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The Use of Plant Extracts of *Ocimum gratissimum* L. to Manage Insect Pests' Infestation of Sweet Melon (*Cucumis melo* L.) In Lafia, Nasarawa State

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Abstract: Plant-based insecticides are considered among the most economical and eco-friendly chemicals for the protection of field plants and even stored grains. The sweet melon (Cucumis melo L.) insect pest causes more than 90% damage to most melon leaves, vines, and balls at its growth stage. The study looked at how effective the plant extract from Africa Basil and the synthetic insecticide Cymbush were at killing insects on sweet melon (Cucumis melo L.). The study explored four different concentrations (2.5, 50, 75, and 100%) and a synthetic insecticide, Cymbush, against insect pests of sweet melon and compared the effects of distilled water, which is used as a control in a Randomized Complete Block Design (RCBD). The toxicity percentage levels of the African basil extracts against field pests of sweet melon were 25, 50, 75, and 100%. Maximum plant protection of the crop was achieved by the synthetic insecticide Cymbush (3.0 pest point), followed by Africa basil extract B100 (3.3 pest point), whereas weak and minimum insect pest protection were observed in the control (5.53 pest point). In conclusion, these results indicate the utility of African basil plant extracts against field insect pests of sweet melon as potential botanicals to control field insect pests and mitigate the hazardous use of synthetic insecticides on humans, animals, and the environment.

Keywords: sweet melon; pest control; synthetic pesticides

1.0. Introduction

The Cucurbitaceae family of vegetables includes the sweet melon (Cucumis melo L.), which has significant commercial significance in several regions of the world (Sabo et al., 2013). According to Zulkarami et al. (2010), the kind of soil present in the northern region of Nigeria has been reported to be ideal for crop production. According to Tamer et al. (2010) and Shaffeek et al. (2015), the sweet melon is reportedly high in biologically active substances like phenols, flavonoids, and vitamins, as well as carbohydrates and minerals, especially potassium. It is also low in fat and calories, high in dietary fibre, and has a pleasant aroma. The performance of sweet melon in terms of growth and yield is more heavily influenced by its density. Given that melon is expensive to produce, producers manage their crops strategically to ensure the highest yield and insect-free conditions (Muhammad and Masdek, 2016; FAOSTAT, 2017). The plant has several pest species, although only a few have been discovered to be significant economically. The majority of melon pests are polyphagous (herbrevous), moving into melon from nearby crop and weed hosts.

Consequently, cultural management techniques may have a quantifiable influence on the dynamics of pest populations, but they often need to be controlled using pesticides to avoid yield and quality reductions (Muhammad & Masdek, 2016). However, when taking into account the safety of food in the field as well as the many agricultural practices used to reduce pest populations below threshold levels for economic viability, Although pesticides are often easier to use to boost crop production due to their abuse in order to produce agricultural goods with a higher yield, pesticides also include certain residues that negatively impact human health and even cause death (Abrol and Shankar, 2014).The two most crucial aspects of agriculture are environmental management and food

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security. In many cases, the abuse of pesticides leads to population resurgence, pesticide residues, and pest resistance. Utilising fewer chances, the once-legendary concept of biological pesticides derived from plant extracts, such as those from the widely used African basil plant, is swiftly gaining hold.

Another efficient and ecologically friendly way to manage pests is by using biological pesticides (Gupta and Dikshit, 2010). Ocimum gratissimum L., or African basil O. gratissimum, is a fragrant perennial that is indigenous to South Asia, Madagascar, and Africa. From its base, it grows to a height of 1 m and produces many branches. This plant has been found to have some antimicrobial, antioxidant, and anti-inflammatory properties that have been demonstrated in vitro and in animal models. These properties are medicinal and mitigate and repel pest attacks on crops (USDA, 2016). Its leaves are oval-lanceolate and taper at both ends, and the flower spikes are long, pale, and white to pink. The study aims to use the aqueous extracts of African basil (Ocimum gratissimum L.) as a biological control against insect pests that might impede the growth and production of sweet melon (Cucumis melo L.) in comparison to the use of a recognised synthetic insecticide, Cymbush and Compare the effectiveness of different dosage rates of aqueous extracts of African basil (Ocimum gratissimum L.) to the recommended dosage rate of the synthetic pesticide on the growth and production of sweet melon.

2.0. Materials and Method

The study was conducted in the field and on the research farm of the Department of Agronomy, Faculty of Agriculture (Shabu-Lafia Campus), Nasarawa State University, Keffi. Lafia is located on 08.330N and 08.320E in North Central Nigeria. One kilogramme of the most commonly cultivated sweet melon cultivar (Honeydew Melon) seeds was purchased from the local market in Lafia. The experimental plot after land clearing was tilled manually using a hand-held hoe. Each plot was measured at 3 x 3 m, with a space of 1 m separating each block to serve as borders. The inter- and intra-row spacing within a plot was 60 x 25 cm, respectively. Two seeds of sweet melon were sown per hole at a depth of 3.5 cm. Ten kilogrammes of African basil plants (leaf) were randomly harvested from the fallowed fields surrounding the Faculty of Agriculture (Shabu-Lafia Campus), and the synthetic insecticide (Cymbush) was purchased from the local market in Lafia.

The harvested plant leaves were further dried under shade in the laboratory at 36 oC (room temperature) and later pulverised in a wooden mortar with a pestle. Further pulverisation was carried out using a kitchen blender, Kenwood®, at 1000 rpm in order to obtain the finest solution extract. Thereafter, the pulverised plant solution extract was sieved using a fine mesh size of 5μm, according to Damalas (2018), i.e., the local Nigerian pap sieve (akamu), to further separate the un-pulverised plant particles from the broth. Thus, one litre of broth of the plant extracts was obtained and further divided into 4 doses for its application: 25 ml, 50 ml, 75 ml, and 100 ml. A synthetic insecticide (Cymbush), purchased from the Lafia local market in Nasarawa State, was split into four similar dosages (25 ml, 50 ml, 75 ml, and 100 ml) as listed above for the plant solution extract, which was mixed in two separate 16-litre Knapsack sprayers before spraying, respectively. The experiment was laid out in a randomised complete block design (RCBD). The treatments include the application of aqueous extracts of African Bassil at rates of 25%, 50%, 75%, and 100%, i.e., 0.25, 0.5, 0.75, and 1L, and a control using water only as treatment was set along. A standard control check containing the synthetic insecticide Cymbush was also set up to be able to compare the efficacy of the treatments. All the treatments were replicated three times.

Table 2.1. Field Layout.

Treatments	REP 1	REP 2	REP 3
T^1 (AB0.25)	CONTROL (C)	T^3 (AB0.75)	CY(Cymbush
T^2 (AB0.5)	T^2 (AB0.5)	CONTROL (C)	T^3 (AB0.75)
T^3 (AB0.75)	T^3 (AB0.75)	T^2 (AB0.5)	CONTROL (C)

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T^4 (AB 1.0)	T^4 (AB 1.0)	CY(Cymbush	T^2 (AB0.5)
CY(Cymbush {Standard Check}	CY(Cymbush	T^4 (AB 1.0)	CONTROL (C)
CONTROL (C)	CONTROL (C)	CY(Cymbush	T^4 (AB 1.0)

Author (2023).

2.1. Weed Control and Fertilization of the Field

Before clearing the ground, the weed population was first controlled using the chemical pesticide glyphosate to lessen its density and intensity following planting. following that, manual weed control was done one week following seedling emergence and two weeks after the previous time it was done during crop propagation. Up until harvest time, manual hand weeding was done as needed using a hand hoe. To provide sufficient nutrient supplies for plant growth, the Field was fertilised using chicken droppings during the preparation of the field and beds.

2.2. Data Collection

Data on the following parameters will be taken during the growth of the crop on five tagged plants within a plot for each treatment:

Plant height: Plant height was measured from the ground level to the tip of the plant leaf using a measuring tape at 2 weeks after emergence (WAE), and this was carried on every two weeks thereafter until maturation.

Number of leaves produced: This was counted physically on each vine from the first day of sprouting and at 2-week intervals.

Pest incidence: This was achieved by observing, recording, and catching the types of insects infesting sweet melon in the field with the use of sweet nets. The insects caught were counted and identified.

Severity of pest infestation: This was done by observing, recording, and counting the symptoms (damage) of insects on plant leaves and balls.

Number of melon balls produced per plant (number of melon balls ha-1): The total number of melon balls from each of the tagged plants or plots was counted during harvest. The number produced was extrapolated to the amount produced per hectare.

Weight of melon balls produced yield (kg ha-1): The total weight of melon balls from each of the tagged plants or plots was taken during harvest. The weight was extrapolated to the weight produced per hectare.

2.3. Method of Data Analysis

Data collected was analyzed using Analysis of Variance (ANOVA) with the use of Statistical Package of the Social Sciences and the differences between means were separated by Least Significant Difference (LSD) at 5% ($P<0.05$) probability level.

3.0. Results and Interpretation

The result in Tables 3.1–3.5 shows that there are no significant differences among all treatments means of the experiment on the plant height, number of leaves, leaves length, leaves width, and girth stalk and also in the yield parameters, owning that both the botanical plant extracts and synthetic insecticides tested together had no negative impacts on the plant height of the crop (sweet melon). However, B25, B75, B10, and Control had the highest mean recorded values of (78.81cm, 82.03cm, 81.72 cm, and 76.42cm) plant height, number of leaves, leaf length, leaf width, and girth stalk, as well as yield parameters. The result also shows that there is no significant difference in the number of leaves; the highest mean is in treatment B10 from weeks 4, 8, 6, 10, and 12, with the mean recorded at (27.80, 21.07, 36.50, 28.73, and 28.40), respectively. There is no significant effect on leave length among the treatment means in all the weeks; the highest mean recorded (9.45cm and 9.31 cm) was at week 6

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for treatment synthetic and B25, respectively, so there is a significant difference on leave width at week 8, with the highest mean recorded (5.13cm).

Table 3.1. Effect of the Botanical Africa Basil and Synthetic Insecticide (Cymbush) Tested Together on the Plant Height of Sweet Melon.

Treatment	**Plant Height**				
	W4	**W6**	**W8**	**W10**	**W12**
B100	25.19	39.83	59.55	69.86	78.81
B25	27.39	41.64	61.60	70.31	82.03
B50	18.63	32.20	52.25	60.52	70.62
B75	27.89	43.93	62.88	72.78	81.72
CONTROL	27.61	40.01	56.51	66.00	76.42
Synthetic	15.99	29.83	47.06	55.96	66.23
SE±	2.35	2.64	3.15	3.24	3.40
Sig.	NS	NS	NS	NS	NS

Author Compilation (2023).

Table 3.2. Effect of the Botanical Africa Basil and Synthetic Insecticide (Cymbush) Tested Together on the Numbers of Leaves Of Sweet Melon.

Treatment	**Numbers of Leaves**				
	W4	**W6**	**W8**	**W10**	**W12**
B100	27.80	21.07	36.50	28.73	32.13^{ab}
B25	9.50	20.07	33.40	27.00	29.67^{ab}
B50	12.77	15.80	26.40	33.87	23.40^{ab}
B75	14.60	22.2O	25.70	24.87	28.6^{ab}
CONTROL	14.50	21.93	27.20	29.33	33.73^{a}
Synthetic	13.33	15.13	24.10	34.05	21.07^{b}
SE±	2.10	1.36	2.99	3.44	1.64
Sig.	NS	NS	NS	NS	NS

Author Compilation (2023).

Table 3.3. Effect of the Botanical Africa Basil and Synthetic Insecticide (Cymbush) Tested Together on the Leaves Length of Sweet Melon.

Treatment	**Leaves Length**				
	W4	**W6**	**W8**	**W10**	**W12**
B100	7.09	8.57	8.55	7.25	8.27
B25	8.14	9.31	8.39	7.09	7.45
B50	7.82	8.53	8.17	7.42	7.59
B75	7.61	8.23	8.17	7.73	7.43
CONTROL	7.16	8.69	8.87	7.67	7.84
Synthetic	7.56	9.45	8.52	7.73	7.59
SE±	0.19	0.20	0.13	0.13	0.12
Sig.	NS	NS	NS	NS	NS

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Table 3.4. Effect of the Botanical Africa Basil and Synthetic Insecticide (Cymbush) Tested Together on the Leaves Width of Sweet Melon.

Treatment	Leaves Width				
	W4	**W6**	**W8**	**W10**	**W12**
B100	4.27	5.24	5.09[a]	4.27	4.92
B25	4.28	6.19	4.7[b]	4.46	4.75
B50	4.57	4.73	5.2[a]	4.44	4.57
B75	4.39	5.00	4.6[b]	4.81	5.07
CONTROL	4.35	5.67	5.13[a]	4.81	5.03
Synthetic	5.05	6.63	4.85[ab]	4.58	4.79
SE±	0.16	0.22	0.67	0.09	0.09
Sig.	NS	NS	**	NS	NS

Author Compilation (2023).

Table 3.5. Effect of the Botanical Africa Basil and Synthetic Insecticide (Cymbush) Tested Together on the Girth Stalk of Sweet Melon.

Treatment	Girth Stalk				
	W4	**W6**	**W8**	**W10**	**W12**
B100	7.01	12.62	16.89	17.77	17.35
B25	6.98	12.91	17.00	16.73	18.35
B50	6.46	11.53	15.83	16.58	17.47
B75	8.12	12.18	14.73	17.05	16.48
CONTROL	7.00	12.14	15.49	17.87	17.26
Synthetic	8.18	13.78	17.87	17.08	16.94
SE±	0.37	0.42	0.45	0.37	0.45
Sig.	NS	NS	NS	NS	NS

Author Compilation (2023).

The girth stalk shows no significant difference among the treatments, with the highest mean recorded (18.35) at week 12 for B25, followed by (17.87) at weeks 8 and 10 for synthetic and control, and (17.77 and 17.47) at weeks 10 and 17 for treatments B10 and B50, respectively, deterring any form of insect pest invasion, thus agreeing with the findings of Isman (2014) and Laxmishree and Nandita (2017 who stated that botanical pesticides also interfere with the production of important enzymes such as those responsible for moulting, thus inhibiting growth and development of the insect, thereby aiding the plant's physiological growth. Khan et al. (2016) reported the systematic investigation of the effects of seven plant extracts on the physiological parameters, yield, and nutritional quality of radish (Raphanus sativus var) with a decrease in the total phenolic compounds content as well as a varied impact on the steam volatile compounds, fatty acids, sterol, and glucosinolates composition. However, the most beneficial effects of the plant botanical extracts on radish in the experiment by Khan et al. (2016), in terms of physiological and biochemical properties, were found in groups treated with extracts based on the common dandelion, valerian, and giant goldenrod rather than synthetic insecticides.

The result in Table 3.6 shows that there are also no significant differences among the treatment means in both fruit size and pest point, with the highest mean recorded at (81.26) fruit size for treatment B75 and (5.53 and 4.07) pest point for treatment Control and B25, respectively. Thus, the experiment proves worthwhile in the control of some field insect pest melon using Africa basil botanical extract, as the level of insect pest incidence was mitigated at all levels except for the control treatment, which without any application of both synthetic and botanical insecticides had the highest mean of pest points of 5.53, followed by treatment B25 (4.07), therefore affirming the report of Govindarajan et al. (2011) suggesting that the oil extract from basil is a promising insect repellent against insects in the order Diptera and some melon aphids such as the anopheles and the peach aphid, melon aphid (Myzus persicae).

Table 3.6. Effect of the Botanical Africa Basil and Synthetic Insecticide (Cymbush) Tested Together on the Fruit Size and Pest Point of Sweet Melon.

Treatment	Fruit size	Pest point
B100	78.65	3.33
B25	73.57	4.07
B50	79.16	3.67
B75	81.26	3.67
CONTROL	74.87	5.53
Synthetic	77.26	3.0
SE±	2.14	0.31
Sig.	NS	NS

Author Compilation (2023) [abc] Means bearing different superscripts on the same column are significantly different ($p < 0.05$) ** Significant at 95% (0.05) SEM = standard error for mean, Sig= Level of significance NS = Not significant.

The treatment synthetic insecticides and the botanical extract B100 having the least pest point mean at 3.0 and 3.33, respectively, thus agreeing with the findings of Akbar et al. (2022), who reported the results from the investigation of the insecticidal potentials of five selected botanicals: Melia azedarach, Nicotiana rustica, Azadirachta indica, Nicotiana tabacum, and Thuja orientalis, explored at six different concentrations (0.5, 1.0, 1.5, 2.0, 2.5, and 3.0%) against C. maculatus and compared to the effects of distilled water, which is used as a control. Toxicities of 3% (V/V) extracts of N. tabacum, N. rustica, A. indica, and T. orientalis against C. maculatus were 100%, 86.11%, 80.56%, and 72.22%, respectively. Maximum mortality was caused by N. tabacum and N. rustica (100%), followed by A. indica (82%), whereas minimum mortality was observed in T. orientalis (64%), at 2.5%. Thus, the result from this experiment could be useful in the search for natural, bio-friendly repellent compounds for major field insects causing damage to melon.

4.0. Conclusions and Recommendations

The natural environment is a rich source of many types of plants, some of which have been used to treat human, animal, and plant diseases. Considering human health, environmental safety, and strict regulations on pesticide residues in agricultural products, synthetic pesticides must be used with caution and only when absolutely necessary. However, even with prudent use of synthetic pesticides, continued reliance on these chemicals due to their effects still poses a threat to the environment, non-target organisms, and human health. Therefore, the effectiveness and role of botanical pesticides in controlling crop pests need to be evaluated due to their reproducibility and their contribution to human and environmental safety and should be reconsidered. Considering that the production of botanical pesticides requires large quantities of raw materials, parent crops can be grown on a large scale in marginal areas that are not suitable for farming to avoid competition with food crops. Commercialising the production of such crops will generate income that will help sustain the livelihoods of communities in semi-arid regions. Low-growing plants such as rhizomes and herbs can be grown in forested areas without disturbing the trees.

Compounds found to have insecticidal properties in plants can also be synthesised after collaboration between chemical engineers and scientists. Processing and extraction of plant pesticides using inexpensive solvents should be investigated to reduce production costs and minimise problems associated with waste disposal. This will allow small farmers to afford and use safe pesticides. The rapid biodegradability of botanical pesticides is good but also problematic due to their short shelf life. Therefore, further research is required to develop long-acting formulations while maintaining the desired efficacy. Studies on the stability of botanical pesticides are recommended, especially under field conditions. The use of nanotechnology as a formulation technique has contributed significantly to stability, with reported effective dispersion of active compounds under field conditions. In turn, this will increase the effectiveness of botanical pesticides at the agricultural level. Further research is needed to improve the use of bioactive compounds in plants relevant to crop protection. This may involve the domestication and improvement of identified wild plants through breeding to increase the content of active molecules, in addition to developing appropriate livestock practices, including plant nutrition and agronomic practices. Improving parental plants may involve the identification of genes that regulate the formation and accumulation of active compounds, which will further guide breeding methods and lead to higher yields of target pesticide compounds.

These compounds should then be formulated into products that are particularly accessible to small farmers. Concerned stakeholders should raise awareness of the need to use phytocides and other natural products as safe pest control tools to support researchers and policymakers. The task of researchers and scientists working on such products is to provide consistent and reproducible field efficacy data. Increased use of biopesticides in integrated crop protection strategies will increase acceptance of agricultural products in niche markets, thereby contributing to improvements in international trade, food safety, biodiversity conservation, environmental protection, and human health.

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