EFFECTS OF GARLIC (Allium sativum L) EXTRACTS IN THE CONTROL OF MAIZE STEM BORER (Busseolafusca F) IN SOUTH EAST NIGERIA

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Abstract

This experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, between May and August 2019. The experiment investigated the effect of garlic *(Allium sativum)* extracts in the control of maize stem borer (Busseola fusca) in Owerri. The experiment was arranged in a Randomized Complete Block Design (RCBD) with four treatments and three replications. In this trial, various levels of treatments were used. (0ml, 50ml, 100ml, 150ml) and (0g, 50g, 100g, 150g) for crude liquid and crude powder extracts. Proximate analysis was carried out on *Allium sativum* which revealed the nutritional contents in percentages such as moisture content (62.86), Ash Content (0.90). Phytochemical analysis was carried out which revealed the presence of anti-nutritional constituents in percentages, such as Tannin (0.97), Phenol (0.15), Alkaloid (4.77), flavonoid (1.96), Saponin (1.44), oxalate (3.38), HCN (0.01) and Phytate (0.19). More so, infrared spectroscopy of Allium sativum revealed the presence of bioactive compounds and the different wavelength at which they were absorbed. Such compounds are amines (1032.36 and 3998.00), alkane and alkyl (2935.00), Alkene (1641.00), Aromatic compounds (1406.39), Alcohol (1126.14), Alkyl halides (532.36 and 593.00). data were collected on number of insects, number of plants infested leaf area, leaf area index, plant height, number of leaves, number of fruits per plot, stem girth and fruit yield and subjected to analysis of variance at 0.05% level of significance. The results of the trial revealed that the plots that received 50mls, 100mls and 150mls of crude liquid extracts suppressed number of insects (1.0, 1.3 and 1.0) also, plots that received 50mls, 100mls of crude liquid extract at 1WAT reduced the number of plants infested (0.3 and 0.3) than the crude powder extract (0.6 and 1.0) and these were significantly different ($P \leq 0.05$). The lowest mean (51.38kg/ha) and (2.67) in fruit yield and number of fruit per plot were recorded from untreated plots. The plant height showed no significant difference ($P \leq 0.05$). In this study, Allium sativum reduced the number of insect pests attack (Busseola fusca) on maize plant. This action might be due to the anti-nutritional or bioactive compounds inherent in Allium sativum.

Keywords: *Allium sativum, Busseola fusca*, phytochemicals

INTRODUCTION

Maize (Zea mays) is one of the most Important, consumed and popularly cultivated cereals in Nigeria.

Maize ranks third after wheat and rice in world production (Chopman and Carter, 1976). The major maize production areas are located in temperate regions of the globe. The United States, China, Brazil and Mexico account for 70% of global production. Africa produces 6.5% and the largest African producer is Nigeria with nearly 8 million ton followed by South Africa (FOASTAT, 2008).

In Nigeria, maize ranks fourth after millet, sorghum and rice.
It is one of the principal diet of man and also for livestock feeding. To man, it may be consumed directly as a supplement to other foods or may undergo refinement or processing which the final product is consumed that is beverages (Anochili, 1978).

Maize starch is used in the pharmaceutical industry as fillers diluents, humectants, binders and disintegrants. As disintegrants, it enables tablets and capsules to breakdown into smaller fragments.

In spite of these high trends in production rate of maize, efforts have been made towards reducing pest infestation of this crop which tend to reduce the market value of the crop and making it unfit for human consumption. Some of the pests are stem borers, cutworms, grain moths, beetles, grain borers, rootworms.

All the above mentioned pests damage the crop but various species of stem borers rank as the most devastating maize pests in Africa. They can cause 20-40% losses during cultivation and 30-90% losses post-harvest, and during storage (FAO, 2017). The damage is mainly caused by the larvae stage of the insect where it burrow into the stalks near ground level and eat their way upward through the Centre.

The menace of pests of maize are enormous that man has in the bid to check this damage by pests engage in the use of synthetic pesticides. The health risk and high cost associated with synthetic pesticides have necessitated the need to look for alternative means of control, which will reduce or eliminate the health and environmental hazards that go with synthetic pesticides. This

quest therefore necessitated the use of botanicals which are readily available to the farmer, quite easy to prepare, effective and non-toxic to the environment (Murdock et al., 2003).

Many plants are known to possess insecticidal or pesticidal effects (Anon, 1992). The recent problems of resistance by pests to pesticide (synthetic) and hazardous effects of these chemicals on non-target organism and the environment in general have renewed interest in exploiting the unlimited pest control potentials of plants (Lale and Mustapha, 2000).

The rising demand for alternative and safe method of protecting agricultural field crops from pests heightened the search for botanicals that can serve this purpose and at the same time protect the environment. It is on this search for more suitable botanicals that Allium sativumwas investigated as the broad objective.

Materials and methods

The experiment was conducted at the Teaching and Research Farm of Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. The site lies between latitude 5^0E and 6^0N and longitude 6^0N and 7^0E having an attitude of 90m above sea level within the south east agricultural zone of Nigeria.(Meteorological unit, ministry of lands and survey, 2006). Previous studies showed that the soil is sandy-loan with pH value of 5.2, the average temperature, annual rainfall with relative, humidity of Owerri are 27^0C, 2500mm and 25% respectively (Meteorological unit, Ministry of lands and survey, 2006). The region has a tropical humid climate with distinct wet and dry seasons. The wet season is from late March to October with little dry season in July and August.

Experimental Design and Layout

The experiment was laid out in Randomized Complete Block Design (RCBD) with the two (2) Blocks, with four (4) treatment levels replicated three (3) times making it twenty four (24) experimental (beds). The experimental site was manually cleared, parked and seed beds were prepared before planting. The size of the experimental plot is 12m x 10m making it area of 120m^2. The planting space was 50cm x 50cm, each bed measure 2m x 1m and the distance between each bed was 0.5m x 0.5m.

Preparation of botanicals

Vitamin maize (Oba 6) was used for this experiment. The garlic cloveswere ground with grinding machine and 500g of the ground garlic was soaked with 1500ml of hot deionized water for 24hours, sieved with 0.2mm mesh to get the crude liquid extract while the powder extract was oven dried crushed to get the power extracts. The ground garlic and its liquid solution were measured in the following level;0g, 50g, 100g, 150g and 0ml, 50ml, 100ml and 150ml respectively.

Data Analysis

Data collected was analyzed statistically using Genstat statistical software package and was subjected to Analysis of Variance (ANOVA) appropriate to Randomized Complete Block Design (RCBD) and mean separation was done using the least significant difference at 0.05 level of significance (Onuh and Igwemma, 2001)

RESULTS

Results on proximate analysis of Garlic revealed the % moisture content, % ash content, % fat content, % protein content and % fibre content (Table 1). On the other hand, phytochemical (%) analysis of garlic was determined. The following compounds were present: Tannin, Phenol, Alkaloid flavonoid, Saponin, Oxalate, HCN and phytate, the infrared spectroscopy revealed the various wavelength in which organic compounds were absorbed in garlic, see (Table 1 – 3).

Results of this experiment showed that the treatments (crude liquid and crude powder) extracts of Garlic (Allium sativum) controlled the level of maize stem borer (Busseolafusca) infestation in the field. Initially, when the maize plants were planted in the yield, before treatment application, other insect pests like lady birds, grasshopper, praying-mantis, caterpillars, snails etc. were observed in the field but they were also controlled by the treatments (crude liquid and crude powder) after application. But due to the main objective of this work was majored on maize stem borer (Busseolafusca) only; data were not collected on other insect pests (ladybird, snail, grasshopper etc).

Table 1: Proximate analysis of garlic (*Allium sativum*) in percentage

Proximate compositions	Percentage Value(%)
Moisture	62.86
Ash	1.37
Fat	1.10
Protein	10.13
Fibre	0.90

Table 2:Phytochemical screening of garlic (*Allium sativum*) in percentage

Parameters	Percentage (%) value
Tannin	0.97
Phenol	0.15
Alkaloid	4.77
Flavonoid	1.96
Saponin	1.44
Oxalate	3.38
HCN	0.01
Phytate	0.19

Table 3:Infrared spectroscopy and the different wave lengths at which the different organic compounds were absorbed

Wave number (cm^{-1})	Functional group	Remarks
2935.00	Alkane, Alkyl C-H	Medium to strong
1641.00	Alkene C=C	Medium
1406.39	Aromatic compound O	Strong
1126.14	O-H Alcohol	Strong
1032.36	Amines C-N	Medium
593.00	Alkyl halides C-Br	Strong
532.36	Alkyl halide C-Br	Strong

Discussion

The results of the study on proximate analysis revealed the percentage (%) nutritive constituents of Allium sativum such as moisture content, Ash content, fat content, protein content and fibre content. Phytochemical screening revealed the presence of the bioactive compounds comprising tannin, phenol Alkaloid, flavonoid, saponin, oxalate, HCN and phytate. This is in line with the work done by (Yusuf *et al*., 2018) that organic compounds contain some moisture constituents and phytochemicals.

The infrared spectroscopy of A. sativumrevealed bioactive compounds such as Amines, Alkane, Alkene, Alkyl, Aromatic compounds, Alcohol and Alkyl halide which were absorbed at different wave lengths. The infrared was carried out based on the need to find out the different compounds inherent in A. sativum. The result observed was in line with the works done by Emeribe *et*

al., (2016) which said that botanicals contains organic compounds which were absorbed at different wavelengths.

Based on the data collected, the results of the study revealed that the extracts (crude liquid and powder) of *Allium sativum* showed significant differences ($P \leq 0.05$) in some of the parameters tested in the control of maize stem borer (Busseola fusca) in the field.

On the number of insect pests, the crude powder and liquid extracts of *Allium sativum* reduced the presence of insect pests on maize plants. The results showed that both crude powder and crude liquid of *Allium sativum* 50g, 100g, 150g and 50mls, 100mls and 150mls respectively at one week and three weeks (1WAT and 3WAT) after treatment suppressed the incidence and attack of *Busseola fusca*. This action is in consonance with the work of (Katazyna and Beata, 2018) which stated that Garlic, wormwood and tansy have an advantageous effect on potato in protecting them against peach potato aphid, (Mycuspersicae). Also these results are in line with the works done by Baidoo and Mechiah, 2016) which reported that *Allium sativum* and capsicum frutescens significantly reduced the incidence of *Brassica oleracea* (L). similarly, Ogah *et al*., (2011) stated that neem seed kernel *(Azadirachta indica)* extracts significantly reduced stem borer damage compared to untreated check, and also, significantly increased number of productive fillers with resultant increase in grain than the control plots.

On the number of plants (maize plants) infested before and after application of crude powder and crude liquid of Allium sativum, the treatment inhibited the destruction of maize plants by *Busseola fusca*, especially the crude powder extract at 1WAT and 3WAT. Treatment(s) L_1 (50g), L_2 (100g) and L_3 (150g) protected the maize against the infestation of *Busseola fusca*. Also, the crude liquid extract at 1WAT and 3WAT on treatment L_1, L_2 and L_3 (50ml, 100ml and 150ml) also controlled the infestation of *Busseola fusca* on maize plants. This phenomenon is in accordance with the findings of Emeribe *et al*., (2016) which stated that crude extracts of Piper nigrum and A. meleguetainhibited the destruction of maize seeds from being eaten up by Sitophiluszeamaisin storage, Emeribe and Mavis, (2017), found out the effect of *Vernonia amygdalina* in the control of maize stem borer revealed success using 50 – 150 levels of treatment. On leaf area, there was no significant difference ($P \leq 0.05$) between and after application of crude powder and crude liquid extracts of *Allium sativum*. See tables (6a and 6b).

This is further supported the works of Emeribe and Mavis (2017) which stipulated that *Vernonia amygdalina* had no significant effect on leaf area.

Data collected on leaf area index showed no significant different ($P \leq 0.05$) both before and after application of crude powder and crude liquid extracts of *Allium sativum*. On plant height (cm), there was no effect of the treatment (crude liquid and crude powder) extracts of *Allium sativum* before and after application.

On number leaves per plant, there was significant effect at 3WAT on the crude liquid extract of Allium sativum but at 4WAP, 1 WAT and 3WAT, there was no significant difference ($P \leq 0.05$) on the crude powder extract of *Allium sativum*. This is in disagreement with Se Ji Jang and Yong InKuk (2019) that soybean, Chinese chive and stem extracts increased growth in lettuce.

Data collected on number of fruits per plot for both crude powder and crude liquid of *Allium sativum* showed significant difference ($P \leq 0.05$), this is seen at (P_0 = 0g; P_1 = 50g; P_2 = 100g, P_3 = 150g) and L_0 = 0ml; L_1 = 50ml; L_2 = 100ml and L_3 = 150ml) respectively.

On stem girth, there was significant effect at 2WAP (before application) for crude powder extract but there was no significant difference at 4WAP, 1WAT and 3WAT. Also, there was no significant effect on the crude liquid extract.

Also, on fruit yield (kg/ha) showed a significant difference ($P \leq 0.05$) for both crude powder and crude liquid extracts of *Allium sativum* at (P_0 = 0g; P_1 = 50g; P_2 = 100g; P_3 = 150g) and (L_0 = 0ml; L_1 = 50ml, L_2 = 100ml; and L_3 = 150ml) respectively. This is in agreement with the word done by Kamran *et al*., (2015) which said that the use of extracts of neem, thiodan reduced insect pests of okra and increased yield.

Conclusion and Recommendations

The foregoing discussion therefore, revealed that application of Allium sativum extracts reduced the level of maize stem borer (*Busseola fusca*) infestation in the field but did not add to the growth of maize plant. It is therefore recommended that, this experiment be tried using higher concentration of the extracts to obtain higher repellency and mortality rate Maize stem borer. Based on this trial, treatment levels (50, 100)ml, (100, 150)g respectively should be used by farmers to control *Busseola fusca*. The

crude liquid extract showed more potency in controlling *Busseola fusca* than the crude powder extract. There is need to carry out analysis such as High Pressure Liquid Chromatography (HPLC), Gas Chromatography Mass Spectrometer (GCMS) and Nuclear Molecular Resonance (NMR) to find out the active ingredients that controlled pests using *Allium sativum*.

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