INTERNATIONAL JOUNAL OF: AGRICULTURAL RESEARCH AND BIOTECHNOLOGY

TIMBOU-AFRICA ACADEMIC PUBLICATIONS
INTERNATIONAL JOURNAL, MAY, 2022 EDITIONS
VOL. 9 NO. 1 ISSN: 3438-2901

EFFICACY OF SELECTED PLANT EXTRACT MIXTURES ON MAJOR FIELD INSECT PESTS OF WATERMELON (*CITRULLUS LANATUS* THUN.)

ALAO FATAI OLAITAN, OLANIRAN OLADELE ABIODUN AND ADEBAYO THIMOTY ABIODUN

Ladoke Akintola University of Technology, Department of Crop and Environmental Protection, Ogbomoso, Nigeria

ABSTRACT

Use of secondary biologically active compounds in the protection of field insect pests of crops has been considered as an alternative to the use of synthetic insecticides. In the light of this, selected plant extract mixtures of *Tephrosia vogelii, Moringa oleifera, Annona squamosa* and *Anarcadium occidentalis* nuts were tested on the field insect pests of

Introduction

Cultivation of crops can be enhanced through the application of fertilizer which increases the soil fertility meanwhile without the effective crop protection, the yield will be considerably low. Therefore, crop production and crop protections go hand in hand. Watermelon (*Citrullus lanatus* L.) is one of important curbitacea crops which is very common in the tropics and subtropics (Yamaguchi, 2006). This crop was believed to have originated from Africa continent (Schippers, 2000). Its cultivation is very rampant in Nigeria, especially northern part of this country. According to Alao and Adebayo (2015), farmers in Western part of Nigeria have picked interest in the cultivation of watermelon due to its economic and nutritional important. Watermelon has been described as juicy fruit and acts as body coolant (Cobley, 1999). It is very rich in Lycopene, Carotenoid and has antioxidant

watermelon during the early and late cropping of 2019. The tested plant extracts were prepared with cold water. Lambdachyalothrin and control were included in the experiment for comparison. The experiment was set up in a Randomised Complete Block Design and each treatment was replicated three times. Data were collected on number of insect infestations, defoliated leaves, fruit damage and fruit yield. The results show that four insect pests were observed and all the tested plant extract mixtures exhibited insecticidal action against the observed insects. Among the plant extract mixtures, combination of *M. oleifera* and *T. vogelii* (MO + TV) had highest insecticidal efficacy (55%) during early season. During late planting season, insecticidal potential of plant extract mixture of *M. oleifera* and *T. vogelii* was comparable with synthetic insecticide (Lambdancyhalothrin). Highest yield (21.3 – 18.2 t/ha respectively) was obtained from the plants treated with Lambdacyhalothrin followed by the plants treated with *M. oleifera* + *T. vogelii* (19.1 – 15.0 t/ha) during both planting seasons. Therefore, plant extract mixtures can be incorporated into the field insect pest management of watermelon.

properties that improve health (Bohm *et al*., 2002; Cho *et al*., 2004). Watermelon has been reported to contain high proximate, vitamins and mineral contents especially potassium which helps in controlling blood pressure and possibly strokes (Sodeke *et al*., 2005: Auchu *et al*., 2005; Collins, 2007).

Insect pest is one of the most discouraging factors in the cultivation of watermelon in Western part of Nigeria due to the favourable climatic condition in this region. According to Alao *et al*., (92018) insect infestation of watermelon can be categorized into pre and post flowering insects of which pre-flowering insects include flea beetles (*Phyllotreta* species, *Aulocophora Africana*), Red pumpkin beetle, cucumber beetle (*Diabrotical undecimpunctata*), Grasshoper (*Zonocerus variegatus*) e.t.c these insects cause heavy defoilation of leaves which could hinder photosynthetic ability of watermelon plants. However, major post-flowering insect pest is *Bactocera cucurbitea* attack the

TIJARBT
ISSN: 3438-2901

flower as well as both young and mature fruits. Infestation of young fruits results to abortion of watermelon fruit while the attack of mature fruits lead to secondary infection of the fruits by disease and loss of economic yield (Dhillion, 2005; Alao *et al*., 2018).

Control of aforementioned destructive insect pests becomes imperative (Alao *et al*., 2020) in order to get impressive yield. The use of conventional insecticides has become the order of the day by our local resource farmers, this can be attributed to their effectiveness against the target insects (Isman and Grieneisen, 2014; Olaniran *et al*., 2016). Synthetic insecticide groups such as Organophosphate, Organochlorine, Carbamates and Phyrethroids have been implicated to have caused environmental pollution (Isman, 2008) and they are not affordable to farmers due to high exchange rate. Insect pests have been known to develop resistant to these insecticides after prolong use (Isman, 2008). Therefore, environmental friendly approach should be developed; this has led to the use of plant extracts as botanical insecticides. Several secondary metabolites from plants have been tested in Nigeria and reported to be effective against field insect pests of cowpea, watermelon, okra, egg plants and roselle (Oparaeke, 2005; Egbo and Emosarrue, 2010; Odewole *et al*., 2014; Alao and Adebayo, 2015; Olaniran *et al*., 2016; Olaniran *et al*., 2018).

However, mixture of secondary metabolites may be deterrent to insects and herbivores for longer period than single compound and, different physical properties may allow more deployment or longer persistence of defenses (Rameshwar, 2010). Therefore, this experiment was conducted to determine effects of plant extract mixtures against field insect pests of watermelon.

MATERIALS AND METHODS

Study Site

The field experiment was conducted in the cropping season of 2011 and 2012 at Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm, Ogbomoso, Oyo State.

Experimental Design and Management

The experimental field was harrowed and ploughed once and twenty four (24) plots were demarcated and each experimental plot size was 3 m x 3 m with four plant stand rows. This experiment was arranged and

TIJARBT
ISSN: 3438-2901

demarcated in a Randomized Complete Block design. There were six treatments with three replicates. Two to four watermelon seeds (sugar baby) were sowed per hole. Two weeks after planting, thinning was done to one plant per stand. Each plot contained four plant rows.

Preparation of Plant Extracts

The plant materials (*T.vogelii, M. oleifera, A. squamosa* and Cashew seed nut) were air dried for 7 days to reduce the moisture content. The plant plants were crushed separately in a mortal with pestle. 500 g each of the crushed plant materials were weighed separately with the sensitive scale into 10-litre plastic bucket containing 1000 ml of water. The plant powder were mixed in different buckets according to their respective treatments in ratio 1:1 and 2-litre of water were added to each bucket and allowed to stay overnight. The solutions were filtered with muslin cloth. The filtrate collected was stored in a 5-litre keg from which 1000 ml of stock solution was collected which served as stock solution for the concentration (20% v/v).

Treatment Application

Each of the plant extract mixture was in ratio 1:1 which was applied at 20% v/v. An unsprayed and synthetic insecticide (Lambdachyalothrin) plots were included for comparison. Spraying commenced two weeks after seedling emergence with five spray applications at weekly interval. This was done with hand-held sprayer. The various treatments are indicated as follows:

Summary

Lambdachyalothrin = applied at manufacturer's recommended rate

Control = unsprayed plots

AO + AS = *Anarcardium ocidentalis* + *Annona squamosa*

TV + MO = *Tephrosia vogelii* + *Moringa oleifera*

TV + AS = *Tephrosia vogelii* + *Annona squamosa*

TV + AO = *Tephrosia vogelii* + *Anarcardium ocidentalis*

MO + AO = *Moringa oleifera* + *Anarcardium ocidentalis*

MO + AS = *Moringa oleifera* + *Annona squamosa*

TIJARBT
ISSN: 3438-2901

Data Collection
Population densities of insect pests were counted visually from four plant stands in the two middle plant rows. The observed adult insects collected were taken to Insect Mucium at University of Ibadan for identification of the species.
Percentage Defoliated Leaves: Estimation of defoliated leaves were done 2nd week after spraying and the leaves showing evidence of shot holes were considered as being damaged. This was done visually by counting the defoliated leaves and total number of leaves from the four selected plant stands in the two middle plant rows. Percentage defoliated leaves was determined using the formula described below:

$$\% \text{ Leaves damaged} = \frac{\text{Total no. of leaves produced per plant} - \text{No. of undamaged leaves}}{\text{Total number of leaves produced}} \times 100$$

Yield: Three months after planting, the matured fruits were harvested and weighed on the field with manual scale in kilogram (kg) which was later calculated in ton per hectare (t/ha).

Data Analysis
Data collected were subjected to analysis of variance (ANOVA) using randomized complete block design. Significant means were separated with Ducan Multiple Range Text at 5% probability. To normalize variances for all analyses, the numbers of insects were square-root transformed. However, insecticide efficacy of the main treatments was calculated using abbot formula (1972):
Efficacy = (CA – TA / CA) X 100.
CA = Insect count on untreated plants
TA = Insect count on treated plants

RESULTS
The result presented in table 1 shows significant different among the treatments. Among the plant extracts, combination of *M. oleifera* + *T. vogelii* (MO +TV) exhibited highest insecticidal effect against *Phyllotreta cruciferae* when compared with other plant extracts mixtures closely followed by combination of *A. occidentalis* + *A. squamosa* (AO+AS) and *A. occidentalis* + *T. vogelii* (AO+TV). Meanwhile, highest *P. crucifera* infestation was observed in the untreated plants during both planting

season. During late planting season, the tested plant extract mixtures compete effectively with Lambdacyhalothrin in the control of *P. cruciferae* infestation

In respect to *Diabroitical undecimpunctata*, the least *D. undecimpunctata* was observed in the plants treated with Lambdachyalothrine during the two planting seasons. Combination of *M. oleifera* + *T. vogelii* (MO +TV) significantly performed better than other plant extracts mixture in the control of this insect. Among the plant extracts mixture, plants treated with *A. occidentalis* + *A. squamosa* (AO+AS) had highest *D. undecimpunctata* infestation in both planting seasons. During late planting season, *M. oleifera* + *T. vogelii* (MO+TV) exhibited the same insecticidal potential with Lambdacyhalothrin.

The least insecticidal effectiveness was observed on the plants sprayed with *A. occidentalis* + *A. squamosa* (AO+AS) when compared with other applied extract mixture during both planting seasons against *Bactrocera curcurbitae* infestations. During early planting season, all the plant extract mixture except (AO+AS) compete effectively with Lambdacyhalothrin against *B. curcurbitae*. No significant different was detected among the plants treated with MO+TV, TV+AS, and MO+AS in the control of this insect.

As presented in table 2, highest leave defoliation was observed in the unprotected plants during late and early planting seasons. Among the plant extract mixtures, the least leaf defoliation was detected on plants treated with *M. oleifera* + *A. occidentalis* (MO+AO) in the early planting season while the least defoliation was recorded on the plots treated with Lambdacyhalothrin in the late planting season. Among the plants extract mixtures, plants sprayed with *T. vogelii* + *A. squamosa* (TV+AS) had highest significant leave damage in the early season while plants sprayed with *M. olefera* + *A. squamosa* (MO +AS) effectively protected the leaves from being defoliated compared with other extract mixtures treated plants during late planting season

In respect to fruit damage, the least fruit damage was observed on the plots treated with Lambdacyhalothrin (15%) closely followed by the plots sprayed with *M. oleifera* +*T. vogelii* (MO+TV) (19%) during both planting season. All the applied plant extract mixtures had significant lower fruit damage compared with untreated plants (55.1 and 43.1% respectively) in both planting seasons.

Highest fruit yield (21.3 and 18.2 tha^{-1}) were observed in both planting seasons treated with Lambdacyhalothrin. Among the plant extract mixtures, application of *M. oleifera* + *T. vogelii* (MO+TV) resulted into highest significant yield (19.1 t/ha) in both planting seasons but the plants

TIJARBT
ISSN: 3438-2901

sprayed with *A. ocidentalis* + *A. squamosa* (AO+ AS) had the least significant yield (11.6 t/ha) during the early season while the least yield was observed during the late season was reported on the plants treated with *T. vogelii* + *A. squamosa* (TV+AS).

Table 1: Effects of plant extracts mixtures on insects infestations

	Insect population(early season)			Insect population(Late season)		
Treatments	***P.cruciferae***	***D. undecimpuntata***	***B. cucurbitae***	***P. cruciferae***	***D. undecimpuntata***	***B. cucurbitae***
Control	2.38^{a}	2.03^{a}	1.84^{a}	1.03^{a}	1.43^{a}	1.61^{a}
Lambda	0.95^{d}	0.82^{d}	0.85^{b}	0.71^{b}	0.71^{c}	0.82^{c}
AO+ AS	1.91^{b}	1.71^{ab}	1.59^{a}	0.78^{b}	1.28^{ab}	1.37^{ab}
AO+ TV	1.81^{b}	1.35^{bc}	1.13^{b}	0.71^{b}	0.96^{bc}	1.13^{bc}
MO+AO	1.72^{bc}	1.38^{bc}	1.23^{b}	0.82^{b}	1.07^{abc}	1.08^{bc}
MO+AS	1.67^{bc}	1.34^{bc}	1.08^{b}	0.78^{b}	0.82^{bc}	1.02^{c}
TV+AS	1.63^{bc}	1.45^{bc}	1.04^{b}	0.71^{b}	0.85^{bc}	0.97^{c}
MO+TV	1.35^{c}	1.11^{cd}	0.93^{b}	0.71^{b}	0.71^{c}	0.95^{c}

KEYS:
Lambda- Lambdacyhalothrin
AO-*Anacardium occidentalis*
AS- *Annona squamosa*
TV- *Tephrosa vogelli*
MO- *Moringa oleifera*

Table 2: Effects of plant extracts mixtures on insects infestations

	Yield Parameters(Early season)			Yield Parameters(Late season)		
Treatments	**Defoliated leaves(%)**	**Fruit damage (%)**	**Yield(t/ha)**	**Defoliated leaves(%)**	**Fruit Damage (%)**	**Yield (t/ha)**
Control	55.1^{a}	40.4^{a}	3.40^{g}	35.1^{a}	43.1^{a}	9.93^{h}
LD	28.8^{g}	15.0^{hg}	21.3^{a}	8.43^{b}	15.0^{h}	18.2^{a}
AO+ AS	41.17^{b}	33.9^{b}	11.6^{f}	25.0^{d}	31.0^{ab}	10.1^{g}
AO+ TV	41.1^{c}	30.1^{c}	13.6^{d}	25.0^{d}	28.8^{c}	13.0^{d}
MO+AO	24.5^{h}	29.2^{d}	13.6^{d}	29.4^{b}	35.0^{b}	12.5^{e}
MO+AS	35.3^{e}	23.9^{f}	17.7^{c}	13.7^{e}	28.1^{c}	13.8^{c}
TV+AS	36.9^{d}	27.2^{e}	13.4^{e}	26.0^{c}	23.87^{f}	11.7^{f}
MO+TV	32.2^{f}	19.0^{ch}	19.1^{b}	29.5^{b}	23.3^{g}	15.0^{b}

Means with the same alphabet(s) along the column are not significantly different at 5% probability using DMRT

KEYS:
LD- Lambdacyhalothrin
AO-*Anacardium occidentalis*
AS- *Annona squamosa*
TV- *Tephrosa vogelli*
MO- *Moringa oleifera*

TIJARBT
ISSN: 3438-2901

DISCUSSION

The integral component of crop production is the crop protection which can either be the use of synthetic or botanical insecticides. However, synthetic insecticides constitute environmental hazard when compared with botanical insecticides. Therefore, this experiment was conducted to determine the effectiveness four plant extract mixtures (*M. oleifera, T. vogelii, A. squamosa* and *A. occidentalis*) in the control of field insect pests of watermelon. Three insects were observed namely; *P. crusciferae*, *D. undecimpunctata* and *B. cucurbitae. P. cruciferae* and *D. undecimpunctata* attacked the vegetative part while *B. cucurbitae* infested on flower and fruiting stage of water melon (Dihillon *et al.,* 2005, Alao *et al.,* 2016; Sapkota *et al*., 2010). The tested plant extract mixtures were found to be effective in the control of field insect pests of the observed insect pests when compared with untreated plants. This is an indication that the tested plant extracts exhibited insecticidal action. The earlier report by Alao and Adebayo, 2015 has proved that field insect pest of watermelon can be controlled by *T. vogelii* and *M. oleifera*. In a similar research work, jhlomal extract was found to be effective against the watermelon fruit fly (Sapkota *et al*., 2010)

Among the plant extract mixtures, combination of *M. oleifera* and *T. vogelii* exhibited higher insecticidal control than other applied plant extract mixtures against field insect pests of this crop. This suggests that there is synergistic action between *M. oleifera* and *T.vogelii* than the others. This observation concurs with earlier work by Taun *et al*., 2014 who reported the effectiveness of garlic with chilli against insect pests of Cabbage.

Data collected suggest that none of the applied plant extract mixtures were effective as Lambdacyhalothrin during early planting season meanwhile application of *M. oleifera* + *T. vogelii* and other plant extracts mixture compete effectively with Lambdacyhalothrin in the late planting seasons. This suggests that plant extract ,mixture can serve as perfect alternative to Lambdocyhalothrin in the late planting season, this can be attributed to low rain fall during late planting season which might have responsible for the washing away of the plant extracts after application (Alao *et al.,* 2020).

Yield has been reported as the ultimate goal of a farmer irrespective of the chemicals used to achieve this aim. The yield obtained from both planting seasons clearly shows that synthetic insecticide treated plants had highest yield in both seasons. However, the yield obtained from the plants sprayed with MO+TV was reasonably higher than other plant extract mixture. This might have been due to the lower level of insect pests in the plants treated with MO + TV. This concurs with the ealier research works by Ibekwe *et al*., (2013) and Mhuammed *et al*., (2013) who reported that synthetic and botanical insecticides effectively controlled insect pests which resulted into stunted plant growth and yield of watermelon.

CONCLUSION

Combination of the tested plant extracts exhibited insecticidal potential in the control of the observed field insect pests of watermelon. Meanwhile, combination of *M. olifera* with T. vogelii had significant higher insecticidal control than the other applied plant extract mixtures. The demand for organically produced crops is becoming extremely high, therefore, use of the tested plant extracts mixture is a welcome development in the management of field insect pests of watermelon.

REFFERENCES

Auchu M.B., Fokou E., Tchiegang C., Fotso M. and Techonanguep F.M. (2005). Nutritive value of some *cucurbitaceae* oilseeds from different regions in Cameroon. *African J. Biotechnology*, *4*, 1329-1334.

Alao F.O. and Adebayo T.A. (2015). Comparative efficacy of *Tephrosia vogelii* and *Moringa oleifera* against insect pests of watermelon (*Citrullus lanatus* Thumb). *International Letters of Natural Sciences*, 35:71-78.

Alao F.O., Adebayo T.A. and Olaniran A.O. (2018). Bioefficacy of *Moringa oleifera* and *Anacardium occidentale* against insect pests of watermelon (*Citrullus lanatus* Thumb) and their effects on watermelon fatty acid profile. Acta fytotechn zootechn, 21(3): 84–92

Alao F.O., Adebayo T.A. and Olaniran O.A. (2020). Bioactivity and effects of spraying interval of selected plant extracts for control of pre-flowering insect pests of watermelon (*Citrulus lanatus* (Thunb.). *Acta Agriculturae Slovenica*, 110-116

Bohm V., Puspitasari–Nienaber N.L., Ferruzzi M. and Schwartz S.J. (2002). Trolox equivalent antioxidant capacity of different geometrical isomers of -Carotene, b-Carotene, lycopene and zeaxanthin. J. agric. Food Chem. 50:221-226.

Cho E., Seddon B., Roser E.C., Willet S.E. and Hankinson F. (2004). Prospective study of intake of fruits, vegetables, vitamins and carotenoids and risk of age, *Maculopathy*, 6, pp- 883-892.

Collins J.K. (2007). Watermelon consumption increases plasma arginine concentrations in adult, *Nutr. Mar.* 23(3): 261-266.

Sodeke V.A. (2005). Extraction of oil from watermelon seed and analysis, *Ouarterly research service*, 4: 25-30.

Cobley L. (1999). An introduction to the Botany of Tropical crops. 2nd Edition, Longman, London.

Dhillion, M.K., Singh, R., Naresh, J.S. and Sharma, H.C. 2005. The melon fruits fly, *Bactrocera cucurbitae*: a review of its biology and management. *Journal of Insects Science*. 5:15- 40, available online: insect science.org 15.40

Egbo E.O. and Emosarrue S.O. (2010). Effect of Neem seed kernel extract on major insect pests of cowpea (*Vigna unguiculata* (L.) Walp and influence on yield under calendar and monitored sprays. *Annals of Biological research* 1(2): 210 – 220.

Ibekwe H.N., Nwanguma E.I., Uwalaka O.A., Opara S.C., Ngbede S.O. and Onyegbule U. (2013). Evaluation of the efficacy of some plant leaf extracts on insect pest infestation, growth and yield of water melon in Okigwe south-eastern Nigeria. 31st Annual Conference Book of Abstract of HORTSON held at RMRDC, 22nd -26th September, 2013, pp. 86.

Muhammad S.M., Afolayan S.O., Idris B.A., Gwammaja M.Y., Habu S.H., Yaduma J.J., Bala M.G. and Giginya Y.G. (2013). Comparative yield potentials of five varieties of Water melon in the Guinea Savannah Ecological Zone of Kano, Nigeria. 31st Annual Conference Book of Abstract of HORTSON held at RMRDC, 22nd-26th September, 2013, pp. 86.

Odewole A.F, Alao F.O, Agboola A.A. and Adedapo B.F. (2014). Comparative efficacy of plant extracts with synthetic insecticide against insect pests of okra (Abelmoschusesculentus L. Monech). *International Letters of Natural Sciences*, 14(2) 52-58

Olaniran, O.A., Alao, F.O., Yusuf, S.Y. and Adebayo T.A. 2016. Effects of Selected Plant Extracts Formulation on Insect Pests and Nutritional Quality of Egg Plant Fruits (S*olanum melogena* L.). International Journal of Applied Agricultural and Apicultural Research, 12 (2): 59-70

Olaniran O.A., Alao F.O., Yusuf S.Y. and Adebayo T.A. (2018). Bioefficacy of *Petiveria alliacea* and *Annona squamosa* against *Podagrica* species of Roselle (*Hibiscus sabdariffa* Linn). *Journal of Zoology and Entomology study*, 6(4):862-866

Oparaeke A. (2005). Studies on insecticidal potential of extracts of *Gmelina arborea* products control of field pests of cowpea (*Vigna unguiculat* (L.) Walp the pod borer; *Maruca vitrata* and the coreid bug *Clavigralla tomentosicolis*. *Journal of plant protection research*, 11:50-56.

Rameshwar S.R. (2010). Mechanism of action of insecticidal secondary metabolites of plant origin. *Crop Protection*, 29, 913-920

Sapkota, R. (2010). Damage assessment and management of cucurbit fruit flies in spring-summer squash. *J. Entomol. Nematol,* 2:7–12

Schippers R.R. (2000). African indigenous vegetable, pp: 56-60. An overview of the cultivated species chatthan, U.K RN. RACO, EU pp: 56-60

Tuan N., Anh B. and Anh B. (2014). Efficacy of Garlic and Chili Combination Solution on Cabbage Insect Pests and Crop Growth in Vietnam. International Journal of Biological, Agricultural, Food and Biotechnological Engineering, 8(10).

Yamaguchi M. (2006). World Vegetables: Principles, Production and Nutritive Values. AVI Publishing Co., Westport, USA.