Control of Insect Pests of Chilli Pepper (*Capscicum frutescens*) Using Aqueous Garlic Extract for Sustainable Agricultural Development in Africa

BY

Benson, G. A. S.[1], Joda, A. O.[2], Sanni K. O[1]., Nofiu, O. A.[1] & Bello, N. O[1]
[1]Lagos State Polytechnic, School of Agriculture, Ikorodu.
[2]Olabisi Onabanjo University, College of Agricultural Sciences, Yewa Campus, Ayetoro

ABSTRACT

This study was conducted to evaluate the effect of different levels of Allium sativum and lambda-cyhalothrin in the control of insect pests of Capsicum frutescence at the Teaching and Research Farm of the Department of Crop Production and Horticulture, Lagos State Polytechnic, Ikorodu. It comprised of five levels of aqueous garlic extract (10, 20, 30, 40 and 50g of garlic extract / litre of water), recommended rate of lambda-cyhalothin and untreated control plot. Parameters measured were growth parameters, yield parameters and pest control parameters. Finding from the study showed that aqueous garlic extract applied at 20g per litre of water increased plant height, number of leaves, number of fruits per plant, fruit diameter, most effective against insect pest of chilies pepper among the treatments and consequently with high fruit yield. Regressing increasing rate of garlic concentration and plant growth, pest control and yield components of C. frutescens showed significant positive relationship. In view of the significant difference among the treatments, A. sativum extracts at 20g/litre of water can serve as alternative to synthetic insecticides in controlling insect pests of pepper as pathway to sustainable agricultural development in Africa.

KEYWORDS: ***Capscicum frutescens*, garlic concentration, lambda-cyhalothrin, growth and yield.**

INTRODUCTION

Although headcount poverty rates have decreased, Africa is still a poor continent and rapid economic growth has not reduced inequality. Hunger remains widespread on the continent, especially in sub-Saharan Africa, while access to energy is inadequate (Donald, 2012). Environmental and socioeconomic changes present further challenges for Africa. Notably, climate change, global population growth and shifting consumption patterns are putting additional pressure on Africa's natural resources. Viable solutions to these and future challenges are anchored on growth pathways that encourage efficient and sustainable management of natural assets; are less carbon-intensive than conventional pathways; and ensure that the benefits of growth are shared equitably to ensure poverty reduction, reduce income inequalities, and improve livelihoods (Donald, 2012). According to Schwarb *et al*. (1995), given the conditions of climate and poverty in developing countries, the economic risks and uncertainties are many times higher than in industrialized countries.

Green growth in Africa encompasses the achievement of critical development objectives while seeking to maximize efficient use of natural resources, minimize waste and pollution, and enhance the resilience of livelihoods. The majority of the poor in Africa depend on natural resources for their livelihoods. Thus, continued use of natural resources to satisfy these needs inevitably requires that resources are managed sustainably. Increasing agricultural production in Africa on a sustainable basis requires a diverse toolkit, including green and conventional practices, with the clear target of preserving the natural systems upon which food security depends.

Peppers are crop valued for its ascorbic acid and rich source of vitamin C; belongs to the Solanaceae family and originated from Central and South America (Grubben and El-Tahir, 2004). It is however susceptible to a host of pest and pathogens causing considerable losses. The most economically important pests to peppers in West African are thrips (*Franklinella* spp) feeding on the leaves, flowers and fruits: aphids (*Myzus persicae*) feeding on young leaves and shoot, whitefly (*Bemisia tabaci*) feeding on leaves; armyworm (*Spodoptera spp*); leaf miners (*Lyriomyza spp*); tomato fruit worm (*Helicoverpa*) and pepper weevil (*Anthonomus eugenii*) to mention but a few. The high rate of these insect pest infestations on pepper requires the use of insecticides to control them. The pests are often controlled using synthetic insecticides of which lambda-cyhalothrin is major. These are however not without the associated problems of insecticides resistance and negative effect on non-target organisms including man and the environment and hence negating the wide spread acceptance of the use of these synthetic compounds. The indiscriminate use of chemical insecticide has also given rise to many well-known and serious problems, including genetic resistance of pest species, toxic residues in stored products, increased cost of application, hazards from handling and environment pollution (FAO, 1992). Since it is well established that chemical insecticides have potential harmful effect on environment, and in accordance with the current global focus towards discouraging the use of synthetic insecticides on consumable items, there is an urgent need for effective botanical pesticides with biodegradable and non-toxic effect on target organisms. Garlic belongs to the onion family Liliaceae. It has the sensory quality of strong and characteristic odour in fresh state and has insecticidal properties. This study was designed to investigate the effect of different levels of *Allium sativum* and lambda-cyhalothrin in the control of insect pests and performance of *Capsicum frutescens* in Ikorodu, Lagos State, Nigeria.

MATERIALS AND METHODS

This research work was carried out at the Teaching and Research farm of the Department of Crop Production and Horticulture, Lagos State Polytechnic, Ikorodu. The area lies roughly between latitude 5^0 10' North and longitude 3^0 16' - 3^0 18' East of the Greenwich meridian. It has an altitude of 50m above the sea level with a mean average temperature of 25^0 and 29^0 C. The experimental plot was ploughed and marked out thereafter. The total plot size was $377m^2$ (29m x 13m). Experiment was laid out in Randomized Complete Block Design (RCBD) having seven treatments, replicated three times to have a total number of twenty one (21) experimental plots. Each net plot was 3m x 3m with 1m discard between each unit. Garlic outer layer was peeled leaving the endocarp which was then blended to paste and weighed in different levels of 10, 20, 30, 40 and 50g each per liter of water and left for 18hrs to dissolve. Spraying of insecticide treatments was carried out at two weeks interval using 16 litre capacity knapsack sprayers.

Data Collection

Six (6) plant stands were randomly sampled and tagged per plot for data collection. Growth parameters taken include plant height at 2, 4 and 6 weeks after planting; number of leaves at 2, 4 and 6 weeks after planting; stem girth at 2, 4 and 6 weeks after planting; and number of days to 50% flowering. Yield parameters taken were average fruit length and diameter; fruit weight; number of fruits per plant; and fruit yield/ha. Pest control parameters included number of aborted fruits and number of perforated leaves.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using ASSISTAT Statistical Software Package (Version 7.7 beta, 2015). Treatment means where significant and were separated using the Duncan Multiple Range Test (DMRT)

RESULTS

Table 1: Effects of garlic extract and lambda-cyhalothrin on growth of *Capscicum frutescens*.

Insecticide treatment	Plant height (cm) WAT			Number of leaf (WAT)			Stem girth (cm) WAT		
	2	4	6	2	4	6	2	4	6
10g garlic extract	11.6	44.39cd	60.77cd	11.66	44.39cd	60.77cd	0.87	1.69	1.82
20g garlic extract	15.22	82.50a	99.39a	15.22	82.50a	99.39a	0.96	2.03	2.10
30g garlic extract	14.22	72.05ab	86.00ab	14.22	72.05ab	86.00ab	1.16	2.29	2.37
40g garlic extract	13.22	70.22ab	85.55ab	13.22	70.22ab	85.55ab	0.96	2.13	2.29
50g garlic extract	12.66	57.44bc	71.16bc	12.66	57.44ab	71.16bc	1.01	1.99	2.12
2ml lambda-cyhalothrin/ L of water	12.50	65.33b	75.16bc	12.56	65.33b	75.16c	0.97	1.80	1.91
Control	9.33	34.72d	51.11d	9.33	34.72d	51.11d	0.82	1.74	1.86

Means followed by the same letters are not significantly different at 5% probability level of significance.

Table 2: Effects of garlic extract and lambda-cyhalothrin on pest control and yield of *Capscicum frutescens*.

Insecticide treatment	Days to 50% flowering	Fruit length (cm)	Fruit diameter (cm)	Number of fruits per plant	Number of aborted fruits/ plant	Yield per Ha
10g garlic extract	54.67b	12.5	1.64b	10.05a	0.45d	1.92b
20g garlic extract	54.00b	12.1	2.71a	9.00ab	0.40d	2.15a

30g garlic extract	56.50b	10.9	1.40b	8.50b	0.35d	1.81b
40g garlic extract	57.67b	12.3	1.56b	9.33ab	0.33d	1.63b
50g garlic extract	58.00b	10.8	1.20b	9.28ab	0.20c	1.46b
2ml lambda cyhalothrin	54.67b	13.5	1.29b	7.50b	0.15b	1.53b
Control	50.00a	11.6	1.77b	6.89c	0.50a	0.74c

Means followed by the same letters are not significantly different at 5% probability level of significance.

Table 3: Simple correlation and regression between increasing rate of garlic concentration and plant growth, pest control and yield components of *Capscicum frutescens*. (n = 5)

Parameters	Correlation coefficient (r)	Regression equation	Significant level
Number of leaves @ 6WAT	0.54	Y = 3.437 - 0.028X	*
Plant height @ 6WAT	0.41	Y = 4.017 + 0.417X	*
Stem girth @ 6WAT	0.44	Y = 3.024 + 0.456X	ns
Days to 50% flowering	0.51	Y = 4.593 - 0.515X	*
Average fruit length (cm)	0.25	Y = 2.798 - 0.128X	*
Average fruit diameter (cm)	0.60	Y = 2.077 - 0.315X	*
Number of fruits per plant	0.43	Y = 3.656 - 0.227X	ns
Number of aborted fruits per plant	0.61	Y = 0.205 + 0.210X	**
Yield per hectare (t)	0.48	Y = 635.7 + 0.188X	*

*, $P \leq 0.1$
**, $P \leq 0.05$

DISCUSSION

Effect of different levels of *A. sativum* and lambda-cyhalothrin on growth parameters of *Capsicum frutescens* is shown in Table 1. There was significant difference ($p<0.05$) in plant height at 4 and 6 weeks after transplanting (WAT). Garlic extract competed favourably with the synthetic insecticide (lambda-cyhalothrin) in improving the growth of pepper. The highest plant height recorded with garlic extracts was probably due to garlic effectiveness against the insect pests which must have reduced the feeding activities on the crop. This view agrees with the report of NRI (1996) and Degri and Yoriyo (2010). This result indicates that garlic at an application rate of 20g/litre of water has high insecticidal potential for controlling aphids and whiteflies on peppers and it can compete favorably with synthetic insecticides in managing them (Isman, 2006, Fuglie, 1998).

Results in the table also show that stem girth of *C. frutescens* was not significantly affected by the treatments. The result further shows that there was significant increase in number of leaves in all treatments across the experimental period. Result of the analysis also showed significant variation ($p>0.05$) at 4 and 6WAT. Number of leaves produced was found to decrease with increasing concentrations of garlic extract application above 20g/l. This assertion confirms the findings of Degri *et al.* (2012) who evaluated botanical insecticides in insect pest management of pepper production.

Effect of different levels of *A. sativum* and lambda–cyhalothrin in the control of insect pests, yield and yield components of *C. frutescens* is presented in Table 2. Earliness to flowering was not significantly different in all the biocide treatments. Result on fruit length revealed no significant difference ($p>0.05$), implying that variation in aqueous garlic extract concentration has no effect on the fruit length of chilli pepper. Fruit length of *C. frutescens* showed substantial reduction in length in plots treated with high concentration of garlic. There was a significant difference ($p<0.05$) in fruit diameter with application of 20g aqueous garlic extract/litre producing the highest mean value of 2.71cm. Increasing aqueous garlic concentration beyond 20g/litre of water inhibits pepper fruit diameter. The results of the effect of aqueous garlic extracts and lambda-cyhalothrin application on number of fruits per plant are also presented in Table 2. Analysis showed significant difference ($p<0.05$) in number of fruits harvested in the treatments. The results show that an application rate of 10g garlic/litre of water gave the highest number of fresh fruits per plant while the control untreated had the least number of fruits per plant. It also means that garlic extracts can be used comfortably in place of lambda-cyhalothrin controlling aphids and whiteflies infestation on peppers conforming with the work of Stoll, (2001), Degri and Yoriyo (2010). The higher number of fruits recorded from the extracts also implies that application of garlic extract reduced aphids and whiteflies piercing and sucking activity which cause loss in plant vigour, growth and yield. Effect of different levels of *A. sativum* and lambda-cyhalothrin have significant variation ($p<0.05$) in the number of aborted fruits. The treatment that caused the highest aborted fruits is the untreated plot while least abortion was recorded in lambda-cyhalothrin treated plots. Analysis of variance on yield indicated that 20g of garlic extract produced the highest significant yield/ha. The yield obtained from plant extracts treated plots, were significantly higher than the synthetic especially at 20 g/litre of water. This is in line with Panhwar (2002) who reported that plant extract applied on field cowpea plant increased flower production per plant. However, application at higher concentration was not as effective as lower rates and resulted in significantly reduced fruit yield.

Regressing increasing rate of garlic concentration and plant growth, pest control and yield components of *Capscicum frutescens* showed significant positive relationship (Table 3).

CONCLUSION

This study evaluated the use of different levels of aqueous extract of garlic and recommended rate of lambda-cyalothrin in chilli pepper production. The performance of *A. sativum* is not unconnected with its ajoene and allicin content. The study has further corroborated the reports of other researchers (Arannilewa *et al*, 2006, Benson *et al*, 2015) that extracts from *A. sativm* can be used to control field insect pests. Result of the experiment showed that the tested plant extracts have potential value to substitute synthetic insecticides in boosting pepper production within the framework of sustainable pest management.

RECOMMENDATIONS

It is recommended that *A. sativm* can be used as substitute to synthetic insecticides. Earliness to flowering, number of fruit and number of aborted fruits is negatively affected by increased biocide concentrations. This is an indication that increase in garlic concentration may reduce the activities of pollinating insects and consequently have an effect on yield and thereby not desirable. Increasing the concentration of garlic above 20g/litre of water reduced fruit length, diameter and yield. This connotes that concentration above this level might be a wasteful exercise and in addition might be detrimental to the quality of fruits and hence not advisable. Lower concentration of garlic extract produced higher number of fruits compared with other higher concentrations which is an indication that concentration lowered than 20g/litres might be suitable and/or exploited and therefore recommended for future work.

REFERENCES

Arannilewa, S. T., Ekankene, T. E. and Akinneye, J. C. (2006): Laboratory evaluation of four medicinal plants as protectant against the maize weevil *Sitophilus zeamais*. *African Journal of Biotechnology*, 5(21): 2032-2036

ASSISTAT (2015). *ASSISTAT Statistical Software Package*. Version 7.7 beta. Website http: //www.assistat.com

Benson, G. A. S., Ofuya T. I., Aladesanwa, R. D. and Okeowo, T. A. (2015): Biocides application in Okra (*Abelmoschus esculentus* L. Moench) production and implications for profitability in South Western, Nigeria. *International Journal of Applied Research and Technology,* 4(1), 3 – 9.

Degri, M. M., Ayuba, M. M and Yoriyo, K. P. (2012). Bio – efficacy of some aqueous plant extract and cyromazine (trigard 169). In the management of leaf miner (*Lirionyza* spp) on Egg plants in the Northern Guinea Savanna of Nigeria. *Journal of Experimental and Applied Biology* 13(2): 125-130.

Degri, M. M and Yoriyo, K. P. (2010) Efficacy of three plants extracts for the control of aphids (*Aphis gossypii* Glov) (Homoptera: Aphididae) on sweet peppers (*Capsium annum* L.) (Solanaceae) in Nigeria Sudan Savanna. *International Journal of Food and Agricultural Research* 7(1): 256-262.

Donald K. (2012): *African Development Bank (AfDB) Group Report*. Towards Green Growth in Africa. Pp 133. www.afdb.org.

FAO (1992): *Pesticide residue in food report*. 116: 146

FAOSTAT (2012). *Agricultural Organization of the United Nations Statistical Database,* Rome, Italy.

Fuglie, F. J. (1998). *Producing food without pesticides.* Local solution to crop pest control in west Africa, CTA, The Netherlands, 158pp

Grubben, G. J. and El Tahir, I. M. (2004). *Capsicum annum* l. In: Grubben, G. J. H and O. A. Denton (eds.) PROTA 2: Vegetables/Legumes. [CD-Rom] PROTA, Wageningen, The Netherlands.

Ismam, M. B. (2006). Botanical insecticides deterrents and repellents in modern Agriculture and increasingly regulated world. *Annual Review of Entomology* 51(1): 45 - 66.

Natural Resources Institute (NRI) (1996): *A guide to insect pests of Nigerian crops*. Identification, biology and control. UK: Overseas Development Administration. 240pp.

Panhwar, S. B. (2002): Farmers adoption of plant materials for insects control. *International service for National Agricultural Research, Haque, Netherland,* 4(1), 61-68

Schwarb A., Gorgen R. & Dobson L. (1995). *Insecticides for plants*. Decker Inc, New York

Stoll, G. (2001). *Natural crop production in the Tropics*. Magraf Publishers, Weikersheim.