Available online at www.aappbckv.org

The Journal of Plant Protection Sciences, **5**(1) : 10-16, June, 2013

Evaluation of the effects of climate change on increased incidence of cowpea pests in Nigeria

[1]A.A. Oyerinde, [1]P.Z. Chuwang, P.Z. and [2]G.T. Oyerinde

[1]Department of Crop Science, University of Abuja, Abuja, Nigeria, [2]Laboratory of Applied Hydrology, University of Abomey-Calavi, Benin, E-mail:oyerindehyphae2002@yahoo.com

(Received : 15 November 2012; 5 April 2013)

A B S T R A C T

Insect response to rise in atmospheric temperature and carbon dioxide differ from one region to the other. The latest assessment report from the Intergovernmental Panel on Climate Change (IPCC) predicts an increment in mean atmospheric temperature from 1.1 to 6.4°C toward the year 2100 with equally increasing atmospheric carbon dioxide (CO_2). Such climatic changes could profoundly affect insect's population on essential crops. This study was conducted during the 2010 and 2011 cropping season at the University of Abuja Teaching and Research Farm (Nigeria) in order to determine the impacts of climate change on the population of insects associated with cowpea production in the region. The result showed an increase in the number of taxa encountered on the cowpea field from 21 to 31 orders of insect in the 2010 and 2011 cropping seasons, respectively. Also, no significant difference was established in the forms of destructions recorded at the various growth stages of the cowpea plant in the two seasons. Therefore the advent of increased fauna on cowpea established in this study portrayed a need to find possible ways to reduce the emission of Greenhouse gases in the region in order to ameliorate the effects of induced global warming on cowpea production in the country and also provide effective control of the identified pest in order to maintain or stall resurgence.

Keywords: Climate change, insect pest, cowpea, pest resurgence

Introduction

Cowpeas *Vigna unguiculata* L. otherwise known as black eye peas, or simply beans in many parts of Africa, are widely grown in the tropics and subtropics for human as well as for animal food. Nigeria, Brazil and Niger are among the major producers and account for over 70% of the worlds production (Singh & Van Emden 1979; Parh 1983; Emosairue *et al*. 2004). Nigeria alone produces about 900,000 tons annually (Singh *et al*. 1983). The crop is grown mainly as a secondary crop in association with other staples such as maize, sorghum, millet, and cassava. Cowpeas constitute the cheapest source of dietary protein and energy for most poor people in the tropical world (Alabi *et al*. 2003). They are eaten as green seeds, green pods, dry grains and tender leaves are used as a vegetable (Kayumbo 1978; Alabi *et al*. 2003). In addition, the haulm is fed to cattle in a number of countries (Alabi *et al*. 2003).

Like many other crops with a long history of cultivation, they are subject to heavy losses or entire crop failure (Taylor 1978; Egho 2011) as a result of severe insect pest predation (Kayumbo 1978). The pest spectrum is wide and practically every part of the cowpea plant has an adopted pest species. While the pest status of the different insects may vary from one country or region to another (Singh *et al*. 1978; Egho 2011), the losses reported suggest

that anyone major pest of cowpeas can cause substantial economic loss if left uncontrolled (Singh & Allen 1980).

However, an increase in global temperature as a result of climate change caused sea levels to rise and changed the amount and pattern of precipitation and an expansion of subtropical deserts. Other effects of the warming include more frequent occurrence of extreme weather events including heat waves, droughts, heavy rainfall, species extinctions due to shifting temperature regimes and changes in crop yields (FAO 2005). As the earth warms, pest can more easily migrate to new areas. Hence, the ecosystem services upon which human livelihoods depend would not be preserved (Fleming & Volney 1995). Besides, the earth is warming and leading to unnatural migration, global warming is being blamed for insects becoming populous and larger in size (Chakraborty *et al.* 2000). Populations of insect pests like mosquitoes and beetles are growing much faster because of the warmer weather (Chakraborty *et al.* 2000). Of note is the fact that if the climate change continues at the pace it's going presently; it implies that these species could take over certain ecological regions in the shortest possible period. This study was informed by the necessity to ascertain the influence of climate change on incidence of cowpea pests in Nigeria.

Materials and Methods

V. unguiculata seeds (cultivar Sampea 11) were obtained from the Institute for Agricultural Research (IAR) Zaria, Nigeria. The plant was raised on the experimental plot of the Teaching and Research Farm University of Abuja, Federal Capital Territory (FCT Abuja), Nigeria. The FCT is located on Longitude 9.2°9.6'N and latitude 6.8°7.2'E. This region falls within the Southern Guinea Savannah agro-ecological zone of Nigeria, with the mean annual rainfall of1500mm spanning between March/April to October/November (Agboola 1979).

An experimental plot of about 9.0m x 9.0m located at least 100m away from cowpea growing fields was divided into 16 blocks of 1.5m x 2.0m each, with 1.0m spacing between each block lengthwise and breadth wise along the midline, thus allowing three access sides per block. Also, within each block are three rows of 2.0m ridges, 50cm apart with ten planting holes of 20cm spacing and 2 grains per planting hole.

A daily observation was done from day of planting through germination and seedling stage, once weekly observations were carried out after the seedling stage. Insects were collected using wide mouthed insect net, and hand brush. Large insects were collected by handpicking after careful observation for special habit and damage characteristics. Small insects were preserved in 70% ethanol while larger insects were first killed in a killing jar containing ethyl acetate before preserving dry, pinned and put in entomological boxes containing naphthalene. Taxonomy of insect collection was done in the Insect Museum, Department of Crop Protection, Faculty of Agriculture, Ahmadu Bello University, Nigeria.

Results

The incidence of the insect species on cowpea in the 2010 growing season recorded a total number of 21 taxa (Table 1) partitioned according to the various growth stages. During the germination and seedling stage, one species of Coleoptera (*Ootheca mutabilis*), two species of Hymenoptera (*Camponotus sericeus* and *C. pennyslivaricus*) and one Orthoptera (*Zonocerus variegatus*) infested the plants, at this stage of growth. In addition, two species of insects (one Coleopteran and one Homopteran*)* were encountered during the vegetative growth while the flowering stage had four species. Also four species infested the plant at both the flowering and pod formation stages. But, majority of the pest were encountered during the poding stage of the crop leading to abortion or premature dropping as well as shriveling of the pods. The taxa recorded during this season can be grouped into key, occasional and visiting pest. The key pest includes *O. mutabilis, Empoasca dolich, Mylabris biparti, Aspavia armigera, Nezara viridula, Aphis craccivora, Clavigralla shadabi, Maruca testulalis, Anoplocnemis curvipes, Megalurothrips sjostedti*, *Ophiomyia phaseoli, C. tomentosicollis* and *Riptortus dentipes* while the occasional pests are *Zonocerus variegatus, Medythia quarterna, Paracomacris stenoptera* and *Helicoverpa armigera.* The other species are merely visitors.

On the other hand, the infestation of the cowpea planted during the 2011 cropping season had a higher number of insect compared with the previous season (Table 2). A total number of 31 insect faunas were encountered in this season. The germination and seedling stage had six different species ranging from Coleoptera (*O. mutabilis, Nematocerus acerbus* and *Cheilomenes sulphurea*), Orthoptera (*Omocestus viridulus*) and two species of Hymenoptera (*C. sericeus* and *C. pennyslivaricus*) while the vegetative stage was infested with two species of insects (i.e. *E. dolich* and *M. quarterna*). The flowering stage recorded eight species of insects compared to the four species encountered in the previous season and as well a verse majority of the insect species occurred at the pod formation stages. The key pests encountered in the 2011 cropping season were similar with those recorded in the previous season while an increase was established in the number of both occasional and visiting insects. The occasional pests observed in the 2011 cropping season include *O. viridulus*, *Homorocoryphus* sp.*, Paracomacris stenoptera, Parva violacea, Pseudagrion torridum* and *Palpopleura lucia.*

Discussion

Most of the bugs observed may have been attracted to the plants to suck sap or for breeding purposes. The insects which occurred at the vegetative stage were in low numbers. Their presence did not show obvious damage on the plants. Any attack by the insects only causes negligible damage since their numbers were few; their occurrence do not reflect any quest for feeding on the plants. The cowpea

crop may not be a good food choice for this group of insects. For instance at the period when the insect samples were collected, there were many *Zonocerus variegatus* in nearby amarantus, yet only a few were recorded on the cowpea farm. Apart from the insects that cause little damage to the cowpeas at the vegetative stage, some others were mere visitors and may be of benefit to the plants. For instance, the activities of some insects are of importance in pollination of crops. Also, beetles such as *C. sulphurea* can predate on aphids and other insects infesting the crops.

At the flowering and pod bearing stage, the numbers of insects infesting the plants were more than at the other stages. Flowers attacked by the various pests failed to produce pods. Their attack resulted in pod malformation, premature drying and formation of empty pod. This feeding consequence was earlier noted by Okonkwo and Okoye (2002) as well as on the developing pods of green gram, *Vigna radiata* in Northern Guinea Savannah (Adamu *et al*. 1999).

The result of this study showed that the cowpea crop was infested by large numbers of insects in the 2011 cropping season compared to the number of species observed in 2010 season. This can be linked to the resultant effects of climate change on the development, distribution and resurgence of insect pests of crop as earlier predicted (Chakraborty *et al.* 2000). Singh and Van Edem (1979) had also shown that large number of insect species attack all part of this crop at all stages from seedling to harvest. The advent of low number of taxa at the vegetative stage had no significant effect because the plants were able to recover from the damage at this stage through rapid vegetative growth. However, the highest number of insect occurred at the flowering and pod formation stages, this notwithstanding, the damage effects in the two years of studies were not significantly different.

Table 1.
Checklist of insect species in the cultivated plots of *Vigna unguiculata* during 2010 in Abuja, Nigeria

Order	Family	Species	Common Name	Crop Stage
Coleoptera	Chrysomelidae	*Ootheca mutabilis* Sahlb.	Leaf eating beetle	G&S
Orthoptera	Pyrgomorphidae	*Zonocerus variegatus* Linn.	Grasshopper	G&S
Hymenoptera	Formicidae	*Camponotus sericeus* Fab.	Carpenter ants	G&S
Hymenoptera	Formicidae	*Camponotus pennsylvanicus* De Geer	Black carpenter ants	G&S
Coleoptera	Chrysomelidae	*Medythia quarterna* Fair	Striped foliage beetle	V
Homoptera	Cicadellidae	*Empoasca dolich* Paoli	Leafhoppers	V
Orthoptera	Acrididae	*Paracomacris stenoptera* Schuam.	African grasshopper	F

Contd...

Order	Family	Species	Common Name	Crop Stage infesting
Coleoptera	Coccinellidae	*Epilachna similis* Thunb.	Lady-bird beetle	F
Diptera	Diopsidae	*Diopsis apicalis* Dalm.	Stalk-eyed fly	F
Coleoptera	Meloidae	*Mylabris biparti* Baudi	Blister beetle	F
Heteroptera	Pentatomidae	*Aspavia armigera* F.	Shield bug	P&F
Heteroptera	Pentatomidae	*Nezara viridula* L.	Green shield bug	P&F
Lepidoptera	Noctuidae	*Helicoverpa armigera* Hubn.	Earworm	P&F
Homoptera	Aphididae	*Aphis craccivora* Koch.	Aphids	P&F
Heteroptera	Coreidae	*Clavigralla shadabi* Dolling	Spiny brown bug	P
Lepidoptera	Pyralididae	*Maruca testulalis* Geyer.	Legume pod borer	P
Heteroptera	Coreidae	*Anoplocnemis curvipes* Fab.	Giant pod bug	P
Thysanoptera	Thripidae	*Megalurothrips sjostedti* Trybom.	Legume pod thrips	P
Diptera	Agromyzidae	*Ophiomyia phaseoli* Tryon	Bean fly	P
Heteroptera	Coreidae	*Clavigralla tomentosicollis* Stal.	Spiny brown bug	P
Heteroptera	Alydidae	*Riptortus dentipes* Fab.	Pod sucking bug	P

G&S: Germination and Seedling Stage; V: Vegetative Stage; F: Flowering Stage; P: Pod Stage; P& F: Pod and Flowering Stage

Table 2.

Checklist of insect species encountered in the cultivated plots of *Vigna unguiculata* during 2011 in Abuja, Nigeria

Order	Family	Species	Common Name	Crop Stage infesting
Coleoptera	Curculionidae	*Nematocerus acerbus* Fst.	Bean beetle	G&S
Coleoptera	Coccinelidae	*Cheilomenes sulphurea* Oliv.	Bean beetle	G&S
Orthoptera	Acrididae	*Omocestus viridulus* L.	Grasshopper	G&S
Hymenoptera	Formicidae	*Camponotus sericeus* Fab.	Carpenter ants	G&S
Hymenoptera	Formicidae	*Camponotus pennyslvanicus* De Geer	Black carpenter ants	G&S
Coleoptera	Chrysomelidae	*Ootheca mutabilis* Sahlb.	Leaf eating beetle	G&S
Homoptera	Cicadellidae	*Empoasca dolich* Paoli	Leafhoppers	V
Coleoptera	Chrysomelidae	*Medythia quarterna* Fair	Striped foliage beetle	V
Orthoptera	Tettigoniidae	*Homorocoryphus nitidulus* Scopoli	Cricket	F
Orthoptera	Acrididae	*Paracomacris stenoptera* Schuam.	African grasshopper	F
Orthoptera	Pyrgomorphidae	*Parva violacea* Kevan.	Grasshopper	F
Coleoptera	Coccinellidae	*Epilachna similis* Thunb.	Lady- bird beetle	F

Contd...

Order	Family	Species	Common Name	Crop Stage infesting
Diptera	Diopsidae	*Diopsis apicalis* Dalm.	Stalk-eyed fly	F
Odonata	Libellulidae	*Palpopleura lucia* Dry	Lucia widow	F
Odonata	Coenagriidae	*Pseudagrion torridum* Selys.	Senegal sprite	F
Coleoptera	Meloidae	*Mylabris biparti* Baudi	Blister beetle	F
Heteroptera	Pentatomidae	*Aspavia hastator* F.	Shield bug	P&F
Heteroptera	Pentatomidae	*Nezara viridula* L.	Green shield bug	P&F
Lepidoptera	Noctuidae	*Helicoverpa armigera* Hubn.	Earworm	P&F
Homoptera	Aphididae	*Aphis craccivora* Koch.	Aphids	P&F
Heteroptera	Coreidae	*Clavigralla shadabi* Dolling	Spiny brown bug	P
Heteroptera	Coreidae	*Clavigralla tomentosicollis* Stal.	Spiny brown bug	P
Heteroptera	Alydidae	*Mirperus jaculus* Thunbg.	Pod sucking bug	P
Heteroptera	Alydidae	*Riptortus dentipes* Fab.	Pod sucking bug	P
Lepidoptera	Pyralididae	*Maruca testulalis* Geyer.	Legume pod borer	P
Heteroptera	Coreidae	*Anoplocnemis curvipes* Fab.	Giant pod bug	P
Thysanoptera	Thripidae	*Megalurothrips sjostedti* Trybom.	Legume pod thrips	P
Diptera	Agromyzidae	*Ophiomyia phaseoli* Tryon	Bean fly	P

G&S: Germination and Seedling Stage; V: Vegetative Stage; F: Flowering Stage; P: Pod Stage; P& F: Pod and Flowering Stage

Literature Cited

Adamu RS Dike MC Ogunlana MO. 1999 Insects Associated with Soybean [(*Glycine max* (L.) Merr.] in the Northern Nigeria. *Journal of Sustainable Agriculture and the Environment* 1 (2): 272-78.

Agboola SA.1979 *Agricultural Atlas of Nigeria*. Oxford University Press, London 97p.

Alabi OY Odebiyi JA Jackai LEN. 2003 Field evaluation of cowpea cultivars (*Vigna unguiculata* (L) Walp.) for resistance to flower bud thrips (*Megalurothrips sjostedti* Trybom) Thysanoptera: Thripidae). *International Journal of Pest Management* **49** (4): 287-91.

Chakraborty S Tiedemann AV Teng PS. 2000 Climate change: potential impact on plant diseases. *Environmental Pollution* **108**:317-26.

Egho EO. 2011 Effects of two agro-ecological zones on insect species of cowpea (*Vigna unguiculata* L.) Walp during the late cropping season, Delta State, Southern Nigeria. *Agriculture and Biology Journal of North America* **2**(3): 448-53.

Emosairue SO Nwofia GE Umuetok SBA. 2004 Observation on the Insect complex associated with cowpea (*Vigna unguiculata* (L.) Walk in Umudike, South-eastern Nigeria. *Journal of Sustainable Agriculture and the Environment* **6**(1):38-43.

Fleming RA Volney WJA. 1995 Effects of climate change on insect defoliator population processes in Canada's boreal forest: some plausible scenarios. *Water, Air and Soil Pollution* **82**: 445-54.

Food and Agriculture Organization (FAO). 2005 Adaptation of forest ecosystems and the forest sector to climate Change. Forests and Climate Change Working Paper No.2, Rome, FAO/ Swiss Agency for Development and Cooperation.

Kayumbo HY. 1978 *Pests of cowpea and their control in Tanzania*. London, New York, Academic Press, 200p.

Okonkwo EU Okoye WI. 2002 Effect of plant materials damage and germination of cowpea seeds stored on small farms. *Nigerian Journal of Entomol*ogy **19**: 90-98.

Parh IA. 1983 Species of *Empoasca* associated with cowpea, *Vigna unguiculata* (L.), Walp in Ibadan and three ecological zones in Southwestern Nigeria (Homoptera: Cicadellidae). *Review of Zoology in Africa* **97**:202-10.

Singh SR Allen OJ. 1980 Pests, diseases, resistance and protection of *Vigna unguiculata* (L.) Walp, pp. 419-43. In *Advances in Legume Science* (Eds Summerfield RJ Bunting AH). London: Review of Botanical Gardens, Kew and Ministry of Agriculture, Fishery, Food. 667p.

Singh SR Singh BB Jackai LEN Ntare BR. 1983 Cowpea research at IITA, *Information Series* No. **14**, 20p.

Singh SR Van Emden HF Taylor TA (Eds). 1978. *Pests of Grain Legumes: Ecology and Control,* London, New York, Academic Press. 454p.

Singh SR Van Emden HF. 1979 Insect pests of grain legumes. *Annual Review of Entomology* **24**:255-78.

Taylor TA. 1978 *Maruca testulalis:* an important pest of tropical grain legumes, pp 192-200. In *Pests of Grain Legumes: Ecology and Control* (Eds Singh SR van Emden HF & Taylor TA). London, New York, Academic Press. 454p.