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EFFECTS OF CHEMICAL INSECTICIDES ON THE PROPERTIES OF SOIL USING MAIZE AS A TEST CROP

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ABSTRACT

A pot experiment was conducted to evaluate the effect of commonly used chemical insecticides on some soil properties using maize as a test crop. The insecticides include Dichlorvos, karate, and phoskill at the rates of 0 l/ha (R1 control), 1.2l/ha (R2), 0.8l/ha (R3) and 0.4l/ha (R4). Upland sandy soil was used which was treated with the chemicals. The experiment was laid in a completely randomized design replicated 3 times. Plant hight, and leaf number were measured weakly starting from 2 weeks after emergence. At the end of the experiment (8 weeks), the plants were harvested in two portions (shoot and root) which were oven dried at 65^{o}C for 24 hours and the dry matter determined. Soil properties such as pH, exchangeable bases, organic carbon and total nitrogen were determined. The result on plant height and dry matter shows no significant effect (P> 0.05) of insecticides. Similar trend was observed in most soil properties, but comparing the mean values, control shows better performance .the result on plant leaf number shows a significant effect of chemical insecticides. The general non significant effect of the chemical insecticides on plant growth parameters, dry matter and soil properties have been attributed to the sandy nature of the soil which has poor adsorption capacity and the due to the little time the chemicals are exposed to the soil.

KEYWORDS : Insecticides, Chemicals, Soil Properties, Upland Sandy Soils, Test Crop

Insecticides are at the moment man's chief weapon against insect pest (Kumar, 1999). The large scale use of agrochemicals is one of the main factors in minimizing losses due to pests. Marked increase in yield has been observed due to application of insecticides in controlling insect pests. Most experts agree that removal of insecticides from crop protection will result in immediate drop in food supply (NAS, 1975). There exist insect pest that cannot be controlled by any means other than chemical control (Dent, 1991).

On the other hand, these chemicals being toxic in nature have adverse effect on the environment, be it crop plant, soil and water bodies (Kumar, 1999). According to Martin, (1973), a note worthy development in present time use of chemicals in combating pest is the growing concern over the contamination of the environment and a greater attention to the ecological consequences of the use of toxic chemicals for pest control.

Chemical insecticides affect to a greater extent the biological processes occurring in soils, which may invariably affect the physico-chemical properties of soils. Farmers in Sokoto state at present hold the view that the decreasing productivity of their crops may not be unconnected to declining soil fertility which application of chemical insecticides to control pest is a major factor. It is against this background that this research was carried out to find out the effect of insecticides on soil properties and growth of Maize.

MATERIALS AND METHODS

Study Area

The research was conducted at the Botanical garden, Usmanu Danfodiyo University, Sokoto. Sokoto state is located at the extreme northwest corner of Nigeria on latitude11^{0}30^{1}to 13^{0}50^{1}N and longitude 4^{0} to 6^{0}E. The vegetation is categorized as Sudan Savanna. Sokoto state enjoys semi-arid climate characterized by a long dry season and short rainy season. The mean annual rainfall varies from 380- 889 mm decreasing northwards.

Soil Sample Collection and Preparation

Soil samples were collected randomly from different upland locations at the back of the University Administrative building (Ahmad Bello House). The samples were composited, and part of the composite sample was taken for analysis before treatment and the remaining was filled in plastic pots for the experimental treatment.

Treatments and Experimental Design

Three kilograms of the soil was weighed into plastic pots to which the chemical insecticides were applied at the rate of 0l/ha, 1.2l/ha, 0.8l/ha and 0.4l/ha and mixed

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thoroughly. The experimental design was randomize complete block design (RCBD) with three different insecticides and four rates of application replicated three times giving a total of 36 treatment combinations. Six seeds of the test crop (maize) were planted in each pot, which were later thinned to three per stand. Weekly observations (plant height and leaf number) were taken two weeks after emergence. At the termination of the experiment (8 weeks) the maize plant was harvested for dry matter determination.

Soil Analysis

The analyses conducted include Soil pH, organic carbon, total nitrogen, exchangeable bases, cation exchange capacity and particle size analysis.

 Particle size analysis was done with the Bouyoucos hydrometer method as described by (Gee and Bauder, 1986). Soil pH was measured in 1:1 soils to water with a glass electrode pH meter. Organic carbon was determined by the dichromate wet oxidation method (Nelson and Sommers, 1982). Cation exchange capacity (CEC) of the soils was determined by saturating the soils with neutral ammonium acetate, washing out the excess ammonium with alcohol and subsequently distilling the adsorbed ammonium into boric acid. The distillate was titrated against standard hydrochloric acid. Exchangeable bases were determined using the ammonium acetate extract. Sodium (Na) and Potassium (K) were determined using flame photometer, while Calcium (Ca) and Magnesium (Mg) were determined using the EDTA titration method (Page et al., 1982). Total Nitrogen was determined by the Macrokjedhal digestion distillation method.

RESULTS AND DISCUSSION

Effect of Insecticides on Plant Height

Result of the effects of insecticides on plant height is presented on Table, 1 and figure 1, 2 and 3. A non significant effect of insecticides type and rates on plant height was observed. Figure 1, 2 and 3 show a clear trend of insecticides effect with control rate (0 l/ha) and lower rate (0.4 l/ha) giving the highest plant height. Comparing the means of the different insecticides and rates, karate gave the least plant height while R0 and R3 gave highest plant height.

Table 1. Effect of chemical insecticides on maize plant height (cm)

Treatment	Rats	Weeks after Planting (WAP)			
		2	4	6	8
Dichlorvos	R0	9.7	22	44.8	55.1
	R1	8.4	17.7	36.2	44.6
	R2	8.7	17.8	36.8	45.2
	R3	9.1	18.5	37.7	45.3
Karate	R0	9.1	18.9	18.9	46.6
	R1	8.4	14.6	14.6	41.6
	R2	8.6	18.6	18.6	42.7
	R3	8.8	17.8	17.8	45.3
Phoskill	R0	9.3	23.7	46.8	55.6
	R1	8.4	16.2	36.4	43.3
	R2	8.6	16.3	34.8	43.8
	R3	9.1	16.9	37.1	43.8
LSD	**0.05**	**Ns**	**Ns**	**Ns**	**Ns**

Ns= Not significant

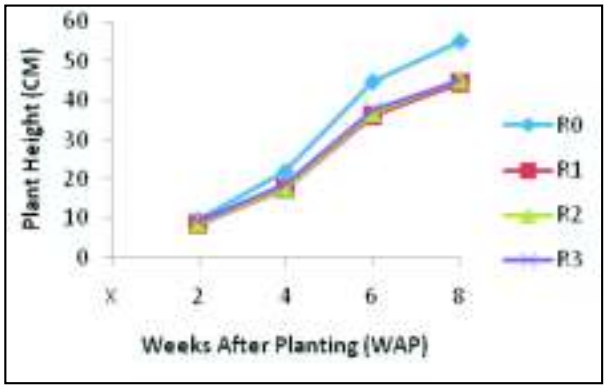

Figure 1. The effect of Dichlorvos on Maize Height

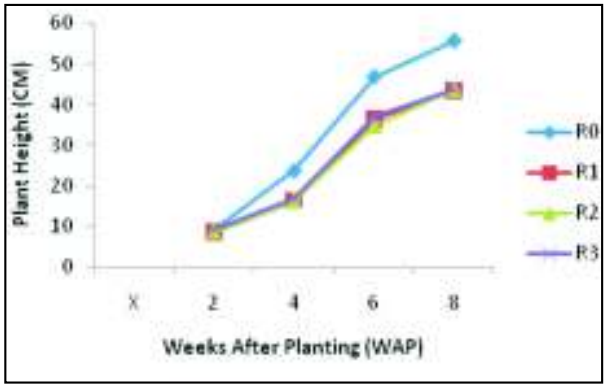

Figure 2. Effect of Karate on Maize Height

Effect of Insecticides on Plant Leaf Number

The result of the effect of insecticides type and rates on plant leaf number is presented on Table, 2. Types of insecticides has no significant difference (P>0.05) on leaf

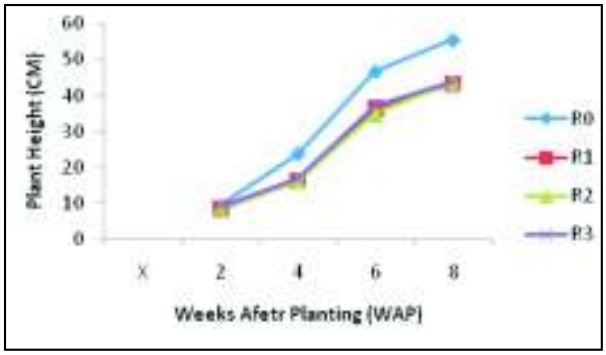

Figure 3. Effect of Phoskill on Maize Height

Table 2. Effect of chemical insecticides on maize leaf number

Treatment	Rats	Weeks after Planting (WAP)			
		2	4	6	8
Dichlorvos	R0	5	7	9	11
	R1	3	5	7	9
	R2	3	5	7	9
	R3	4	6	8	9
Karate	R0	4	6	9	11
	R1	4	6	7	9
	R2	4	6	8	10
	R3	4	6	8	10
Phoskill	R0	4	6	9	11
	R1	3	5	7	8
	R2	3	5	8	9
	R3	4	6	8	10
LSD	**0.05**	**Ns**	**Ns**	**0.37***	**0.64***

Ns= Not significant *= Significant

number. Rates of application show significant difference ($P<0.005$) on leaf number at 6 and 8 weeks after planting. This significant effect at the 6 and 8 weeks could be due to increasing hybrid vigour over time and a corresponding adaptability to environmental stress (effect of chemical).

Effect of Insecticides on Dry Matter Yield

The result of the effect of insecticides on dry matter yield of both shoot and roots is presented on Table,3 and Figure,3. A non significant effect ($P>0.005$) of insecticides on dry matter yield of both shoot and root was observed. Despite the non significant effect of these insecticides, Dichlorvos gave the highest dry matter. Comparing the rates of application, control (R0) has the highest dry matter yield and R1 (1.2 l/ha) has the least dry matter yield.

Table 3. Effect of chemical insecticides on dry matter yield (t/ha) of Maize

Treatment	Rats	Shoot dry matter	Root dry matter
Dichlorvos	R0	3.6	1.8
	R1	2.7	1.4
	R2	2.8	1.5
	R3	3.2	1.6
Karate	R0	3.7	1.7
	R1	2.6	1.5
	R2	2.7	1.5
	R3	3.1	1.5
Phoskill	R0	3.1	1.6
	R1	2.8	1.3
	R2	2.9	1.4
	R3	3.0	1.5
LSD	**0.05**	**Ns**	**Ns**

Ns= Not significant

Table 4 : Effect of Chemical Insecticides on Soil Chemical Properties

Treatment	Rates	pH	Organic C	Total N	Exchangeable Bases (C molkg^{-1})				CEC (C molkg^{-1})
			---(gkg^{-1})	---	Ca	Mg	Na	K	
Dichlorvos	R0	6.78	0.30	0.05	0.03	0.05	0.04	0.07	16.0
	R1	6.61	0.10	0.04	0.03	0.03	0.03	0.05	13.8
	R2	6.63	0.24	0.05	0.02	0.03	0.03	0.05	14.0
	R3	6.72	0.29	0.05	0.03	0.05	0.03	0.05	16.0
Karate	R0	6.76	0.32	0.05	0.02	0.06	0.03	0.07	14.8
	R1	6.65	0.16	0.04	0.02	0.03	0.02	0.05	12.8
	R2	6.71	0.16	0.04	0.02	0.04	0.03	0.05	13.4
	R3	6.71	0.30	0.04	0.02	0.05	0.03	0.06	14.8
Phoskill	R0	6.74	0.42	0.05	0.03	0.06	0.04	0.07	15.2
	R1	6.59	0.34	0.04	0.02	0.04	0.03	0.05	11.6
	R2	6.64	0.38	0.04	0.02	0.04	0.03	0.07	12.6
	R3	6.71	0.42	0.05	0.02	0.05	0.03	0.07	13.6
LSD	**0.05**	Ns	**Ns**	**Ns**	**Ns**	Ns	**Ns**	**Ns**	**Ns**

Effect of Insecticides on Soil Chemical Properties

The result of the effect of insecticides on soil chemical properties is presented on Table 4. A non significant effect (P>0.005) was observed in all the soil chemical properties under investigation. However, comparing the mean values revealed a higher concentration of nutrient elements, higher CEC, and higher pH in the control (0 l/ha). Lower values were observed in higher rates (R1 and R2). Hill and Waller (1999), Brady and Weil (1999) reported that volatility and leaching prevents persistence of insecticides in mineral soils. Poor adsorption capacity of the soils and the little time the chemicals are exposed to the soil could be attributed to their non significant effect on soil chemical properties.

CONCLUSION

There is evidence from the result to support that despite non significant effect of chemical insecticides on plant growth parameters, dry matter and soil chemical properties; there was indeed a slight reduction in growth of plant and decrease concentration of nutrient elements of the soil. This was evident with lower values at high rates of application and good performance of the control. The non significant effect of the chemical insecticides on soil chemical properties was attributed to their volatility and leaching and poor adsorptive capacity of the soil. This research could further be broadened from a pot experiment to a true field situation so that the effect of these chemicals to agricultural productivity could be better understood than imagine.

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