Bio – efficacy of Aqueous Plant Extracts and Cyperdicot on Insect Pests Infestation, Growth and Yield of Sweet Pepper (Capsicum annum L.) in the Dry Savanna of Nigeria

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Abstract: ***Field experiments were conducted at the Faculty of Agriculture orchard farm, University of Maiduguri during 2011 and 2012 cropping seasons. The aim was to compare the efficacy of neem (Azaradichta indica) seed oil, garlic (Allium sativa) bulb and bitter leaf (Vernonia amygdalina) aqueous plant extracts with the synthetic insecticide cyperdicot 400 EC in the control of aphids on sweet pepper (Capsicum annum L.). The treatments consisted of three aqueous plant extracts at $5^0/_0$ w/v and cyperdicot 400 EC replicated four times including control in a randomized complete block design .Each plot measured 4.0 m by 3.0 m with 1.5 m inter-spaced per adjacent plot. Results of the study showed that neem seed oil and garlic treatments were effective against aphids as the synthetic insecticides cyperdicot in controlling sweet pepper aphids (Aphis gossypii). Cyperdicot 400 EC significantly (P≤0.05) reduced aphids infestation followed closely by neem seed oil and garlic bulb. Sweet pepper plant heights were significantly higher in neem seed oil and garlic extracts treatments than bitter leaf treated plants. Fruit number and fruit yield were also improved more than bitter leaf treated plots and control. Among the three aqueous plant extracts, neem seed oil and garlic extracts proved effective in controlling the pest, therefore they are recommended for controlling sweet pepper aphids due to their low cost, potency and efficacy.***

Index Terms: sweet pepper, aphids, cyperdicot, aqueous plant extracts, yield

I. INTRODUCTION

Sweet pepper (*Capsicum annum* L.) also known as mild bell pepper is a herbaceous annual crop that belongs to the family Solanaceae. It is grown in many countries in the world (Romain, 2001) and widely grown in Nigeria and is regarded as the third in importance among the cultivated vegetable crops after onions and tomatoes (Uzu, 1984, Ado, 1998, Romain, 2001). Northern Nigeria happens to be the largest producer of pepper in Africa covering about $50^{\%}$ of total African production (Ado, 1990).
Sweet pepper is unaffected by photoperiod; it does not tolerate high temperatures and grows best when the daytime temperature lies between 21^0C and 25^0C. Any excessive heat will check its growth, make the leaves drop off and inhibit development of the fruits (Omonijo and Afuye, 2009). Sweet pepper needs relative large amount of water. It needs frequent watering especially when the fruits are forming. Any excess or lack of water may cause the flowers to drop and can also favour pests attack (Ado, 1990 Schippers, 2000, Abu and Uguru, 2006, Omonijo and Afuye, 2009 Degri and Yoriyo, 2010).

Sweet pepper plays a significant role in the nutritional balance of the rural and urban dwellers by supplying vitamins and minerals in their diets. The fruit contains 92g water, 1.3g protein, 10.3g carbohydrate 1.4g cellulose, 12mg calcium, 0.9mg Iron, 1.8mg carotene, 0.07mg thiamine, 0.08mg riboflavin, 0.8mg niacin and 103mg vitamin c.

In spite of the economic importance of this pepper, production and yield continued to decline due to climatic and pest infestation (Ado, 1990, Echezona and Nganwuchu, 2006). Among the insect pests that attack sweet pepper are cutworm (*Agrotis spp*), lesser any worm (*Spodoptera exigua*), false codling month (*Cyptophlebia laucotreta*). American bollworm (*Helicoverpa armigera*) mediterranean fruitfully maggots (*Ceratitis capitata*) Aphids (*Aphis gossypii*), whiteflies *(Bemisia tabaci)*, mite *(Polyphagtarsonemus latus)* and moderately susceptible to rook- knot nematode *(Meloidogyne spp.*).

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Aphids and whiteflies are the major insect pest attacking peppers and other vegetable crops grown throughout Nigeria they attack the crop both in the nursery and main field (Degri and Yoriyo, 2010). Adults and nymphs of these pests suck the sap from tender leaves and growing shoots, pegs, flowers and fruits which lead to loss in plant vigor,, stunted growth and yield (AVRDC, 1985), Erinle, 1989). Ado, 1998, Echezona and Nganwuchu, 2006). The infestation of aphids andwhiteflies seem to be severe when the rain is scanty. Their population increase rapidly during dry spelt but decline sharply as the rain become heavier and more consistent and the plant advance in age (Onyango, 2002, Omonijo and Afuye, 2009).

Application of pesticides has proved effective but the problem of environmental hazards and chemical residue on fruits has aggravated the problem. Although extensive literature search shows that aphids and whiteflies control using synthetic insecticides like karate, cypermethrin are available but little or none has been reported on indigenous plant extracts in the study area, hence, the present study was conducted to indentify promising indigenous plant extracts having the potential for aphids and whiteflies control on sweet pepper in the semi-arid zone of Nigeria.

II. Materials and Methods

Field experiments were carried out at the Faculty of Agriculture orchard farm, University of Maiduguri (11^0 51'N and $13^0$05'E, 525 mm mean annual rainfall at the dry savanna zone of North eastern Nigeria during 2011 and 2012 cropping seasons (June – October) to compare the effects of three indigenous plant extracts on insects pest infestation, growth and fruit yield of sweet pepper. The materials tested include the extracts of neem seed oil (NSO), garlic bulb, bitter leaf and conventional insecticides cyperdicot 400EC(a combination of cypermethrin 250g/l and dimethoate 150g/l). The experiments were carried out in a randomized complete block design replicates four times including controls. Each treatment plot measured 4.0 m x 3.0 m (120 m^2) and was separated by a 2.0 m alley. The replications and borders were separated 1.5m apart. Sweet pepper seeds were obtained from Borno State Agricultural Development programme (BOSADP) input store at Damboa road. The three plant materials tested were collected from plants around the Faculty and Research farm while the synthetic insecticide tested was purchased from an accredited Agrochemical dealer in Bama road Maiduguri. The seeds of sweet pepper were first grown in nursery beds measuring 6 – 8 cm high for 4 weeks before being transplanted to the experimental field at 60 cm x 40 cm spacing. The experimental field was cleared, ploughed, harrowed and sub-divided into plots of 4.0 m x 3.0 m before transplanting the seedlings. One seedling each was transplanted per stand after 30 days when they were about 12 cm high. Fertilizer application (NPK 15: 15: 15) as basal dressing at 3, 6 and 9 WAT), watering was done once daily and weeding was done manually throughout the experiment.

Aqueous extracts of neem seed oil, garlic bulb and bitter leaf were prepared as described by Cobbinah and Osei-Uwusu (1988). The aqueous plant extracts were applied at 5% w/v concentration while cyperdicot 400EC was applied at 2.0g a.i/ha. Both aqueous plant extracts and cyperdicot were applied using CP-15 Knapsack sprayer. Each sweet pepper stand was sprayed with an insecticide that was re-applied one week after wards when the previous application waned off.

The number of aphids (*Aphis gossypii*) and whiteflies (*Bemisia tabaci)* per plant were counted and recorded. This was done by looking down under the leaf surface, shoots, pegs flowers/fruits from 5 randomly selected plants in each plot. The randomly selected sweet pepper plants were also measure using a graduated ruler to know their height in centimeters and recorded the number of fruits per plant and fresh fruit yield were collected and recorded after fruit formation and harvest.

The data collected on number of aphids and whiteflies/plant, plant height, number of fresh fruits/plant and fresh fruit yield were subjected to analysis of variance (ANOVA). Least significant difference (LSD) was used to separate the treatment means at 5% level of probability. Duncan multiple test range (DMRT) was used to separate the number of fresh fruit/plant and fresh fruit treatment means at $P< 0.05$ level of probability.

III. Results and Discussion

The effect of the aqueous plant extracts and cyperdicot application on aphids and whiteflies population on sweet pepper plants taken at different stages of the plant is presented in Table 1.

The result showed that the population of the aphids and whiteflies on treatment plots were significantly different ($P < 0.05$) from the untreated control. Neem seed oil (NSO), garlic bulb and cyperdicot treated plots had lower number of aphids and whiteflies in both cropping seasons than bitter leaf treated plots while untreated control had significantly the highest aphids and whiteflies population during the same period. The significantly lower aphids and whiteflies count recorded in neem seed oil, garlic and cyperdicot treated plots indicates that these two aqueous plant extracts (neem seed oil and garlic bulb) were as effective as the synthetic insecticide,

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cyperdicot against the pests.The two aqueous plant extracts significantly reduce the population of the aphids and whiteflies on the plant hence, the reduction in the sucking activities of both the adults and nymphs of the pests.This has also significantly reduced the loss in vigour and stunted growth of the plant (Degri and Yoriyo, 2010). The lower count of aphids and whiteflies recorded under the two plant extracts implies that these plant extracts posses active ingredients that are know to have repellent, antifeedant and phago-deterrent effects against the aphids and whiteflies (Degri and Yoriyo, 2010, Degri *et al.*, 2012).

Table 1: Effect of aqueous plant extracts application on aphids and whiteflies of sweet pepper.

Treatment	Aphids and whiteflies count/ plant			
	2011		2012	
Neem seed oil (*Azadirachta* sp)	0.4*	0.3**	0.5*	0.5**
Garlic bulb (*Allium sativum*)	0.5	0.5	0.3	0.4
Cyperdicot 400EC	0.3	0.2	0.2	0.1
Bitter leaf (*Vernonia amygdalina*)	1.0	1.0	2.0	3.0
Control	2.3	3.0	4.0	6.0
SE +	0.51	0.62	0.82	0.84
LSD (0.05)	1.10	1.30	1.56	1.58

*Aphids ** whiteflies

Table 2 shows the effect of aqueous plant extracts application on sweet pepper plant height during the two- year study period. Neem seed oil, garlic bulb competed favourably with the synthetic insecticides cyperdicot in improving the growth of the plant while control treatment did not had the opportunity to grow due to aphids and whiteflies activities during the study period. Bitter leaf extract had moderate plant height when compared with the other two plant extracts. The high plant height recorded under cyperdicot, neem seed oil and garlic bulb was probably due to their effectiveness against the aphids and whiteflies which must have reduced their piecing and sucking activities on the crop. This view agrees with the report of NRI (1996) and Ado (1990). The moderate and lower plant heights recorded under bitter leaf and control treated plots in both years were due to serious piercing and sucking activities of the pests which caused the stunted growth in the plant and possible subsequent entry of pathogen into the plant and their transmission across the plant parts resulting to serious reduction in photosynthetic activity and yield. This finding agrees with the report of Degri and Yoriyo (2010). This result indicate that bitter leaf has little pesticidal potential for controlling aphids and whiteflies on peppers and it cannot compete favourably with cyperdicot in managing them (Isman,2006 Fuglie, 1998).

Table 2: Effect of aqueous plant extracts application on sweet peppers plant height

Treatment	Plant height (cm)	
	2011	2012
Neem seed oil	29.3	29.1
Garlic bulb	28.0	28.3
Cyperdicot 400EC	30.1	29.89
Bitter leaf	20.6	21.2
Control	16.3	16.1

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SE+	2.78	2.89
LSD (0.05)	5.50	5.80

The results of the effect of aqueous plant extracts and cyperdicot application on number of fruits per plant are presented in Table 3. The results show that neem seed oil and garlic bulb had significantly ($p<0.05$) higher number of fresh fruits per plant than bitter leaf treated plots while control treatment had significantly the least number of fruits per plant. The higher number of fruits per plant recorded under neem seed oil and cyperdicot treated plots indicate that they are more effective in reducing aphids and whiteflies infestation on sweet pepper than bitter leaf. It also means that neem seed oil and garlic extracts can be used comfortably in place of cyperdicot in controlling aphids and whiteflies infestation on peppers (Stoll, 2001, Degri and Yoriyo, 2010). The higher number of fruits recorded also implies that these two plant extracts had significantly reduce aphids and whiteflies piercing and sucking activity which used to cause loss in plant vigour, growth and yield. However bitter leaf had lower fruit number due to little reduction of the aphids and whiteflies activity on the plant, hence the reduction in the growth and subsequent reduction in fruits formed (NRI, 1996, Fulie, 1998, Stoll, 2001, Degri and Yoriyo, 2010).

Table 3: Effect of aqueous plant extract applications on number of fruits/plant

Treatment	mean number of fruits/plant	
	2011	2012
Neem seed oil	42.33b	41.67b
Garlic bulb	41.78b	42.22b
Cyperdicot 400EC	46.27a	46.10a
Bitter leaf	30.10c	30.31c
Control	20.48d	20.87d

Figures followed by the same letters in the same Colum do not differ significantly at 5% level of probability according to DMRT.

Table 4 shows the result of the effect of plant extracts application on sweet pepper fruit yield. Cyperdicot, neem seed oil and garlic bulb treated plots had higher fruit yield than bitter leaf treated plots while untreated control had the lowest fruit yield during the two years study period. The higher fruit yield recorded under neem seed oil and garlic bulb indicate they are effective in controlling aphids and whiteflies on pepper like the conventional insecticide cyperdicot 400EC Erinle, 1989; Ado, 1990; Ado, 1989 and AVRDC, 2002). Bitter leaf which had lower fruit yield indicates that it is not as effective as the after two extracts and therefore cannot be compared with the synthetic insecticide, cyperdicot. This result clearly indicates that neem seed oil and garlic bulb aqueous plant extracts can be comfortably used as an alternatives to cyperdicot in controlling the piercing and sucking aphids and whiteflies infestation on peppers (Degri and Yoriyo, 2010).

Treatment	mean fruit yield (kglha)	
	2011	2012
Neem seed oil	562ab	601ab
Garlic bulb	478b	492b
Cyperdicot 400EC	589a	613a
Biitter leaf	386c	383c
Control	154d	161d

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Figures followed by the same superscripts are not significantly different at P< 0.05 according to DMRT.

IV. Conclusion

The study showed that aqueous plant extracts (5% w/v concentration) of neem seed oil and garlic bulb applied at one week interval were found to be effective against piercing and sucking *Aphis gossypii* and *Bemisia tabaci* and were at par with cyperdicot 400EC. The application of the two extracts reduced their population on sweet pepper, improved the plant height and number of fruits/plant and consequently improved the fruit yield and quality. It is therefore recommended that sweet pepper producers in the dry savanna region adopt the application of neem seed oil and garlic bulb extracts at one week spray interval to improve sweet pepper growth and fruit production.

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