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Influence of Incubation Periods and Dosage on the Bioefficacy of Cow Urine against Melon Aphids (*Aphis gossypii*) and Pickleworms (*Diaphania hyalinata*) in Watermelon Cultivation

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Abstract: The aim of this study was to evaluate the effect of incubated cow urine and its application rates against melon aphids (*Aphis gossypii*) and Pickleworms (*Diaphania hyalinata*) was investigated. Incubation periods of 7, 14 and 21 days at doses 5, 10 and 15% were tried in a randomized block design with three replications. Results from analysis of variance (Anova) show that all treatments significantly reduced the incidence of both pests. However, a post hoc analysis using Turkeys HSD reveals that 14 days incubation at the various dosage levels proved superior to other treatments. Maximum fruit yields of 79816, 78178 and 54109 kg/ha were also recorded for 14 days incubation at 10, 15 and 5%, respectively. Therefore, 14 days incubation time is recommended for cow urine FOR adoption in pest control on watermelon.

Key words: Bioefficacy, cow urine, incubation time, melon aphids, pickleworm

INTRODUCTION

One of the most serious pre-harvest problems confronting watermelon (*Citrullus vulgaris* L.) cultivation in Africa is insect pest. Amongst these dangerous insects are melon Aphids (*Aphis gossypii*) and Pickleworms (*Diaphania hyalinata*). Melon Aphids are soft, oblong insects about 2.5 mm in length and are with or without wings but sucks the plant sap which eventually develops into curly and shrivel leaves that may turn brown and die. On the other hand, pickleworms feed on the leaves, flowers and also bore into the newly developed fruit thereby causing fruit necrosis. The activities of these pests if not properly checked could lead to both quantitative and qualitative losses. It is against this backdrop, that several synthetic insecticides have been manufactured and applied in watermelon management (Hedge and Nandihalli, 2009; Kamara *et al*., 2004; Gupta *et al*., 2000). Some of the commonly used organophosphate insecticides in sub-Saharan Africa are cyperforce, delthrin, karate, karto, tamarom and nuva. These insecticides contains dangerous active ingredients intended to prevent , destroy, repel or control insect pests. However the continued used of these chemicals not only increases the overhead cost of the farmer but has led to many side effects, including loss of biodiversity, residual toxicity, pest resistance, long-term human health problems and environmental pollution (Roger and Kurihara, 1988; Wilson and Tisdell, 2001; Tahir and Butt, 2009). Thus, the failure of these chemicals has led the scientific community to drum-up support for traditional approach to pest control (Gujar, 1992; Lakshmanan, 2001; Peries, 1985) and one of such important bio-alternatives is cow urine which contains urea, ammonia, growth hormones, uric acid, and minerals like iron, potassium, magnesium, calcium, copper and nitrogen. However, the applicability and potency of cow urine as a bio-pesticide depends on the fermenting time and dosage. It is therefore the objective of this study to evaluate the effect of incubation periods and dosage on the bioefficacy of cow urine in controlling aphids and pickleworms in watermelons cultivation.

MATERIALS AND METHODS

The experiments were carried out at the Ebiburu farms in the Ahoada-West Local Government Area of Rivers State, Nigeria in the 2009 and 2010 planting seasons.

The trials were laid out in randomized block design with three replications each at plot sizes of 2m × 5m with planting distance of 1m x 1m. Watermelon seeds (Sugar Baby variety) were sown following standard agronomic practices and nine treatments were then tested along with untreated control. These includes: T_1 (7 days incubation at 5% dose), T_2 (7 days incubation at 10% dose) T_3

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Table 1: Experimental design

	5% Dose	10% Dose	15% Dose
7 days incub	N = 3	N = 3	N = 3
17 days incub	N = 3	N = 3	N = 3
21 days incub	N = 3	N = 3	N = 3

Table 2: Summary of mean melon aphid infestation

	5% Dose	10% Dose	15% Dose	Mean incub. time
7 days	42.8	31.0	28.5	34.1
14 days	17.0	9.2	2.1	9.4
21 days	22.9	19.0	16.3	19.4
Mean dose	27.6	19.7	15.6	

(7 incubation at 15% dose), T_4 (14 days incubation at 5% dose), T_5 (14 days incubation at 10% dose), T_6 (14 days incubation at 15% dose),T_7 (21 days incubation at 5% dose), T_8 (21 days incubation at 10% dose), T_9 (21 days incubation at 15% dose), and T_{10} (untreated control).
The cow urine was collected with 20 L plastic cans at the Agip abattoir in Port Harcourt, Rivers State, Nigeria. This was incubated under the sun for 7, 14 and 21 days at a mean ambient temperature of 27ºC. Treatments were then imposed on the 20th, 40th and 60th days after sowing with a 20 L-capacity knapsack sprayer.

Melon aphid population was recorded on ten (10) leaves of 5 plants selected at random per plot. For this reason, aphids were gently brushed out on a white paper and counted. Similarly, the pickleworm number was also recorded on these five (5) plants. These observations were made 3 days before and after each spray and average populations recorded. On the 75th day, fruits were harvested and yields recorded on hectare basis.

Data analysis: All data were subjected to statistical analysis by two-factor Anova using SPSS software (version 17.0). The two-factor Anova was used to assess the impact of incubation time (Factor A) and dosage (Factor B) on the rate of insect infestation (the dependent variable) and also assess the interaction between the two factors. Furthermore, to ascertain the statistical significance of any mean difference, a Post Hoc test was conducted and means of the various treatments compared at 5% confidence level using Turkey HSD.

Schematically, the experimental design is as follows:
Thus, the three different null hypotheses tested were:

Null hypothesis	Alternative hypothesis
H_{01}: $\mu_{7days} = \mu_{4days} = \mu_{1days}$	H_1: Not H_{O1}
H_{02}: $\mu_{5\%} = \mu_{10\%} = \mu_{15\%}$	H_2: Not H_{O2}
H_{03}: no interaction between the two factors	H_{03}: Not H_{O3}

RESULTS AND DISCUSSION

Based on the experimental design indicated in Table 1 and the consequent experimentation and data collection, a summary of the effect of incubation period and dosage of cow urine on mean melon aphid infestation in watermelon management is shown in Table 2 and the two-way anova and descriptive statistics in Table 3.

Table 3: Effect of incubation time and dosage on aphid infestation

	Type III SS	df	MS	F	Sig.
Corrected mode	l3511.873[a]	8	438.984	46.677	0.000
Intercept	11907.000	1	11907.000	1266.054	0.000
dose	660.162	2	330.081	35.097	0.000
incubation	2765.736	2	1382.868	147.038	0.000
dose * incubation	85.976	4	21.494	2.285	0.100
Error	169.287	18	9.405		
Total	15588.160	27			
Corrected total	3681.160	26			

*:a. R^2: 0.954 (Adjusted R^2 = 0.934); b. Computed using alpha: 0.05; SS: Sum of Sruare; MS: Mean Square

Table 4: Summary of mean pickleworm infestation

	5% Dose	10% Dose	15% Dose	Mean (incub. time)
7days	29.4	22.6	12.9	21.6
14days	17.8	5.1	2.6	8.5
21days	12.5	8.8	7.6	9.6
Mean (dose)	19.9	12.2	7.7	

Table 5: Effects of incubation time and dosage on pickleworm infestation, Tests of between-subjects effects

	Dependent variable: infestation				
	Type III SS	df	MS	F	Sig.
Corrected model	1906.016[a]	8	238.252	54.153	0.000
Intercept	5289.200	1	5289.200	1202.192	0.000
dosage	492.305	2	246.153	55.948	0.000
incubationtime1	318.276	2	659.138	149.817	0.000
dosage * incubationtime	95.435	4	23.859	5.423	0.005
Error	79.193	18	4.400		
Total	7274.410	27			
Corrected total	1985.210	26			

a: R^2: 0.960 (Adjusted R^2 = 0.942); SS: sum of square; MS: Mean Square

It is evident from Table 3, that there was a significant main effect of dosage on melon aphid infestation as $F_{(2, 18)} = 35.097$, MSE = 9.405 and $p<0.05$. There was also a significant main effect of incubation time on melon aphid infestation as $F_{(2, 18)} = 147.038$ and $p<0.05$. However, the p-value (0.100) for interaction (dosage × incubation time) is higher than 0.05 which shows there was no significant effect of interaction on aphid infestation as $F_{cal(4,18)} = 2.285 < F_{0.05(4,18)} = 2.93$. Therefore, the null hypotheses H_{O1} and H_{O2} were rejected while H_{03} retained. Consequently, a Post hoc analysis using Turkey HSD and mean values in Table 2 reveals that, all treatments had a significant difference in controlling aphid pests. However, it is obvious from Table 2 that 14 days incubation period at all doses (5, 10 and 15%) had fewer aphid infestation compared to 7 and 21 days incubation periods with same dosage. Mean infestation values of 17.0, 9.2 and 2.1 were recorded at 14 days incubation period of 5, 10 and 15% doses, respectively, which differed significantly from the mean values of her 7 and 21 days counterpart. This aphid repelling performance may be attributed to the ammoniacal and skunky odour that peaks at about the 14th

Table 6: Effect of incubation time and dosage of cow urine on fruit yield and economics of watermelon

Treatments	Fruit yield (kg/ha) 2009	2010	Mean	Monetary returns ($/ha)	Protection cost ($/ha)	Benefit: Cost ratio
T_1 (7 days incubation @ 5% dose)	1000	011020	10500	7000	600	11.6
T_2 (7 days incubation @ 10% dose)	11404	12708	12056c	8037.3	600	13.4
T_3 (7 days incubation @ 15% dose)	10525	11730	11128c	7418.7	600	12.4
T_4 (14 days incubation @ 5% dose)	51873	56344	54109b	36072.6	600	60.1
T_5 (14 days incubation @ 10% dose)	75690	83941	79816a	53210.5	600	88.7
T_6 (14 days incubation @ 15% dose)	76210	80143	78178a	52118.7	600	86.9
T_7 (21 days incubation @ 5% dose)	50532	49615	50074b	33382.4	600	56.6
T_8 (21 days incubation @ 10% dose)	48310	40214	44262b	29508.0	600	49.2
T_9 (21 days incubation @ 15% dose)	45224	38493	41859b	27906.0	600	46.5
T_{10} (untreated control)	3120	12752	198d	1465.3	-	-

Means followed by the same alphabet do not differ significantly by DMRT (0.05)

day of incubation. Therefore, to enhance the bioefficacy of cow urine in controlling melon aphids, more emphasis should be placed on 14 days incubation time at 15% dosage.

Results shown in Table 5 indicated that there was a significant main effect of incubation time on pickleworm infestation with $F_{cal(2,18)}$ = 149.817, MSE = 4.400 and $p<0.05$. Also, significant main effect of dosage on pickleworm infestation was recorded as statistical values of $F_{cal(2,18)}$ = 55.948 and $p<0.05$ were observed. It was further noted from same Table 5 that there was an interaction between incubation time and dosage as the p-value (0.005) is less than 0.05. To this end, a post hoc analysis using Turkey HSD on Table 4 reveals that 14 and 21 days of incubation time at all dosage levels proved superior to just 7 days incubation time. Mean pickleworm infestation values of 17.8, 5.1, 2.6 and 12.5, 8.8, 7.6 were recorded for 14 and 21 days incubation times respectively as compared to 29.4, 22.6 and 12.9 for 7 days incubation. Results of this research are in conformity with those of Peries (1985) and Hedge and Nandihalli (2009).

Furthermore, results depicted in Table 6 have it that, all treatments had a significant difference in fruit yield as compared to untreated control. Nevertheless, 14 days incubation at doses 10 and 15% were superior with yields 79816 and 78178 kg/ha, respectively. The second best yield was observed in 21 days incubation period with 50074, 44262 and 41859 kg/ha for doses 5, 10 and 15%, respectively. This improvement in fruit yield may not be unconnected with the fact that cow urine contains minerals like potassium, nitrogen, urea and ammonia, which constitutes the basic components of a good organic fertilizer and on fermentation, becomes easily absorbable by the green parts of watermelon plant. An economic analysis in Table 6 reveals that, the monetary cost of protection for all treatments are the same. However, the monetary returns were relatively higher in 14 days incubation period at all doses. Incremental cost benefit ratio was also higher in 14 days incubation time with 60.1, 88.7 and 86.9 for doses 5, 10 and 15%, respectively. This was followed by 21 days incubation time with 56.6, 49.2 and 46.5 for doses 5, 10 and 15%, respectively.

CONCLUSION

Based on results obtained, it can be said that melon aphids and pickleworms can be controlled using 14 days incubated cow urine at doses 5, 10 and 15%. A further analysis also reveals that this treatment is cost-effective and yield oriented and is therefore recommended for adoption by farmers.

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