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Effect Of Organic Insecticides Extract Spray Regimes And Varieties On Insect Pests Of Organic Farming Of Watermelon In Potiskum, Yobe State, Nigeria

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ABSTRACT

The Research evaluated the effect of neem seed extract and ginger seed extract spray regimes on insect pest and performance of organic farming of watermelon in Potiskum local government area of Yobe State during 2024 and 2025 rainy seasons. The experiment was designed using organic manure on a split-split plot design with three replications during the rainy seasons. The factorial experiment consist of five watermelon varieties commonly grown by farmers in north east Nigeria, two organic insecticides (Neem seed aqueous extract and Ginger rhizome extract), untreated control and three insecticides spray regime at 2 weeks after planting (WAP) that is at seedling stage (first spray); at 4 weeks after planting (WAP) that is at vegetative/flowering stage (second sprays), and at 8 weeks (WAP) that is at fruiting stages (third sprays). Yield parameters collected include days to 50% flowering, days to 50% fruiting's, number of drop and damaged flowers and numbers of damaged and undamaged fruits. Data were analyzed using ANOVA in SAS (2010) with significant means separated at 5% probability. There is highly significant interaction between insecticides and spray regimes on the number of days to 50% flowering and highly interaction on the number of days to 50% fruiting was attributed to the number of sprayed of the insecticides. As indicated spray thrice recorded the lowest number of aborted and damaged flowers as compare with sprayed once which highest number of damaged flower followed by sprayed twice. The result of the finding suggest that neem seed extract and ginger seed extract have potentials as natural alternatives to chemical insecticides for managing insect pests of watermelon.

Keywords: Watermelon, neem, ginger, spray regimes, organic manure.

INTRODUCTION

Watermelon *Citrullus lanatus* (Thumb.) Matsum and Nakai, belong to the family Cucumbitaceae which include about 118 genera and 825 species (Dane and Liu, 2007). It originated from Africa as described by Schippers (2000); Olunaiya and Adedeji (2014); Rai and Yadau (2005) and now found in tropical and subtropical climatic environment worldwide. The crop is grown commercially in areas with long frost free warm period (Majid, 2011) China, Turkey, Iran, Brazil, Uzbekistan, Algeria, United State, Russian Egypt Maxico and Nigeria are the major watermelon producers (Food and Agricultural Organization (2010), Guo *et al.*, 2012 and 2013). Worldwide production of watermelon

was 99,392,661 metric ton (MT) in 2018 season. It is produced commercially by these countries in the order of decrease in the production, China (79,244,271 tons), Brazil (20,079,547 tons), Turkey (3,928,892 tons), Iran (3,813,850 tons), Brazil (2,079,432 tons), Uzbekistan (1,976,373 tons), Algeria (1,877,0696 tons), USA (1,923,160 tons), Russia (1,757,972 tons), Egypt (1,680,994 tons), Mexico (1,199,648 tons) and Nigeria (1,002,300 tons). Watermelon is a warm season crop, which requires continuous warm temperature during the entire growing period (Chamo *et al.*, 2016). The crop prefers a hot, dry climate with mean daily temperature of about 22° to 30°C. The maximum and minimum temperature for its growth range from 35° and 18°C respectively, the crop has an optimum soil temperature range of 20°C to 35°C Food and Agricultural Organization Statistics (FAOSTAT, 2001). Warm dry spells are essential during fruit maturity to increase the sweetness of the fruits (Henry *et al.*, 2002), watermelon grows best on sandy loam soils, with good drainage and a fairly tolerant to soil pH as low as 5.5 but grows best where soil pH is between 6.0 and 6.8 and if soil pH is below 5.5 based on Oklahoma State University (OSU) soil test results the P₂O and K₂O are recommended (Jim *et al.*, 2010).

There are over 1000 varieties of watermelon ranging in weight from less than 1.40kg to more than 32kg. Some are round and others are oblong in shape. The varieties also vary in skin color from light green to dark green while some have strip. The colour of the flesh may be red, orange yellow or white (Anikwe *et al.*, 2016) and Bukar *et al.*, (2023b). In Nigeria its cultivation is confined to the drier savannah region Ufoegbene *et al.*, 2014 and Bukar *et al.*, (2023b).

The study was carried out with the following purposes;

- to screen some watermelon varieties for resistance to *Dacus cucurbitae* larvae;
- to determine the best botanical insecticide and insecticidal spray regime against damage caused by *D. cucurbitae* in the area;
- to assess fruit damage and percentage reduction in fruit yield of watermelon against insect pests.

MATERIALS AND METHODS

The experiment were conducted in Potiskum, Yobe state during 2024 and 2025 rainy seasons. A split-split plot was designed for this research work laid on a prepared and spread organic fertilizer on the farm land. The factorial experiment consist of five watermelon varieties, two organic insecticides (Neem seed aqueous extract and Ginger rhizome extract) and untreated control and three insecticides spray regime at 2 weeks after planting (WAP) that is seedling stage (first spray); at 4 weeks after planting (WAP) that is at vegetative/flowering stage (second sprays), and at 8 weeks (WAP) that is at fruiting stages (third sprays). Each insecticide was allocated to the main plots of 20 x 44m, Spray regimes were allocated to sub- plots of 6 x 44m and Cultivars were also allocated to sub-sub plots of 6 x 8m and untreated control in each replication. Each was replicated three times per block. The plots were separated by 1m between and within replications as shown in the experimental layout of split-split plot design. Seeds of the five varieties of watermelon (*Citrullus lanatus* Thunb.) commonly cultivated by farmers in the North Eastern Nigeria were used for planting in both study areas. The seeds were obtained from farmers and vegetable markets in Yobe States for planting. The varieties used are; Grey - green rind and round shape (Mickylee), Grey - green rind and oblong shape (Carleston), Green - strip rind and round shape (Jublee), Green- strip rind and oblong shape (Royal sweet) and Green - rind and round shape (Petite sweet).

Botanical extracts Preparation

Neem seed aqueous extract (NSAE)

Matured dried neem seeds were collected; the seeds were ground to powder with manual blender. The powder was mixed with deionized water, stirred vigorously for 1-2 minutes and was allowed to stand overnight. Bukar *et al.*, (2023b). This was filtered by using a muslin cloth before spraying. The extract was used at the rate of 50g of powder/1liter of water (w/v) as recommended by El - Shafie and Basedow (2003); Abdalla *et al.* (2010). Bukar *et al.*, (2023b).

Ginger rhizomes dried powder

Matured ginger rhizomes were collected, clean and washed thoroughly before cutting it into small pieces and allow it for sun dry for some days. The dried rhizomes were then grounded into powder with pestle and mortar Bukar *et al.*, (2023b). The powder were mixed with deionized water, stirred

vigorously for some minutes and allowed to stand for 12 hours. This was then filtered by using a muslin cloth before spraying as described by Mustapha *et al.* (2015) and Sayed *et al.* (2016). The extracts were used at the rate of 50g of powder/1liter of water (w/v) as recommended by El- Shafie and Basedow, (2003), Bukar *et al.*, (2023b).

Assessment of fruit yield and fruits yield loss.

Fruits yield losses and percentage losses in each of the treatment was calculated both by using the method of Judenko (1972) as modified in Sastawa *et al.*, (2014), Bukar and Sastawa, (2015), and Malgwi *et al.*(2011, 2013) as follows

$$\text{Percentage loss (L)} = \frac{(a-b) \times 100}{a}$$

Potential fruits yield/plot was calculated as

$$W = \frac{100ab}{100 - L} \text{ (kg)}$$

Fruit yield/plot was calculated as

$$w - (w - ab) \text{ (kg)}$$

Fruit loss was calculated as

$$w - ab \text{ (kg)}$$

Whereas a = mean weight of uninfested fruit /plot (kg)

b = mean weight of infested fruit / plot (kg)

P = percentage fruit infested i.e = $\frac{\text{mean no of infested}}{\text{Mean no. of uninfested fruit}} \times 100$

Method of data Analysis

The data collected were subjected to the analysis of variance (ANOVA) as describe by Gomez and Gomez (1983). The data were transformed using logarithms transformation, SAS version 9.2 (2010) software was used for the analysis. The significant means separation was done by Student Newman Keuls (SNK) to determine the significant difference among the treatment means at 5% level of probability as adopted by Malgwi *et al.* (2011).

RESULTS AND DISCUSSION

The effects of neem seed extract and ginger seed extract spray regimes and varieties on days to 50% flowering and fruiting during 2024 and 2015 rainy season in Potiskum (Yobe) States trials is presented in Tables 1. The results indicated that the lower number of days to 50% flowering and 50% days to fruiting was as a result of applications of the organic insecticides (neem seed aqueous extract and ginger rhizome extract) at various spray regimes. The higher days to flowering (42.4) and fruiting (48.6) Table 1, as observed in the control plots was as a results of non - application of any insecticides. The observed variation in the number of days to 50% flowering and fruiting was reported by Alao *et al.* (2016) and Dhillon *et al.* (2005) who reported that during flowering stage, majority of insect such as *Dacus cucurbitae* defoliate the cotyledon of the leaves and caused damaged to all seedling stages that may prolong flowering and fruiting that lead to the variations in the number of days to 50% flowering and 50% fruiting. It has been reported also, that lower number of set fruits in chemically treated plot might be due to chemical sensitivity in flowers resulting in poor fruit set. Since fruit fly maggots feed inside the fruiting bodies it is difficult to control this pest with insecticides (Neupane, 2000).

The highly significant interaction between insecticides and spray regimes on the number of days to 50% flowering and highly interaction on the number of days to 50% fruiting was attributed to the number of sprayed of the insecticides Table 1. In studies by (Alao *et al.*, 2016), those plant products can be considered as better options for insect pests control, if they can be categorized for having different efficacy against different insect in pest control. Bio pesticides or botanical extracts are good alternative to synthetic pesticides having edge of environmental friendly and safe for natural enemies, human and other animals, most of botanical pesticides have low to moderate mammalian toxicity and having no advance effect on the environment (Anaso and Lale, 2001). The result recorded showed that neem seed extract have presence of phytochemicals in the constituents which give protective or repellency to plants. Azadirachtin extract from the seeds, leaves and bark of the neem tree has been reported to have strong biological activities against insect pests, but with very low toxicity to mammal

and the environment (Umar *et al.*, 2002; Biu *et al.*, 2009) and Bukar *et al.*, (2023a). Also, from the result of ginger rhizome extract, it showed that the extract contain presence of phytochemical in some of its constituents that gave ginger presence of bioactive non – nutritive plant chemicals that have preventive properties against insects. According to Jacob *et al.* (2018), phytochemical examined were present in ethanol, water and acetone respectively. Ginger extract has recently been shown to have a variety of biological activities (Kamtchonsing *et al.*, 2002). Ginger major active ingredient such as zingerone, gingerdiol, zingibrene, gingerols and shogol as its primary chemical compound. Primary purpose is as a repellent or feeding deterrent (Zancan *et al.*, 2002, and Sunday, 2012).

The effects of spray regimes on the number of aborted and damaged flowers indicated that the lower number of aborted and damaged flowers caused by the fruit fly *D. cucurbitae* after first, second and third sprays was attributed to the effective performance of the botanical insecticides that is neem seed aqueous extract and ginger rhizome extract as compared to the control which recorded the highest mean numbers of aborted and damaged flowers (1.4) Table 2. As indicated spray thrice recorded the lowest number of aborted and damaged flowers as compare with sprayed once which highest number of damaged flower followed by sprayed twice. In his early studies on fruit flies Dhillon *et al.*, (2005) and Bukar *et al.*, (2023b) reported that the adult female preferred unopened flowers and young fruits for egg laying and as a results of these a lot of flowers were aborted. According to Oke and Simon (2003); Nath *et al.*, (2007) and Wasim *et al.*, (2009) the eco-friendly insecticides applied one after another as per schedule resulted in minimum fruits damaged by the fruit flies. In another studies by Alao *et al.* (2016) considered *D. cucurbitae* as the destructive insect due to the fact that it attacked the economic part of the crop by oviposition on the flowers, young and matured fruits which led to the flower abortion and feeding on the flowers leading defoliation. Also in another finding of Maynard (2007) who said that high temperature delays female flowering and it usually causes abortion of the female flower buds and ultimately reduces the numbers of fruits in watermelon.

The effects of varieties on the number of aborted and damaged flowers after first spray, indicate that variety carleston produces lower damaged flowers (0.9). After second sprays, variety Jublee gave the lowest number (0.3) of aborted and damaged flowers while after third sprays and also, variety Mickley and Jublee had the lowest damaged flowers (0.1) Table 2.

The effect of spray regimes on the numbers of aborted and damaged flowers after first spray indicated that sprayed thrice recorded the lowest numbers of aborted and damaged flowers with the mean value of 0.00 Table 2. The effect of performance of neem seed extract and ginger seed extract spray regimes and varieties on numbers of aborted and damaged flowers caused by *Dacus cucurbitae* during 2024 rainy seasons were presented in Table 2. There were highly significant ($P \leq 0.05$) interaction between insecticides and varieties on the numbers of aborted and damaged flowers after first and second sprays, the results showed significant ($P \leq 0.05$) interaction between insecticides and varieties. There was significant ($P \leq 0.05$) interaction between spray regimes and varieties on the numbers of aborted and damaged flowers after first sprays and highly significant ($P \leq 0.01$) after second sprays. There were also significant ($P \leq 0.05$) interaction between insecticides and spray regimes on the numbers of aborted and damaged flowers after first spray. Also, there was highly significant ($P \leq 0.05$) Interactions between insecticides and spray regimes on the numbers of aborted and damaged flowers after second and third sprays as presented.

Table 1: Mean performance of organic Insecticidal Spray regime and Varieties on Days to 50% flowering and Days to 50% fruiting of watermelon *Citrullus lanatus* (Thumb.) of 2024 and 2025 rainy seasons.

Insecticides	Days to 50% Flowering		Days to 50% Fruiting	
	2024	2025	2024	2025
Neem seed aqueous extract	40.6	39.5	47.9	45.8
Ginger seed extract	40.9	39.7	47.8	45.9
Control	42.4	40.3	48.6	46.4
Mean	41.3	39.8	48.1	46.1
P of F	0.02	0.0004	<.0001	0.07
S E ±	0.60	2.51	0.59	3.39
CV (%)	6.61	6.21	3.83	7.29
Spray regime (SR)				
Sprayed once (SR1)	40.7	39.9	45.4	45.9
Sprayed twice (SR2)	41.6	41.1	48.1	46.5
Sprayed thrice (SR3)	41.1	40.5	47.9	46.1
Mean	41.1	40.4	47.9	45.8
P of F	0.53	0.03	0.57	0.52
S E ±	0.57	2.33	0.38	4.25
Varieties (VR)				
Mickey lee (V1)	40.8	40.5	48.1	46.0
Carleston (V2)	41.3	40.1	47.9	46.1
Jublee (V3)	41.7	40.2	47.8	46.4
Royal sweet (V4)	40.9	40.7	48.0	46.3
Petite sweet (V5)	41.1	40.7	48.1	45.9
Mean	41.2	40.7	47.9	46.2
P of F	0.29	0.15	0.60	0.28
S E ±	0.63	2.53	0.40	3.37
Insecticides x SR	**	**	NS	**
Insecticides x VR	NS	NS	NS	NS
SR x VR	NS	NS	NS	NS
Insecticides x SR x VR	NS	NS	NS	NS

Means followed by the same letters in the same column are not significantly different at $P \leq 0.05$ level of probability using the Student Newman Keuls (SNK) method

Table 2: Mean performance of organic insecticidal spray regimes and varieties on the number of Aborted and damaged flowers caused by *Dacus cucurbitae* (Coquillet) of 2024 and 2025 rainy seasons.

Treatment	Damaged and dropped flowers					
	After first spray (2WAP)		After second sprays (4WAP)		After third sprays (8WAP)	
Insecticides	2024	2025	2024	2025	2024	2025
Neem seed extract	0.2	1.0	0.15	1.25	0.05	1.05
Ginger seed extract	0.4	0.9	0.15	1.25	0.1	1.05
Control	0.5	1.3	0.3	1.5	0.15	1.4
Mean	0.4	1.1	0.2	1.3	0.1	1.1
P of F	<.0001	<.0001	0.31	0.31	0.03	0.03
S E ±	0.23	0.44	0.24	0.45	0.19	0.45
C V (%)	7.3	41.9	8.13	33.5	11.4	38.2
Spray regime (SR)						
Sprayed once	0.4	1.1	0.4	1.4	0.1	1.2
Sprayed twice	0.3	0.9	0.3	1.3	0.1	1.1
Sprayed thrice	0.3	0.6	0.3	1.6	0.00	1.15
P of F	0.47	0.27	0.02	0.02	0.17	0.31
S E ±	0.23	0.44	0.23	0.45	0.19	0.44
Varieties (VR)						
Mickey lee	0.3	1.1	0.4	1.3	0.1	1.2
Carleston	0.3	0.9	0.4	1.3	0.1	1.3
Jublee	0.3	1.2	0.3	1.4	0.1	1.2
Royal sweet	0.3	1.1	0.4	1.4	0.05	1.2
Petite sweet	0.3	1.1	0.3	1.4	0.05	1.15
P of F	0.17	1.1	0.8	0.9	0.27	0.45
S E ±	0.27	0.37	0.24	0.45	0.19	38.2
Insecticides x SR	NS	*	**	**	**	**
Insecticide x VR	**	NS	**	NS	NS	NS
SR x VR	*	NS	NS	NS	NS	NS
Insectic. x SR x VR	NS	NS	NS	NS	NS	NS

Means followed by the same letters in the same column are not significantly different at $P \leq 0.05$ level of probability using the Student Newman Keuls (SNK) method of mean separation, CV=Coefficient of variation, SE= Standard error, insect = insecticide

he results of the performance of insecticides on the percentage fruit yield and yield losses produced indicated that after first, second and third sprays, the percentage fruit yield losses was very high mean number in the control (8.3) Table 3. Likewise, the fruit yield losses was higher in the control (8.4) than in neem seed aqueous extract Table 3. This occurs as a result of the effect of the insecticides. During the research, it was observed that increasing the spray of the insecticides resulted in reducing the attack by the larvae of *Dacus cucurbitae* which resulted in lower number of fruits yield losses by the larvae as indicated. Ginger seed extract (Alao *et al.*, 2016) and Bukar *et al.*, (2023b) describe it as effective against fruit flies of watermelon. In this studies, mixtures of insecticides (neem seed aqueous extract and ginger rhizome extract) proved to be effective when they were applied at sprayed once, sprayed twice and sprayed thrice during the melon vegetative period which resulted in lower percentage fruit yield losses than the control. According to report of Nath *et al.* (2007), Wasim *et al.* (2009) and Oke and Simon (2013) reported that insecticides applied one after another as per schedule resulted in minimum fruit damaged by the fruit flies *D. cucurbitae*.

During the research it was observed that fruit flies larvae attacked the early stages of fruits development and this was a result of the eggs that were laid on the young fruits and immediately when hatched the larvae get entry into the young fruit easily and caused damaged to the fruits. Dhillon *et al.*, (2005) reported that fruit fly favored early stages of fruits and the infested fruits failed to develop properly and aborted off the plant. Spray regimes adopted in this studies resulted in reducing the attack by larvae of *Dacus cucurbitae* which resulted in lower number of fruit yield losses by the larva

Table 3: Mean performance of organic insecticidal, spray regimes and varieties on percentage fruits yield losses and fruits yield kg/plots before and after sprays of 2024 and 2025 rainy seasons.

Treatment	Percentage fruits yield losses and fruits yield losses (% FYL)							
	%FYL AFT.2 nd		FYLAFT 2 nd		% FYL AFT 3 rd		FYL AFT 3 rd sprays	
	sprays	sprays	sprays	sprays	sprays	sprays	sprays	sprays
Insecticides	2024	2024	2025	2025	2024	2025	2024	2025
Neem seed extract	0.5	0.53	6.25	5.45	4.45	2.2	4.3	4.3
Ginger seed extract	0.6	0.55	6.15	3.85	3.0	1.7	2.4	2.4
Control	0.63	0.82	8.3	3.85	7.9	8.2	4.7	4.7
Mean	0.56	0.63	6.2	4.7	4.7	3.9	3.75	3.75
P of F	<.0001	<.0001	0.001	0.003	0.0001	0.001	0.017	0.017
S.E ±	0.68	0.64	3.24	3.57	3.25	2.7	3.61	3.61
CV (%)	11.06	22.65	33.5	15.5	24.9	16.9	19.1	19.1
Spray regime								
Sprayed once	0.39	0.23	6.5	4.5	4.8	4.2	3.9	3.9
Sprayed twice	0.31	0.6	5.4	4.05	4.2	3.5	3.6	3.6
Sprayed thrice	0.22	0.54	6.7	4.5	5.1	3.75	3.7	3.7
Mean	0.31	0.46	6.20	4.35	4.7	3.76	3.73	3.73
P of F	0.35	0.32	0.02	0.06	0.001	0.002	0.05	0.05
S.E ±	0.68	0.64	3.25	2.07	3.10	2.66	3.61	3.61
Varieties								
Mickey lee	0.34	0.6	5.9	4.4	4.9	4.0	3.6	3.6
Carleston	0.94	0.73	6.3	4.1	4.4	3.8	3.3	3.3
Jublee	0.72	0.62	5.9	4.4	4.7	3.6	3.9	3.9
Royal sweet	0.81	0.71	6.2	4.1	4.8	3.6	3.9	3.9
Petite	0.74	0.59	6.4	4.9	4.7	4.3	3.9	3.9
Mean	0.71	0.65	6.14	4.38	4.70	3.86	3.72	3.72
P of F	0.42	0.4	0.9	2.13	0.62	0.76	0.91	0.91
S.E ±	0.68	0.64	3.24	4.32	3.25	2.65	3.60	3.60
Insectic. x SR	NS	NS	**	**	NS	*	NS	NS
Insectic. x VR	NS	NS	NS	NS	NS	NS	NS	NS
SR X VR	NS	NS	NS	NS	NS	NS	NS	NS
Insectic. x SR x VR	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letters in the same column are not significantly different at ($P \leq 0.05$) level of probability using the Student Newman Keuls (SNK) method of mean separation, AFT= After, insect. = Insecticide

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