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EFFECT OF CHILLI PEPPER EXTRACT IN THE CONTROL OF DIAMONDBACK MOTH (*Plutella xylostella* L.) CATERPILLAR INFESTATION IN AMARANTHUS IN MAIDUGURI, BORNO STATE

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ABSTRACT

The experiment was conducted at the Faculty of Agriculture Research Farm, University of Maiduguri in 2015 to investigate the effect of chilli pepper (*Capsicum annum* L.) fruit extract in the control of diamondback moth (DBM) *Plutella xylostella* caterpillar infestation in *Amaranthus tricolor*. Three concentrations (10, 20 and 30%) of chili pepper fruit extract and a control were tested in a randomized complete block design (RCBD). The results revealed that chili pepper fruit extract had insecticidal properties against DBM larvae. Plots treated with 10, 20 and 30% of the extract had significantly reduced the number of damaged leaves and the population of DBM larvae. Plots treated with 30% chili pepper fruit extract had the best leaf yield and the lowest population of *P. xylostella*. About 32.65 – 66.32% number of DBM larvae was reduced as a result of treating the crop with 10, 20 and 30% of chili extract. The highest population of *P. xylostella* and highest number of damaged leaves occurred in the control plots. This implies that amaranthus farmers have safer alternative with which amaranthus can be protected and its yields improved.

Keywords: Chilli pepper; diamondback moth; amaranths; insect pests

INTRODUCTION

Amaranth is popularly known as spinach, which is widely grown in Nigeria and sub-saharan Africa. The vegetable *Amaranthus tricolor* is one of the most important green leafy vegetables of the tropics, it provides minerals and vitamins (especially vitamin A) which are highly beneficial for the maintenance of good health and prevention of diseases (Onyango *et al.*, 2008). The production levels of amaranth are not known. However, recent research indicates that under cultivated conditions, amaranth produces fresh leaf yields of up to 40 t/ha. The yield of grain amaranth is highly variable with 1 000 kg/ha considered a good yield (DPP, 2010). In Nigeria for example, this vegetable is widely grown for subsistence and it offers a significant opportunity for poor households to generate income through commercial production of the vegetable (Emokoro *et al*, 2007).

Diamondback Moth (*Plutella xylostella* L.) (Lepidoptera: Plutellidae), is the most serious insect pest of cruciferous crops throughout the world (Sarfraz *et al*., 2006). The adults are small, grayish-brown moths with three diamonds on their body, and are more

distinct on males than females (Serafinchon, 2001). They lay yellow eggs singly on the underside of the leaves near the veins. The larvae are green and feed under the leaf epidermis first and later on the outer layer of the leaf. Larvae feed on leaves, buds, flowers, seed, and the green stems. When larvae are small, damage is evident as small irregular holes of "shot hole" in the leaves. If larvae are numerous, they may eat the entire leaf, leaving only the veins (Serafinchon, 2001). If no control measures are undertaken, this insect can cause up to 100% crop loss (Shelton *et al*., 1993).

Control of *P. xylostella* is largely by synthetic insecticides. However, these chemicals become less effective because of its quick development of resistance to almost all groups of insecticides; including organochlorines, organophosphates, carbamates, pyrethroids, insect growth regulators, abamectins, pyrazoles, oxadiazines, neonicotinoids, spinosad and indoxacarb (Abdel-Razek *et al*., 2006; Charleston *et al*., 2005; Qian *et al*., 2008). Georghiou (1981) reported resistance of diamond-back moth to 36 insecticides in 14 countries. In addition, the indiscriminate use of synthetic insecticides has given rise to many ecological problems, including toxic residues, harm to mammals and the accumulation of harmful residues in the environment (Shelton *et al*., 1993; Khan *et al*., 2005). It has been estimated by the World Health Organization (WHO) that about 20,000 people die each year from pesticide poisoning and at least 3 million people suffer acute health effects (Barbara, 1993). In view of these, an alternative substances that is ecologically safe and effective against the pest could be an important component of a sustainable Integrated Pest Management program. Among current alternative methods aiming at decreasing the use of synthetic insecticides, are botanical insecticides which have little or no harmful effects on non-target organisms and the environment. Chilli pepper and neem extract are effective for the control of diamondback moth, aphids and whitefly (Stoll, 2000). This study evaluates the effects of chili pepper extract in the management of population of diamondback moth in amaranths.

MATERIALS AND METHODS

Study Area

The experiment was conducted at Orchard Farm of Faculty of Agriculture, University of Maiduguri in 2015. It is located (latitude11^0 51'N; longitude 13^0 16' E and altitude 354 mm above sea level) in the northern Sudan Savannah belt of Nigeria. Diamondback moth is a major pest of amaranths in the area.

Experimental Design and Field Layout

The experiment was conducted on an area of 130 m^2, harrowed and marked out in RCBD design with three replications. Each treatment was applied onto a 4 m^2 plot separated by 1 m walking alley. A certified amaranth seed with 97% germination was used. Two grams of seed was sown by drilling eight strips per plot. Irrigation and weed control were carried out based on the need.

Preparation and Application of Treatments

Extract of chili pepper was prepared by weighing 500g of powdered dried fruit with an electronic balance into 4 litres of water and boiled for 90 minutes. The extract was filtered through cheese cloth to obtain the aqueous extract. Treatments of 10, 20 and 30% (v/v) were prepared by mixing 100, 200 and 300 ml of the crude aqueous extract with 900, 800 and 700 ml of tap water, respectively. The treatments application started at 14 days after sowing (DAS). Subsequent application of the treatments was carried out at weekly intervals.

Data Collection

In each plot, the number of larvae of diamondback moth was counted visually per plot. Weight of plant per plot was determined by harvesting all the plants in each plot and weighing them fresh using an electronic balance. Damaged and undamaged plants in each plot were separated and weighed. A plant with more than 25% of its leave damaged was considered a damaged plant otherwise it is undamaged plant. Leaf with more than 25% of its area damaged was considered a damage leaf.

Data Analysis

Analysis of Variance (ANOVA) for each parameter was conducted to determine significant difference among treatments and means were separated using Fisher's least significant difference (LSD) test at 0.05 probability level.

RESULTS

The number of damaged leaves per plot in plots treated with 0, 10, 20 and 30% were not significantly ($P>0.05$) different at week I and II (Table 1). However, the damaged leaves were significantly ($P<0.05$) lower in plots treated with chilli extract than the control in weeks III and IV. Application of 30% chilli extract had significantly ($P<0.05$) lowered the number of damaged leaves than the control in weeks III and IV after each treatment. At the end of week III and IV after treatment, the number of leaves per plot was significantly ($P<0.05$) lower in plot treated with 10, 20 and 30% chilli extract than the control. The combined mean of 4 weeks indicates that 30% chilli extract had significantly ($P<0.05$) lowered the number of damaged leave than the control. These indicate that chilli extract is effective against the diamondback moth (DBM) larvae.

Table 1: Number of amaranths leaves damaged per $4m^2$ by *Plutella xylostella* larvae after spraying chilli pepper extract during 2015 cropping season in Maiduguri

Treatment	Week I	Week II	Week III	Week IV	Combined
0%	6.67±0.89	8.00±1.00	$10.67±0.87^{a}$	$11.33±0.33^{a}$	$9.17±1.33^{a}$
10%	5.67±0.89	6.00±1.00	$7.33±1.20^{b}$	$7.67±0.87^{bc}$	$6.67±2.12^{ab}$
20%	5.33±0.89	5.67±0.67	$7.33±0.87^{b}$	$8.33±0.67^{b}$	$6.67±1.86^{ab}$
30%	4.33±0.67	5.43±0.33	$5.67±0.67^{b}$	$6.00±0.58^{c}$	$5.43±2.03^{b}$
LSD	2.72	2.61	3.03	2.11	2.62

The result in Table 2 shows the number of DBM larvae per plot. The population of DBM larvae was significantly ($P<0.05$) reduced by application of 20-30% chilli extract than the control in week I and IV after sowing. Larvae population was significantly ($P<0.05$) reduced by the application of 10% chilli extract at week III and IV than the control. The combined mean of leaf per plot was significantly ($P<0.05$) lower in plots treated with chilli than the control. This indicates that chilli extract has some insecticidal properties against DBM larvae.

Table 2: Number of Diamond Back Moth larvae per $4m^2$ plot after spraying chilli pepper extract during 2015 cropping season in Maiduguri

Treatment	Week I	Week II	Week III	Week IV	Combined
0%	12.00 ± 2.08^{a}	15.67 ± 1.86^{a}	31.67 ± 1.45^{a}	38.67 ± 2.19^{a}	24.50 ± 4.36^{a}
10%	10.33 ± 0.89^{ab}	13.67 ± 1.76^{a}	21.67 ± 1.45^{b}	21.33 ± 2.91^{b}	16.67 ± 5.33^{b}
20%	7.67 ± 0.67^{bc}	10.67 ± 1.67^{ab}	21.33 ± 0.89^{b}	21.67 ± 1.76^{b}	15.33 ± 2.19^{b}
30%	4.00 ± 0.58^{c}	6.67 ± 0.89^{b}	9.33 ± 0.89^{c}	13.33 ± 0.33^{c}	8.33 ± 2.40^{c}
LSD	3.96	5.19	3.92	6.61	3.42

Table 3 shows the harvested yield in kg / $4m^2$ plot after 4 weeks. The weight of damaged plants per 4 m^2 plot was not significantly ($P>0.05$) different for all the treatments. However, the weight of undamaged plants and the total weight per plot were significantly ($P<0.05$) higher in plots treated with 30% chilli extract than in plots treated with either 10 or 20% chilli extract and the control. The results indicate that chilli extract is effective against DBM larvae. However, the higher weight of damaged plants in plots treated with 30% chilli extract compared with the control is attributed to the lower population of DBM recorded in the plots. This further indicates that chilli extract can not only reduce the population of DBM larvae but increases the yield of amaranthus spp.

Table 3: Yield ($kg/4m^2$) of Amaranths treated with chilli pepper extract for the control of Diamond Back Moth during the 2015 cropping season in Maiduguri

	Yield in $kg/4m^2$		
Treatment	Damaged plants	Undamaged plants	Total yield
0%	1.83±0.12	0.67 ± 0.15^{b}	2.50 ± 0.12^{b}
10%	1.83±0.39	1.73 ± 0.59^{b}	3.57 ± 0.49^{b}
20%	1.57±0.15	2.36 ± 1.05^{b}	3.93 ± 0.99^{b}
30%	2.48±0.42	5.68 ± 0.36^{a}	8.17 ± 0.67^{a}
LSD	0.99	2.06	2.12

DISCUSSION

It is obvious that the chilli extract had insecticidal effects on the diamondback moth (DBM) larvae, *Plutella xylostella* L. This is evident in the population of DBM larvae which reduces with application of chilli extract. This agrees with Stoll (2000) who reported that, chilli pepper and neem extract are effective in the control of diamond back moth, aphids and whitefly. This study has further confirmed the insecticidal properties of chilli pepper

against DBM larvae. The reduction in the number of DBM larvae has resulted into an increase in the weight of undamaged plants which is an indication of antifeedant mode of action of chilli peper extrsct. Larvae of *P. xylostella,* feed voraciously on the foliage of the cruciferous plant from the seedling stage to harvest and greatly reduce the yield and quality of produce (Talekar and Shelton, 1993). The result therefore, implies that the feeding effect of the larval stage of *P. xylostella* was drastically reduced by application of chilli pepper fruit extract. As also shown in the control plots, higher population of DBM larvae was responsible for relatively higher number of damaged leaves which ultimately resulted into lower weight of total yield in kg/4m^2.

All the three different concentrations (10, 20 and 30%) of chilli pepper fruit extract were effective against DBM larvae; however, the most effective concentration appeared to be 30% concentration. This was shown in the population of DBM larvae which was reduced by an increase in the concentration of chilli pepper fruit extract. It was reported that the higher the concentration of chilli pepper fruit extract, the lower the damage by *Plutella xylostella* (Sharma *et al.*, 2006; Okunlola *et al.,* 2008). Reduction in the number of damaged leaves and increase in the number of undamaged leaves was attributed to the reduction in the population of DBM larvae caused by an increase in the percentage concentration of chilli pepper extract.

The increase in the population of larvae in subsequent weeks was attributed to the continuous hatching of eggs laid by the adult DBM. This clearly indicates that eggs were not affected by the chilli pepper fruit extract, which also implies that application of chilli pepper extract at earlier stage could be more effective in reducing the plant damage.

CONCLUSION

Chilli pepper fruit extract has insecticidal properties against DBM larva, *Plutella xylostella*. Spraying *Amaranthus tricolor* with 10-30% chilli pepper fruit extract can reduces DBM larvae and increases the weight of undamaged yields. This implies that amaranths farmers in the study area have safer alternative with which amaranths can be protected and its yields improved.

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