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Evaluation of two Botanicals in Management of Aphids (*Aphis craccivora* koch) Population on Cabbage (*Brassica Oleracea* L.) Along River Galma, Zaria, Nigeria

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ABSTRACT: Field experiment was conducted at Galma Bizzara, Zaria during the 2015 dry season. Two different botanicals pawpaw (*Carica papaya*) and moringa (*Moringa oleifera*), were compared against Cypermethrin for the management of *Aphiscraccivora* (Koch)population on Cabbage (*Brassica oleracea* L.). The experiment consisted of four treatments laid in Randomized Completely Block Design (RCBD) replicated five times. Each plot was 4m by 3m. Moringa and pawpaw leaves were air-dried at room temperature (25^{o}C) and pounded into powdery form. 20g each of pawpaw (*Carica papaya*) and Moringa (*Moringa oleifera*)leaf powders were soaked separately into 1 litre of water overnight prior to spray. Muslin cloth was used to squeeze and prevent foreign particles into the aqueous solution of moringa and pawpaw. Visual assessment was used to count the number of Aphis per plant. The efficacy of the standard (Cypermethrin) on mean population of *A.craccivora* was highly significant compared to Moringa leaf which was also significantly more efficient than pawpaw leaf at the first spray ($p<0.05$). In the second spray however, Cypermethrin gave the overall best effect while there was no significant difference between Moringa and Pawpaw leaves. From this study, Moringa could be a use for the management of *A.craccivora*population on cabbage in place of the synthetic pesticide (Cypermethrin).

Keywords: Botanical, *Aphis craccivora*, Cypermethrin, Cabbage B. *oleracea*

INTRODUCTION

Cabbage (*Brassica oleracea* L.) of the family Brassicae (or Cruciferae) is a leafy green vegetable, a herbaceous, biennial dicotyledonous flowering plant distinguished by a short stem upon which is crowded a mass of leaves, usually green but in some varieties red or purplish, which while immature form a characteristic compact, globular cluster (Cabbage head) (Oguwike*et al.*, 2014). It is a crop with many cultivated varieties in the temperate and tropical regions (Jim and Tony, 2006). Cabbage has been domesticated and used for human consumption since the earliest antiquity (Olaniyi and Ojetayo, 2011). Production is done in all continents including Africa, North America, South America, Asia, Oceania and USSR. World leading countries in cabbage production are china with 136mt/ha, Japan with 37.5mt/ha, Romania 34.5mt/ha, Poland with 30.6mt/ha, Russia with 22.6mt/ha, USA with 21.4mt/ha, Italy with 20.7mt/ha, Yugoslavia with 14.6mt/ha and Korea Republic with 12.4mt/ha (FAO, 2010).

Brassicas are important as they are a key components of the local diet and nutritionally very important for people who cannot afford alternative vegetables (Oruku and Ndun'gu, 2001). Holland *et al.*, (1991) reported that 100g of edible portion of cabbage, when prepared raw supplies 1.9g protein, 4.1g carbohydrate, 0.4 g fat,109 Kj energy, vitamins (B and C) and several mineral elements. It alsoreducesrisk of heart

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disease and stroke, alleviate rheumatisms and skin problems (Odewole and Adebayo, 2014). Cabbage is an excellent source of vitamin C and vitamin K containing more than20% of the daily value (DV) for each of these nutrients per serving (right table of USDA nutrient values) (USDA 2014). It is high in beta-carotene, vitamin C and fibre. In Nigeria, the crop is very much gaining popularity because of its nutritive value. It serves as a good raw material for the catering industry, a good source of income to farmers and has easy and variable ways of preparation into dishes (salad, soup and as component of other dishes).

Insect pests and diseases constitute major problems to cabbage crop in Nigeria (Anon, 2005). *Aphis craccivora* feed by sucking sap from cabbage plant produces a sugary waste product called "honeydew"(Opfer and McGrath, 2013).Continued feeding by *aphis craccivora* causes yellowing, wilting and stunting of plants (Opfer and McGrath, 2013).Severely infested plants become covered with a mass of small sticky aphis (due to honeydew secretions), which may lead to leaf death and decay (Griffin and Williamson, 2012). Cabbage aphis feed on the underside of the leaves and on the center of cabbage head (Hines and Hutchison, 2013). With synthetic chemical giving the best control (Anaso *et al.,* 1988). Excessive use of insecticides has led to insecticidal resistance development, pest resurgence, residue hazards in foods and overall environmental contaminations (Begna and Damtew, 2015). Apart from being expensive, most of them are nerve poison, affecting and damaging non-target and beneficial insects. Continuous usage has resulted in the selection of races resistant to insecticides. According to Devonshire (1989), 18 species of aphis have been reported to be resistant to chemical pesticides. The reduction of natural enemies' population by the use of broad spectrum insecticides will in the long run increase the potential damage of the pest (Spencer, 2003). Added to these peasant farmers have no or little technical skill for the application of these chemicals (Teetes and Gilstrap, 2000). The hazardous effects of synthetic pesticides to human, livestock's health and its effects on the environment are additional constraints to the dependence on synthetic pesticides. In view of this, there is a need for research into the potentials of botanical plants, which are natural, pose less risk to humans, livestock and as well as the environment, cheaper; thus serving as one of the options to synthetic pesticides in the Integrated Pest Management Programme (Anaso *et al.,* 1988).

This study aims to compare the efficacy of leaf extracts of pawpaw (*Carica papaya*) and Moringa (*Moringa oleifera*)in the management of A.*craccivora* populations on Cabbage (*Brassica Oleracea* L.) at Samaru Zaria, in Kaduna State.

Materials and Methods

Experimental Site

The trial was conducted during dry season at river Galma in 2015. It is a stream and is located in Kaduna, Nigeria. The estimated terrain elevation above sea level is 595 metres (GPS, Ubale). The river Galma has different spelling or name in other languages such as River Galma and River Gulma. The latitude is $10^{o}38'19.61$'N and the longitude is $7^{o}42'5.5$'E with the temperature of $21^{o}C$ – $31^{o}C$ (GPS, Ubale 2015).

Materials and Sources

The materials used for this trial were pawpaw and Moringa leaves, then Fungicide (carbendazin), seed dressing chemical Apron plus (Benomyl and Thiran) were bought from an Agro-chemical dealer, Farmers Escort) Samaru Market Zaria. Others were fertilizer (N.P.K 15:15:15) and cabbage seed variety (hybrid white cabbage: Gloria) bought from PZ Sabon – Gari market, Zaria. Irrigation machines (Honda, Zinchen water pump) was obtained from the Division of Irrigation Engineering Bizzara (Galma), Zaria. Camel hair brush, mortar

and pestle, plastic sack and muslin cloth wereobtained from Crop Protection Department, Ahmadu Bello University, Zaria. Manual operated hydraulic knapsack sprayer (CP_3) (20litres), protective clothing (hand gloves, polythene bag, nose mask, rain boot, helmet,clothing material, nose mask), measuring tape, weighing scale, hoe, garden fork, knife were allobtained from Sabon Gari market Zaria. The pawpaw and moringa leaves used for the experiment were gotten from Horticultural section of Samaru College of Agriculture, Ahmadu Bello University, Zaria.

Experimental Design

Experimental design used was Randomized Complete Block Design (RCBD). There were four treatments replicated five times, each replicate consisted of four plots, with four ridges per plot and a total of 20 plots. The treatments were as follows; T1: Pawpaw (*Carica papaya*) leaf, T2: Moringa leaf, T3: Cypermethrin (Standard), T4: (water) control. Plot size used was 4m long and 3m wide, between each bed 1m spacing separated each of the plots. Spacing between cabbage plants was measured to be 60cm by 60cm apart, spacing between ridges were measured to be 1m. The seeds (hybrid white cabbage: Gloria) sown were previously treated with Apron plus® seed dressing chemical at the rate of 10g per 4 kg of seeds.

Nursery Preparation

Nursery site was cleared, cultivated and dug to a fine tilt using hoe and the soil was mixed with farmyard manure. The beds were made andeach bed was measured to be 4m x 3m in size. Water was applied to cabbage using irrigation pump and was left for one day before transplanting. The seeds of cabbage were broadcast on 27th January, 2015 on the top of beds. The beds were mulched and covered with dry grasses and lightly watered every other day. Upon germination, dry grasses were used as mulching material were removed one week after sowing. After germinating, a light surface irrigation was applied to each bed at weekly interval. Three times weeding was done manually at two weeks interval. Seedlings were allowed to grow in the nursery for four weeks before transplanting to main plots.

Transplanting

When the seedlings reached four weeks after sowing in the nursery beds, the seedlings were carefully uprooted with garden fork. A little water was applied by irrigation before uprooting the seedlings; water was applied immediately after transplanting the seedlings in the main experimental plots. Weeding of the plots started at three weeks after transplanting. Transplanting was carried out in the evening from 4:00 pm to 6:00 pm to minimize damage. Weeding was carried out three times at interval using hoe. Optimally cabbage requires 60- 85 kg N/ha; 60-80 kg P_2O_5/ha; and 30-90kgK_2O/ha (Shika and Doug, 2001).Fertilizer application took place three times after the first weeding in the experimental plot using N.P.K 15:15:15 at the recommended rate of 72 g per plot and about 3g per plant of N, P and K was applied at two weeks after transplanting at an interval of two weeks. Flooding surface irrigation was conducted in this experiment using Irrigation machine (Honda Zincheng water pump). Irrigation was applied to the experimental plots eleven times at weekly interval beginning when the plants reaches two weeks in the main plots after transplanting the seedlings.

Extraction of Materials

Pawpaw (*Carica papaya*) and *Moringa*sp.leaves were air-dried at room temperature (25^oC) for two weeks, crushed with pestle and mortar and pounded into powdery form and a sieve was used to separate the fine powder from the chaff. Then, 20g of each powder was poured in 1 liter of water and allowed to stand overnight. A muslin cloth was used to filter the extract solution.

Aphid Count

A modified visual assessment was made and 1 – 5 scoring scale, where 1 represents no aphid and 5 represents extremely heavy infestations was used, after Lowe (1984). Three plants per plot were selected at random for aphid count both before and after spraying. A leaf with aphis under each category was removed and taken to the laboratory where allthe aphis were dislodged on a white paper using the camel hair brush and counted physically. The rating scalewas as follows:

Ratings	No. of Aphid	Appearance
1	0	No aphis
2	1 – 8	A few individual
3	9 – 14	Several small colonies
4	15 – 20	Many isolated colonies
5	21 – 25	Large colonies

Application of Treatments

Spraying commenced three weeks after transplanting to allow aphid establishment and treatments were administered in the morning (7 – 9am) with CP_3 knapsack sprayer. The spraying was done twice before harvesting of cabbage with the leaf extract solution of *Moringaoleifera* and pawpaw (*Carica papaya*) leaves and cypermethrin 5ml per liter of water respectively. About 20ml of cypermethrin and 80g of pawpaw and Moringa extracts were used at 4 litres each per knapsack. The prevention of mixing up materials was also ensured by washing of the knapsack sprayer twice with water and rinsed with part of the solution to be sprayed.

Data Collection

Three (3) plants were randomly selected and tagged. Aphid count was done before and a day after spraying. Data collected was subjected to statistical analysis of variance (ANOVA) and significant meanswere separated using LSD at ($p<0.05$).Result showed that Cypermethrin (standard) and Moringa had significant effect in reducing *A.craccivora* on cabbage, compared to pawpaw which was less effective. The aqueous extract of botanical (Moringa) is a potential botanical insecticide against A.*craccivora* infestation on cabbage. Since the efficacy was conducted under field condition, this botanical Moringa extract could serve as an alternative to chemical (synthetic) insecticides.

Results

The result in Table 1 shows the effects of botanical sprays on the mean population of *A.craccivora* on cabbage. That insecticidal properties of all the treatments at ($p<0.05$) with Cypermethrin (standard) having the highest efficacy followed by Moringa ($p<0.05$), followed by Pawpaw (6.50) and followed by the untreated plot (control) 19.50 which has the least efficacy on the mean population of *A.craccivora*. However, the result in Table 2 showed that the effect of the second botanical sprays on the mean population of *A.craccivora*at Galma Bizzara during 2015 dry season. It showed that Cypermethrin (standard) gave the highest efficacy (1.00), followed by Moringa (2.75) which is similar to pawpaw (3.50) but significantly higher than the untreated plot (Control) on the mean population of *A.craccivora* ($p<0.05$).

Table 1: Effect of two botanicals Moringa and pawpaw leaf extracts on *A.craccivora*infesting cabbage in 2015 dry season.

	Mean population of *A.craccivora*	
Treatment (Aqueous)	**Before Spray**	**After Spray**
Moringa	12.75	4.5[c]
Pawpaw	12.75	6.50[b]
Standard(Cypermethrin)	13.25	1.25[d]
Control	22.50	19.50[a]
LSD	3.13	1.19
SE(±)	0.86	2.13

**** Means within the same column with the some letter are not significantly different (p<0.05).**

Table 2: Effect of two botanicals Moringa and pawpaw *A.craccivora*infesting cabbage in 2015 dry season.

	Mean population of *Aphiscraccivora*	
Treatment (Aqueous)	**24hours Before Spray**	**24hours After Spray**
Moringa	7.75	2.75[b]
Pawpaw	19.75	3.50[b]
Standard (Cypermethrin)	7.25	1.00[c]
Control	26.25	29.25[a]
LSD	2.43	1.61
SE(±)	2.14	3.04

**** Means within the same column with the some letter are not significantly different (p<0.05).**

DISCUSSION

Aphis craccivora population buildup was observed to peak at the early stages of cabbage growth usually 3 – 4 weeks after transplanting. In general, the two extract at 20g showed high effectiveness than control, a synthetic pyrethroid insecticides (cypermethrin) was slightly more than 20 g of extract of moringa and 20 g of extract of pawpaw while effectiveness of 20 g of extract of moringa was higher than 20 g extract of pawpaw at these result revealed that those two botanicals have the potential to be developed as one of the option to management population of *A. craccivora* on cabbage. Result agreed with the observations of Isman (2006) who reported that there was variation in the susceptibility of insect to different species of plant extracts. This work supports the findings of Mugisha-Kamatenesi *et al.,* (2008), who listed *C. papaya* among plants with anti pest activity. Dadang *et al.,* 2007 reported the strong efficacy of a mixture of *Piper retrofractum* with *Annona squamosa* and *Aglaia odorata* which produced 100% and 94% mortality when *C. pavonana* larvae were treated with 0.05% extract mixture at 48 hours after treatment. The extract mixture of *Aglaia odorata* and *Annona squamosa* gave a synergistic combination with multiple actions, as feeding inhibition and insecticidal activity (Dadang *et al.*, 2007). It has been report that the extract of *Piper retrofractum* has been known to have insecticidal activity to *Plutella xylostella* and *C. pavonana* (Dadang, 1999; Dadang *et al.* 2007). Other insectsthat were affected by *Piper retrofractum* extract were *Forficula auricularia* (dermaptera: Forficulidae), *Culex quinguefasciatus* and *Aedesaegypti* (Diptera: Culicidae), and *Coptotermesgestroi* (Isoptera: Rhinotermitidae) (Assabgui *et al.,* 1997; Chansang *et al.*, 2005; Alfian 2007).

CONCLUSION

Moringa and pawpaw leaf extract at 20 g per litre of water have potential to serve as option in the management of *A. craccivora*on cabbage in Samaru Zaria, Nigeria.

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