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MORTALITY OF RED FIRE ANT (*SOLENOPSIS INVICTA*) AS AFFECTED BY DIFFERENT CONCENTRATION OF WOOD VINEGAR

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ABSTRACT

This study was conducted to determine the mortality of ants as affected by different concentrations of wood vinegar. The study was conducted at President Ramon Magsaysay State University, San Marcelino, Zambales, Philippines. Completely Random Design (CRD) was used in this study with four treatments.

The four (4) treatments were as follows: Treatment 1 (25%) concentration of wood vinegar (Positive Control); Treatment 2- 50% concentration of wood vinegar; Treatment 3 (75%) concentration of wood vinegar and Treatment 4 (100%) concentration of wood vinegar. Each treatment has one hundred (100) samples each and was replicated thrice.

It is concluded that the higher concentration of wood vinegar, the faster reaction on the mortality of red fire ants compared to the control in 50-minutes duration.

Keywords: wood vinegar, red fire ants, and mortality

INTRODUCTION:

Mutualism is defined as an interaction between individuals of different species that results in positive (beneficial) effects on per capita reproduction and/or survival of the interacting populations (Holland & Bronstein, 2008). According to Stadler and Dixon (2008), aphid-ant mutualism has served as one of the models in general descriptions of mutualism.

Generally, the larger ants offer protection from predators and disease and clean the smaller aphids. In turn, aphids produce a sugar-rich substance known as honeydew, the waste product of an aphid's plant sap diet. Ants derive all or a large part of their nutrients from this honeydew as a source of food (Begon et al., 2011; Detrain et al., 2010).

Red fire ants, Solenopsis invicta (Buren) are widespread, invasive ants that are notoriously aggressive and voracious (Holway et al., 2002). Fire ants are attracted to plants infested with aphids and are effective at protecting aphids from predators. Fire ants, for example, preferentially forage on aphid-infested cotton plants compared with aphid-free cotton plants, and fire ant and cotton aphid abundances are positively correlated in the field (Kaplan & Eubanks 2005).

Ant workers were also able to detect infective conidia on the cuticle of living aphids and responded by either removing or grooming these aphids. The results extend the long-standing view of ants as mutualists and protectors of aphids by demonstrating focused sanitizing and quarantining behavior that may lead to reduced disease transmission in aphid colonies (Nielsen et al., 2010).

Wood vinegar can be used as raw material for making repellents, insecticides,

molluscicides, herbicides, and fungicides. In most of the products, the efficacy is based on a mixture of many components. This is one of the main difficulties in the registration of botanicals as pesticides. It is very often that frequent use of botanicals is needed compared to the use of synthetic chemicals and the push and pull theory must be known e.g. in control of insects and other mobile pests. Formulation of slow-release products will increase the efficacy of botanicals such as wood vinegar (Lindqvist et al., 2010).

The characterization of fast pyrolysis liquids has been continued for a long time. The products contain many organic components and the composition is very complicated (Tiilikkala et al., 2011). According to the literature, the main organic components of liquids from fast pyrolysis are methanol and acetic acid (Tiilikkala et al., 2010). Other components are acetone, methyl acetone, acetaldehyde, allyl alcohol, furan, and furfural, as well as formic, propionic, and butyric acids. The settled tars can be fractionated into light and heavy oil fractions. The former consists of aldehydes, ketones, acids, and esters. Various phenols, including a high proportion of cresols and pitch, are present in the heavy oil fraction. The chemical composition, physical properties, and fuel oil quality of fast pyrolysis liquids have been extensively developed and described by Oasmaa and Meier (2005).

Wood vinegar contains 80-90% water and 10-20% organic compounds including more than 200 chemical components with mainly acetic acid. It also contains various kinds of phenol, carbonyl, and alcohol compounds. It is widely used in agricultural crop production toward plant growth stimulation, germination, soil disinfection, and the control of weed, disease, and pests (Rico et al., 2007).

With this, a study on the effectiveness of wood vinegar in mortality and ants was proposed.

MATERIALS AND METHODS:

Materials:

The materials used in this study were filter paper, petri dish, sprayer, forceps, test tube, Erlenmeyer flask, wood vinegar, and red fire ants.

Experimental Treatments and Design:

The study was conducted at the College of Agriculture and Veterinary Medicine (CAVM). Completely Random Design (CRD) was used in this study with four treatments.

The four (4) treatments are as follows: Treatment 1 (25%) concentration of wood vinegar (Positive Control based on Pangnakorn et al., 2012); Treatment 2 (50%) concentration of wood vinegar; Treatment 3 (75%) concentration of wood vinegar and Treatment 4 (100%) concentration of wood vinegar. Each treatment has one hundred (100) samples each and was replicated thrice.

Data Gathering Procedure:

Average Mortality Rate:

The average mortality rate was recorded by counting the dead ants in every 10 minutes' interval at a 50-minutes duration.

Statistical Analysis of Data:

The significant differences were evaluated using Analysis of Variance (ANOVA) for Completely Random Design (CRD. Mean of results were compared employing the Least Significant Difference (LSD) at 5% and 1% of significant level.

RESULT AND DISCUSSION:

In this study, the mortality of ants in different concentrations of wood vinegar was evaluated and discussed.

Table1.a presents the average mortality of ants at a 50-minutes duration.

Table 1a. Average Mortality of Ants at 50-Minutes Duration

Treatment	Rep. I	Rep. II	Rep. III	Treatment Total	Treatment Mean
Treatment 1	44.00	50.00	32.00	126.00	42.00
Treatment 2	96.00	81.00	92.00	269.00	89.67
Treatment 3	98.00	97.00	96.00	291.00	97.00
Treatment 4	99.00	100.00	99.00	298.00	99.33
Rep Total	337.00	328.00	319.00		
Grand Total				**984.00**	
Grand Mean					**65.60**

Treatment 4 has the greatest number of mortality, with 99.33%, followed by Treatment 3, Treatment 2, and Treatment 1 with an average of 97%, 97%, 89.67%, and 42% respectively.

Table1.b presents the analysis of variance of average mortality of ants at 50-minutes duration.

Table 1b. Analysis of Variance of Average Mortality of Ants at 50-Minutes Duration

Source of Variance	Degree of Freedom	Sum of Square	Mean of Square	Computed F	Tabular F 5%	1%
Replication	2	40.50	20.25	**0.48**	4.46	8.85
Treatment	3	6552.67	2184.22	**52.25****	3.84	7.01
Error	6	250.83	41.81			
Total	14	6844.00				

**=highly significant

CV 8.54%

LSD 5%=12.92

LSD 1%=19.57

The result revealed a highly significant difference among the different concentrations of wood vinegar. Although treatment 2, treatment 3, and treatment 4 showed no significant differences. Among the tested concentrations of wood vinegar, the 100% concentration showed the highest effect on the mortality of ants. The result confirmed by the study of Pangnakorn et.al 2012 that as the concentration increased, the observed mortality also increased. Furthermore, Yatagai et. al., (2002) stated that formaldehyde, phenol, and acetic acid could be active components that contributed to this pesticidal activity.

Table 2.a presents the average mortality of ants every after 10 minutes.

Table 2a. Average Mortality Every After 10 Minutes

Treatment	Rep. I	Rep. II	Rep. III	Treatment Total	Treatment Mean
Treatment 1	8.80	9.60	6.40	24.80	8.27
Treatment 2	19.00	15.60	17.00	51.60	17.20
Treatment 3	18.40	19.00	18.40	55.80	18.60
Treatment 4	19.80	20.00	19.80	59.60	19.87
Rep. Total	66.00	64.20	61.60		
Grand Total				**191.80**	
Grand Mean					**12.79**

It reflected that treatment 4 has the greatest percentage among other treatments. In the first 10 minutes, Treatment 4 has the highest percentage of mortality with an average of 10.33, followed by Treatment 3 with an average of 2.33 while Treatment 2 and Treatment 1 that has no mortality.

On the next 10 minutes of the observation, Treatment 4 raised the average percentage of mortality to 80.33, followed by Treatment 3, and 2 with an average of 50.66 and 27.33 while Treatment 1 shows the lowest percentage of mortality with an average of 4.67

In 30 minutes of observation, Treatment 4 raised the average percentage of mortality to 84, followed by Treatment 3, Treatment 2, and Treatment 1 with an average of 71.66, 69, and 16.67 respectively.

On the 40 minutes of observation, the average percentage of mortality in treatment 4 raised to 87.67, followed by Treatment 3, Treatment 2,

and Treatment 1 with an average of 83.66, 78.67and 35.34 respectively.

Up to the last minutes of observation, Treatment 4 still shows the highest percentage of mortality with an average of 99, followed by Treatment 3, Treatment 2, and Treatment 1 with an average mortality of 97.99, 86, and 41.34 respectively.

The table shows that the higher concentration of wood vinegar has the fastest reaction on the mortality of red fire ants.

Table 2.b presents the analysis of variance of mortality of ants every after 10 minutes.

Table 2b. Analysis of Variance of Mortality Every After 10 Minutes

SOV	DF	SS	MS	COMPUTED F	TABULAR F	
					5%	1%
Replication	2	2.45	1.22	**0.80**	4.46	8.85
Treatment	3	248.86	62.22	**40.55****	3.84	7.01
Error	6	9.21	1.53			
Total	11	260.52				

**=highly significant

CV 9.69%

LSD 5%=2.47

LSD 1%=3.75

The ANOVA of Average Mortality every after 10 minutes revealed a highly significant difference among treatments of wood vinegar because the computed F value was higher than 5% and 1% level of significance.

CONCLUSION AND RECOMMENDATION:

The result of the study showed high significance on the use of different concentrations of wood vinegar on the mortality of ants. It is concluded in the study that a higher concentration of wood vinegar can be used as a replacement for carbaryl or synthetic pesticide in controlling ants.

Based on the result of the study, shows that different concentrations of wood vinegar affect the mortality of red fire ants. The evaluation of the average mortality of ants at 50-minutes duration showed that Treatment 4 has the greatest number of mortality, with 99.33%, followed by Treatment 3, Treatment 2, and Treatment 1 with an average of 97%, 97%, 89.67%, and 42% respectively.

Among the different tested concentrations of wood vinegar, the 100% concentration showed the highest effect on the mortality of ants. The result was confirmed by the study of Pangnakorn et.al 2012 that as the concentration increased, the observed mortality also increased. Formaldehyde, phenol, and acetic acid could be active components that contributed to this pesticidal activity (Yatagai et al., 2002).

Further studies on the effect of different concentrations of wood vinegar in crop pests are recommended.

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