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A Study of the Effects of pesticides on nutritional content of some selected Vegetables.

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Abstract: *While the primary aim of pest control in agriculture is to improve crop yield for the ever increasing world population, their residue often have other effects on the plant. This study was conducted to determine the effects of pesticide residues on the proximate composition of some vegetables. The vegetables:Lactuca sativa L, Amaranthus hybridus L., and Solanum lycopersicum L. were sprayed with pesticides. The pesticides: Benlate, Mencozeb and Milzeb were applied into the vegetables at 5,50 and 100mg/ml. The effects of pesticides on the nutritional content of the selected vegetables were observed. The results obtained showed thatthere was significant differences (P>0.05) in nutritional content between plant sprayed with pesticides and the control. Control has the highest percentage of nutrients with 0.47 and (5mg/ml) recorded the least (0.28) for nitrogen content.*

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I. Introduction

With the understanding concern about the use of pesticides in agriculture, there is need to search for the effect of the pesticides on plants. Also, some pesticides have lost their effectiveness because of the development of resistant pathogens (Allen et al., 1981) even the chemical product sometimes produces questionable control. The perceived negative effect of fungicides, bactericides and pesticides on agricultural land and water coupled with their possible toxicity to man and animal has resulted in the consideration of more friendly control measures.

Ideally, pesticides should reduce pest population, be target specific, break down quickly and have low toxicity to humans and other mammals. Although, pesticides such as Sulphur, Menozeb, hmand Benlate have been an important part of pest management for many years, the disadvantages and risk of using them have become apparent. Some of these pesticides leave unwanted residues in vegetables which affect both the physiological, growth and nutritional content of the vegetables. The increasing use of a wide range of toxic chemicals deliberately released into the environment is causing wide spread concern about their safety on plants and human health and the damage caused by the environment, particularly in developing countries, which usually lack appropriate resources to minimize the risk and rectify problems. Several pressures have accelerated the research for more environmentally and toxically safe and more selective and efficacious pesticides.

The vegetables use in these research were Tomatoes (Solanum lycopersicum), Lettuce (Lactuca sativa), and Amaranth (Amaranthus hybridus) and thepathogen inoculated into the vegetables were pythium, Fusarium and Phythophthora Species. The pesticides appliedon the vegetable were mainly fungicides which include Benlate, Mencozeb and Milzeb.

II. Methodology

2.1 Source of Seed and Rising of Seedlings of the Vegetable

The seeds were sourced from Sokoto State Agricultural and Rural development Authority (SARDA). The seeds used for tomato was Roma VHN, letuce UC 82B, and Amaranths UA 45b. The seeds of tomatoes, lettuce and Amaranths were sown in an autoclaved soil for 3 weeks and then transplanted into 150 sterile polytene bags, and were watered once daily.

2.2 Experimental Site

Field experiments were carried out at the Biological Garden of the Usmanu Danfodiyo University, Sokoto, located at the Northern part of Sokoto city in Wammakko Local Government Area of Sokoto State. Sokoto is located in the Sudan savanna ecological zone of Nigeria on latitude $13^{0}0^{1}$n longitude $5^{0}15^{1}$E and at an altitude of about 350m above sea level. The climate of the area is semi-arid with mean annual rainfall of about 600mm (Kowal and Knabe, 1972). The relative humidity ranges from 21-47% in the dry season and 51-79%

during the rainy season. Average temperature ranges from 14-15% (SERC, 2008). The area has a long dry season characterized by cool dry air (harmattan) during November to February and hot dry air in March to May (Davis, 1982). The soils of the site was found to be predominantly clay loam.

Application of Fungicides

The fungicides used in this research were Milzeb, Benlate and Mencozeb. They are used in three different concentrations; 5, 50 and 100mg/ml respectively.

Test on the Nutritional Content of Vegetables (Macro-kjeldahl method)

2.14 Determination of Nitrogen Content

Two (2g) of each sample were weighed and placed in macro kjeldahl flasks. 1 tablet of mercury catalyst was added, and 20ml of concentrated H_2SO_4 was added through an automatic pipette. The flask was heated cautiously at low heat on the digestion stand. When the water has been removed and frothing was ceased, the heat was increased until the digest was cleared. The mixture was boiled for 1 hour, the heat were regulated during this boiling so that the H_2SO_4 condenses about halfway up the neck of the flask. The flask was allowed to cool and 50ml of water was added slowly to the flask. Ten (10ml) of the digest was carefully transferred into another clean macro-kjeldahl flask (750ml) and 20ml of H_3SO_3 indicator solution were also added into a 250ml erlenmeyer flask which was then placed under the condenser of the distillation apparatus. The end of the condenser was about 4cm above the surface of the H_3SO_3 solution. The 750ml kjeldahl flask was attached to the distillation apparatus and 29ml of 40 NaOH was poured in through the distillation flask opening the funnel stopcock commence distillation. The condenser was kept cool (below 30^0C) by allowing sufficient cold water to flow through and regulate heat to minimize frothing and prevent suck-back. 40ml of the distillate were collected and then the distillation was stopped. The NH4N in the distillate was determined by heating with 0.1N using a 25ml burette graduates at 0.1ml intervals. The aliguote was changed at the end point from green to pink. The %N content was calculated using this formula.

$$\%N = \frac{TV \times 0.01 \times 0.014 \times 50}{\text{Weight of sample x mls of Aliguote}} \times 100$$

Tv = Titration Value

2.15 Determination of Crude Protein

The estimation of crude protein involves the determination of total nitrogen by the kjeldahl procedure. The amount of crude protein was obtained by multiplying the nitrogen content by 6.25. This factor was based on the assumption that all feed proteins contain 16% nitrogen and that all nitrogen in the tissue is present as protein. Protein content may vary in nitrogen content from 13% to 18%. Some factors are known to apply to different feeds. We used leaf therefore the factor used was 6.6.

2.16 Moisture Determination

The moisture-can was weighed empty (W_0). Two (2g) of the sample was added and weighed again with the plant sample (W_1) the sample was then dried in the hot air oven at 105-110^{0}C for 24hours. The sample was cooled in a descicator. The can was weighed with the dry sample (W_2) and then returned to the oven for further 24 hours to make sure the drying was completed the weighed again, till W_2 became constant.

$$\%\text{Moisture} = \frac{W_1 - W_2 \times 100}{W_1 - W_0}$$

Where W_0 = Weight of empty moisture-can

W_1 = Weight of moisture-can with sample

W_2 =Weight of moisture-can with dried samples

2.17 Ash Determination

The crucible dish was weighed empty (W_0) the sample was added and weight of crucible plus sample (W_1) and ashed in muffle furnace at 500-600^{b}C for 3 hours. The sample was allowed to cool in a descicator. The crucible with dry sample (W_2) was weighed

$$\%\ \text{Ash} = \frac{W_2 - W_0 \times 100}{W_2 - W_0}$$

Where W_0 = weight of empty crucible.

W_1 = weight of crucible plus sample

W_2 = weight of crucib;e and dried sample

2.18 Crude Fibre Determination

Two grams of the ground sample was weighed into one litre conical flask (W_0).
20 mls of boilling 10% H_2SO_4 was added and 200mls water, boiled gently s s sfor30 minutes using cooling finger to maintain a constantvolume. The contentwas filteredthrough muslin cloth, rinsed well with hot distilled water. The materials wasscraped back into flask with spatula, 20ml of boilling 1% NOH was added and allowed to boil gently for 30 minutes using cooling fingers to maintain a constant volume and filtered through poplin clotyh. Theresidue was washed thoroughly with hot distilled water, rinsed once with 10% HO1 and twice with industrial methylated spirit, acetone. The content was finally rinsed three times with petroleum ether (BP – 40 – 60^bC), allowed to drain-dry and the residue scraped into a crucible. It was dried overnight at 1050C in the oven and then cooled in a descicator and weighed (W_1), arshed at 55^00 C for 90 minutes in a mufle furnace and cool in a descicator and weighed again (W_2)

% Crude fibre = $\frac{W_1 - W_2 \times 100}{}$

Where W = weight of sample
W = weight of dried sample
W = weight of ashed sample

2.19 Determination of Crude Fat

A 250ml extraction flask was dried in the oven at 105 – 1100C. After allowing it to cool in the descicator, the extraction flask was weight empty. 0.5 – 2g of the gound sample was weighed accurately into labelled porous thimble. The porous thimble's mouth was coverd with clean white cotton wool. About 200ml of pretrolum ether was added into the dry 250ml extraction flask, covered porous thimble was placed into the condenser and asemble the apparatus and extraced for about 4-5 hours. The porous thimble was removed with care and the petroleum ether was collected in the top container (tube) and the extractoin flask was removed from the water bath when it was almost free of petroleum ether. It was oven dried at 105 – 110^0C for one hour and cooled in the descicator and the weight taken after cooling.

% Fat = $\frac{W_2 - W_1 \times 100}{W_0}$

Where Wo = weight of sample
W1 = weight of empty flask
W2 = weight of flask plus oil

2.20 Determination of soluble carbohydrate (Nitrogen0-Free Extract)

The Nitrogen Free Extract (N.F.E) referred to as soluble carbohydrate, is not determined directly but obtained as the difference between crude protein and the sum of ash, protein, crude fat and crude fibre.

N.F.E = 100 – (%ash + %crude fibre + %crude protein)

2.21 Data Analysis

The data generated were subjected to analysis of various (ANOVA) using Statistical Analysis System (SAS, 2003). Treatment means found to be statistically significant were compared using least significance difference (LSD)

III. Results And Discussion

Effects of fungicide on nutritional content of the vegetables are presented in table 1

Table 1: Effect of fungicide on Nutritional content of vegetables

Treatments	N	Cp	CHO	Moisture	Ash	Lipid	Fiber	D. ash
Amaranthus hybridus	0.4181a	2.8275a	90.6042b	78.1670a	3.8750	2.2083a	1.2917a	14.5417b
L. esculentum	0.3835a	2.6425a	91.5742b	74.6670b	3.8333	1.6667b	1.4583a	15.1607b
Lactuca sativa	0.2988b	2.1500b	93.4040a	77.5000a	3.2500	1.1250c	0.8780b	18.8750a
S.E	0.0191	0.1096	0.3597	1.0771	0.2476	0.0962	0.1250	0.5231
Sig level	0.0006	0.0006	0.0001	0.0700	0.1585	0.0001	0.0089	0.0001
	*	*	*	ns	ns	*	*	*
Concentration								
0	0.470a	3.44067a	93.4600a	78.6670	3.5000b	1.5000b	1.3333	17.0001
5	0.2867c	1.8756c	92.5756a	74.7220	3.2778b	1.3889c	0.8880	15.1111
50	0.3243b	2.2100c	91.4567b	76.4440	3.2778b	1.7222b	1.2778	16.0556
100	0.3823b	2.6678b	89.9522b	77.4440	3.2778b	1.7222b	1.2778	16.0556
S.E $\pm$	0.0221	0.1266	0.4154	1.2438	0.2859	0.1111	0.1443	0.6041
Sig level	0.0001	0.0001	0.0001	0.1823	0.0115	0.0015	0.1130	0.1667
	*	*	*	ns	*	*	ns	ns
Interaction								

Fungicide x conc.	0.1508	0.0516	0.0162	0.7487	0.8761	0.0097	0.6587	0.0748
	Ns	ns	*	ns	ns	*	ns	ns

Key: within a treatment group, means in a column followed by same letter (s) are not significantly different at 5% level using LSD, Pn = Percentage nitrogen, Pcp = Percentage crude protein, Pcho = Percentage carbohydrate, Pm =

Table 2: Mean separation for the interaction of vegetables and fungicides at percentage carbohydrate.

Conc. (mg/ml)	L. sativa	A. hybridus	S. lycopersicum
0	93.40^{cab}	93.40^{cab}	93.40^{cab}
5	94.87^{a}	90.97^{d}	91.93^{cdb}
50	93.83^{ab}	90.57^{d}	89.90^{d}
100	91.40^{cd}	87.43^{c}	90.93
S.E ±	**0.719**	**0.634**	**0.894**

Table 3: Mean separation for the interaction of vegetables and fungicides at percentage lipids.

Conc. (mg/ml)	L. sativa	A. hybridus	S. lycopersicum
0	$1.50d^{ce}$	1.50^{dc}	1.50^{dc}
5	0.66	2.17^{b}	1.33^{dc}
50	1.00^{fe}	2.33^{ab}	1.83^{dce}
100	1.33^{de}	2.83^{a}	2.00^{cb}
S.E ±	**0.192**	**0.281**	**0.198**

The result revealed that there is significant ($p<0.05$) response of treatment to fungicide at percentage nitrogen, crude protein, carbohydrate, lipid, fiber, and dry ash. But there was no significant response in percentage moisture and ash content. Amaranthus hybridus has the highest percentage of nitrogen (0.4187) against Lactuca sativa which has the lowest with(0.2988). Amaranthus also has the highest percentage crude protein (2.8275) and Lactuca sativa with the lowest (2.1500). Lactuca sativa has the highest carbohydrate content and Amaranthus has the least (90.6042). Amaranthus has the highest percentage moisture and ash content followed by Lactuca sativa and Solanumlycopersicum respectively. Amaranth also has higher percentage of lipids and Lactuca sativa has higher percentage Fiber and dry ash.

Effect of fungicide on the nutritional content of Amaranthus hybridus Lactuca sativa and Solanumlycopersicumshowed that there was significant ($p<0.05$) response of fungicide to percentage Nitrogen, crude protein , carbohydrate, lipids, fiber and dry ash respectively . There was no significant difference in percentage moisture and ash content. Amaranthus has the highest percentage of nitrogen crude protein, moisture, ash and lipids and the Lactucasativa have the lowest percentage of nitrogen, crude protein, ash content, lipids and fiber, being Lactuca sativa having the lowest percentage of nutrient. This could be as a result of presence of pesticide (fungicides) as reported by Amar and Reinhold (1973) that, different suggestions have been proposed to elucidate mechanism leading to biochemical changes brought about by pesticide which results in the change in of nutritive composition.

In concentration fungicide shows significant ($p<0.05$) response in percentage nitrogen, crude protein carbohydrates, ash, lipids and not significant ($p<0.05$) response in percentage moisture and fiber. The concentration ha percentage of all nutrient and even in the growth parameters, control has the highest numbers. This could be attributed to the various effects of pesticides (fungicides). This agree with the findings of Rengel and Wheal (1997), Taiz and Zeyer (2003) who reported that the presence of pesticides residues in soil decrease the uptake of water along with nutrient. Pesticides residues get attached with the nutrient soil particles affecting the nutrient soil particles affecting the nutrient uptake from the soil to the root (Rengel and wheal, 1997).

IV. Conclusion

This study has investigated the effect of pesticide on plants and found that the residue tend to destroy the nutritional content of the plants investigated. It is therefore important to strike a balance between the nutritional content of the plant and the high yield that results from pest control. However, higher concentrations are substantially phytotoxic for the growth of vegetables.

V. Recommendations

1. More research is needed to find out the phytotoxity associated with systemic n fungicide.
2. Benlate should be used in the treatment of fungal disease of vegetables because it is very effective.
3. The pesticide should be used in low (50mg/ml).

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