International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Efficacy of Fermented Botanical Plant Extracts in the Management of White Flies and 28-Spotted Beetles in Tomato

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Abstract: ***A field study was conducted to evaluate the effectiveness of four individually fermented botanical plant extracts in the control and management of whiteflies and 28-spotted beetles in tomato. The treatments used in the study were neem (T_1), kakawate (T_2), marigold(T_3) and makabuhay (T_4) with the synthetic pesticide Magnum as the control (T_0). Results revealed that T_3 attained the tallest height measurement at maturity, T_2 and T_3 obtained the highest mean on the number of whiteflies reduced, T_2 registered the highest mean on the number of 28-spotted beetles reduced, T_0 recorded the least number of days from transplanting to flowering and T_3 obtained the least number of days from flowering to fruit setting. However, results of statistical analysis revealed that there were no significant differences among treatments.***

Keywords: Fermentation, Botanical Plant, Management, Whiteflies, 28-spotted Beetles, Tomato

1. Introduction

Tomato is considered the most important vegetable in the world. In fact, it is planted to about 4.4 million hectares around the world [1].

In the Philippines, tomato ranks second to eggplant in production. According to the Bureau of Agricultural Statistics, the total production of tomato has reached 203, 577.74 metric tons in 2012 [2]. However, tomato yield in the country is considered to be lower than the world average. This is due to pest infestations that cause significant losses to farmers. Whiteflies and beetles with 28 spots are two of the major pests of tomato. These are sucking insect pests that inflict damages on the crops and reduce the quality and quantity of yield.

Due to lack of effective means of controlling pests, most farmers resort to synthetic pesticides that are both hazardous to human health and the environment. Compared to other forms of control, synthetic pesticides are highly effective. On the other hand, these pesticides are not only toxic to the target organisms but are also toxic or hazardous to a certain degree to man, plants and the environment. Moreover, continued use of pesticides can promote the development of resistant pest populations.

With the rising costs coupled with health and environment hazards of synthetic pesticides, there is a need to find and develop practical, safe and effective alternatives. The use of plant derivatives has been studied throughout the world. Over 2, 000 plant species have been reported to possess pest control characteristics [3]. Natural pest controls like botanicals are safer to the user and to the environment because they break into harmless compounds within hours and days in the presence of sunlight [4].

As natural pesticides are prepared from natural products, application of these materials has a less unfavorable impact to the environment than chemicals [5]. Once proven that certain botanical plants are effective and comparable to their synthetic counterparts, more farmers will adopt these alternatives without reservations.

Thus, this study was undertaken with the aim of evaluating the effectiveness of fermented botanical plant extracts in the management of whiteflies and 28-spotted beetles in tomato.

2. Methodology

2.1 Research Design

The Randomized Complete Block Design was used in the study. The research area was divided into four equal blocks. Each block contained the five treatments of the study. The treatments were the following:

T0 – Magnum (control)
T1 – fermented Neem (*Azadirachta indica)* extract
T2 – fermented Kakawate (*Gliricidia sepium*) extract
T3 – fermented Marigold (*Tagetes erecta*) extract
T4 – fermented Makabuhay (*Tinosphora rumphi*) extract

2.2 Experimental Procedure

2.2.1 Land Preparation

An area of 170 square meters of land was cleaned of weeds and debris. Digging and re-digging were done before pulverizing and leveling of plots. Two sacks of IFSU Bio-organic Fertilizer were incorporated in the soil two weeks before planting.

2.2.2 Preparation of Planting Materials

Tomato seeds of Marimar variety of were bought from an agricultural supply store. These were sown on seedling trays

with moist garden soil as soil medium. The seeds germinated at 4-6 days after sowing.

2.2.3 Preparation of Fermented Botanical Plant Extracts

The botanical pesticides were prepared following a modified procedure of Oriental Herbal Nutrient. Leaves of neem, kakawate and marigold and makabuhay stems were gathered before the preparation.

Figure 1: Botanicals collected

The botanicals were chopped separately. Each kilogram of chopped botanicals was put in labeled container. One bottle of gin (700 ml) was added to each container, then covered with Manila paper and placed in a cool and dark place. After 12 hours, the covers were removed and one kilogram of molasses was poured into each container and mixed thoroughly. Then the containers were covered and placed in a cool and dry place to ferment for 10 days.

After 10 days, 2.5 liters of coconut vinegar were added to each container and allowed to ferment for another 10 days. The chopped botanicals were strained to separate the juice. The strained juice from each container was put in separate marked bottles and used as stock solution. The dosage used when spraying was 10 ml stock solution to 5 liters of water.

2.2.4 Transplanting

At 28 days after sowing, healthy seedlings with uniform height were transplanted following the single line of planting. A planting distance of 50 cm was employed. The seedlings were watered immediately after transplanting

2.2.5 Care and Management

Watering was done every day except on rainy days and weeds were pulled when necessary. Hilling up was done 14 days after transplanting. Stakes were provided to support the plants and prevent them from lodging. The botanical plant extracts were sprayed in a weekly interval. Spraying was done in the afternoons.

2.3 Data Collection

Using the simple random sampling, five sample plants were selected in each treatment in the four replications. The following data were gathered in the conduct of the study:

a. Weekly height of plants (in cm)
b. Height of plants at maturity (in cm)
c. Number of whiteflies reduced after spraying
d. Number of 28-spotted beetles reduced after spraying
e. Number of days from transplanting to flowering
f. Number of days from flowering to fruit setting

2.4 Statistical Treatment

All measured data were subjected to statistical analysis using the Analysis of Variance (ANOVA). The computed F value was tested against the tabular F values at 0.05 and 0.01 levels of significance to determine if there is a significant difference among the treatments.

3. Results and Discussions

3.1 Average Weekly Plant Height

Figure 2 below shows the average weekly plant height starting from 7 days to 35 days after transplanting.

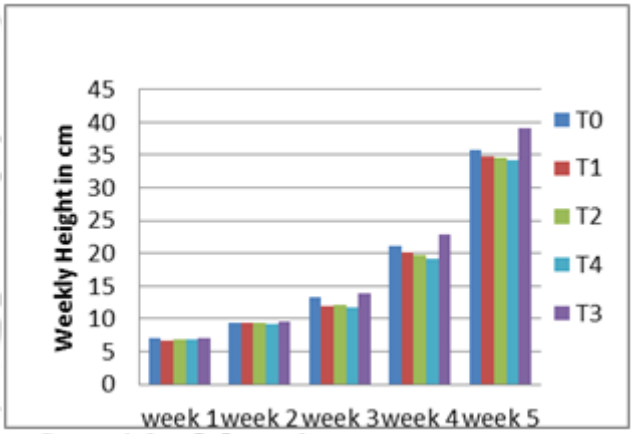

Figure 2: Average weekly plant height

The different colored lines illustrate the five treatments in terms of average weekly growth of plants. T_3 was observed to be the tallest among the treatments from the second week until the final week.

3.2 Final Plant Height

Final plant height was taken at 35 days after transplanting. It was the onset of the flowering of the crops. Table 1 below shows that T_3 attained the highest height measurement with a mean of 39.03 cm.

Table 1: Final plant height

	Block					
Treatments	I	II	III	IV	Total	Mean
T_0	27.28	33.48	39.78	42.90	143.44	35.86
T_1	29.00	35.18	35.80	39.80	139.48	34.87
T_2	27.48	32.70	36.50	42.10	138.78	34.70
T_3	33.68	39.54	37.78	45.10	156.10	39.03
T_4	30.40	34.90	35.20	36.70	137.20	34.30

The statistical analysis revealed a computed F value of 2.41 that is lower than the F values at 0.05 and 0.01 levels.

Therefore, the null hypothesis that there is no significant difference among the treatments cannot be rejected.

Table 2: Analysis of variance on average plant height at 35 days after transplanting

Source of Variance	Degrees of Freedom	Sum of Square	Mean Square	Computed F Value	Tabular F Value 5%	Tabular F Value 1%
Block	3	355.17	118.39	19.41**	3.49	3.26
Treatment	4	58.91	14.73	2.41ns	5.95	5.41
Error	12	73.24	6.10			
Total	19	487.32				

CV= 6.91% ns - not significant ** - highly significant

3.2 Average Number of Whiteflies Reduced after Spraying

Whiteflies were observed on the plants at 8 days after transplanting. These were counted and recorded a day before and after the application of the botanical plant extracts. The difference between the pre-application and post-application counting was recorded as the number of whiteflies reduced after spraying. Counting of whiteflies was done for 7 weeks starting at 14 days after transplanting. As shown in the table below, T_2 and T_3 recorded the highest mean of whiteflies reduced with a mean of 7.32.

Table 3: Average number of whiteflies reduced after spraying

	Block					
Treatments	I	II	III	IV	Total	Mean
T_0	6.86	6.86	6.86	6.43	27.01	6.75
T_1	7.00	6.71	6.57	7.71	27.99	7.00
T_2	6.86	7.43	7.14	7.86	29.29	7.32
T_3	8.14	7.00	6.57	7.57	29.28	7.32
T_4	7.29	7.14	7.43	7.53	28.57	7.14

The statistical analysis presented in Table 4 yielded a computed F value of 1.35 which is lower than the tabular F values at 0.05 and 0.01 levels. Therefore, the null hypothesis that there is no significant difference among the treatments is accepted. The justification is that the fermented botanical plant extracts have the same effect as the synthetic pesticide in reducing the number of whiteflies. This conforms to the study of Tapo, et. al. that neem, kakawate and makabuhay have the same effect as that of the synthetic formulation in reducing insect pests of eggplant [6].

Table 4: Analysis of variance on average number of whiteflies reduced after spraying

Source of Variance	Degrees of Freedom	Sum of Square	Mean Square	Computed F Value	Tabular F Value 5%	Tabular F Value 1%
Block	3	1.10	0.37	2.18ns	3.49	3.26
Treatment	4	0.92	0.23	1.35ns	5.95	5.41
Error	12	2.04	0.17			
Total	19	4.07				

CV= 5.80% ns - not significant

3.3 Average Number of 28-spotted Beetles Reduced after Spraying

Beetles with 28 spots were counted before and after spraying for 6 weeks. T_2 registered the highest mean of 3.08 unit pest reduced with T_1 having the lowest mean of 2.75 unit pest reduced.

Table 5: Average number of 28-spotted beetles reduced after spraying

	Block					
Treatments	I	II	III	IV	Total	Mean
T_0	3.00	3.17	2.83	3.17	12.17	3.04
T_1	3.00	2.50	2.67	2.83	11.00	2.75
T_2	3.00	2.83	3.17	3.33	12.33	3.08
T_3	3.33	2.50	3.00	2.83	11.66	2.92
T_4	3.17	2.67	2.83	3.33	12.00	3.00

It can be gleaned from the statistical analysis in Table 6 that the test showed no significant differences among the treatments. This implies that the effect of synthetic pesticide used in the study has no difference with that of the botanical plant extracts in the reduction of 28-spotted beetles. This agrees with the study of Allig that the effect of botanical plants as control agent against insect pests of snap beans is comparable to the synthetic pesticide used [7].

Table 6: Analysis of variance on average number of 28-spotted beetles reduced after spraying

Source of Variance	Degrees of Freedom	Sum of Square	Mean Square	Computed F Value	Tabular F Value 5%	Tabular F Value 1%
Block	3	0.46	0.15	3.75**	3.49	3.26
Treatment	4	0.27	0.07	1.75ns	5.95	5.41
Error	12	0.53	0.04			
Total	19	1.26				

CV= 6.76% ns - not significant ** - highly significant

3.4 Average Number of Days from Transplanting to Flowering

The number of days from transplanting to the opening of flower buds was counted and recorded. As shown in Table 5, T_0 registered the least number of days to flowering with a mean of 36.75 while T_4 recorded the highest number of days to flower at a mean of 37.50.

Table 7: Average number of days from transplanting to flowering

	Block					
Treatments	I	II	III	IV	Total	Mean
T_0	37.40	37.00	36.20	36.40	147.00	36.75
T_1	38.20	37.00	35.80	39.80	149.20	37.30
T_2	37.60	37.40	37.00	36.60	148.60	37.15
T_3	37.00	36.20	36.20	37.80	147.20	36.80
T_4	37.80	37.80	37.80	36.60	150.00	37.50

Shown in Table 8 below, the computed f value of 1.31 is lower than the tabular values at 0.05 and 0.01 levels. This denotes that there is no significant difference among the five treatments of the study and that there is no delaying effect of the botanicals in the flowering of plants.

Table 8: Analysis of variance on average number of days from transplanting to flowering

Source of Variance	Degrees of Freedom	Sum of Square	Mean Square	Computed F Value	Tabular F Value 5%	Tabular F Value 1%
Block	3	1.86	0.62	1.94^{ns}	3.49	3.26
Treatment	4	1.66	0.42	1.31^{ns}	5.95	5.41
Error	12	3.88	0.32			
Total	19	7.40				

CV= 1.52% ns – not significant

3.5 Average Number of Days from Flowering to Fruit Setting

The number of days from flowering to fruit formation is recorded. T_3 recorded the least number of days to fruit setting with a mean of 3.35 while T_2 showed the highest mean with 3.50.

Table 9: Average number of days from flowering to fruit setting

	Block					
Treatments	I	II	III	IV	Total	Mean
T_0	3.40	3.20	3.60	3.40	13.60	3.40
T_1	3.60	3.20	3.60	3.40	13.80	3.45
T_2	3.40	3.60	3.40	3.60	14.00	3.50
T_3	3.60	3.40	3.20	3.20	13.40	3.35
T_4	3.40	3.60	3.40	3.40	13.80	3.45

The analysis of variance revealed that the computed F value of 0.33 is relatively lower than the tabular values at 0.05 and 0.01 levels. This indicates that there is no significant difference as to the effects of the treatments in fruit setting of the crops. It can be stated that the botanical plant extracts used in the study has no delaying effect on the formation of fruits of the crops.

Table 10: Analysis of variance on average number of days from flowering to fruit setting

Source of Variance	Degrees of Freedom	Sum of Square	Mean Square	Computed F Value	Tabular F Value 5%	Tabular F Value 1%
Block	3	0.02	0.01	0.33^{ns}	3.49	3.26
Treatment	4	0.05	0.01	0.33^{ns}	5.95	5.41
Error	12	0.35	0.03			
Total	19	0.42				

CV= 5.05% ns - not significant

4. Conclusion

In view of the findings, the study concludes that the fermented botanical plant extracts are as effective and comparable to the synthetic pesticide in terms of final plant height, average number of whiteflies reduced after spraying and average number of 28-spotted beetles reduced after spraying. Furthermore, there is no significant difference as to the effects of the botanical plant extracts on the number of days to flowering and fruit setting as compared to the synthetic pesticide.

5. Recommendations

It is hereby recommended that a similar study in a different plant month be conducted so as to validate the pest incidence and the effects of the fermented botanical plant extracts in plant growth performance and pest reduction. Effects of the botanicals on plant diseases and yield can also be recommended to be studied.

6. Acknowledgment

The authors are indebted to **Ifugao State University** for the conduct of the study in the university experimental area.

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