain of allelopath in solution. Many research shows that increasing dosages in extract of seed Acasia (Tambaru dan Santosa, 1999) affect to the increasing allelopath contains, also Tetelay (2003) raported to the same effect on maize and mungbean seeds was affected by using skin outer of stem, leaf and root of Acasia.

Experiment result in glasshouse shows that application of clove leaf-litter extract with several dosages (0, 10 , 20 dan 30 g) not significantly affect to plant height, leaf-number, leaf area and total dry weight both of maize and mungbean. There is no significantly inhibition not mean that is not absence the compound of allelopathy contains in leaf (Waluto, 2008), but there is level of allelopath contains in clove leaf-litter extract not adequate as a phytotoxic to both of maize and mungbean growth, and these dosages of allelopath not effect to the growth of maize and mungbean. The same result also occure an experiment by Olofsdotter et al. (2002 in Khanh et al., 2007) repports that phenolic acid which have been identified in rice plant not capable as it's role to inhibit weed growth sourounding in their environment, and it was caused by the level of phenolic acid which released from rice plant root not enough to reach as a phytotoxic.

IV. Conclusion

Aplication of extract clove leaf-litter can inhibit the percentage and root growth of germination of both plants (maize and mungbean), but it's not effect on the vegetative growth on maize and mungbean until at 30 days after planting.

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