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Insecticidal Activities of *Allium sativum* and *Capsicum annum* extracts in field against thrips (*Megalurothrips sjostedti*) damage on cowpea plant in Kano State-Nigeria

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Abstract

The insecticidal activities of Capsicum annum fruits and Allium sativum cloves methanolic crude extracts were assessed on field against M. sjostedti damage on cowpea plants. Two genotypes IAR-48 and IT97K-499-35 were planted separately in a randomized block design, for a cowpea genotype four plots each measured 5mx3m with 1.5m space between plots replicated three times given the total of twelve plots were formed. Within the plots are three pairs of ridges (70cm apart) tallied with the three different concentrations (200, 600 and 1000ppm) for the plant extracts treatments application. Plant extract treatments along side with synthetic chemical insecticide (Magic force) as control check were applied to the plots using Knapsack sprayer 33 days after sowing. The results showed that the damage rates of M. sjostedti on susceptible cowpea genotype IAR-48 was significantly (p>0.05) higher as expected when compared with resistant genotype IT97K-499-35. The least significant (P 0.05) M. sjostedti damage rate was recorded on IT97K-499-35 genotype treated with A. sativum at 1000ppm concentration level which is similar to control check (synthetic chemical). Also the genotype IAR-48 had the lower damage rate on plant treated with A. sativum at 1000ppm which differed significantly (p>0.05) with untreated control. Although the least significant (p>0.05) damage rate was recorded in control check (synthetic chemical). For a safe crop production, there is the need to boost the use of plant extracts technically in field as segment of integrated pest management.

Keywords: *M. sjostedti,* damage rate, *C. annum*, *A. sativum*, concentrations.

Introduction

In West Africa, the insects *Megalurothrips sjostedti* were considered among the significant pest of cowpea[1]. Total loss in cowpea production is regularly liable to their activities[2]. Plants with severe infestation do not produce flowers. When the population of thrips is higher on plant, the flowers that open are damage and discoloured. Therefore, pods are not developed owing to the early fall of flowers[1]. *M. sjostedti* can cause complete crop loss and is vector of Cowpea Yellow Moisaic Virus (CYMV)[3]. Previous studies identified cowpea cultivars with moderate resistant to *M. sjostedti*, an effective protection will be provided when these cultivars are combined with few insecticide applications[1]. The thrips belong to order Thysanoptera, family Thripidae and genus *Megalurothrips / Taeniothrips*[3]. According to Dugje *et al.*[2] Adult thrips, are very tiny black insects and are found feeding on flower buds and flowers. Adults are less than 1mm in length and shiny black which allows them to be easily noticed on flower buds and they are very active and move around the flower when disturbed[3]. Also Singh and Allen[1] stated that adult thrips feeds on flower buds and flowers, they shiny black tiny insects. At least two species of thrips attack cowpea plants in Africa; *Sericothrips occipitalis* and *Frankiniela schultzei*. The former is a minor pest of cowpea at seedling stage particularly during drought stress conditions. Adults of these insects are pale in color with a black band around their abdomen. The later is found to be connected with cowpea flowers and they are brown insects with slightly yellowish head[1]. For a sustainable production of cowpea, the management insect pests on the field and in storage are very fundamental. Application of chemical insecticides is the existing means of managing cowpea insect pests. Numerous synthetic insecticides formulated for the control of insect pests; are often too expensive to the resource-poor farmer and they are not readily available[4]. In Nigeria, previous studies on the insecticidal activity of plant extracts were mostly screen-house trials using neem, African nutmeg, *Piper guineense* and garlic products[5]. Studies have shown some fungicidal, acaricidal, insecticidal, nematicidal, and bacteriocidal properties of garlic[6]. It was reported by Oparaeka *et al.*[7] that chili pepper based extracts application reduced the population of thrips, pod suckers and pod borers on cowpea. The use of synthetic chemical insecticides for the control insect pests on plants is associated with dangers such as pollution, poisonous to mammals, obliteration of non-target organisms, hazards to users and consumers, high cost of equipment and insecticides. However, naturally occurring pesticides extracted from plants break down readily in the soil and are not stored in plant or animal tissue, and their effect are not long lasting as those of synthetic pesticides. Also there are little or no information on

the use of plant base insecticides for the control of insect pests in field. Therefore, the significance of this study is to investigate the capabilities of *A. sativum* and *C. annum*, in single form for the control of *M. sjostedti* damage on cowpea plants.

Materials and methods

Study site: Field study was conducted at the research farm of International Institute of Tropical Agriculture (IITA) Kano, situated at Wasai town, Minjibir Local Government Area (12^0 08'N : 07^0 38'E)[8]. The laboratory investigation was however conducted at the Department of Biology, Kano University of Science and Technology, Wudil.

Collection and processing of plant materials: The bulbs of garlic (*A. sativum*) and chili pepper (*C. annuum*) fresh fruits were purchased from Yankaba market (12.0106^0N : 8.5806^0E), thoroughly washed to remove debris and the earth remains. Both the chili fruits and the garlic cloves were chopped into bits using vegetable grater (HAOCAI) and allowed to dry under shade[9]. The dried samples were differently pulverized using mortar and pestle, further sieved using strainer of mesh size 70µm to obtained fine powder and stored in air-tight containers.

Extraction of plants materials: The procedure of Zuharah *et al.*[10] was adopted for the extraction of plants materials with some slight modification. The plants powders were subjected to extraction using methanol (250ml, Sigma aldrich) in soxhlet apparatus. Fifty gram (50g) of the powder each weighed using electronic balance (Model: XY500JB) in paper thimble was placed in the extraction tube and the boiling point of the apparatus was set to 64ºC. The apparatus was allowed to run for three hours until the methanol in the siphon tube turns virtually colourless. This procedure was replicated twice by replacing the powder in each phase. Using a vacuum rotary evaporator (Model: RE52-3) the extra methanol on the crude extracts collected was evaporated at 64ºC water bath temperature. The leftover methanol on the concentrated crude extracts was further eliminated by placing them in electric oven at 65ºC, six hours for two days. The stock solution was prepared in accordance to the procedure of Shrankhla *et al.*[11]. These stock solutions were stored at room temperature in laboratory until required for use whereby they were diluted with water to prepare 600ml of the range of desired test concentrations viz 200, 600 and 1000ppm during the time of plant spray.

Land preparation and planting in the plots: A randomized block design modified from Ogah[12] was made for the planting plots. For a cowpea genotype, five plots each with three replicates, giving the total of fifteen plots were formed. A plot measured 5mx3m with 1.5m space between plots. Within the plots are three pairs of ridges (70cm apart). The three pairs of ridges tallied with 200ppm, 600ppm and 1000ppm concentrations respectively for the plant extracts treatments application. These treatments were *A. sativum* spray plots, *C. annuum* spray plots, Magic force spray plots and Plots without treatment. The two cowpea genotypes consisted of an improved medium maturing cowpea seed (68 days) IAR-48 susceptible to all major pests of cowpea[8] and IT97K-499-35 resistance to pests [2] obtained from IITA were planted during the main planting season (July–October, 2015) at space of 30cm intra-row (within ridge)[12]. Three seeds were planted at the depth of 4-5cm per hole. At 10 days after emergence, the seedlings were thinned to two plants per stand.

Spraying of the plots: The treatments (*A. sativum*, *C. annuum* and Magic force) were applied to various plots which were labeled with pegs using Knapsack sprayer[7] at 33 days after sowing (DAS)[3].

Determination of *M. sjostedti* infestation level on the two cowpea genotypes after treatments application: The observations of *M. sjostedti* infestation on five cowpea stands selected randomly from each pair of ridges were done according to the procedure of Egho[13] with slight modification. The observation commenced 33 DAS at the interval of 6 days. The damage was rated visually based on symptoms, using the scale provided by Egho[13]; where (1= no burning of leaf, flower buds, stipules, and no bud abscission, 3=burning of leaf, flower buds, stipules begins; no bud abscission, 5=noticeable burning of leaf, flower buds and stipules; few bud abscission, 7=burning of stipules and buds; significant bud abscission and non elongation of peduncles and 9= intense burning of stipules and buds; terrible bud abscission, and clear non-elongation of almost all the peduncles). The rate for each stand was recorded and two observations were made from each treatment. These rated values for each treatment and concentration were summed and divided by the last number on the scale to obtain the infestation levels.

Data analyses: Data collected were subjected to two way analysis of variance (ANOVA), after checking the validity of the assumptions underlying the test. Where the ANOVA indicated significant difference, least significant difference (LSD) was used to separate means. All ANOVA analyses were conducted with OpenStat statistical software (version 08.12.14)[14].

Results and discussion

The treatment of *A. sativum* at 1000ppm concentration level had the least damage rate of *M. sjostedti* on the cowpea plants which was equivalent to control check. The concentration level of 200ppm at both treatments of the plant extracts with respect to the damage rate were not significant ($p>0.05$) from the untreated control which had the highest significant ($p<0.05$) *M. sjostedti* damage rate when compared with other concentration levels. Also the plant extracts treatments at various concentration levels on both cowpea genotypes did not differed significantly ($p > 0.05$) with control check (Table-1).

Table-1: Means of Damage Rate of *M. sjostedti* on Cowpea Plants treated with *A. sativum* and *C. annuum* Extracts at Various Concentration Levels.

Treatments	Concentrations (ppm)	Mean damage rate of *M. sjostedti*
A. sativum	200	2.267±0.427^{abc}
	600	2.017±0.838^{bc}
	1000	1.933±0.745^{c}
C. annuum	200	2.257±0.383^{abc}
	600	2.133±0.528^{bc}
	1000	2.000±0.660^{bc}
Control check	1207.5	1.883±0.458^{c}
Untreated Control	-	2.850±0.378^{a}
LSD		0.611

Means±standard deviation with the same letter within column are not significantly different from each other (LSD - least significant difference P<0.05), ppm - part per million.

Cowpea genotype IAR-48 had the high *M. sjostedti* damage rate in all treatments as expected, the least significant (p<0.05) damage rate was recorded in control check. This was followed by *A. sativum* and *C. annuum* treatments respectively which did not differ significantly with untreated control of genotype IT97K-499-35. In this genotype all the plant extracts treatments were similar with control check. The highest significant (p<0.05) *M. sjostedti* damage rate was observed in untreated control of IAR-48 genotype (Table-2).

Table-2: Means of Damage Rate of *M. sjostedti* on Two Different Cowpea Genotypes (IAR-48 and IT97K-499-35) treated with *A. sativum* and *C. annuum* Extracts.

Cowpea Genotype	Treatments	Mean damage rate of *M. sjostedti*
IAR-48	*A. sativum*	2.456±0.477^{b}
	C. annuum	2.611±0.465^{b}
	Control check	2.000±0.346^{c}
	Untreated control	3.100±0.173^{a}
IT97K-499-35	*A. sativum*	1.689±0.621^{d}
	C. annuum	1.856±0.362^{d}
	Control check	1.767±0.492^{d}
	Untreated control	2.600±0.312^{b}
LSD		0.402

Table-3 shows the mean damage rates of *M. sjostedti* on the two cowpea genotypes after treated with plants crude extracts at various concentrations. Both genotypes had least *M. sjostedti* damage rates in plants treated with the extracts at 1000ppm concentration level. The concentration levels of 600ppm and 1000ppm of genotype IT97K-499-35 significantly (p<0.05) lowered the damage rates of these insects as compared with other concentrations particularly those of genotype IAR-48.

Table-3: Means of Damage Rate of *M. sjostedti* on Two Different Cowpea Genotypes (IAR-48 and IT97K-499-35) treated with *A. sativum* and *C. annuum* extracts at Various Concentration Levels.

Cowpea Genotype	Concentrations (ppm)	Mean damage rate of *M. sjostedti*
IAR-48	200	2.733±0.258^{a}
	600	2.483±0.571^{ab}
	1000	2.388±0.512^{ab}
IT97K-499-35	200	2.100±0.276^{b}
	600	1.667±0.513^{c}
	1000	1.550±0.561^{c}
LSD		0.389

The study showed some degree of *M. sjostedti* damage control following the applications of *A. sativum* and *C. annuum* crude extracts in single form. This is in agreement with the findings of Oparaeka[15] who reported some insecticidal properties of neem, ginger and garlic extracts which are lethal to a wide species of insects including *M. sjostedti*. Also Ogah[12] reported significant reduction in the population of both thrips and maruca insect pests as compared with the control following the application plant extracts (Neem, garlic and ginger) on cowpea plants at flowering/podding stages, thus suggesting that the toxic organic poisons in the extracts of plants is effective in reducing insect pest population. During the period of this study it was observed that the density of thrips declined after rainfall in all the treatments plots. This agreed with studies conducted by Barry *et al.*[16] who stated that after rainfall, the cowpea thrips density dropped down in all the treatments. Similarly Akintala *et al.*[17]; Fanou *et al.*[18] highlighted that rainfalls, high speed winds can displace insects from their location points in plant organs. The most effective insecticide treatment was *A. sativum* which was comparable with synthetic chemical. In line with this, reports have shown that difference in insecticidal efficacy vary between one part of plant and the other, depending on the level of concentration of the anti-insect or anti-feedant compounds present therein[19]. Field observation after the spray revealed that both plant extracts used for this study do not produce phototoxic effect on the leaves of the two cowpea genotypes. This agreed

with Ahmed *et al*.[20] who reported that field observations indicated that none of the plant extracts including that of chili pepper and garlic used produce any phototoxic on cowpea leaf. It was reported by Olaifa and Adenuga[21] that application of neem products brings about yellowing and succeeding shedding of leaves. Early morning or late evening sprayed of plant extracts possible will improved the efficacy of these plant-base insecticides[22].

Conclusion

The extract of *A. sativum* at the level of 1000ppm concentration was the most effective particularly on genotype IT97K-499-35 recording the least *M. sjostedti* damage which was comparable to the synthetic chemical treatment. The materials of these plants are used in ethnobotany for the remedy of various ailments; they are therefore safe, inexpensive, breakdown easily and environmental friendly unlike the synthetic insecticide. The use of *A. sativum* extract is recommended for field spray against *M. sjostedti* particularly on insect's resistant cowpea genotypes. Further research should also be carried out to isolate, identify and characterized the active ingredients of these extracts and their mode of action.

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