# Phytosanitary monitoring and surveillance system for integrated management of oil palm pests in Ghana : A review

S. O. APPIAH
*CSIR-Oil Palm Research Institute, P. O. Box 74, Kade, Ghana*

**ABSTRACT**

This paper discusses a phytosanitary monitoring and surveillance system as a component of an integrated pest management strategy. The main stages of the system are alert, census and action. The education and training of farmers, plantation personnel, and extension workers to recognise the main pests, early damage symptoms, and points of development of the pest are crucial for the successful implementation of the monitoring system. A monthly census and a visual assessment of the foliage to determine the extent of defoliation are essential. Two types of checks, ordinary and special, were used depending on the population levels of the various pests. The surveillance data collected from the field were processed and appropriate recommendations issued, based on the indices of pest infestation levels. The adoption and use of the system of monitoring and surveillance can lead to great savings in the huge investment, human and material, needed to control the pest if an outbreak occurs. Regular monitoring of the pests in a plantation is essential to determine natural relationships of pests and their natural enemies, which play a key role in lowering equilibrium positions of the pests for their sustainable management.

**RÉSUMÉ**

APPIAH, S. O.: *Système phytosanitaire de monitorage et de surveillance pour la gestion intégrée de ravageurs de palmier au Ghana: Une révision.* Un système phytosanitaire de monitarage et de surveillance comme un élément de la strategie de la lutte intégrée contre les ravageurs est décrit. Les étapes du système sont: vigilance, recensement et action. L'éducation et la formation d' agriculteurs, de personnels de plantation, et de vulgarisateurs de reconnaître les ravageurs majeures, les symptômes de dégats précoces et les dégrés de développement de ravageurs sont cruciaux pour l'exécution réussite du système. Un recensement mensuel et une évaluation visuelle du feuillage pour déterminer le niveau de défeuillaison sont essentiels. Deux types de contrôle: ordinaire et spécial, sont faits selon les niveaux de population de différents ravageurs. Les données de surveillance obtenues sur le terrain sont traitées et des recommandations appropriées étaient faites basées sur les indices de niveau d'infestations de ravageurs. L'adoption et usage du système de monitorage et de surveillance peut mener à une grande épargne et à un investissement énorme en hommes et en matériel, exigés pour effectuer la lutte contre les ravageurs en l'occurrent d'éruption. Le monitorage régulier de ravageurs existants dans une plantation est essentiél pour déterminer les relations naturelles de ravageurs et leurs ennemis naturels qui jouent un rôle-clé dans la diminution des positions équilibrés de ravageurs pour une lutte suivie contre les ravageurs.

NARS edition; revised 05 Jun 07.

## Introduction

The oil palm industry in Ghana has developed over the years into an important industry, which comes next only to cocoa in the agricultural tree crop sector of the economy (Anon., 1986). The oil palm provides palm oil and palm kernel oil for culinary and industrial uses. Besides the domestic and industrial uses, palm oil has the potential to generate significant foreign exchange from secondary products if efficiently produced and processed into secondary products (Anon., 1987).

The establishment of commercial oil palm plantations on a vast scale as a monoculture, and the expansion of smallholdings by individual farmers have resulted in insect pest problems, from the nursery to the field. The insect pests include the oil palm leaf miner, *Coelaenomenodera minuta* Uhmann (Coleoptera: Chrysomelidae; Hispinae), which can cause severe defoliation; leading to substantial yield losses. Other insect pests of economic importance are *Rhynchophorus phoenicis* Fabricius (Coleoptera: Curculionidae), *Temnoschoita quadripustulata* Gyellenhall (Coleoptera: Curculionidae), *Oryctes monoceros* Olivier (Coleoptera: Scarabeidae; Dynastinae), and *Zonocerus variegatus* Linne (Orthoptera: Acrididae).

The principal means of controlling these pests by the industrial estates (oil palm plantations) have been the use of insecticides (Mariau, 1985). The Ghana Oil Palm Development Company (GOPDC) in 1987 had to resort to aerial spraying, using Evisect 'S', to control the oil palm leaf miner on 2000 ha of its plantation at Kwae in the Eastern Region. The Benso Oil Palm Plantation (BOPP) similarly used aerial spraying on 1800 ha of its estate at Adum Banso, Western Region, in1989. At the Twifo Oil Palm Plantation Limited (TOPP) in the Central Region and the National Oil Palm Limited (NOPL) at Prestea in the Western Region, hot fogging of insecticide was extensively used to combat the potential threat posed by the leaf miner.

The methods applied (ground or aerial spraying and hot fogging) are indiscriminate, equally harmful to beneficial insects, and pose a health hazard to plantation workers. The Integrated Pest Management (IPM) strategy that uses all suitable techniques compatibly, offers better prospects for the sustainable management of insect pests (Smith & Reynolds, 1966). Developing an IPM programme involves (i) analysing the 'pest' status of each of the reputedly injurious organisms and establishing economic thresholds for the key pests; (ii) devising schemes for lowering equilibrium positions of key pests; and (iii) devising monitoring and surveillance techniques to counter the pests.

Monitoring forms an important part of IPM strategies because knowledge of the extent of pest attack, the stage of development of the pest and associated factors can improve the efficiency of control measures (Deit, 1991). Pest monitoring schemes aim to provide farmers with a more rational basis for their actions. Monitoring provides information to serve as the basis of issuing warnings to farmers when pests reach levels that can cause economic damage. The warnings are usually issued according to the time scale within which the farmer is expected to act (Way & Cammell, 1974; Tait, 1977). Long-term warnings allow time for the farmers to anticipate their pest control action, whereas short-term warnings require them to take immediate action (Heong, 1981).

The paper discusses a surveillance and monitoring system designed to detect incipient or low levels of infestation of the pests of the oil palm, with particular reference to the oil palm leaf miner, *C. minuta,* before the pests build up to cause economic damage.

## Methods of monitoring

A previous method for monitoring oil palm defoliators consisted of counting the number of larvae and adult stages of the observed pests on a representative frond at fixed census points in every 2.83 ha of the field (Wood, 1968). This system of monitoring was observed to be ineffective in detecting points of development of the pests until several outbreak points coalesced (Lay, 1996). The system of monitoring now is designed to detect incipient or low levels of the insects' infestation before building up to damaging proportions. The main stages of the system are alert, census, and action.

### *Alert stage*

The alert stage involves the active participation of farmers to generate their awareness of the potential threat posed by the insect pests. Extension agents and farmers are trained to recognise the pests, and the signs of damage associated with various stages of development of the pests. Gen-

erating such awareness, especially in farmers, will lead to early reports of pest infestation to the Department of Agricultural Extension Services (DAES) and the Plant Protection and Regulatory Services Department (PPRSD) of the Ministry of Food and Agriculture (MOFA) for advice and further action to prevent an outbreak or explosion of the pest. Proper training of extension and plantation personnel as well as farmers to recognise early damage signs is of crucial importance in implementing the phytosanitary monitoring and surveillance system.

***Census stage***

Wood (1968) described a system of census based on fixed points for oil palm defoliators. It was subsequently observed that pest outbreaks were only detected when infestation reached the fixed census points. Thus, the pest population could increase and pass unnoticed until several outbreak points coalesced and covered the census point. It would then appear as if the outbreak had "exploded" over a large area overnight.

Lay (1996) modified a different census system described by Syed & Speldewinde (1974). The modified census system essentially comprises two stages, namely (i) detecting (fresh damage and recording apparent damage), and (ii) enumeration in which a detailed census is used to determine the species involved, intensity of attack, and the exact area infested (Lay, 1996).

The newly designed phytosanitary monitoring and surveillance system for the integrated pest management of oil palm pests in Ghana seeks to merge the two stages of detection and enumeration into a single operation, and also makes room for visually assessing damage of the vegetation (foliage). The new census system has two types of checks.

*Ordinary checks*. Routine checks are applied in the nursery and the field (plantation) to forestall any insect attacks and prevent foci of infestation from developing into large-scale swarming, or an outbreak which could have serious effect on crop yield to warrant heavy insecticide use.

a. *Nursery*. One row of seedlings out of every 10 rows within a stock of seedlings are critically examined for insect pests (Anon., 1981). The pests are detected by (i) their physical presence, (ii) damage caused and feeding activity, and (iii) presence of fibre and frass and perforations. Considering the delicate nature and vulnerability of the nursery seedlings and the speed with which a pest can cause damage, inspection and census are carried out once a month. All observations and records are entered on a record sheet.

b. *Field (plantation)*. On every fifth row, two palms selected at random but evenly spread are examined. A representative frond (a lower green frond) is selected for the sampling (Anon., 1981). In older crops (over 8 years) the frond is cut to enable a thorough observation. For younger palms, the frond is pulled downwards toward the checker for the examination. All pests found on the selected frond are recorded, including the stage of development of the pest and any damage and sign of feeding observed. The pests are counted and the total used to calculate an average for the fields. This gives the mean index of infestation.

The inspection and sampling (census) are carried out at monthly intervals. On all fields, particular attention is paid to the border trees and those in the low-lying humid portions of the plantation, because these areas serve as the main sources of insect pest infestation and build-up (Anon., 1988). If during the ordinary checks an abnormal increase in the population of a pest is observed on several palms, for example in *C. minuta* when the larval + pupal index is greater than 40 or when the external adult index is over 5, supplementary checks (called special checks) are undertaken. The index is the average of the various stages of development of the pest per plot. It gives information on the trend in population changes on the field, and is used to determine the frequency at which the checks are applied and when artificial intervention measures are appropriate.

*Special checks*. The primary purpose of the special checks is to determine the extent of the

focus of infestation and the exact level of the populations (Morin & Phillipe, 1977, 1978). Their pursuit and frequency depend on the pest and on the seriousness of the attack. The special check is usually restricted to only the infested area, and is essential for determining treatment options (Anon., 1988).

*Visual assessment of foliage.* A visual grading method described by Mariau (1985) has been modified to assess the extent of defoliation of the palm trees. This involves grading the damage (defoliation) by the pest between 0 (no defoliation) and >70 per cent (very extensive defoliation). The full grading in this system is as follows: (i) no defoliation (ND), lower leaves green without mines or galleries of the pest; (ii) slight defoliation (SD), numerous galleries and mines (brown patches indicating larval presence and feeding) present on the lower leaves, but at the level of defoliation of only 20-40 per cent; (iii) average defoliation (AD), galleries and mines on the middle and high leaves, but defoliation up to 50 per cent is found on only the lower half of the crown; (iv) extensive defoliation (ED), defoliation of 50-70 per cent over the crown; (v) very extensive defoliation (VED), over 70 per cent of the green matter destroyed with the occasional exception of two to five young leaves.

One advantage of this system, a one-step operation, is the saving in time and personnel required for the two-step procedure of enumeration and detection. Another and, perhaps, the most important advantage is that census is moved to points of infestation in a field. The census points are not fixed. It, therefore, facilitates the early detection of pest outbreaks and treatment of such outbreaks when they are relatively small.

### *Action stage*

The action stage represents one at which action has to be taken to either restore an affected plantation to healthy state, or to consolidate a prevailing situation that lends itself to sustainable plant protection. The surveillance data gathered from the different plots on an estate need to be channelled to a central point (estate management) for analysis and recommendation. On a national scale, the data from all the estates and other oil palm-growing areas are processed at a designated collating centre from where the appropriate recommendations are issued to the estates. The basic information on the biology and ecology of the pest are also important to aid in better decision-making. The surveillance data may be processed for two main purposes: to assist in taking decisions on pest control, and to assist in strategy planning (Heong, 1981, 1985).

*Pest control.* Decisions about crop protection are concerned with short-term control options when the need arises. From the analysis of the surveillance data, the available remedial measures are evaluated and the most suitable for a particular situation selected. The prevailing climatic condition, age of the palms, and topography of the land are also essential in selecting the best of, or combination of treatment options, and the best time to apply the treatment to restore the plantation or farm to a healthy state.

*Strategy planning.* Strategy planning deals mainly with long-term planning (Heong, 1981). The data collected from pest surveillance may be synthesised to assist in formulating research programmes and control policies. The data may also be useful in designing cropping systems for sustainable plant protection.

## Conclusion

Pest outbreaks do not occur over a short period. The pest population build-up requires time to reach the outbreak level (Tiong, 1996). A phytosanitary monitoring and surveillance system is, therefore, necessary for the early detection of levels of infestation of insect pests and swarming foci. Adopting and using the system of surveillance can lead to great savings in the huge investment, human and material, needed to control pests if an outbreak occurs.

The importance of monitoring in developing and implementing an integrated pest management programme for oil palm pests cannot be overemphasised. Regular monitoring of the pest spe-

cies in the plantation is essential to determine natural relationships of pests and their parasites or predators, a key part in the mechanism for naturally lowering the equilibrium positions of pests and keeping their populations at tolerable levels. Close monitoring is also necessary in collecting qualitative and quantitative population data on insect pests in the plantation to make a wise choice of treatment concerning the best time of year or the area to be treated or both when insecticides have to be used.

## REFERENCES


**Anon.** (1981) Oil palm and coconut pests in West Africa. *Oléagineux* **36** (4), 222-225.

**Anon.** ( (1986) *IDA funds for the improvement of the Oil Palm Research Centre (OPRC) Working Programme, 1986-1990.*

**Anon.** (1987) *Report of the Task Force on the Development of the Oil Palm Industry in Ghana.* 54 pp.

**Anon.** (1988) *Report on training course in entomology at the IRHO Station, Principal de La Me, Bingerville, Cote d'Ivoire. January - March 1988.*

**Deit, D.** (1991) *Insect pest management.* CAB International, Wallingford, UK. 604 pp.

**Heong, K. L.** (1981) The uses and management of pest surveillance data. *Malay. agric. J.* **53** (2), 65-89.

**Heong, K. L.** (1985) Systems analysis in solving pest management problems. In *Integrated pest management in Malaysia* (ed. B. S. Lee, W. N. Loke and K. L. Heong), pp. 133-150. The Malaysian Plant Protection Society, Kuala Lumpur.

**Lay, T. C.** (1996) Integrated pest management of leaf eating caterpillars of oil palms in Sabah. *Planter* **72**,395-405.

**Mariau, D.** (1985) *IRHO Entomological Mission to Ghana on behalf of the World Bank, January 1985. Doc No. 1891.* 17 pp.

**Morin, J. P.** & **Phillipe, R.** (1977) Phytosanitary checks on adult oil palm plantations in West Africa. I - Ordinary checks. *Oléagineux* **33**(8-9), 431-432.

**Morin, J. P. & Phillipe, R.** (1978) Sanitary checks on adult oil palm plantations in West Africa II - Special checks. *Oléagineux* **33** (8-9), 431-432.

**Smith, R. F. & Renolds, H. T.** (1966) Principles, definitions and scope of integrated control., *Proc. FAO Symp. Integrated Pest Control, Rome.* **1**, 11-17.

**Syed, R. A. & Speldewinde, H. V.** (1974) Pest detection and census on oil palm. *Planter* **50** (581), 230-233.

**Tait, E. J.** (1977) The use of forecasting as a method of rationalising pesticide applications. In *Proc. 1977 British Crop Protection Conference-Pests and Diseases.* pp. 235-240.

**Tiong, R. H. C.** (1996) The regulatory roles of natural enemies of some oil palm pests. *Planter* **72,** 653-666.

**Way, M. J. & Cammell, M. E.** (1974) The problem of pest and disease forecasting - possibilities and limitations as exemplified by work on the bean aphid, *Aphis fabae.* In *Proc. 7th British Insecticide and Fungicide Conference, 1973*. pp. 933-954.

**Wood, B. J.** (1968) *Pests of the palm in Malaysia and their control.* Incorporated Society of Planters, Kuala Lumpur. 204 pp.