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Potentials of *Mitracarpus villosus* (L.) and *Balanites aegyptiaca* (Del.) Plant Extracts and Cypermethrin in the Management of Tomato Fruitworm (*Helicoverpa armigera* Hubner) Damage in Maiduguri, Nigeria

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Field studies were carried out during 2009 and 2010 cropping seasons in Maiduguri within the semi-arid region of Nigeria to evaluate the insecticidal potentials of the aqueous plant/leaf extract (APE/ALE) (10% w/v) of two botanicals (the asthma plant, *Mitracarpus villosus* (SW.) DC. and *Balanites aegyptiaca* (Linn.) Delile) against a synthetic insecticide (Cypermethrin) in managing tomato fruitworm (*Helicoverpa armigera* Hubner) infestation. These treatments were assessed in studies laid out in randomized complete block design replicated four times. Where, treatment sprays commenced at the onset of fruiting and continued at fortnightly intervals. Total fruit yield (t/ha) and the number of damaged fruits were respectively higher and lower on tomato plants treated with Cypermethrin (28.3 and 2.4) and APE of *M. villosus* (24.9 and 2.3) than with ALE of *B. aegyptiaca* (22.3 and 3.3). In contrast to the ALE of *B. aegyptiaca*, plant treatment with Cypermethrin, followed by APE of *M. villosus*, gave better protection of tomato fruits against *H. armigera* infestation and damage. However, having focused on a single extract concentration and spray regime in this study, more studies will be necessary to ascertain the efficacy of these botanicals that for instance may be concentration or dose dependent.

Keywords: *Balanites aegyptiaca*, botanical extracts, Cypermethrin, *Helicoverpa armigera*, infestation, *Mitracarpus villosus*, tomato fruit.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) belonging to the Solanaceae family, is the second most important vegetable crop in the world after potatoes (Gerald and Frank, 2005). It is the most commercially grown vegetable in Africa, and parts of Northern Nigeria (Schippers, 2000). Although its cultivation is ecologically restricted due to its temperature and humidity requirements (Erinle, 1989), tomato continues to gain popularity because of its high demand and revenue return (Kabura et al., 1999). Tomato production in the Sudan Savanna is constrained by a complex of pests that includes the tomato fruit worm (*Helicoverpa armigera* Hubner), white flies (*Bemisia tabaci* Genn.), nematodes and beetles (Lange and Bronson, 1981; Umeh et al., 2002). Of which, *H. armigera* is a major insect pest of tomato. As larval boring and feeding activities primarily injure tomato fruits, and then predispose infested fruits to the entry of fungal pathogens (Erinle, 1989; Martin et al., 2000, 2005; Ratnadass et al., 2011). Synthetic insecticides including Carbaryl, Karate, Cypermethrin, Dimethoate and Monocrotophos have been documented to effectively protect tomato fruits

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against *H. armigera* infestation (Cameron and Walker, 2002; Khan and Griffin, 1999; Singh and Narang, 1990). The use of these synthetic insecticides is however of great concern as they leave residues in food products consumed and also the larger environment. Moreover, the use of these synthetic insecticides by resource poor farmers is limited by either their high costs or scarcity at crucial times of need. Alternative natural pesticides which may be readily available or affordable, safe or environmentally friendly and uncomplicated in preparation are increasingly being advocated for the replacement of synthetic insecticides that otherwise can be harmful and toxic to the producers and consumers (Babarinde et al., 2008; Fuglie, 1998; Ivbijaro, 1990; Stoll, 2000). This study therefore evaluated the efficacy of the extracts of the asthma plant, *Mitracarpus villosus* (SW.) DC. and *Balanites aegyptiaca* (Linn.) Delile) as compared to the conventional synthetic insecticide, Cypermethrin, in managing *H. armigera* infestation of tomato fruits in Maiduguri, Semi-arid region of Nigeria.

MATERIALS AND METHODS

Field studies of four treatment replications laid out in a randomized complete block design were conducted during 2009 and 2010 cropping seasons in the Research Farm, University of Maiduguri, Borno State, Nigeria. Treatments tested include two botanicals (the aqueous plant extract (APE) of *M. villosus* and aqueous leave extract (ALE) of *B. aegyptiaca*) and one standard synthetic insecticide, Cypermethrin. The tomato variety UTC, characterized by its thick fleshy large fruits with few seeds was used in the study. The tomato seeds were sourced from the Borno State Agricultural Development Programme.

Tomato seedlings were raised in a shaded nursery at the beginning of the rainy seasons, June in 2009 and July in 2010, at the Faculty of Agriculture Orchard, University of Maiduguri. Prior to seedling transplantation, the entire field was cleared, ploughed, harrowed and field plots of 5.0 m x 4.0 m size with 1.0 m inter plot space, 1.5 m alley and 1.5 m outside border prepared. Following the watering and drain-off to field capacity of the nursery beds, five weeks old tomato seedlings were gently transplanted at the spacing of 60 cm x 60 cm along with root earthen ball to avoid root exposure and transplanting shock. Within the immediate week after transplantation, failed stands were re-transplanted to fill all existing gaps. Afterwards, the plots were weeded and the NPK 15:15:15 fertilizer applied at 37 g per plant stand (Ibrahim and Dadari, 2002).

The fresh and clean plants of *M. villosus* and leaves of *B. aegyptiaca* were collected from Dollori, along Bama road, Maiduguri. The 10 g pounded paste of each plant material was weighed into a 250 ml conical flask; unto which, 100 ml clean water was added and then manually stirred for 20 minutes. The supernatant of each plant material was left for 24 hours, and thereafter, filtered through a 1.0 mm sieve into a plastic bottle (Babarinde et al., 2008; Fuglie, 1998; Stoll, 2000).

Following fruiting onset, the tomato plants were sprayed with the prepared 10 per cent (%) weight per volume (w/v) concentration of APE of *M. villosus* and ALE of *B. aegyptiaca*, and also Cypermethrin (at 150 g active ingredient / hectare). These treatments were sprayed using a CP-16 knapsack sprayer. Treatment sprays were then sustained at fortnightly intervals until fruit harvesting was completed. Data collection at harvest time was made from five randomly selected plants per plot. The numbers of bored holes per fruit, damaged and undamaged fruits per plant, fruit weight (g) per plant using the Mettler balance (2000 model), fruit size (the measure of fruit diameter at the broadest portion) (mm) per plant and total fruit yield (the weight of total undamaged and damaged tomato fruits) (t/ha) were recorded.

Data analysis

Data recorded on various parameters under study were subjected to analysis of variance (ANOVA) using Statistix (8.1). Mean separation were then performed using the Least Significant Difference (LSD) at 5% level of probability (Gomez and Gomez, 1984).

RESULTS

The results of number of larval holes per fruit, and also damaged and undamaged fruits per plant are presented in Table 1. The maximum number of larval holes per fruit was from tomato plants treated with the ALE of *B. aegyptiaca* (3.3), whilst the minimum was from those treated with the APE of *M. villosus* (2.4) or Cypermethrin (2.3). The number of damaged fruits per plant was highest (5.7 – 6.3) on tomato plants treated with APE of *M. villosus* and ALE of *B. aegyptiaca* and lowest on their counterparts treated with Cypermethrin (3.6). The number of undamaged fruits per plant was higher when treated with Cypermethrin (53.9) and APE of *M. villosus* (47.0) than with ALE of *B. aegyptiaca* (41.8). The weight and size of fruits obtained per plant were greater from tomato plants treated with Cypermethrin (32.0 and 42.2) and APE of *M. villosus* (29.7 and 37.0) than with ALE of *B. aegyptiaca* (26.2 and 30.9) (Table 2). Similarly, the

Table 1. Effect of extracts of two botanicals and Cypermethrin on tomato fruitworm damage during 2009 and 2010 cropping seasons in Maiduguri.

Treatment	No. holes / fruit	No.damaged fruits / plant	No. undamaged fruits / plant
Balanites aegyptiaca (ALE)	3.25a	6.31a	41.83c
Cypermethrin	2.25b	3.61b	53.93a
Mitracarpus villosus (APE)	2.35b	5.70a	47.01b
SE ±	0.19	0.40	3.85
LSD (0.05)	0.50	0.88	9.43

Means within the same column followed by the same letter are not significantly different at 5% level of probability according to DMRT.
ALE = aqueous leave extract; APE = aqueous plant extract.

Table 2. Effect of extracts of two botanicals and Cypermethrin on mean tomato fruit weight and size during 2009 and 2010 cropping seasons in Maiduguri.

Treatment	Fruit weight (g)	Fruit size (mm)
Balanites aegyptiaca (ALE)	26.23c	30.95c
Cypermethrin	32.01a	42.18a
Mitracarpus villosus (APE)	29.73b	37.00b
SE ±	0.87	1.42
LSD (0.05)	2.12	3.47

Means within the same column followed by the same letter are not significantly different at 5% level of probability according to DMRT.
ALE = aqueous leave extract; APE = aqueous plant extract.

Table 3. Effect of extracts of two botanicals and Cypermethrin on mean tomato fruit yield during 2009 and 2010 cropping seasons in Maiduguri.

Treatment	Total fruit yield (t/ha)
Balanites aegyptiaca (ALE)	22.33c
Cypermethrin	28.30a
Mitracarpus villosus (APE)	24.84b
SE ±	0.80
LSD (0.05)	1.86

Means within the same column followed by the same letter are not significantly different at 5% level of probability according to DMRT.
ALE = aqueous leave extract; APE = aqueous plant extract.

total number of fruits obtained was higher from tomato plants treated with Cypermethrin (28.3) and APE of *M. villosus* (24.8) than with ALE of *B. aegyptiaca* (22.3) (Table 3).

DISCUSSION

Altogether, lower numbers of damaged fruits per plant and larval holes per fruit, as well as greater number of undamaged fruits, fruit weight, fruit size and total fruit yield from tomato plants treated with Cypermethrin indicates that the synthetic insecticide was most effective in protecting tomato fruits against *H. armigera* infestation and damage as compared to the APE/ALE of the two botanicals tested. This is possibly due to: 1) greater photostability of Cypermethrin, a pyrethroid insecticide, on the tomato plants after spraying in the field, and 2) stronger and rapid debilitating effect on the biting and sucking activities of *H. armigera* larvae that bore into and feed on tomato fruits. Greater knockdown effect of pyrethroid insecticides compared to natural insecticides was, for instance, reported to be responsible for better control of insect pests on tomato (Khan and Griffin, 1999; Singh and Narang, 1990).

Contrary to the number of damaged fruits per plant and larval holes per fruit that were not significantly different, the higher number of undamaged fruits, fruit weight, fruit size and total fruit yield from tomato plants treated with APE of *M. villosus* (24.8) than ALE of *B. aegyptiaca* suggests that the former botanical performed better in managing *H. armigera* infestation and feeding activities than the latter. The reason for the differences was not clear. However, reduction in the boring and feeding activities of *H. armigera* was at the least thought to be partly due to their repulsion by the APE of *M. villosus* (Babarinde et al., 2008; Ivbijaro, 1990). Yusuf and Muhammed (2009) also partly attributed a reduction in the bruchid, *Callosobruchus maculatus* (F.), infestation in cowpea grains stored for up to 3 months to the strong pungent odour and taste of *M. villosus* leaf powder applied. The extracts of *Mitracarpus* spp. with varied concentrations of alkaloids, saponins, tannins, flavonoids, cyanide, steroid, pyranonaphthoquinone and psychorubrin have been documented to posses antitumor, antibiotic and antileishmanial properties (Fabri et al., 2012; Irobi and Daramola, 1994; Ubani et al., 2012). Ubani et al. (2012), for instance, with samples from Nsukka and Enugu found that with the inhibition zone diameter of 7 – 28 mm and minimum inhibitory concentration of 12.5 - 100 mg/ml, the ethanol extract of *M. villosus* leaves and inflorescence were active against the bacteria *Klebsiella pnenomiae* Schroeter, *Staphyococcus aureus* Rosenbach, *Escherichia coli* (T.) Escherich and *Pseudomonas aeroginosa* Schröter. Contrary to its effect as a microbial agent, studies on the effects of *M. villosus* extracts against insect pests remain scanty. *Balanites aegyptiaca*, on the other hand has been established to have larvicidal or insecticidal properties against some insect pests. Saponins concentration of 500 - 1500 ppm from the root-derived callus of *B. aegyptiaca* up to 7 days after exposure gave 100% larval mortality of the mosquito, *Aedes aegypti* Linnaeus, the principle vector for arbovirus or dengue hemorrhagic fever (Chapagain et al., 2008). Wiesman and Chapagain (2006), likewise found the extract and fraction (0.0014% w/v) of saponin containing *B. aegyptiaca* fruit mesocarp to sufficiently inhibit the emergence of 50% of the larval population of *A. aegypti*, and as a result, drastically reduced the population of mosquitoes. Also, the numbers of pod–sucking bugs (including *Maruca vitrata* F., *Clavigralla tomentosicollis* Stal., *Anoplonemis curvipes* L., *Riptortus dentipes* F., *Mirperus jaculus* L. and *Nezara viridula* L.) and undamaged pods per plant were lower and the number of damaged pods and pods/seeds per plant as well as pod/seed weight per plant and total cowpea grain yield higher from crops treated with the leaf extracts of *B. aegyptiaca*, and followed by *Momordica balsamina* L. than those treated with *Vernonia amygdalina* L. at 7 days spray intervals (Degri et al., 2012).

CONCLUSION

Better performance of APE of *M. villosus* over the ALE of *B. aegyptiaca* against *H. armigera* boring and feeding activities on tomato fruits in this study was based on 10% w/v concentration of the extracts of the two botanicals that were sprayed fortnightly from fruit set till harvest. The efficacy of botanicals however generally depends on the plant part (Chapagain and Wiesman, 2005) or extract concentration (Babarinde et al., 2011; Gupta et al., 1990; Olaitan and Abiodun, 2011) and dosage utilized (Chapagain et al., 2008). As such, more studies will be necessary to ascertain the efficacy of the two botanicals tested in this study against *H. armigera* infestation of tomato fruits.

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