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## Insecticidal Effect of Leaf Extract of Gamal (*Gliricidia sepium*) from Different Cultivars on Papaya Mealybugs (*Paracoccus marginatus*, Hemiptera: Pseudococcidae)

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**Abstract:** Polar extract of gamal leaves (*Gliricidia sepium*) from various cultivars in Lampung, Indonesia, is revealed to show insecticidal effect on various types of mealy bugs, but its effect on papaya mealy bugs (*Paracoccus marginatus*) is not yet known. This study aims to determine the insecticidal effects of water extract formulation of gamal leaf powder from four different cultivars, namely Bandar Lampung (BL) cultivars, Pringsewu (PR), North Lampung (LU) and West Lampung (LB) against papaya mealy bugs. There were five formulation prepared namely Formula 1, 2, 3, 4 and 5. Each formula is differentiated based on the LC<sub>50</sub> ratio of each cultivar extract (BL:PR:LU:LB) consecutively are 1:1:1:1, 2:1:1:1, 1:2:1:1, 1:1:2:1 and 1:1:1:2. Mortality data were analyzed by probit analysis to determine LC<sub>50</sub>, then continued with Anova test and LSD test with SPSS 16.0 to determine the effectiveness of the formulation. The results showed that crude leaf extracts of gamal from LU, PR, LB, and BL cultivars can kill papaya mealy bugs with the LC<sub>50-72</sub> values of 0.033%, 0.090%, 0.184% and 1.818% respectively. The bioassay test of the formulation showed a mortality rate up to 86.7%. Formula 1 is more effective than the other four formulas. Thus it can be concluded that the extract of gamal leaf water has the potential to be used as a natural insecticide.

**Keywords:** mealybug, papaya mealybug, *Paracoccus marginatus*, gamal, *Gliricidia sepium*

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### I. Introduction

India, Brazil and Indonesia are the top three papaya producing countries in the world. In the period of 2008-2010 these three countries contributed up to 63% of world's papaya [1]. Unfortunately, since 2008 papaya farmers in India and Indonesia face challenges that are not easily overcome, the presence of a new pest, papaya mealybug named *Paracoccus marginatus* (Hemiptera: Pseudococcidae). This highly destructive polyphagous pest is recorded for the first time in Java, Indonesia and Tamil Nadu, India [2]. In Indonesia alone, infestation of mealy bugs on papaya plants that occurred in 2009, causing a decrease in papaya production in Bogor Regency by 58% and economic losses reaching 84% [3].

Lately, there have been many studies testing the polar extract (methanol, ethanol and water) of gamal leaves on a laboratory scale against mealy bugs. The gamal plant extracts from different cultivars namely Bandar Lampung (BL), West Lampung (LB), North Lampung (LU), and Pringsewu (PR) cultivars. Among the results reported are presented in Table 1.

Current study is aimed to find out whether formulation prepared from leaf extracts of *Gliricidia sepium* from four cultivars mentioned above is potent to be used in controlling papaya mealybugs, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae).

**Table 1.** Results of previous tests used extracts of gamal from different cultivars against mealybugs

Type of Extract	Cultivar	Insects	LC <sub>50</sub> (%)	References
Water and ethanol	BL	<i>Paracoccus marginatus</i>	0.40 - 2.26	[4]
Water and methanol	PR	<i>Paracoccus minor</i>	0.047 - 0.054	[5]
Water and methanol	LB	<i>Paracoccus cryptus</i>	0.061 - 0.096	[6]
Water and methanol	LU	<i>Paracoccus citri</i>	0.033 - 0.039	[7]

## II. Material and Methods

### Plant Samples and Extraction

Leaves of gamal plant (*Gliricidia sepium*) used in this study were collected from four different districts in Lampung province namely Bandar Lampung (BL cultivar), Pringsewu (PR cultivar), West Lampung (LB cultivar) and N. Lampung (LU cultivar). For taxonomic verification, the plant sample was brought to the Botany Laboratory, Faculty of Mathematics and Sciences, University of Lampung, Indonesia. The leaves were air-dried at room temperature for 10 days and ground into fine powder using disk-mill machine. The dry leaves powder (500 g) then prepared to be aqueous extract using maceration technique for 24 h with three replication. After being evaporated using a rotary evaporator, extracts were diluted in series according to the desired concentration. The extract concentration levels of each gamal cultivar prepared to be used in bioassay were based on LC<sub>50</sub> values found in previous researchs shown in Table 1, which is as follows (Table 2).

**Table 2.** Concentration series of gamal plant extract prepared from four different cultivars

Cultivar	Extract concentration series (%)				
	1	2	3	4	5
BL	0	0.7	1.4	2.1	2.8
PR	0	0.05	0.1	0.16	0.20
LB	0	0.06	0.12	0.18	0.24
LU	0	0.02	0.04	0.06	0.08

### Bioassay test

Bioassay carried out in this experiment was a residual test by soaking young papaya fruits in leaves extract of gamal of 5 different concentration levels as shown in Table 2 for 10 minutes. Insect mortalities were observed at 24, 48 and 72 hours after treatment. Each experimental treatment was repeated three times. Test solution with an LC<sub>50</sub> value of less than 5% considered as an effective ingredient.

### Formulation test

There were five formulation prepared namely Formula 1, 2, 3, 4 and 5. Each formula is differentiated based on the LC<sub>50</sub> ratio of each cultivar extract (BL:PR:LU:LB) consecutively are 1:1:1:1, 2:1:1:1, 1:2:1:1, 1:1:2:1 and 1:1:1:2. Then the formula is tested on insects in the same way as the bioassay test described above. Observations on insect mortality were carried out at 24, 48 and 72 hours and repeated three times.

### Study Parameters and Data Analysis

Mortality rate of test insects was expressed as percentage, whereas effectiveness of extract in killing the insect was expressed as LC<sub>50</sub> (lethal concentration 50%). Two-way Anova was applied to compare mortality rate between levels of extract concentration and duration of exposure. The LC<sub>50</sub> was determined using Probit EXE Analysis Program.

## III. Results

Mean mortality of papaya mealybugs fed on aqueous leaf extracts of gamal cultivars by level of concentration and duration of exposure (hours) are presented in Table 3. Results of mean difference analysis of the data using two-way Anova are tabulated in Table 4. Based on the F- and P-values of each source of variation it can be inferred as follows. Both plant cultivar (BL, PR, LB and LU) and time of exposure (24, 48 and 72 hours) resulted in different levels of mortality on the papaya mealybugs. The interaction between cultivar and time of exposure is also show a significant effect on the mortality of mealy bugs ( $p < 0.05$ ).

**Table 3.** Mortality rate of papaya mealy bugs after treatment with leaves extract of gamal from different cultivars by duration of exposure

Cultivar	Concentration (%)	Mortality (%)		
		24 hours	48 hours	72 hours
BL	0.00	0	0	10
	0.70	20	53	83
	1.40	30	33	60
	2.10	20	27	47
	2.80	30	37	47
PR	0.00	0	0	7
	0.05	0	10	53
	0.10	7	33	73
	0.15	0	23	67
LB	0.20	0	33	63
	0.00	0	0	10

	0.06	17	27	37
	0.12	7	20	47
	0.18	20	40	53
	0.24	30	57	57
	0.00	0	0	17
	0.02	7	17	50
LU	0.04	20	20	53
	0.06	23	23	70
	0.08	17	27	87

Results of probit analysis for analyzing the dose-response data are presented in **Table 5**. The data suggest that all leaf extracts of gamal cultivars (BL, PR, LB and LU) are toxic to the *P. marginatus* with  $LC_{50}$  values of 1.818%; 0.091%; 0.184%; 0.033% respectively. However, when the four cultivars are compared, it appears that for the papaya mealybugs, gamal extract of LU cultivar is the most toxic, whereas extract of BL cultivars is somewhat less toxic.

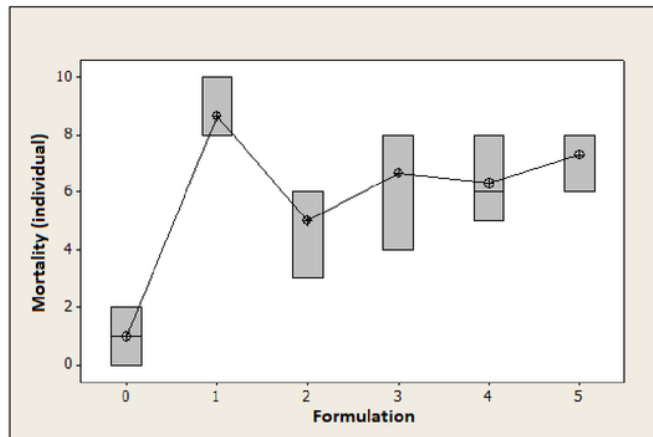
Graphical presentation in Fig.1 shows the effect of five formula made from leaf extracts of gamal from different cultivars on mortality of papaya mealybugs (*P. marginatus*) after 72 hours of exposure. Statistical analysis using Anova and a post hoc test (LSD) resulted in the values tabulated in Table 6.

**Table 4.** Two-way ANOVA of mortality rate of mealybugs (*P. marginatus*) by gamal cultivars and duration of exposure

Source of variation	df	Seq SS	Adj MS	F	Sig
Cultivar	5	131.704	26.341	15.80	0.000
Time of exposure	2	171.370	85.685	51.41	0.000
Cultivar*Time of exposure	10	38.407	3.841	2.30	0.033
Error	36	60.000	1.667		
Total	53	401.481			

**Table 5.**  $LC_{50}$  values of crude water extract of gamal from different cultivars after 72 hours of treatment

Cultivar	$LC_{50}$ (%)
BL	1.818
PR	0.091
LB	0.184
LU	0.033



**Fig. 1.** Boxplot for Formula 1, 2, 3, 4 and 5 after 72 hours of treatment. The concentration ratio (BL:PR:LU:LB) used in each formula consecutively are 1:1:1:1, 2:1:1:1, 1:2:1:1, 1:1:2:1 and 1:1:1:2.

**Table 6.** Mortality of papaya mealy bugs treated with 5 different formulation of leaf extracts of gamal at different hours of exposure

Hours of Exposure	Mortality of insect (mean $\pm$ SD)					
	Control	Formula 1	Formula 2	Formula 3	Formula 4	Formula 5
24	0.00 $\pm$ 0.00 <sup>a</sup>	1.33 $\pm$ 0.58 <sup>ab</sup>	2.00 $\pm$ 1.00 <sup>bc</sup>	1.00 $\pm$ 0.00 <sup>ab</sup>	1.33 $\pm$ 1.53 <sup>ab</sup>	3.33 $\pm$ 2.31 <sup>c</sup>
48	0.00 $\pm$ 0.00 <sup>a</sup>	4.67 $\pm$ 1.53 <sup>c</sup>	3.67 $\pm$ 1.53 <sup>bc</sup>	2.67 $\pm$ 0.58 <sup>b</sup>	3.67 $\pm$ 0.5 <sup>bc</sup>	4.67 $\pm$ 1.15 <sup>c</sup>
72	1.00 <sup>a</sup>	8.67 $\pm$ 1.15 <sup>c</sup>	5.00 $\pm$ 1.73 <sup>b</sup>	6.67 $\pm$ 2.31 <sup>bc</sup>	6.33 $\pm$ 1.53 <sup>bc</sup>	7.33 $\pm$ 1.15 <sup>bc</sup>

Values in the same row followed by the same superscript are not different at  $\alpha=0.05$  by LSD test

#### IV. Discussion

The results of this study confirm some previous research results [2] the insecticidal effects of gamal plant (*Gliricidia sepium*) extract. From Tamil Nadu, India, it reported that ethanol extract of *G. sepium* leaves showed repellent activity against *Aedes aegypti* mosquito [8, 9]. It has been also reported that ethanolic extracts from *G. sepium* showed acaricidal effects against *Tetranychus cinnabarinus* (Boisduval) (Acari: Tetranychidae) [10]. In addition, *G. sepium* extract revealed to be effective for controlling insect pest (*Godasa sidae*) of *Mansonia altissima* (A.Chev) seedlings [11].

Bioactive components that have been identified from plant extracts of *G. sepium* which have anti-insecticide effects consist of Alkaloids, Terpenoids, Phenolics, Coumarin, Tannins, Saponins, Flavonoids, Quinones, Proteins, and Sterols [12]. Tannin, saponins, fatty acids and alkaloids are among bioactive found in flower extract *alotropis gigantea* that were revealed to have insecticidal activity (90-95%) at 2000 ppm within 24 hours against papaya mealy bug infestation in *Ailanthus excelsa* [13].

Concerning flavonoids, many study reports have shown the toxic effects of these substances in various species of organisms. Among flavonoids that are known to be toxic to insects are biochanin and pinocembrin. Biochanin was revealed to reduce fecundity in primary reproductives of the termite [14]. Wheareas, pinocembrin was known to show anti-feeding and mortality effects in the larvae of butterfly *Spodoptera frugiperda* [15].

This study successfully demonstrated that gamal extract from different cultivars had a deadly toxic effect on papaya mealybugs. However, the toxic levels of each cultivar extract is somewhat different. This is something natural because differences in cultivars cause differences in plant secondary metabolites [16]. In *Tithonia diversifolia*, for instance, the metabolites in the inflorescence and root parts were mainly affected by variation of some soil nutrients such as Ca, Mg, P, K and Cu [17].

#### V. Conclusion

All leaves extract of gamal cultivars from different districts of Lampung Province, Indonesia, either separately or in combination (formulation) have lethal effect on papaya mealy bugs *Paracoccus marginatus*. Thus, plant leaves extract of gamal (*Gliricidia sepium*) is potential to be use as bioinsecticide for papaya mealy bugs.

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#### References

- Evans E.A. and Ballen F.H. An Overview of Global Papaya Production, Trade, and Consumption. FE913, Food and Resource Economics Department, UF/IFAS Extension. The Institute of Food and Agricultural Sciences (IFAS). 2012; <http://edis.ifas.ufl.edu>.
- Muniappan R, Shepard BM, Watson GW, Carner GR, Sartiami D, Rauf A, and Hammig M.D. First report of the papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae), in Indonesia and India. Journal of Agricultural and Urban Entomology, 2018; 25(1):37-40
- Iskandarm, L. M. 2010. *Dampak Ekonomi Serangan Hama Asing Invasif Paracoccus marginatus (Hemiptera:Pseudococcidae) pada Usahatani Pepaya di Kabupaten Bogor*. Tesis. Sekolah Pascasarjana Institut Pertanian Bogor. Bogor.
- Pratami, G. D. 2011. *Senyawa Flavonoid dari Ekstrak Air Serbuk Daun Gamal (Gliricidia maculata) dan Uji Toksisitasnya Terhadap Hama Kutu Putih Pepaya (Paracoccus marginatus)*. Skripsi. Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Lampung, Bandar Lampung.
- Andriyani, R. 2016. *Daya Insektisida, Jenis dan Struktur Isolat Mumi Ekstrak Polar Serbuk Daun Gamal (Gliricidia maculata Hbr.) terhadap Kutu Putih (Planococcus minor Maskell) pada Tanaman Kakao (Theobroma cacao)*. Tesis. Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Lampung. Bandar Lampung.
- Aksah, F. 2016. *Perbandingan Daya Racun Isolat Mumi Ekstrak Metanol dan Ekstrak Air Daun Gamal (Gliricidia maculata) terhadap Mortalitas Kutu Putih (Pseudococcus cryptus) Pada Tanaman Sirsak (Amnona muricata)*. Tesis. Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Lampung. Bandar Lampung.
- Sukmal, N., Rosa, E., Apriliani and Kanedi, M. Insecticidal Effects of the Flavonoid-Rich Fraction of Leaves Extract of Gamal (*Gliricidia sepium*) on the Coffee Mallybugs (*Planococcus citri* Risso). Annual Research & Review in Biology., 2017; 16 (6): 1-9
- Nazli R., Akhter M., Ambreen S., Solangi A.H. and Sultana N. Insecticidal, Nematicidal and Antibacterial Activities of *Gliricidia sepium*. Pak. J. Bot., 40(6): 2625-2629, 2008.
- Krishnaveni K.V., Nayaki R.T. and Balasubramanian M. Eff ect of *Gliricidia sepium* leaves extracts on *Aedes aegypti*: Larvicidal activity. Journal of Phytology 2015, 7: 26-31. DOI: 10.19071/jp.2015.v7.2898
- Sivira A., Sanabria M.E., Valera N. and Vásquez C. Toxicity of ethanolic extracts from *Lippia organoides* and *Gliricidia sepium* to *Tetranychus cinnabarinus* (Boisduval) (Acari: Tetranychidae). Neotrop Entomol. 2011; 40(3): 375-379.
- Ayeni O.D., Onilude Q.A., Ibode R.T., Ehigiator O.R., Adeniyi M.A. and Ajibade Y.A. Comparative assessment of synthetic pesticide and extract of *Gliricidia sepium* (Jacq.) as bio-agent on the control of insect pest of *Mansonia altissima* (A.Chev) seedlings. Journal of Forestry Research and Management., 2017; 14 (2): 154-165. [www.frin.gov.ng/frin1/journals.html](http://www.frin.gov.ng/frin1/journals.html)
- Jose S. and Sujatha K. Antifeedant activity of different solvent extracts of *Gliricidia sepium* against third instar larvae of *Helicoverpa armigera* (Hubner) (Lepidoptera : Noctuidae). Int. J. Adv. Res. Biol. Sci., 2017; 4(4): 201-204. DOI: 10.22192/ijarbs.

- [13]. Sumathi R., Rajasugunasekar D., Babu D.S., Senthilkumar N. and Murugesan S. Insecticidal Property of Calotropis Gigantea against Papaya Mealybug (Paracoccus Marginatus) on Ailanthus Excelsa. IJRST –International Journal for Innovative Research in Science & Technology, 2017; 4(1): 232-236. <http://www.ijrst.org/articles/IJRSTV4I1069.pdf>
- [14]. Boue S.M. and Raina A.K. Effects of Plant Flavonoids on Fecundity, Survival, and Feeding of the Formosan Subterranean Termite. Journal of Chemical Ecology, 2003; 29(11):2575-2584
- [15]. Diaz Napal, G.N. and Palacios, S.M. Bioinsecticidal effect of the flavonoids pinocembrin and quercetin against Spodoptera giperda. J Pest Sci., 2015; 88: 629. doi:10.1007/s10340-014-0641-z
- [16]. Le Bourvellec, C., Bureau, S., Renard, C. M., Plenet, D., Gautier, H., Touloumet, L., Girard, T., ... Simon, S. (2015). Cultivar and Year Rather than Agricultural Practices Affect Primary and Secondary Metabolites in Apple Fruit. *PLoS one*, 10 (11), e0141916. doi:10.1371/journal.pone.0141916
- [17]. Sampaio, B. L., Edrada-Ebel, R., & Da Costa, F. B. (2016). Effect of the environment on the secondary metabolic profile of *Tithonia diversifolia*: a model for environmental metabolomics of plants. *Scientific reports*, 6, 29265. doi:10.1038/srep29265

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