Pests and Diseases of African Yam Bean, *Sphenostylis stenocarpa* (Hoechst. Ex. A. Rich.) Harms

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Abstract

Several pests and diseases were identified on African yam bean, *Sphenostylis stenocarpa*. The pests attacked both the vegetative and reproductive stages of the crop. The pests of the vegetative stage were identified as cutworms (*Agrotis* spp), aphids (*Aphis craccivora*), grasshopper (*Zonocerus variegatus*), *Maruca testulalis*, *Cydia ptychora* and leaf–rolling caterpillars (*Sylepta derogata*). Both the larvae and adults of these pests attacked the crop. Pests of the reproductive stage identified were: *Cydia ptychora, Heliothis armigera, Riptortus dentipes, Apion varium and Nezara viridula*. The larvae and adults of these pests were also observed on the reproductive part. The diseases identified on African yam bean included wilting, powdery mildew, root gall, rust and leaf mosaic. These diseases attacked the crop between seedling emergence and pod maturity.

Introduction

Tropical grain legumes are subject to many natural hazards, especially pests and diseases, but there is a great deal of variation in the susceptibility and resistance of the cultivars within a given legume species (Rachie and Rockwood, 1972). An understanding of this is crucial in improving productivity of the species.

Rachie and Silvestre (1977) showed that the most widespread diseases of legumes include seedling blights and wilts caused by *Rhizoctonia solani, Pythium aphanidermatum* and *Fusarium* spp; stem blight caused by *Colletotrichum* spp and *Rhizoctonia solani,* and root rot caused by *Phytophthora manihotis.* The above fungal diseases can be controlled through cultural and fungicidal treatments. It has been shown that the most practical and promising approaches to the control of these diseases are by the use of resistant cultivars and the use of chemical seed treatments (11TA, 1973). Several other diseases such as rust, leaf spot, downy mildew, anthracnose, powdery mildew, pod blight, bacteria pustule, root-knot, green mottle virus and yellow mosaic virus (Rachie and Silvestre, 1977) have also been identified from different legume species.

Insect pests that attack legumes can be grouped into foliage and stem feeders; floral bud and flower feeders; and pod and seed feeders (Jackai and Adalla, 1997). Pest attack causes varying degrees of crop loss. According to Dina (1977), total crop failure is at times attributable to these pest species, most especially during the late cropping season in western Nigeria. Insect pests attack legumes in all stages of growth and in storage, and are considered the major limiting factor in their production in the low humid tropics (Ezueh and Taylor, 1984). Ng and Marechal (1985) showed that pest problems on legumes are clearly more severe in Africa than elsewhere, probably because many of the pests are considered indigenous to the continent and/or have had ample time to co-evolve with the crop in its centre of domestication. Insect pests are usually controlled by the use of insecticides. Many insecticides used on legumes are foliar sprays, either as emulsifiable concentrates or wettable powders. Several of these chemicals are effective against most pests, although there is greater specificity in some cases against specific groups, a distinction related to the feeding behaviour of the different pests (Tamo *et al.*, 1997).

African yam bean is a pulse crop and "pulse" is the collective name for crops

which belong to the legume family (Elegbede, 1998). The crop is cultivated in some parts of Africa for its tubers (NAS, 1979) and in south eastern Nigeria for its edible seeds. The seeds have crude protein levels that vary from 21 to 29 per cent and these are lower than soybean that has up to 38 per cent. The chemical composition of tubers compares favourably in starch and crude protein content with various yam cultivars (Enwere, 1998). Information seems to be lacking on the pests and diseases of this valuable crop. This paper, therefore, aims at investigating the pests and diseases of African yam bean.

Materials And Methods

Seed source: Viable seeds of African yam bean, *Sphenostylis stenocarpa* were collected from the seed bank of the Department of Crop Science, University of Nigeria, Nsukka and used for this study.

Land Preparation: A portion of land located in the Botanical Garden of the Department of Botany, University of Nigeria, Nsukka was used for the field studies. The land was cleared and a plot that measured 12x12m was marked out. The plot was divided into four blocks each measuring 2.5m in width, with a path between that measured 0.5m in width. Each block was further divided into five sub-plots each measuring 2m with also a path of 0.5m in between the sub-plots.

The plot was tilled with hoe and beds made. Ten seeds were planted per sub-plot at a spacing distance of 50 cm within lines and 90 cm between lines. The seedlings were staked two weeks after emergence when they had developed prominent vines.

Data collection: Observations were made on the crop for four and half months starting from seedling emergence to the time of harvest, with a view to identifying those pests and diseases that attack the crop. Such pest infested or diseased plants were collected and taken to the laboratory for identification of the organisms involved.

Since it was not easy to identify the larvae of the insect pests that attacked the crop, the approach adopted was to allow these larvae to grow to adult stage in order to facilitate identification. The larvae of the insect pests were, therefore, collected from the parts of the crop and nurtured in perforated plastic bowls that were covered with wire mesh to prevent their escape. The plastic bowls were perforated to allow for aeration. The larvae placed inside the bowls were then fed with those parts of the crop that they attacked, till adulthood was attained. The adults were later identified using the methods of Biddle *et al* (1992).

Disease identification was carried out first by carefully uprooting the infected plants and cutting the roots, leaves or vines into small pieces with a razor blade. These were then sterilized by immersion in 75 per cent ethanol for 30 seconds and then in 0.1 per cent mercuric chloride for 2 minutes. They were then rinsed in two changes of sterile distilled water. The sterilized materials were transferred into Petri dishes containing water agar (20 g of agar + 1 litre of distilled water, sterilized for 15 minutes in an autoclave at 1.05 kg /cm^2 pressure). The set-up was allowed to stay for 4 days. When mycelial growth was noticed, they were transferred with sterile needles into Petri dishes containing potato dextrose agar (20 g of agar + 20 g of dextrose + 200 g of peeled sliced potato + 1000ml of distilled water) inside a sterile laminar- flow chamber. The mycelia were allowed to grow for 4 days. A little portion of the mycelium was collected with a sterile needle from the periphery of the culture and mounted in lactophenol and studied under the microscope. The fungi present were identified using the methods of Ainsworth *et al* (1973), Barnett and Hunter (1999).

Results

Several pests encountered during the growth of the African yam bean and their severities of attack are shown in Table 1. The pests were grouped according to the stage of the growth of the crop at which they attacked them.

Table 1: Pests of African yam bean showing parts attacked and severity

Stage of attack	Pests	Parts affected	Severity
Vegetative	*Agrotis* spp	Young stems	++++
	Aphis craccivora	Tips of young vines	+++
	Zonocerus variegatus	Leaves	++++
	Maruca testulalis	Leaves	+++
	Cydia ptychora	Leaves	++
	Leaf-rolling caterpillars *(Sylepta derogata)*	Leaves	+++
Reproductive	*Cydia ptychora*	Flower buds and pods	++++
	Heliothis armigera	Flower buds, flowers and young pods	+++
	Riptortus dentipes	young pods	+++
	Apion varium	Pods, seeds and tips of vines	+++
	Nezara viridula	Pods and seeds	++

Key: ++++ = very high; +++ = high; ++ = low

Vegetative stage pests: Cut worms *(Agrotis* spp.) were observed during seedling emergence. These pests damaged young seedlings by cutting their stems, leaving a dead end. The seedlings cut at that level could not grow any longer. Small black aphids (*Aphis craccivora*) were also identified. Both the nymph and adult stages of this pest fed on the tips of the seedlings, nipping off their apical buds. Grasshoppers *(Zonocerus variegatus)* were the most frequent insect pests observed at the experimental site. Adult grasshoppers fed on the leaves, stripping off portions of the leaf lamina (Plate 1) creating holes on them. The larvae and adults of *Maruca testulalis* and *Cydia ptychora* all fed on the leaves. The activities of leaf-rolling caterpillars (*Sylepta derogata)* were also observed on the crop (Plate 2). These caterpillars caused leaf-rolling on the plants. Such rolled leaves were deprived of enough sunlight needed for photosynthesis to occur.

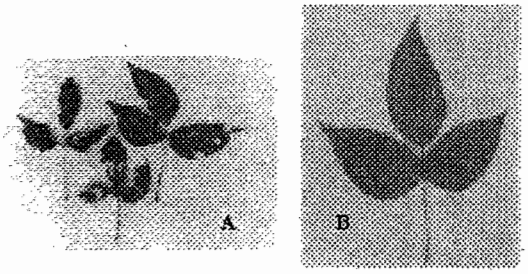

Plate 1 Leaves of *S. stenocarpa*, (A) attacked by Lepidopterous insects and (B) control

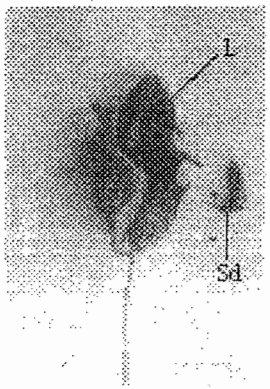

Plate 2: Leaf-rolling caterpillar, *Sylepta derogata* (Sd) and rolled leaf (L) of *S. stenocarpa*.

Reproductive stage pests: Pest attack at the reproductive stage of the crop ranged from destruction of flower buds, flowers, pods, immature pods to mature seeds. The larvae of *Cydia ptychora* bore into flower buds and young developing pods leaving holes on the affected part (Plate 3). The larvae fed on the essential parts of the flowers and seeds while inside the flower buds and pods. Some of the attacked flower buds either dried up or fell off from their peduncles. The larvae of *Heliothis armigera* were also identified to have attacked the flower buds, flowers and developing pods of African yam bean. The larvae fed in clusters on the flower buds and developing pods by burrowing inside them. The point of entry of the larva into

the pod is usually marked with dark small hole on the surface of the pod (Plate 4).

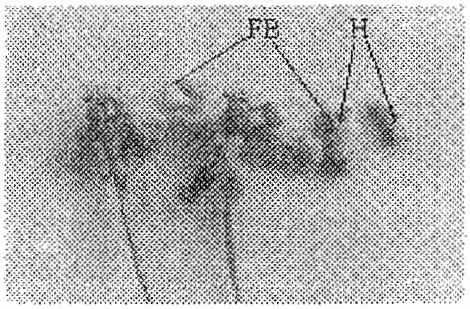

Plate 3: Flower buds (FB) of *S. stenocarpa* attacked by the larvae of *Heliothis armigera* showing holes (H) on the buds

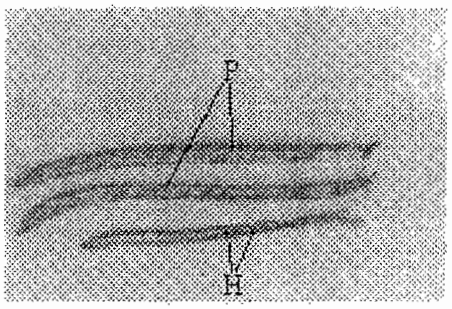

Plate 4: Pods (P) of *S. stenocarpa* attacked by the larvae of *Cydia ptychora* showing holes (H) on the affected parts

Riptortus dentipes, a pod sucking bug was observed on the plant. It pierces the young pod with the proboscis and then sucks the developing seeds. *Apion varium* was identified to attack the pods and seeds of African yam bean. The adults lay eggs, which later hatched into larvae that fed on the seeds within the pod. *Nezara viridula* was another pod sucking bug observed on the crop. The bug also pierces the pods and feeds on the seeds. The point where the pod was attacked normally rots, leaving a dark brown mark on the pod.

Diseases: The diseases observed on African yam bean grown in the field included wilting, powdery mildew, root gall, rust and leaf mosaic (Table 2). Wilting was the most prominent of all the diseases encountered. This disease was caused by *Fusarium oxysporum* (Plate 5) and it attacks the roots, leading to blockage of the xylem vessels. As a result, the aerial part of the plant is deprived of water supply from the soil.

Table 2: Diseases of African yam bean showing parts attacked, period of attack and severity

Disease	Parts affected	Period of attack	Severity
Wilting	Leaves	Emergence-flowering	++++
	Roots	Emergence-flowering	++++
Powdery mildew	Leaves	Emergence-flowering	+++
Gall	Roots	Flowering-pod maturity	++++
Rust	Leaves	Emergence-flowering	++
	Lower potion of vines	Emergence-flowering	++
Leaf mosaic	Leaves	Emergence-flowering	+++

Key: ++++ = very high; +++ = high; ++ = low.

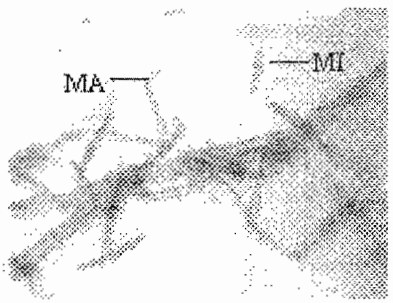

Plate 5: *Fusarium oxysporum* showing macro (MA) and micro (MI) conidia

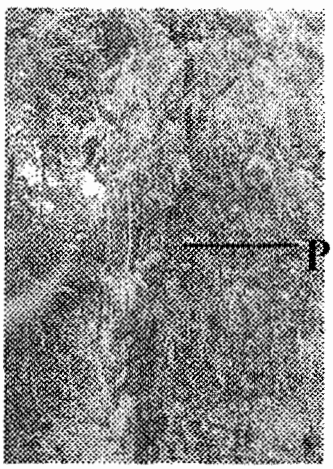

Plate 6: *S. stenocarpa* plant (P) attacked by *F. oxysporum*

The above ground symptoms of a plant infected with *F. oxysporum* include yellowing of leaves, scorching of leaf edges, withering and shedding of leaves (Plate 6). The infected plant shedded all its leaves within one week of its attack and this was followed by death of the plant.

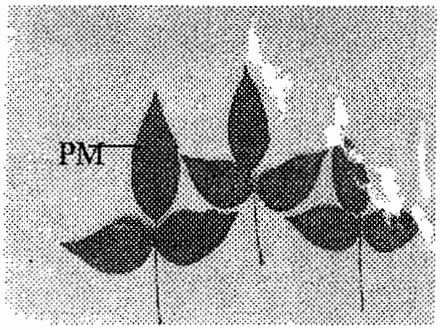

Plate 7: Leaves of *S. stenocarpa* infected by powdery mildew (PM)

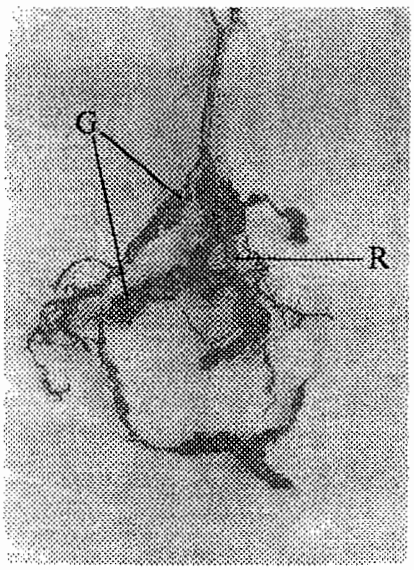

Plate 8: Roots (R) of *S. stenocarpa* showing galls (G), caused by nematode

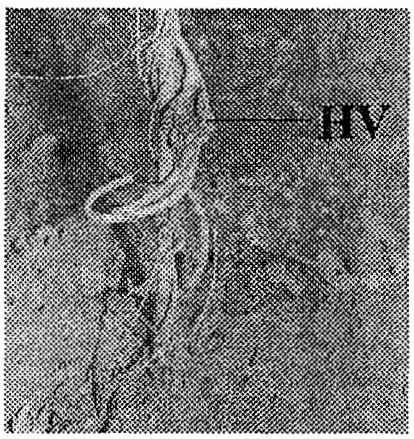

Plate 9: A hypertrophied vine (HV) of *S. stenocarpa,* caused by rust organisms

Powdery mildew disease was observed on the upper surfaces of leaves as white, diffuse, powdery or dusty patches (Plate 7). This later turned into a grey colour and finally darkened. Nematode infestation was identified in the roots of African yam bean plants.

The organism invades the root system and caused galls on the roots (Plate 8).

Another disease of yam bean identified was stem rust. The rust organism damages the lower portions of vines, causing hypertrophy of the vines (Plate 9). This is usually followed by secondary invasion by rot organisms. An unidentified viral disease effects were also observed on the crop. These included malformation of leaves, discoloration of leaves, curling of leaf margins and general stunting of infected plants. A comparison of a normal (healthy) yam bean leaf with that infected possibly by virus is shown in Plate 10. Such yam bean plants infected by the virus produced little or no flowers and pods. Where the plant produced pods, they were usually stunted and unfilled.

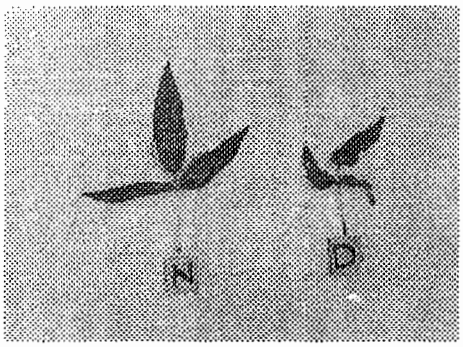

Plate 10: Normal leaf (N) and diseased leaf (D) of S. *stenocarpa,* plant

Discussion

The pests identified on African yam bean during the vegetative stage of growth were similar to those of other legumes. Cutworms *(Agrotis* spp*), Aphis craccivora, Zonocerus* variegatus, *Maruca testulalis*, leaf-rolling caterpillars (*Sylepta derogata)* and *Cydia ptychora* observed on yam bean have also been reported to attack other legumes like lima bean and soybean (Rachie and Roberts, 1974), winged bean and cowpea (Jackai and Adalla, 1997). It appears that these pests are common to most legumes since those reported for other legumes have been identified on yam bean.

The reproductive stage pests identified on yam bean have also been reported on other legumes. Lepidopterous pests that attack the flower buds or flowers

and young developing pods, coreid bugs that pierce the pods and suck the developing seeds of yam bean have been reported for soybean (Rachie and Silvestre, 1977), winged bean (Lamb and Price, 1978) and cowpea (Ogbiakhe and Odulaja, 1993). Other pod sucking bugs such as *Riptortus dentipes, Apion varium* and *Nezara viridula* identified on yam beans had earlier been reported on pigeon pea (Rachie and Roberts, 1974) and winged bean (Srinivasan *et al.*, 1978).

The diseases identified on African yam bean were similar to those reported for cowpea, bambara groundnut and soybean (Rachie and Silvestre, 1977). The wilting disease observed on yam bean has earlier been reported on cowpea between emergence of seedlings and flowering (Oyekan, 1977). However, wilting occurred between the period when the seedlings had commenced climbing the stakes and before the plants reached full vegetative activity in yam bean. The powdery mildew disease identified on yam bean has also been reported on winged bean (Price, 1978). The presence of the whitish powdery cover on the surfaces of leaves possibly reduced the amount of sunlight required to penetrate the leaves for photosynthesis. Powdery mildew symptoms occurred first as small white spots on any leaf which later spread on the entire leaf surface. The leaf surface then becomes coated with a fine white powder that brushes off easily.

Root-knot nematodes that caused galls on the roots of yam bean plants have been reported on cowpea (Jackai and Adalla, 1997). Formation of galls on the roots possibly leads to blockage of the vascular system, thereby preventing water from reaching the aerial parts from the soil. This results in yellowing and wilting of leaves, which contribute to yield reduction. The symptoms of nematode attack reported for winged bean (Stephenson, 1978) were similar to those observed on yam bean.

The rust attack on the vines of yam bean led to hypertrophy and galling of the host. Similar observations have been made on groundnut (Bromfield, 1974) and lima bean (Rachie and Silvestre, 1977). The activities of rot organisms that follow the rust attack may lead to the destruction of the vines at the affected parts and this could cause a drastic reduction in yield. The viral disease effects observed on the leaves of yam bean has also been reported on lima bean (Williams, 1975), cowpea, pigeon pea and winged bean (Price, 1978). Such viral disease effects cause poor yield.

Conclusion: There are now a known number of pests and diseases of African yam bean and any selection or breeding programme must take into account the effects of these pests and diseases. Pests and diseases could be limiting factors to the production of African yam bean. As a result of the usefulness of the crop in the dietary regimes of west and central African sub-regions, it is necessary to explore avenues of increasing production and yield of African yam bean especially through effective control of pests and diseases. For an appreciable yam bean yield to be attained, control measures must be administered. The use of resistant varieties, pesticide and fungicides is recommended for effective control of these pests and diseases. However, because of the residual effects of the chemical control measures on humans and environment, emphasis should be on biological control measures.

References

Ainsworth, G. C., Sparrow, F. K. and Sussman A.S (1973). *The fungi.* A taxonomic review with keys. Vol. IVA. Academic Press Inc. London. 612 pp.

Barnett, H.L . and Hunter, B.B. (1999) Illustrated genera of imperfect Fungi. The American Phytopathological Society Press, Minnesota. 218 pp.

Biddle, A. J., Hutchins, S. H. and Wightman, J. A. (1992). Pests of Leguminous crops. *In*: Vegetable crop pests. Mckinlay, R. G. (Ed.). Macmillan Press, London. pp. 162-208.

Bromfield, K. R. (1974). Current distribution of rust of groundnut and known sources of resistance. *FAO Plant Protection Bulletin 22(2)*:29-31.

Dina, S. O. (1977). Insecticide testing program to increase yield in cowpea. *Trop. Grain Legume Bulletin 8*:14-17.

Elegbede, J. A. (1998). Legumes. *In*: Nutritional Quality of Plant Foods. Osagie, A. U. and Eka, O. U.(Eds.). Ambik Press, Benin. pp. 53-82.

Enwere, N. J. (1998). *Food of Plant Origin*. Processing and Utilization with Recipes and Technology Profiles. Afro-orbis Publishers, Nsukka. pp. 24-76.

Ezueh, M. I. and Taylor, A. T. (1984). Effects of time of intercropping with maize on cowpea susceptibility of three major pests. *Trop. Agric 61*:82-86.

IITA, (1973). *Grain Legume Improvement Program of the International Institute of Tropical Agriculture*. Published reports of the IITA for 1971 and 1972, Ibadan, Nigeria.

Jackai, L. E. N. and Adalla, C. B. (1997). Pest management practices in cowpea: a review. *In*: Advances in Cowpea research. Singh, B. B.; Mohan. Raj, D. R.; Dashiell, K. E.; and Jackai, L. E. N. (Eds.). IITA, Ibadan. pp. 250-268.

Lamb, K. P. and Price, T. V. (1978). Insect and mite pests of winged bean and their control. *In*: The Winged bean. Paper Presented in the 1st International Symposium on Developing the Potentials of the Winged bean, January 1978. Philippines Council for Agric. And Resources Research. Manila, Philippines. pp 231-235.

NAS (1979). African yam bean. *In:* Tropical Legumes: Resources *for the future*. National Academy of Sciences, Washington D. C. pp. 27-31.

Ng, N. Q. and Marechal, R. (1985). Cowpea taxonomy, Origin and germplasm. *In*: Cowpea Research Production and Utilization. Singh, S. R. and Rachie, K. O. (Eds.). John Wiley and sons, Chichester. pp. 11-21.

Ogbiakhe, S. and Odulaja, A. (1973). A multivariate analysis of growth and development parameters of the legume pod borer *Muruca testulalis* on variable resistant Cowpea cultivars. Entom. *Exp. et Applicata 66(3)*: 275-282.

Oyekan, P. O. (1977). Reaction of some cowpea varieties to Fusarium oxysporum F. sp. *Tracheiphilum* in Nigeria. *Tropical Grain Legume Bulletin* 8:47-50.

Price, T. V. (1978). Diseases of the Winged bean. *In*: The Winged bean. Paper presented in the 1st International Symposium on Developing the Potentials of the Winged bean, January 1978. Philippines Council for Agric and Resources Research. Manila, Philippines. pp. 236-247.

Rachie, K. O. and Roberts, L. M. (1974). Grain legumes of the lowland tropics. *Advances in Agronomy* 26: 1-132.

Rachie, K. O. and Rockwood, W. G. (1972). Research in grain legume improvement. *Span. 16* (1):9-12.

Rachie, K. O. and Silvestre, P. (1977). Grain legumes. *In*: Food crops of the lowland tropics. Leakey, C. L. A. and Wills, J. B. (Eds.). Oxford University Press, London. pp 65-66.

Srinivasan, K., Rajendran, R. and Satyanarayana, A. (1978). Some insect pests associated with winged bean in India. *In*: The Winged bean. Paper presented in the 1st International Symposium on Developing the Potentials of the Winged bean, January 1978. Philippines Council for Agric and Resources. Manila, Philippines. pp. 255-257.

Stephenson, R.A. (1978). Field studies on winged bean growth and yield. *In*: The Winged bean. Paper presented in the 1st International Symposium on Developing the Potentials of the Winged bean, January 1978. Philippines Council for Agric. and Resources Research. Manila, Philippines. pp 191-196.

Tamo, M, Bottenberg, H., Arodokoun, D. Y. and Adeoti, R. (1997). The feasibility of biological control of two major cowpea insect pests. *In*: Advances in Cowpea Research. Singh, B. B., Moham. Raj; D. R., Dashiell, K. E. and Jackai, L. E. N. (Eds.). IITA, Ibadan. pp. 269-273.

Williams, R. J. (1975). A whitefly transmitted mosaic of lima bean in Nigeria. *Trop. Grain Legume Bulletin* 1:11.