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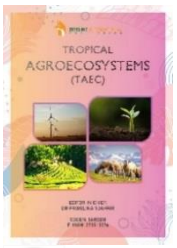


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***RESEARCH ARTICLE***

# EFFECT OF JATROPHA OIL ON THE MANAGEMENT OF FALL ARMYWORM (*Spodoptera frugiperda* JE smith.) IN MINNA, NIGER STATE

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**ABSTRACT**

Indiscriminate use of synthetic pesticides is likely to give rise to fall armyworm (*Spodoptera frugiperda)* resistance and environmental pollution which may result in poisoning of human. In view of these, there is need to develop naturally occurring insecticides which may be less toxic to man and animals but as effective against fall armyworm (*Spodoptera frugiperda)* of various cereals as synthetic insecticides. Field research was carried out in the Teaching and Research Farm of Federal University of Technology, Minna to evaluate the effect of *Jatropha* oil on the management of fall armyworm. The experiment was arranged in Randomised Complete Block Design (RCBD) with three replicates and six varieties. 45 ml/ L of *Jatropha* oil was applied every week for four weeks using Knapsack sprayer. Data on severity of fall armyworm infestation, plant height, stem diameter, number of ears, number of rotten ears, fresh and dry cob weight and grain yield were subjected to Analysis of Variance (ANOVA) the means were separated using Duncan Multiple Range Test (DMRT). The results indicated that OPV maize variety recorded the highest grain yield while Oba super 6 demonstrated a tolerance against the infestation of fall armyworm (*Spodoptera frugiperda*). Therefore, farmers could plant OPV maize variety for its high grain yield and Oba super 6 for its tolerant against the infestation of fall armyworm.

**KEYWORDS**

Maize, Fall armyworm, *Jatropha, Spodoptera frugiperda*, Variety.

## 1. INTRODUCTION

Maize (Zea mays L.) is one of the most important cereal grains grown worldwide in a wider range of environments because of its greater adaptability (Kogbe and Adediran, 2003). It is referred to as "queen of cereal" because it is highly yielding adaptable to wider agro ecologies, cosmopolitan crop. It is mainly used as a food source and now has become the most important raw material for animal feed (Pimentel and Patzek, 2005). Maize grain is extensively used for the preparation of corn starch, corn syrup, corn oil dextrose, corn flakes, gluten, grain cake, lactic acid and acetone which are used by various industries such as textile, foundry, fermentation and food industries. In the developed world, maize is mostly used for animal feed (70%) and only a small percentage (5%) is consumed by humans. The developing countries consume about 62% of maize as food and 34% is used as feed. The remaining proportion is used for varied industrial uses and as seed. Generally, Africa produces but just 6.5% of the world's maize consumption with Nigeria being the largest African producer seconded by South Africa: it is widely grown all over the country but the highest production is from Niger, Kaduna, Taraba, Plateau, and Adamawa. Native to the Americas, the fall armyworm (FAW; Spodoptera frugiperda(JE Smith) Lepidoptera,Noctuidae) was first reported as present on the African continent in January 2016 (Goergen et al., 2016).Subsequent investigations have revealed the pest in nearly all of sub-Saharan Africa (SSA), where it iscausing extensive damage, especially to maize fields and to a lesser degree sorghum and other crops.Currently, over 30 countries have identified the pest within their borders including the island countriesof Cape Verde, Madagascar, São Tomé and Príncipe, and the Seychelles. Generally, the control of insect largely depends on the use of synthetic insecticides in the field and stored product in particular, however indiscriminate use of many synthetic insecticides is associated with many fold; human technical, environmental, non – target organism. Even insect pest management such as resistance of insect pest, food and product contamination with toxic residue, biodiversity erosion and other side effects, impacts incredible magnitude on human's health. In addition, non-availability insecticides to countryside farmers and ventilation restrictions in storage grains are the negative effect of synthetic chemicals. Thus, the search for economic friendly, health hazard free, cost effective, easily available insect pest management option with the use of plant oil is earnestly adopted worldwide as an alternative to reduce the menacing effects caused by the use synthetic chemical insecticides in pest management. Broadly speaking plant oil are effective tools in wild range of insect pest management with broad spectrum action. Indiscriminate use of synthetic pesticides for controlling fall army worm is likely to give rise to fall armyworm (*Spodoptera frugiperda)* resistance and environmental pollution which may result in poisoning of human, especially in developing countries including Nigeria. In view of these, there is need to develop naturally occurring insecticides which may be less toxic to man and animals but as effective against fall armyworm (*Spodoptera frugiperda)* of various cereals as synthetic insecticides. Toxicity of leaf extracts of different plant against fall armyworm (*Spodoptera frugiperda)* has been

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reported by many researchers. Therefore, the present research work tend to use botanical oil extract to control the infestation of the said insect pest of maize in replacement of synthetic insecticide and recommend its effectiveness to maize growing farmers and other agricultural development agencies. Management of fall armyworm (*Spodopterafrugiperda*) in maize fields begins with prevention: Planting dates: avoid late planting, and avoid staggered planting (i.e. planting of fields at different dates in the same area), as this would continue to provide the favoured food of fall armyworm (*Spodopterafrugiperda*) locally (i.e. young maize plants). This is one of the most important recommendations for smallholders. Good soil health and adequate moisture are critical; they are essential to grow healthy plants, which can better withstand pest infestation and damage. Also, unbalanced inorganic fertilization of maize (especially excessive nitrogen use) can increase oviposition by female fall armyworm (*Spodopterafrugiperda*).

Generally, the control of insect largely depends on the use of synthetic insecticides in the field and stored product in particular, however indiscriminate use of many synthetic insecticides is associated with many fold; human technical, environmental, non – target organism. Even insect pest management such as resistance of insect pest, food and product contamination with toxic residue, biodiversity erosion and other side effects, impacts incredible magnitude on human's health. In addition, non-availability insecticides to countryside farmers and ventilation restrictions in storage grains are the negative effect of synthetic chemicals. Thus, the search for economic friendly, health hazard free, cost effective, easily available insect pest management option with the use of plant oil is earnestly adopted worldwide as an alternative to reduce the menacing effects caused by the use synthetic chemical insecticides in pest management. Broadly speaking plant oil are effective tools in wild range of insect pest management with broad spectrum action.

## 2. Materials and Methods

### 2.1 Description of Location of Experiment

The experiment was conducted at the Teaching and Research Farm of Federal University of Technology Minna, (Gidan Kwano Campus) Niger state. The experimental site is located at the Longitude 6° 29′E and Latitude 9° 35′N with altitude 236m above sea level (Android GPS Compass Navigator). The climate of Minna is sub-humid tropical, characterized with a long term mean rainfall of about 1284mm and a mono-modal pattern of rainfall. Minna lies within the Southern Guinea Savanna Agro-ecological zone of Nigeria (Ojanuga, 2006). The soil of Minna is generally classified as Alfisols (Adeboye *et al*., 2011).

### 2.1 Experimental Materials

Six maize varieties were obtained from Institute of Agricultural Research (IAR), Ahmadu Bello University, Zaria, Nigeria. The acquired maize varieties are; SAMMAZ 34, SAMMAZ 15, OBA SUPER 6, OBA SUPER 11, ACROSS 97 And OPV Maize.

### 2.2 Experimental Design

The experiment was arranged in Randomized Complete Block Design (RCBD) with Three Replication and Six Varieties. The net plot size was 14 x 15m$^2$. Each replication consists of 6 plots, each replicate measuring 14 x 4.3m$^2$ and plot measuring 1.75 x 4.3m$^2$. Five ridges were made in each plot with 1m as alley between the replication and 0.5 m between plots. The planting Space of 75 cm between rows and 25 cm within rows. The seeds were sown at a depth of 5cm. The *Jatropha curcas oil* was obtained from Department of Biochemistry at Federal University of Technology Minna, Niger State (Bosso Campus), and 43.3ml of *Jatropha curcas*oil was added to 13litres of water for the spraying of maize plant using knapsack sprayer on 15 X 14m$^2$. The total of 173.2ml of *Jatropha curcass oil* were used for these periods of four weeks application.

### 2.3 Land preparation and sowing

The land was cleared with hand hoes and machete in order to keep the soil loose for good seedbed and subsequent effective germination and seedling emergence. Land was prepared and ridges were made manually. Seeds were sown after the full establishment of rainfall. Maize seed was sown at inter-row and intra-row spacing of 75 cm and 25 cm respectively.

The weeding was done manually three times at interval of three weeks after seedling emergence.

### 2.4 Fertilizer application

NPK 15:15:15 fertilizer was applied three weeks after sowing at the rate of 3.7g and Urea fertilizer was applied at 6weeks after sowing to supplement for nitrogen requirement of maize.

### 2.5 Data Collection

#### *2.5.1 Severity determination*

Fall armyworm (*Spodopterrafrugiperda)* severity was determined by scoring fall armyworm damage to maize plant, using the scale below:

| Visual rating damage | Numerical score | Resist |
|---|---|---|
| No damage | 0 | likely escape |
| Few pin hole | 1 | highly resistance |
| Few short holes on few leave | 2 | résistance |
| Several short holes (<50%) | 3 | resistance |
| Several leaves with short holes (>50%) | 4 | moderately resistance |
| Elongated lesion on a few leaves | 5 | moderately resistance |
| Elongated lesions on several leave | 6 | susceptible |
| Several leaves with long lesions or tattering | 7 | susceptible |
| Several tattering | 8 | highly susceptible |
| Plant drying as a result of foliar damage | 9 | extremely sensitive to damage |

Severity scoring table Source: CIMMYT, 2011)

10 plant samples were randomly selected from the field for measure, from the ground level to the tip of the tallest leaf using a meter rule at 10WAS. The diameter of the stem was measured at 10WAS using vernier caliper. Ear rot was rated on a scale of 1 and 5, where 1= little or no visible ear rot and 5 = extensive visible ear. The number of days from planting to the time when 50% of the plants have tassel shading polar was counted. The number of ear per plant was counted. Immediately after harvesting from the field the average weight of harvest was taken within each replicate. The corn was sundried after which the average weights of each variety within each replicate are taken. Here the total of six varieties in each replication was combined and then weighed.

### 2.6 Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS Version 9, 2009). The treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

## 3. Results

### 3.1 Effect of *Jatropha curcass* oil on the plant height at 10WAS, stem diameter 10WAS, number of ear per plant at 13WAS and rating of rotten ear per plant at 13WAS

The effect of *Jatropha carcass* oil on plant height at 10WAS (Table 1) showed that there was no significant different observed among the varieties. So also, there was no significant different observed among the maize varieties for stem diameter at 10WAS.

No significant difference observed on the number of ear per plant at 13WAS among the maize varieties. So also, there was no significant different observed on the number of rotten ear per plant at 13WAS among the maize varieties.

**Table 1:** Effect of *Jatropha carcass* oil on the plant height at 10WAS, stem diameter at 10WAS, number of ear per plant at 13WAS and rating of rotten ear per plant at 13WAS.

| | Plant height (cm) | Stem diameter (cm) | Number of ear per plant | Rating of rotten ear per plant |
|---|---|---|---|---|
| VARIETIES | | | | |
| SAMMAZ 34 | 147.37 | 2.07 | 1.00 | 1.67 |
| SAMMAZ 15 | 148.53 | 1.93 | 1.00 | 1.70 |
| OBA SUPER 6 | 149..33 | 1.53 | 1.00 | 1.97 |
| OBA SUPER 11 | 149.00 | 1.93 | 1.00 | 1.87 |
| ACROSS 97 | 153.57 | 1.67 | 1.00 | 1.83 |
| OPV MAIZE | 157.37 | 1.27 | 1.00 | 1.87 |
| SE± | 8.56 | 0.27 | 0.001 | 0.11 |

### 3.2 Effect of *Jatropha carcass* oil on fresh weight, dry weight and grain yield of maize varieties

The result of fresh cob weight as indicated in Table 2 revealed that

obasuper 11 had a significant highest (P≤0.05) fresh cob weight compared to OPV maize but not significant different from other varieties. So also SAMMAZ 15, recorded significant higher (P≤0.05) fresh cob weight compared with OPV maize but not significant different from others. Similarly, Obasuper 11 recorded highest (P≤0.05) dry cob weight compare to ACROSS 97 and OPV maize but not significantly different from Obasuper 6, Sammaz 15 and Sammaz 34 on the same vein, ACROSS 97 recorded the lowest significant difference (P≤0.05) compared to Sammaz 15 but not significantly different from other varieties.Grain yield of OPV maize variety was significantly highest (P≤0.05) compared to all other maize varieties with Oba super 11, Sammaz 15 and Sammaz 34 recorded the lowest grain yield which were significantly different (P≤0.05) from Obasuper 6, ACROSS 97 and OPV maize varieties.

**Table 2:** Effect of *Jatropha carcass* oil on fresh cob weight, dry cob weight (g) and grain yield (kg ha$^{-1}$) of maize varieties

| | Fresh cob weight (g) | Dry cob weight (g) | Grain yield (kg ha$^{-1}$) |
|---|---|---|---|
| VARIETIES | | | |
| SAMMAZ 34 | 85.20ab | 47.10abc | 0.80d |
| SAMMAZ 15 | 114.63a | 56.23ab | 0.80d |
| OBA SUPER 6 | 90.60ab | 43.07abc | 1.20b |
| OBA SUPER 11 | 117.93a | 60.77a | 0.80d |
| ACROSS 97 | 87.03ab | 37.03c | 1.10c |
| OPV MAIZE | 77.23b | 39.47bc | 1.40a |
| SE± | 9.40 | 4.91 | 0.11 |

Means followed by the same letter(s) within a column are not significantly different by DMRT at 5 % level of probability

### 3.3 Effect of *Jatropha curcass* oil on visual rating of fall armyworm (*Spodoptera frugiperda)* infestation on maize varieties

No significant different recorded at 1WAS for fall armyworm infestation among the maize varieties, although ACROSS 97 recorded the lowest infestation of fall armyworm. At 2WAS ACROSS 97 showed the highest significant (P≤0.05) level of fall armyworm infestation compared to Sammaz 15 but not significantly different from all other maize varieties. At 3WAS no significant different recorded among the maize varieties, though Sammaz 15 recorded the lowest rate of fall armyworm infestation. At 4WAS, Obasuper 11 and ACROSS 97 recorded the highest significant different (P≤0.05) compared to Obasuper 6 but not significantly different from other maize varieties.

**Table 3:** Effect of *Jatropha curcass* oil on visual rating of fall armyworm (*Spodopterafrugiperda)* infestation on maize varieties

| Treatment | WK1 | WK2 | WK3 | WK4 |
|---|---|---|---|---|
| SAMMAZ34 | 10.63a | 11.03ab | 12.07a | 12.57ab |
| SAMMAZ15 | 10.03a | 10.30b | 11.23a | 12.40ab |
| OBASUPER6 | 9.73a | 11.47ab | 12.27a | 11.43b |
| OBASUPER11 | 9.45a | 11.97ab | 12.10a | 13.10a |
| ACROSS97 | 9.10a | 13.37a | 12.50a | 13.37a |
| OPV MAIZE | 11.23a | 11.60ab | 12.10a | 12.50ab |
| S.E | 0.79 | 0.71 | 0.75 | 0.45 |

Means followed by the same letter(s) within a column are not significantly different by DMRT at 5% level of probability.

## 4. Discussion

The *Jatropha curcass* oil was effective on the infestation of fall armyworm *(Spodoptera frujiperda). T*he result obtained from this study indicated that OPV maize recorded the highest grain yield among the six varieties, and this might be due to the fact that OPV maize variety whose genome as well as the germplasm has confined immunity in it to tolerate the infestation of the fall armyworm (*Spodoptera frugiperda).*

According to Nailul *et al*. (2018), research conducted in Andalas University Padang, Indonesia, that botanical extract of *Gentiana linearis* recorded the highest plant height, leaf area, fresh cob weight and grain yield which was in conformity to this study (Nailul *et al.,* 2018). The study also confirms the study conducted by Biswas *et al.* (2016), which showed that there was positive effects of moringa leaf extract on the number of leaf, root length, fresh weight and grain yield of maize (Biswas *et al.,* 2016). The findings also in concord with the work by Wahedi *et al.* (2016) which shows that neem seed extracts were effective in protecting maize plants from maize stem borers infestation (Wahedi *et al.,* 2016). The studies revealed that maize plants treated with neem seed extracts recorded little or no dead hearts when compared with the untreated neem kernel.

## 5. Conclusion

*Jatropha curcas* oil was effective for the management of infestation of insect pest (fall armyworm, *Spodoptera frugiperda)* of maize. All the six maize varieties of different attributes were treated with *Jatropha curcass* oil against the infestation of fall armyworm (*Spodoptera frugiperda).* OPV maize has demonstrated to have the highest grain yield among all the six maize varieties, also Oba super 6 also demonstrate a tolerant ability on the infestation of insect fall armyworm (*Spodoptera frugiperda*) but not as tolerant as that of OPV maize.

## 6. Recommendations

Farmers could plant OPV maize variety as tolerant against the infestation of fall armyworm (*Spodoptera frugiperda)*. Also, farmers can use *Jatropha curcass* oil for the management of insects infestation on maize field. Further studies should be conducted to validate the results obtained in this study or to clearly understand the mechanisms of resistance that are exhibited by the maize crop and the adoption of the right varieties.

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