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Comparative Efficacy of Organic Mulching and Organic Neem Oil in the Control of spotted and striped cucumber beetles affecting the growth and yield of Cucumber in Uyo, Akwa Ibom State

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ABSTRACT: A research work was undertaken in the University of Uyo Teaching and Research Farm, Main Campus, Uyo, from March to May during the 2023 cropping season to assess the effect of Organic Mulching and Neem Oil in the Control of Cucumber Beetles (spotted "Diabrotica undecimpunctata" and striped "Acalymma vitatum") affecting the growth and yield of Cucumber (Cucumis sativum, Saira F1 variety). The experiment was laid out in Randomized Complete Block Design (RCBD). The experimental plot consisted of three (3) replicates with 2 treatments: organic mulch, organic Neem oil application and control. An early maturing variety of cucumber "Saira F1" was used as planting material sown in March which lasted till May. Data on insect pest population count, growth and yield parameters were studied and the data obtained were analyzed and subjected to analysis of variance using Fisher`s Least Significant Difference (LSD) at 5% probability level. The results from insect population count parameters revealed that Neem oil at 100ml application rate which recorded 10.50 and 6.00 was significantly effective in managing spotted and striped cucumber beetles respectively compared to organic mulch (3kg) which recorded 47.00 and 14.00 for spotted and striped cucumber beetles and control unit which had 61.00 and 42.00 for spotted and striped cucumber beetles respectively. Neem oil at 100ml application rate was also more effective in improving the growth and yield of cucumber plant compared to organic mulch. Hence, Farmers in Uyo, Akwa Ibom State should employ Neem oil in managing spotted and striped cucumber beetles in cucumber production as this is a promising botanical insecticide to check the activities of field cucumber beetles thereby bringing their destructive activities to a minimum and also improves yield.

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INTRODUCTION

Vegetables are important in the human diet for the provision of carbohydrates, proteins, vitamins and trace elements they contain (Bakre, 2004). In addition to dietary benefits, they are important supplementary sources of food and nutrition and also serve as one of the major sources of income for small scale farmers to highly commercial farmers. Cucumber (*Cucumis sativus* L.) is considered the fourth most essential vegetable worldwide, perhaps due to its great nutritional, medicinal and economic potential. In terms of world total production, cucumber is rated an important cucurbit alongside watermelon (*Citrullus lanatus* L.) and melon (*Cucumis melon* L.). Low yield and insufficient use of the product previously contributed to ranking the crop insignificant in Africa. At present, the demand for cucumber is on the increase daily in Africa because of the continued campaigns about the numerous benefits of the crop (Wehner, 2007).

According to Umeh and Ojiako (2018), raw cucumber (with peel) is 95% water, 4% carbohydrates, 1% protein, and contains negligible fat. A 100-gram (3+½-ounce) reference serving provides 65 kilojoules (16 kilocalories) of food energy. It has a low content of micronutrients: it is notable only for vitamin K, at 16% of the Daily Value. Depending on variety, cucumbers may have a mild melon aroma and flavor, in part resulting from unsaturated aldehydes, such as (E,Z)-nona-2,6-dienal and the *cis*- and *trans*- isomers of 2-nonenal. The slightly bitter taste of cucumber rind results from cucurbitacins.

According to Diver and Hinman, (2008), despite the increasing relevance of cucumber, production is seriously constrained by many factors which include scarcity of suitable planting materials, limited access to capital, climatic conditions, plant pests and diseases, among others. More than 40 diseases caused by viral, bacterial, fungal and nematode pathogens severely affect the cultivation and

production of *Cucumis sativus* L. But Insect pests are major constraint and are reported to consume crops sufficient to feed an additional one billion people on a worldwide basis, thereby placing much importance on identifying and managing them prior to infestation. Like other cucurbits, the most common destructive pests of *C. sativus* L. are spotted cucumber beetle (*Diabrotica undecimpunctata*) and striped cucumber beetle (*Acalymma vitatum*). Other pests identified on cucumber fields in Africa include Flea beetle (*Phyllotreta cruciferae*), Hadda beetle (*Epilachna vigintioctopunctata*), banded cucumber beetle (*Diabrotica balteata*), squash bug (*Anasa tristis*) and squash vine borer (*Melittia cucurbitae*). Additionally, *C. sativus* L. harbours a number of aphids which include melon aphid (*Aphis gossypii*), cowpea aphid (*Aphis craccivora*), potato aphid (*Macrosiphum euphorbiae*) and green peach aphid (*Myzus persicae*), which serve as common vectors of important viral diseases of *Cucumis. Sativus*, (Sharma *et al*, 2017). Neem oil and organic mulching have been reported to be effective in controlling cucumber beetles. Neem oil is an effective organic pesticide that can be used to control cucumber beetles early on. It works by disrupting the development of the beetle, preventing them from feeding and reproducing, causing them to die from starvation, (Sharma *et al*, 2017). Also Mulching, using fabric, hay, straw, or plastic, will help keep the soil cool and moist, which will make it less attractive to the beetles. It will discourage the beetles from laying eggs, (William and Wise, 2003).

This research aims at increasing yield, quality and value of *cucumis sativum* by minimizing the destructive activities of cucumber beetles through organic mulching and organic neem oil application while comparing their efficacy alongside.

MATERIALS AND METHOD

EXPERIMENTAL SITE

The experiment was carried out in the University of Uyo Teaching and Research Farm, Uniuyo main campus, Uyo during the 2023 cropping season from March to April. Uyo lies between latitude of 5°215.864 North and longitude 7°5446.062 East. Annual rainfall ranges from 2500-3500mm. Average monthly sunlight hours is about 3.14 hours, the mean monthly temperature are between 28.63°C minimum and 40°C maximum. Uyo has a relative humidity of 79%, evaporation rate of 2.6cm² (Okeowo and Fatoba, 2022).

SOURCES OF EXPERIMENTAL MATERIALS

The cultivar of cucumber used for this research was purchased from a reputable seed vendor in Itam market, Uyo local government area of Akwa Ibom state.

The organic mulching material was obtained from Main campus and the neem oil was bought from a reputation agro-chemical shop (Ekponwa Company limited) off Aka road, Uyo, Akwa Ibom state.

EXPERIMENTAL DESIGN AND TREATMENTS

The experiment was laid out in Randomized Complete Block Design (RCBD). The plot consisted of three (3) replicates with 2 treatments organic mulch, organic neem oil application and control units.

The whole experimental site measured 7m X 6m (42m²). Each experimental units measured 50cm width X 1m long. Each replicates measured 5.5m width X 3m long.

The treatments used in this research are (Bahama grass "Cynodon dactylon" for organic mulch and neem oil "*Azadirachta indica*" for organic bio-insecticide).

AGRONOMIC PRACTICES

LAND PREPARATION: The experimental site of 42m² was manually cleared, stumped and tillage operation carried out to improve the soil structure, check weed and pulverize the soil for good root penetration, adequate aeration and infiltration rate. Ridges were made as well as measuring and marking of the plot. Total plot size was 7m X 6m while each replicates measured 5.5m width X 3m long.

The seed were sown directly at the rate of 3 seeds per hole to the depth of 5cm. Seeds were sown at 0.3m X1m intra and inter row spacing.

THINNING/SUPPLYING: These were done to maintain plant population.

WEEDING: weeding was done manually with hoe for 3 consecutive times at two weeks interval till the plants reached maturity and fruiting.

SOIL TEST AND MANURE APPLICATION: Soil samples were taken randomly from 5 spots at 0 – 15cm depth over the entire field using soil auger of diameter, the soil were collected with separate containers and analyzed before the commencement of the experiment. From the results of the soil analysis, poultry droppings were applied to the soil to supplement and improve the soil productivity and fertility.

PLANTING: planting was done 11/03/2023, germination occurred at 14/03/2023.

FLOWERING: Flowering occurred at 13/04/2023

HARVESTING: This was done at maturity.

PREPARATION OF NEEM OIL FOR SPRAY

20mil of Neem oil, 1 litre of water, 2 tablespoon of liquid detergent

MIXING PROCESS:

Neem oil will not readily combine with water and needs an emulsifying agent, like a mild dish detergent, to effectively mix the oil. 2 teaspoons of dish detergent was added to 1 litre of warm water in a sprayer and mixed thoroughly. Afterward, 20ml of Neem oil was poured into the mixture and mixed thoroughly.

ORGANIC MULCHING

Sufficient quantity of hay (Bahama grass "Cynodon dactylon") as mulching material was obtained from main campus, weighed (3kg) and applied uniformly in the replicates, around the ridges up to the plant base as necessary and replaced when due.

DATA COLLECTION AND ANALYSIS

GROWTH PARAMETERS:

Four cucumber plants were tagged within each experimental units for data collection. Growth parameters were assessed at 14 days, 28 days, after germination.

i. Vine length (cm): The length of four tagged cucumber plants were determined with the use of measuring tape. The tape was placed from the base of the tagged plants to the tip of the vine, and mean of the four tagged vine obtained.
ii. Number of leaves per plant: Leaves of four tagged cucumber plants were carefully counted to determine the number of leaves on each plant and the mean obtained.
iii. Leaf area (m^2): Leaf area of four tagged cucumber plants was measured using measuring tape.
iv. Number of branches: Each of the tagged cucumber plants were carefully counted for branches and mean of the four tagged plants recorded.

YIELD AND YIELD PARAMETERS

i. Length of Cucumber fruit (cm): Length of matured harvested fruits was measured using measuring tape in centimeters.
ii. Circumference of Cucumber fruit (cm): Circumference of matured harvested fruits were measured using measuring tape in centimeters.
iii. Total number of Cucumber fruits per experimental unit was collected at maturity.
iv. Weight of fruits in gram: four fruits from each experimental unit were weighed and recorded.

INSECT POPULATION COUNT:

Insect population was obtained by visual counting at five days interval on nine consecutive times from each experimental units and recorded. This was done at morning hours of the day and in the cool of the evening.

STATISTICAL ANALYSIS

Data obtained were subjected to analysis of variance (ANOVA) using Excel statistics package (2013) and means were separated using Least Significant Difference (LSD).

RESULTS

The results of growth parameters of cucumber plant in response to treatment with neem oil and organic mulching at 2 WAP and 4 WAP are presented in table 1. Neem oil (100 ml) recorded the highest leaf area (39.83 cm) closely followed by Organic Mulch (3kg) which recorded (36.58cm) while control (0 treatment) recorded the lowest leaf area (32.58 cm). In terms of plant height Neem oil (100ml) recorded the highest (40.90cm), closely followed by Organic Mulch (3kg) which recorded (39.00cm) and control recorded the lowest (34.40cm). There was no significant differences between Organic Mulch (3kg) and control (0 treatment) in terms of number of branches as Neem oil (100ml) recorded a significant difference. Neem oil (100ml) recorded the highest (18.75) in terms of number of leaves, closely followed by Organic Mulch (3kg) which had (15.50) while control recorded the lowest (12.75). The result for yield parameters of cucumber is presented in table 2 as follows: Neem oil (100 ml) recorded the highest total fruit collected per plot (9.33) closely followed by Organic Mulch (3kg) which recorded (6.33) while control (0 treatment) recorded the lowest (4.66) at harvest. In terms of circumference of fruit, Neem oil (100ml) recorded the highest (15.68cm), closely followed by Organic Mulch (3kg) which recorded (12.38cm) and control had the lowest (11.30cm). In length of fruit, Neem oil (100ml) recorded the highest (17.93cm) closely followed by Organic Mulching (3kg) which recorded (12.90cm) while control recorded the lowest (10.55cm). There was no significant differences between Organic Mulch (3kg) and control (0 treatment) in terms of weight of fruit in gram as Neem oil (100ml) recorded a significant difference.

Table 3 revealed that the results of the effects of the treatments on insect population were significantly different as Neem oil (100ml) recorded the lowest for spotted, striped cucumber beetles and other insect pest of cucumber plant (10.5, 6 and 8) respectively followed by organic mulch (47, 14 and 15.00) respectively and control unit (61, 42 and 32.33) respectively. Neem oil and organic mulch had no significant differences between striped cucumber beetle and other insect pest of cucumber. Also, table 4.3 revealed that control had the highest insect pests population count compared to Neem oil and organic mulch.
The list of other insect pests encountered in the field is presented in table 4, revealing up to 10 other insect pests.

Table1: Mean Growth Parameters of Cucumber after Treatment with Neem Oil and Organic Mulching At 2 & 4 Weeks after Germination.

TREATMENT	VINE HEIGHT (CM)	NUMBER OF LEAVES	LEAFAREA (CM)	NUMBER OF BRANCHES
Neem oil (100ml)	40.90[a]	18.75[a]	39.83[a]	3.25[a]
Mulch (3kg)	39.00[b] 15.50[b]	36.58[b]	2.55[b]	
Control	34.40[c]	12.75[c]	32.58[c]	2.00[b]
LSD	**4.96**	**4.28**	**4.72**	**1.25**

*Means followed by the same superscript are not significantly different at 5% level of significance using Fisher`s least significant difference (LSD).

Table 2: Mean Yield and Yield Parameters of Cucumber after Treatment with Neem Oil and Organic Mulching At Harvest after Planting.

TREATMENT	Total fruits per plot	Fruit Circumference (cm)	Fruit Length (cm)	Fruit Weight (g)
Neem oil (100ml)	9.33[a]	15.68[a]	17.93[a]	28.20[a]
Mulch (3kg)	6.33[b] 12.38[b]	12.90[b]	22.33[b]	
Control	4.66[c]	11.30[b]	10.55[b]	21.50[b]
LSD	**1.33**	**3.00**	**3.27**	**5.53**

*Means followed by the same superscript are not significantly different at 5% level of significance using Fisher`s least significant difference (LSD).

Table 3: Population of Cucumber Beetles and Other Insect Pests of Cucumber Plant after Treatment Applicatio

TREATMENT	Spotted Beetles	Striped Beetles	Other Insects pests
Neem oil (100ml)	10.50[a]	6.00[a]	8.00[a]
Mulch (3kg)	47.00[b]	14.00[b]	15.00[b]
Control	61.00[b]	42.00[b]	32.33[b]
LSD	**25.49**	**21.74**	**13.46**

*Means followed by the same superscript are not significantly different at 5% level of significance using Fisher`s least significant difference (LSD).

Table 4: Other Insect Pests of Cucumber Encountered in the Field

S/N	Common Name	Scientific Name
1	Green peach aphid	*Myzus persicae*
2	Melon Aphid	*Aphis gossypii*
3	Cabbage Looper	*Trichoplusia ni*
4	Pickleworm	*Diaphania nitidalis*
5	Two-spotted spider mite	*Tetranychus urticae*
6	Beet Armyworms	*Spodoptera exigua*
7	Squash bugs	*Anasa tristis*
8	Squash vine borers	*Melittia cucurbitae*
9	Whitefly spp	*Trialeurodes vaporariorum*
10	Thrips	*Frankliniella occidentalis*

DISCUSSION

Growth parameters, yield parameters and insect population count, presented in table 1, 2 and 3 respectively showed that neem oil at 100ml application rate was more effective in managing spotted and striped cucumber beetles and other insect pests of field cucumber within the growth cycle of cucumber plant and this agrees with the findings of William and Wise, (2003) that neem oil is an effective organic pesticide that can be used to control cucumber beetles. It works by disrupting the development of the beetle, preventing them from feeding and reproducing, causing them to die from starvation.

Whereas result from the control unit agrees with the report of Sharma *et al* (2017), that insect pests of field cucumber cause defoliations of leaves, flowers abortion and fruits damages. Thus, causing reduction in quality and quantity of the crop. Apart from causing direct damage, many insect pests also act as vectors for several viral diseases (Snyder and Wise 2000). Lam and Foster (2005), has reported that insect pests worldwide consume crops sufficient to feed an additional one billion people. Result from the organic mulching unit was significant compare to the control unit which had poor turnout.

CONCLUSION

From the results of the analysis, the following conclusions are drawn

i. Neem oil is a more effective botanical insecticide for controlling cucumber beetles and other insect pests of cucumber plant compared to organic mulch.
ii. Organic mulch had an average effect in controlling cucumber beetles and other insect pests of cucumber plant.
iii. Neem oil at 100ml application rate was more effective in improving the growth and yield of cucumber plant compared to organic mulch.

RECOMMENDATION

Farmers in Uyo, Akwa Ibom State should employ Neem oil in managing spotted and striped cucumber beetles in cucumber production as this is a promising botanical insecticide to check the activities of field cucumber beetles thereby bringing their destructive activities to a minimum.

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