An Overview of the Management and Control of Aphids (*Aphis craccivora*) on Groundnut and Cowpea in Nigeria

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ABSTRACT

An overview of the management and control methods of aphids (Aphis craccivora Koch) in Nigeria was carried out in the north eastern part of the country. The overview shows that, aphid is a principal insect pest of groundnut and cowpea in Nigeria. According to the study, aphids can cause yield loss of up to 40% especially in a drought situation when the plants are young. Some of the notable damages caused by aphids are; sucking of plant sap, curling of leaves, production of large amount of sticky exudates of honey dew which promotes the growth of black sooty mold fungi which can reduce photosynthesis. Moreover, one of the major factors that contributed to the fall of the groundnut pyramid in Nigeria was the groundnut rosette virus (GRV) and Aphis caccivora is the vector that transmits the virus. Different control methods of aphids were studied, some of which are; monitoring and scouting, biological control, use of resistant varieties, biotechnology control, use of botanical plant materials, cultural control, chemical control and integrated pest control method. All these management and control methods reviewed showed various potentials of effectiveness in combating the menace of this devastating insect pest of groundnut and cowpea in the north eastern part of Nigeria. However, the integration of two or more of these methods as depicted by the integrated pest management control method is a sure path to effective performance, total control and sustainable development. The integrated pest management control is cheap, affordable, save and ecologically friendly.

Key words: Overview, Management, Control, Aphids, Groundnut, Cowpea, Insect.

INTRODUCTION

Crop producers face increasingly complex decisions in choosing strategies for protecting the value of their crops especially against aphids and other insect pests. The inability of the farmers to protect their crops from damage caused by these insect pests can have catastrophic consequences resulting in an economic loss to growers and subsequently higher prices for consumers alike (Flint, 1999).

According to Lane (2000), there are approximately 4, 000 aphid species in the world whose life cycles and preferred host vary with each type of aphid. He further noted that, common aphid insect pest of agricultural crops include the green peach aphid (*Myzus persicae*) the melon/cotton aphid (*Aphis gossypii*), the groundnut and cowpea aphid (*Aphis craccivora*), the chrysanthemum aphid (*Macrosiphoniella sanborni*), the rose aphid (*Macrosiphun rosae*), the potato aphid (*Macrosiphum euphorbiae*) and the fox glove aphid (*Aulacorthum solani*) amongst others. Courtney (2005) noted that, historically, many fewer families are recognized as most species were included in the family Aphididae. Around 250 species are known to be serious insect pest of agricultural crops and forestry products as well as an annoyance to gardeners.

Aphids are distributed worldwide, but are more common in the temperate regions in contrast to the many taxa, species diversity which is much lower in the tropics than in the temperate zones (Lane, 2000). Of all these species of aphids, the most widely distributed and devastating species is the groundnut and cowpea aphid, *Aphis craccivora* which this review will consider.

In tropical Africa and Nigeria especially, *Aphis craccivora* Koch is the most devastating insect pest of cowpea and groundnut (Malgwi and Onu, 2004). One of the major factors that contributed to the fall of groundnut pyramid in Nigeria is the groundnut rosette virus and *A. craccivora* is the vector that transmits the virus (ICRISAT, 2008; Khand and Hussain, 1965). The *Aphis craccivora* Koch (Homoptera: Aphididae) is a brownish grey polyphagous insect that attacks all stages of growth in cowpea and groundnut. It sucks the sap and transmits the viruses to the infested plants, buds and flower may be

aborted. They are vectors of groundnut rosette virus (GRV), peanut mottle virus (PMV) and peanuts stripe virus (PSV) in Asia and Africa (Malgwi and Onu, 2004; Singh and Oswalt, 1992; Jackai *et al*., 1992 and Annon, 1988). Aphids can cause yield loss of up to 40% especially in a drought situation when the plants are young (Khand and Hussain, 1965).

Overview of *Aphis craccivora*

Pests and diseases are among the most pressing constraints to crop production in dry lands of sub-Sahara (Rowland, 1993). They are also the main limitation to cowpea and groundnut production and subsequent low yield. Though in marginal rainfall areas, a disease may be more damaging (Jackai and Adaka, 1997; and Rowland, 1993), the largest proportion of land cultivated to cowpea and groundnut is found in Africa, especially in Nigeria in which ease, productivity is low largely due to the documented damage caused by insect pests (Morctimore *et al.,* 1997; Jackai and Adaka, 1997).

These crops are subject to attack by many insect pests among which are: *Clavigralla spp., Aphis craccivora, Mylabris spp., Leptoglossus australis* and *Maruca vitrate,* chief among which is *Aphis craccivora* whose devastating effect could amount to great losses in yield of up to 40-70% (NAERLS, 2006; Singh and Oswalt, 1992; Singh, 1990; Misari *et al.*, 1980; Ezueh, 1978). Their relative importance may vary slightly from one location or regular feature of cowpea and groundnut agro-ecosystem worldwide.

Identification

Aphids may be green, yellow, brown, red or black depending on the species and the plant they feed on (Dreistadt *et al*., 1994). Aphids are found on cowpea, groundnut and other leguminous crops throughout Nigeria especially in Zaria environs (Egwurube and Dike, 2000). In addition to sucking sap which leads to loss in plant vigour, the most important damage caused by this aphid is the transmission of groundnut rosette virus (Misari and Rahaja, 1975). Nymphs and adult of *A. craccivora* occur on the terminal shoots and under the leaves and a few species appear waxy or woolly due to the secretion of a waxy white or grey substance over their body surface.

Generally, adult aphids are wingless but most species also occur in winged forms, especially when population is high or during spring and fall. The ability to produce winged individual provides the insect pest with a way to disperse to other plants when the quality of the food source deteriorates (Douglas, 1998). Although aphids may be found singly, they often feed in dense groups on leaves and stems. Unlike leaf hoppers, plant bugs and certain other insect that might be confused with them, most aphids do not move rapidly when disturbed.

Life Cycle

Aphids have many generations a year especially during mild climate. They produce most or all of the year with adult females giving birth to live offspring (often 12 per day) without mating. Young aphids are called nymphs, they molt by shedding their skins about four times before becoming adult. They have no pupal stage (Singh and Oswalt, 1992 and Palumbo, 1996).

However some species of aphids mate and produce eggs in fall of winter, which provides them a hard condition to survive harsh weather. In some cases these eggs are laid on an alternative host, usually a perennial plant for winter survival (Flint, 1999). When the winter becomes warm, many species of aphids can develop from newborn nymph to reproducing adult in 7-8 days because each adult can produce up to 50 offspring in a matter of week. Aphid population can increase with great speed (Misari and Raheja, 1975 and Flint, 1999).

Effect of Aphids on plants

Low to moderate number of leaf feeding aphids *A.craccivora* are usually not damaging in cowpea and groundnut fields,

however, large populations cause curling, yellowing and distortion of leaves and stunting of shoots, they can also produce large quantities of a sticky exudates known as honeydew, which often turns black with the growth of a sooty and mold fungus (Misari and Raheja, 1975; Dreistadt and Flint, 1994 and Casey, 1997).

Aphid in cowpea and groundnut fields feed by inserting their styled-like, sucking mouth parts directly into the phloem and removing plant sap. As they feed on sugary plant sap, honeydew is excreted which promotes the growth of black sooty mold fungi which can reduce photosynthesis. Also, while they molt, their whitish cast skins may also detract the aesthetic quality of cowpea and groundnut and occasionally ants may be associated with aphid-infested field (Hoffman and Sanderson, 1993; Misari and Raheja, 1975).

Management of Aphids

Although aphids seldom kill mature plant, the damage and unsightly honeydew they generate sometimes warrant control (Flint, 1999). The pest management strategies developed for groundnut in the 70s and the 80s were heavily dependent upon preventive use (Egwurube and Dike, 2000). They further noted that during the 1990s however with additional challenges of pest damage and the risks posed by these chemical to environment and human, research emphasis has shifted to low risk management systems that marginally fit into the definition of IPM.

Biorational materials including insecticides, soap, superior horticultural oil and neem-based materials tend to be more compatible with biological control (Sanders, 1996). Most insecticides, if used destroy beneficial insect pests along with the targeted ones (Dreistadt *et al*., 1994). They further opined that, honeydew produced by aphids can provide a valuable food source for beneficial insects. Various methods therefore have been utilized in the management and controls of aphid (*Aphis craccivora*). Some non-chemical control methods are considered and discussed below:

Monitoring and Scouting Control Method

A regular weekly scouting program is needed to detect aphids early before crops are in flower. Check plants regularly for aphids at least twice weekly when plants are growing rapidly (Dreistadt *et al*., 1994; Gill, 1995 and Flint, 1999). Many species of aphids cause the greatest damage when temperatures are warm but not hot (65° to 80°F).

Catch infestations early, once aphid numbers are high and they have begun to distort and curl leaves, it is often hard to control them because the curled leaves shelter aphids from insecticides or natural enemies (Dreistadt *et al*., 1994). Cassey (1997) stated that, thorough coverage by insecticides is more difficult when plants are in flower, in addition many insecticides will cause spotting of the flowers.

Aphids tend to be more prevalent along the upwind edge of a garden and close to other sources of aphids, while many aphid sources prefer the undersides of leaves, so turn them over to check them (Flint, 1999). In the greenhouse, yellow sticky cards will only attract winged aphids. Place cards near the doors and vents. Focus on random plant inspections for susceptible crops and cultivars to detect the wingless nymphs. Winged adult aphids usually stay on the lower leaves and along the plant stem. Look on the leaf undersides and buds of aphid-susceptible crops (M. Alaisand Ravensburg, 1992; Gilrein, 1995; Sanderson, 1996 and Cassey, 1997).

Biological Control Method

Natural enemies can be very important in the control of aphids, especially in gardens and greenhouses not sprayed with broad spectrum pesticides (Organophosphates, carbamates and pyrethroids) (Dreistadt *et al*., 1994). Although natural enemy populations do not appear in significant numbers until aphids begin to be numerous, there are methods to

argument the natural enemies in the agro-ecosystem, this is done by mass producing and releasing of biotic agents to suppress the pest population to desired non damaging levels. The commonly used bio-agents include parasites such as Trichogramma and predators such as chrysopela (Hills, 1986 and Dreistadt *et al*., 1994).

Among the most important natural enemies of aphids are various species of parasites wasps that lay their eggs inside the aphids and the skin of the parasitized aphid turns crusty and golden brown, a form called a 'mummy'. The generation time of most parasites is quite short when the weather is warm, so once 'mummies' are detected on plants, the aphids population is likely to be reduced substantially within a week or two (Hoffman and Sanderson, 1993; Dreistadt *et al*., 1994 and Flint, 1999).

Many predators also feed on aphids common amongst them are; lady beetle, lacewig and syrphid fly. Naturally occurring predators work better especially in a small backyard situation (Dreistadt *et al*., 1994 and Flint, 1999). Although commercially available lady beetles may give some temporary control when properly handled, most of them will disperse away within a few days in open field cultivation (Krupke, *et al*., 2007a and 2007b).

Use of Resistant Variety Control Method

The development of groundnut cultivars with resistance to rosette, a virus disease transmitted by *A. craccivora* has been an important aspect of breeding programmes in Samaru (Egwurube and Dike, 2000). They further reported that the varieties M25.68 and ex. Bambey (69-101) were recommended in 1972 for general use throughout the Southern Guinea Savannah zone. However, these varieties are long maturing, requiring up to 135 to 140 days on the field, and therefore recommended for the riverine areas only.

At present the groundnut and cowpea breeding programmes in Samaru and ICRISAT Kano Station are involved in the development of viral resistant groundnut and cowpea. The collaborative work between IAR and ICRISAT scientists have resulted in identifying short duration lines that are rosette resistant and currently these lines are being screened across the groundnut producing areas of Nigeria (Harkness *et al*., 1976; Rossel, 1977; Egwurube and Dike, 2000).

Biotechnology Control Method

This involves breeding of crop varieties which are resistant to pest attacks, which is an important strategy in the IPM. The resistant varieties reduce production cost; require less control by limiting damage throughout the cropping season. However, insect biotype may develop that will affect the capability of the resistant varieties to be sustainable which are resistant to some pest species (Stoll, 1988; ICAR, 2006).

Integrated Pest Management (IPM)

The IPM emphasizes the need for simple, economically inexpensive and environmentally safe measures for pest control aimed at reducing environmental pollution and other problems arising from excessive and indiscriminate use of synthetic pesticides (Lale, 2002; ICAR, 2006).

Use of Botanical Plant Extract Control Method

Extracts from plants have been used in the control of different crop pests and diseases worldwide. Most studies in Africa have been on the control of storage pests and few on the field pest (Elwell and Ma'as, 1985; Stall, 1988; Grainge and Ahmed, 1988; Schumutterer and Hellpap, 1988; Ajayi *et al*., 1986). Natural plants products are presently in use against pest infestation because of their ability to produce less harmful, but efficacious biodegradable plant protection chemicals with the hope that their use will greatly minimize the use of highly toxic synthetic insecticides (Schumutterer, 1990 and Oparaeke, 2007).

Fortunately, Nigeria has an array of land races of herbal plants with medicinal and insecticidal properties which could be harnessed for the production of biopesticides for pest management on limited resource farmers farm (Oparaeke, 2007). Other biopesticides used in insect pests control are presented in Table 1 below:

Cultural Control Method

Cultural control method includes production practices that make the environment less favourable for survival, growth or reproduction of insect pests and includes manipulation of sowing and harvesting dates, tillage operations, crop rotations, irrigation and sanitation (Egwurube and Dike, 2000). Booker (1963) and Abubakar (1986) observed that, increased plant populations and groundnut sown prior to the onset of rain in Samaru reduced aphid population and incidence of groundnut rosette virus (GRV). Abubakar (1986) reported that, the groundnut rosette virus and its vector *Aphis craccivora* may be effectively controlled by planting groundnuts at a spacing of 10cm to 20cm early at the onset of rains. John, *et al,* (2005) however stated that, before planting, the surrounding areas should be checked for sources of aphids and remove them.

High levels of nitrogen fertilizer favour aphid production, therefore, use less soluble forms of nitrogen and apply it in small portions throughout the season rather than all at once or better still, use urea-based, time release formulation (most organic fertilizers can be classified as time-release products as compared to synthetically manufactured fertilizers, (Courtney, 2005).

Another way to reduce the aphid populations on plants is to knock them off with a strong spray of water. Most dislodged aphids will not be washed off as well as using sprays. Spraying early in the day allow plants to dry off rapidly in the sun and be less susceptible to fungal diseases (Dreistadt *et al*., 1994 and Flint, 1999).

Chemical Control Method

Chemicals are either applied as preventive or curative measures on cowpea and groundnuts and mostly they are either organophosphate or organochlorine sources. Their uses have been much successful over the years but often with catastrophic result (Anaso *et al*., 1998). Apeji (1988) indicated that, the control of insect pests is perhaps the most important single factor for successful cowpea cultivation in Nigeria. Although different methods have been used, however, Lale (2002) revealed that, chemical control remains the most effective control method and that cowpea cannot be successfully grown in some areas without the application of pesticides.

In Samaru, prior to the 1975 rosette epidemic very little attention was given to research of insecticide, against the rosette virus and its vector (Egwurube and Dike, 2000). After the epidemic however, an interim recommendation of using pirimor ULV was suggested for the control of *Aphis craccivora* (Rossel, 1977). Later various insecticides were tried at Samaru and Disulfoton used as a seed dressing (Frumin Al) and as granules (solvirex) gave good control of both aphids and the rosette disease (Annon, 1978).

Abubakar (1986) recommended the use of insecticides such as carbofuran at the rate of 0.75 to 1.0 kg a.i./ha or ethiofencarb at the rate of 0.5kg a.i./ha. In recent times, chemicals such as Sherpa plus, ragor, uppercott have been found to be effective against aphids.

CONCLUSION

The review have shown a vivid breakdown of aphis (*Aphis craccivora*) and its devastating effect on groundnut and cowpea and how efforts have been put in place at different times to combat the insect through different measures of control and management. The best option however is for the farmers to adopt the friendliest approach to control and management of the pest which is within their reach and is

cheap and affordable. IPM appears to be a panacea for combating the menace of insect pests. However, Egwurube and Dike, (2000) in their findings discovered that farmers have a negative response towards the acceptance of it. They reiterated the fact that, farmers have not been well informed about the usefulness of IPM practices as it regards to the control and management of aphis (*Aphis craccivora*).

For future purposes a national evaluation on the management of control of aphis (*A. craccivora*) should be conducted, hence the following recommendations are made:-

Recommendation

1. Based on the findings of this review farmers should be educated to become familiar with the various method available for the control of pests especially *A. craccivora*.
2. Breeders should intensify efforts in ensuring that more lines are released that are highly resistant to the vectors and parasites they carry.
3. Detailed research should be encouraged to be carried out on the *A. craccivora* with Adamawa State since Adamawa is one of the major producers of groundnut and cowpea in Nigeria.

REFERENCES

Anaso, C. E.; Lale, N. E. S., Aminu, K. M. and Anaso, A. B. (1998). *Use of pesticidal plant extracts for pest control in millet crop system*. Pp 154-160.

Apeji, S. A., (1998). *Pests of Cowpea and Soybeans in Nigeria*. Federal Department of Pests Control. 20pp.

Cassey, E., (1997). Integrated Pest Management for Bedding Plants. A scouting and pest management guide. *Cornell Cooperative Extension Publication.* No. 407 109pp.

Choudhury, D., (1995). Aphid Honeydew: A re-appraisal of the hypothesis of Owen and Wiegert. *Oikos* Vol.45, No.2. Pp287-290.

Courtney, P. (2005). Scientists battles lettuce aphid.http://mw.abc.net.au/landline/content

Degri, M. M. and Hadi, H. M. (2000). Field and Economics of some Insecticides against the major insects of cowpea (*Vigna unguiculata* L.Walp) in Bauchi, Nigeria. In: *Entomology in Nation Building:* The Nigerian Experience. pp 113-118.

Dika, J. and Van Pelt, J. A. (1999). Interaction between phylloshere yeasts, aphids honeydew and fungicide effectiveness in wheat under field conditions pathology, Vol.41, No.6, pp 661-675.

Dixon, A. F. G. (1997). Aphid Ecology – An Optimisation Approach, 2nd edition.

Douglas, A. E, (1998). Nutritional Interaction in Insect Microbial Symbiosis: Aphids and their symbiotic bacteria *Buchnera*. *Annual Review of Entomology* 43: 17 – 21.

Dreistadt, S. H.; Clark, J. K. and Flint, M. L, (1994). Pests of Landscape Trees and Shrubs: *An Integrated Pest Management Guide*. Oakland: University Calif. Agric. Nat. Res. Publ.3359.

Flint, M. L, (1999). Pests, the Garden and Small Farm: *A Growers Guide to using less pesticide*, 2nd edition. Oakland: Uni. Calif. Agric. Nat. Res. Publications 3352.

Gill, S. (1995). Earthly Detection Key to Aphid Control. Grower Talks 59 (2):95

Gillman, D. H. (2005). Sooty Mold. http://www.umassgreeninfo.org/fact_sheets/disease/sooty_mold.pdf University of massachusetts Extension, Fall 2005

Gilrein, D. (1995). Managing Aphids in Greenhouse Crop production. *Cornell Cooperative Extension Greenhouse IPM Update*. 5(1):1-6

Hills, D. S. (1986). *Agricultural Insect Pests of the Tropics and the Control.* 2nd edition Cambidge University Press, Cambridge. 146pp.

Hoffman, M. and Sanderson, J. (1993). Melon Aphid. *Cornell Cooperative Factsheet* No.750:501pp.

Hunter, C. (1997). Supplier of Beneficial Organisms in North America. California Environmental Protection Agency, Department of Pesticides Regulation, Environmental Monitoring and Pest Management Branch, 32pp.

Jahn, G. C.; Almazan, L. P. and Pacia, J. (2005). Effect of Nitrogen Fertilizer on the Intrinsic rate of increase of the rusty plum aphid, *Hysteroneura setariae* (Thomas) (Homoptera: Amphididae) on rice (*Oryza sativa L.*).

Johnson, C.; Agosti, D.; Jacques, H.; Klaus, D.; Dumpert, D. J.; Williams, M. T. And Maschwitz , U. (2001). *Acropyga* and Azteca Ants (Hymenoptera: Formicidae) with scale Insects (Stermorrhyncha: Coccodea): 20 million years of intimate symbiosis. *American Museum Novitates.*

Khand, M. K. and Hussain, M. (1965) Role of Coccinellid and Syrphid Predators in Biological Control of Aphid. *Indian Oilseeds Journal. (67-70)*

Krupke, C., Obermeyer, J and Robert, O. (2007a). Soybean Aphid, A New Begining for 2007. In: Pests and Crop. Issue 7, Purdue Extension Service

Krupke, C., Obermeyer, J and Robert, O. (2007b). Why some Aphids can't stand the heat, *Science Daily*. 102pp.

Lale, N. E. S. (2002). *Stored Product Entomology in Tropical Africa*. Mole Publications, Nigeria Ltd, Maiduguri, pp124

Malais, M. and Ravensburg, W. J. (1992). Knowing and Recognising: The biology of glasshouse pests and their natural enemies. Kopert Biology Systems. 109pp. Sanderson, J. (1996). Management of Aphis and White flies. Pages 109 – 124 in Proceedings of the 12th Conference on insect and Disease Management in Ornamentals sponsored by the Society of American Florists.

McGavin, G. C. (1993). Bugs of the World (http://factsonfile.com)p86

Nichols, C. (2007). *The Most Extreme* Bugs. Josey-Bass, John Wiley and Sons. P.61.

Palumbo, J. C. (1997). Evaluation of Foliar Insecticide approaches for aphid management in head lettuce. Pp 171 – 177. In N.F. Oebker (ed) *Vegetable Report*, University of Arizona, College of Agriculture, Series, P.111.

Piper, R. (2007). *Extraodinary Animals: An Encyclopedia of Curious and Unusual Animanls.* Greenwood Press. Pp 6 – 9.

Reynolds, H. T. And Volk, T. (2007). Tom Volk's Fungus of the Month. University of Wisconsin – La Crosse.

Singh, F. And Oswalt, D.C. (1992). Major Insects of Groundnut. Skill Development Series. ICRISAT Human Resource Development Programme. Patancheru, Andhra, Pradesh 502 324, India. Pp. 16 -17.

Table 1: Plants with Pesticidal Properties on Target Organism

Plant Species	Parts Used	Effective Range	Target Organisms
Derris elliptica	Roots	Insecticidal	Adzuki bean beetle, armyworms, melon aphid and stem borers
Anona spp.	Seeds	Insecticidal	Aphids, rice hopper, diamond black moth, grasshoppers and green buck
Azadirictha indica	Seeds, leaves	Insecticidal, fungicidal	Fruit worms, aphids, rice plant hopper, grasshopper, flea beetles
Capsicum frutescens	Fruits	Insecticidal	Ants, aphids, caterpillars, Colorado beetles, cabbage worms
Nicotiana tobacum	Leaves	Insecticidal	Aphid, caterpillar, flea beetles, leaves miners, stem borers, thrips, mites and grain weevils
Ocimum bacilicum	Leaves, seeds	Insecticidal	Flies, aphids, mites, mosquitoes
Lycopersicon lycopersicum	Leaves, stem	Insecticidal	Moth, aphids, ants, white flies, cabbage worms
Allium sativum	Cloves	Bactericidal, fungicidal and Insecticidal	Bacteria, fungi, aphid, armyworms and stem borers
Quassia amara	Stem, leaves, barks and roots	Insecticidal	Aphids, caterpillars, leaf miners, caper beetles, Colorado beetles
Moringa oleifera	Leaves	Bactericidal and fungicidal	Seedling pests
Carica papaya	Leaves	fungicidal	Rust, powdery mildew, fungi and bacteria

Source: Grainge and Ahmed, 1988; Stoll, 1998 and Fuglie, 1998.