International Journal of Food, Agriculture and Veterinary Sciences ISSN: 2277-209X (Online)
An Online International Journal Available at http://www.cibtech.org/jfav.htm
2013 Vol. 3 (2) May-August, pp. 104-109/Ekpe
Research Article

EFFECT OF PESTICIDE ON THE YIELD AND YIELD CHARACTERISTICS OF MAIZE ON A TYPIC HAPHSTULT IN ABAKALIKI SOUTHEAST NIGERIA

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ABSTRACT
An experiment was set up to determine the effect of insecticide application rates on soil and the yield of maize in Abakaliki Southeast Nigeria. The experiment was laid out in a randomized complete block design with insecticide rates (0,300,600 and 900ml.ha^{-1}, as T1.T2, T 3, and T4 as respectively) of application as treatment. The treatments were replicated into five to give a total of twenty experimental plots. Each plot measured 3 X 3 m with 1m alley between plot within the same block and between blocks within the experimental area. The trial measured bulk density, total porosity, and moisture content of the soil and, leaf area index, stem length, number of leaves and grain yield of the test crop. The results obtained revealed significant difference (P=0.05) when the control was compared the treatments over the physical properties and when the measured agronomic parameters. There was a depressive effect of the insecticide on plant growth parameter and grain yield when the rate of application was increased to 900ml.ha^{-1}. The experiment confirmed that the safe application rate for the tested insecticide on maize plant was 600ml.ha^{-1}.

Key Words: *Pesticide, Yield, Characteristics, Maize, Typic Haphstult*

INTRODUCTION
Increase in agricultural production and consistency of high quality produce is limited to a high degree by the menace of insect pests and soil microbes which compete with crops for the use of soil nutrients (Lewis, 1997). Since earliest period, farmers have suffered frustration from all sorts of loses brought on crop growth and yield by destructive pests.

This is why at all time, farmers, pastoralists and home owners have always waged a constant war against insects, plant pathogens and the unwanted plants that have always competed with them for biological use of crops, animal and homes.

Over the years, farmers have adopted some changes to the way they produce food in order to avert the challenge. By so doing, they have changed the way they farm (Webster *et al*., 1999). Agriculture depends heavily on the control of crop pests. Such control is by the use of pesticides. Plant disease, insect and bird predation, and competition posed by weeds reduce crop yield (Tilman *et al.*, 2002).

Pesticides have permitted an increase in agricultural production. Pesticides brought several benefits, including greater crop protection, increased crop production and quality and control of disease causing organisms (William *et al.*, 2005).

While pesticides have brought us valuable economic and social benefits; they also cause a number of serious problems. Indiscriminate and profligate pesticide use causes problems, such as killing non-target species (crops and organisms), creating new pests or organisms that were preciously not a problem, and causing widespread pesticide resistance among pest species (Eldon and Bradley, 2004) including reduction in crop yield when used in large quantities. From the foregoing the main objective of this study is to determine the effect of pesticides on soil and the agronomic characteristics and grain yield of maize in Abakaliki Southeast Nigeria.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki. The area is located within latitude O6^{0}N and longitude O8^{0}56E in the derived savannah of the South-East agro-ecological zone of Nigeria. The rainfall pattern of the area is bimodal (April-July and September-November) with short spell in august. The total mean annual rainfall during the period ranged from 1800mm to 2000mm. The mean annual temperature range was 21-24^{0}C during rainy season and the relative humidity was between 60-80% (EBADEP, 2009). The soil type is sandy clay loam which in some areas are poorly drained (Anikwe, 2000). The soil is hydromorphic and belongs to the order ultisols under the Ezzamgbo soil association derived from shale and classified as typic Haphstult (FDALR, 1985).

Materials

The materials used were: pesticide (Bretmont Attack Insecticide), maize variety Oba super II, and NPK 20:10:10 fertilizer, purchased from Ebonyi State Agricultural Development Programme (EBADEP).

Land Preparation/Experimental Design/Layout

The experimental site was cleared of existing vegetation manually using cutlass. Debris was removed. The site was mapped out using tape, ropes and pegs. The area of site used was 19.0m x 13.5m (0.0256ha). The land area was demarcated into blocks and each block was further divided into plots. Each plot measured 3 X 3 m^2. Each block was separated by 1m and each plot was separated also by 1m.

The experiment was laid out in Randomized Complete Block Design (RCBD) with 4 treatments. The treatments were replicated five times to give a total of 20(twenty) plots. A blanket application of fertilizer NPK 20:10:10 was made at the rate of 500kg.ha^{-1}.

Planting of Test Crop and Treatment Combination

The maize variety Oba super II was planted 2 seeds per hole at a planting distance of 75 x 25cm between and within rows respectively. After two week of germination, the plants were thinned down to 1 seedling per stand to give a plant population of 53333 stands per hectare. Weeding was done as often as the need arose. Harvesting was done at maturity of the crop which was determined by the turning of the husks to brown.

The treatments comprised of four levels pesticide application as follows:

T1 - 0ml. ha^{-1}
T2 - 300ml .ha^{-1}
T3 - 600ml. ha^{-1}
T4 - 900ml. ha^{-1}

Soil Sampling / and Analysis

Core samplers and soil anger were used to collect pre-planting soils for analysis. Core samples were used to determine soil physical properties. Bulk density was determined using core method (Stolt, 1997). Total porosity was calculated from bulk density data using the formula in equation 1,

$\text{Total porosity} = 1 - \frac{BD}{PD} X100$ ---------------------------------Equ.1

Where;
BD= Bulk Density,
PD=Particle Density

While assuming a particle density of 2.65g/cm^3. Moisture content was determined according to Landon (1990).

Agronomic Data: All agronomic parameters were determined at 8 weeks after planting (WAP) using crops in the net plot.

Plant Height: Five plant stands from each net plot were randomly selected and measured for plant height. Plants height was determined using a calibrated metric rule and was done 8 weeks after planting (WAP) from the soil base to the tip of the longest leaf blade.

Leaf Area Index (LAI): The leaf area index was measured by determining the Length and width of the leaves. The area was determined by multiplying the product with a correction factor of 0.905.
Grain Yield: This was determined when the plant had reached full physiological maturity which was determined by the browning of the husk. The plant cobs were harvested, dehusked and dried before shelling. Grains were threshed and weighed. The maize grain yield was determined at 14% moisture content.
Number of Leaves: this was determined by counting the number of leaf blades on the tagged crop.
Stem Diameter: This was determined at 8 weeks after planting (WAP) by using measuring tape.

Data Analysis

Statistical analysis of data was done based on the procedure outlined by Obi (1995) for randomized complete block design (RCBD). Separation of treatment means for significant effect was done by the use of least Significant Difference (F-LSD) as described by Gomez and Gomez (1986).

RESULTS AND DISCUSSION

Some Selected Physical Properties

The result of the effect of treatment on bulk density, total porosity and moisture content of the soil is presented in table 1. The result of the soil bulk density showed that there was significant difference when the bulk density of the control plot was compared with those of the treated plots, but there was no significant difference when the treated plots were compared with one another. The mean value of 0ml ha-1treated plots revealed 3.72, 7.73 and. 4.28 percentage increments over 300ml $ha^{-1}$and 600ml. ha^{-1} treatments levels and 900ml ha^{-1} respectively.

Table 1: Effect of treatments on some selected physical properties of the soil

Treatment	Bulk density $g.cm^{-3}$	Total porosity (%)	Moisture content (%)
0ml/ha	1.95	26.42	11.84
300ml /ha	1.88	29.21	12.87
600ml/ ha	1.81	31.55	13.64
900ml/ha	1.87	29.51	13.45
FLSD (P=005)	0.08	2.56	0.02

Treatment 300ml ha^{-1}, 600ml. ha^{-1} and 900ml ha^{-1} had a decreased bulk density relative to 0ml ha^{-1}treatments by 3.51%, 7.18% and 4.10% respectively. When the bulk density of 0ml ha^{-1} treated plot was compared with 300ml ha^{-1}, treatment, there was no statistical difference, but there was statistical difference when 0ml ha^{-1}treatment was compared with 600ml ha^{-1} and 900ml ha^{-1}respectively.
The results showed that there was significant difference within treatments in their soil total porosity when the control was compared with the treatments but there was no difference when the treatments were compared with one another. Treatment 600ml. ha^{-1} increased soil total porosity relative to 0ml ha^{-1}, 300ml ha^{-1}, and 900ml ha^{-1} by 19.42%, 8.01% and 6.91% respectively. On the other hand 0ml/ha, 300ml $ha^{-1}$and 900ml ha^{-1} decreased total porosity respectively by 16.26%, 7.42% and 6.47% when compared with 600ml. ha^{-1}.
The result of the soil moisture content revealed no significant difference. Treatment 600ml. ha^{-1} gave the highest mean Moisture content of 13.64% while 0ml ha^{-1}recorded the least soil moisture content with a mean value of 11.84% .yet the moisture content of 300ml ha^{-1} and 900ml ha^{-1} gave 12.87% and 13.45% respectively. Six hundred milliliter per hectare treatment increased soil moisture content by 15.20%, 5.98% and 1.41% relative to 0ml ha^{-1}, 300ml $ha^{-1}$and 900ml ha^{-1} respectively. On the other hand, 0ml ha^{-1},

300ml ha^{-1}, and 900ml ha^{-1} decreased respectively by 13.20%, 5.65% and 1.39% when compared with 600ml. ha^{-1}.

Effect of treatments on plant height, Leaf Area Index, and Stem Diameter at 8 WAP

The results of the effect of treatments on maize plant height, leaf area index, stem diameter and number of leaves are presented in table 2.

Table 2: Effect of treatments on plant height, Leaf Area Index, and Stem Diameter at 8 WAP

Treatment	Plant height (cm)	Leaf Area Index	Stem Diameter(cm2)	Number of leaves
0ml/ha	43.52	301.94	6.08	8.68
300ml /ha	52.20	415.19	6.84	9.76
600ml/ ha	64.40	461.56	7.36	11.48
900ml/ha	44.52	354.72	6.64	9.00
FLSD (P=005)	2.1	16	0.02	1.87

Plant Height

The plant height at that measurement period showed significant difference when the control was compared with the treatments and when the treatments were compared with one another. There were 8.68cm taller plants in plots treated with 300ml ha^{-1} insecticide than the non-treated plot. Also 600ml.ha^{-1} and 900ml treated plots revealed 20.88 and 1 cm taller plants respectively.

Further, 600ml. ha^{-}1 treated soil produced 12.2cm more height than 300ml ha^{-}1 treated soil, while that same treatment was better than 900ml ha^{-1} treatment by producing 19.88 taller plants. The higher rate of application of 900ml ha^{-1} gave even a lower plant height than the control as there was no significant difference when this high level was compared with the control. This scenario revealed that the higher rate of application of insecticide may have impacted negatively on the growth and development of the maize

Leaf Area Index (LAI)

The result of the Leaf Area Index (LAI) showed that there was significant difference when the treatments were compared with the control and when the treatments were compared with one another. Broader leaves of 113.25cm^{-2} was produced when the leaf of plants in the control plot were compared with those on 300ml.ha^{-1} treated plots.

There was also 159.62cm^2 broader leaves when 600ml. ha^{-1} treated soil was compared with the control. The least leaf area index difference was recorded when the control was compared with 900ml ha^{-1} treatment level. There was also positively significant difference when the treatments were compared with one another.

The largest mean difference among the treatments was recorded when LAI of plots treated with 600ml. ha^{-1} was compared with those treated with 900ml ha^{-}1 while the least mean value among the treatments was revealed by the comparism of 300ml .ha^{-1} and 900ml ha^{-1} treatment levels. On the other hand, 0ml ha^{-1}, 300ml $ha^{-1}$and 900ml treatments produced decreased LAI by 34.58%, 10.05% and 23.15% respectively when compared with the LAI of plants on soils treated with 600ml ha^{-1}.

Stem Diameter

The result of the stem diameter revealed that there was statically significant difference when the control was compared with the treatments and when treatments were compared with one another at that period of measurement. Maize stem diameter was thickest by 1.28cm when plants in the control plots were compared with those treated with 600ml ha^{-1}. Further 300ml ha^{-1} treated plants revealed 0.76 cm thicker stem than the plants on the control plots.

There was also 0.56cm increment of the stem diameter over the control when 900ml ha^{-1} application rate was compared with the control. At this treatment level, it produced .020cm lighter stem when 900ml ha^{-1} was compared with 300ml ha^{-1} application rate. The recommended application rate of 600ml ha^{-1} has continued to prove superior to all the other application rates.

The thickness of the stem is a function of the general well being of the crop. When the leaves are attached by insects the leaf area is reduced. The reduced leaf area results in reduced photosynthetic efficiency of the plants. The result is that plants will not have sufficient food to meet metabolic and growth needs. Under extreme condition of attack a total crop failure may result.

Number of Leaves

At 8 WAP the result of the effect of treatment on number of leaves showed that there was statistically significant difference when the control was compared with 600ml. ha^{-1} treated plants and when 600ml. ha^{-1} rate of application was compared with 900ml. ha^{-1}. Multiple Comparative assessments of the other treatments did not reveal any significant difference when compared with the control and when compared with one another. Furthermore, 600ml. ha^{-1} treated plant produced 2.8 times more leaves than the control and 2.48 times more number of leaves than 900ml. ha^{-1} treated plants. The 600ml. ha^{-1} rate of application supported increased number of leaves. This may have resulted from the protective envelop ensured by that rate of application of the insecticide.

Grain Yield

There was statistically significant difference when the yields of the crop in the treated plots were compared with the control and when the treatments were compared with one another (Table 3.). The highest grain increase of 1.39t.ha^{-1} was obtained when the control was compare with the yield obtained when 600ml. ha^{-1} application rate was made. Generally there was 0.88 and 0.75t.ha^{-1} increase in yield when 300ml. ha^{-1} and 900ml. ha^{-1} application rates respectively were compared with the control. Also there was about 0.51t.ha^{-1} increase in grain yield when 300ml. ha^{-1} rate of application was compared with 600ml. ha^{-1} application rate. The least yield increase was recorded when treatment rate of 300ml. ha^{-1} was compared 900ml.ha^{-1} application rates. Insecticide treatment of plants is aimed at increased yield. This increase in yield is the outcome of combinations of improved crop growth and efficient photosynthesis. The principle has played out here, where the most effectively protected crop has revealed higher and greater yield difference when subjected to multiple comparism.

Table 3: Effect of treatments on grain yield of maize

Treatment	Grain yield(t/ha)
0ml.ha^{-1}	2.80
300ml ha^{-1}	3.68
600ml ha^{-1}	4.19
900ml ha^{-1}	3.55
FLSD (P=005)	0.09

Conclusion

The result of the experiment revealed that the most effective and healthy rate of application of the tested insecticide is 600ml. ha^{-1}. At this rate crop growth is enhanced and yield improved beyond the national average of 3t.ha^{-1}. It is recommended that users of this insecticide should always adhere to the recommended rate of application of the manufacturers.

ACKNOWLEDGEMENT

The effort of the Augustine Ifejimalu in gathering the materials for the work is highly appreciated.

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