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# Integrated pest management of coffee for small-scale farmers in East Africa: needs and limitations

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**Coffee in East Africa (Kenya, Tanzania and Uganda) is an important cash and export crop for small-scale farmers. The crop suffers heavy yield losses due to damage caused by a wide range of indigenous pests (insects, diseases, nematodes and weeds). Current recommended pest control measures include a combination of cultural, resistant/tolerant cultivars and the use of broad spectrum chemical pesticides. Chemical pesticides are far more popular at the farm level than any of the other recommended pest control measures. Coffee pest control strategies are often aimed at individual pests with little consideration of the implications for the total coffee pest complex and its agro-ecosystem. This unilateral approach has resulted in increased pest pressure on coffee and some of its companion crops, outbreak of new pests of coffee, development of pest strains resistant to the cheap and commonly available chemical pesticides, increased environmental problems, increased health risks to man and livestock and an overall increase in the costs of coffee production, thus forcing many farmers to neglect their coffee plantations. Measures to alleviate the above problems, particularly the high production costs, are needed to improve coffee production and increase the cash return to the small-scale farmer. Integrated pest management (IPM) offers the best prospects for solving the above problems. However, lack of national IPM policies, poor extension systems, inefficient research–extension–farmer linkage and the lack of a holistic approach will delay the development and implementation of appropriate, acceptable and sustainable IPM practices.**

*Keywords:* East Africa; coffee pests; chemical control; natural enemies; IPM; small-scale farmers.

## Introduction

In East Africa (Kenya, Tanzania and Uganda), coffee is an important cash and export crop which is a source of income to many small-scale farmers and also earns these countries much needed foreign currency. Coffee is the leading export crop for all of these countries. It is basically a smallholder crop with a small proportion being produced by estate farmers, mostly in Kenya and Tanzania. It is estimated that small-scale farmers produce 60% of the export coffee in Kenya (Walyaro *et al.* 1984), 95% in Tanzania (E. Koinange personal communication) and 100% in Uganda (Anon 1991). Both arabica and robusta coffee varieties are grown. Uganda's crop is 90% robusta, whereas over 90% of the coffee grown in Kenya and Tanzania is arabica.

## Major pests and their current status

The major pests (insects, diseases, nematodes and weeds) in East Africa are all indigenous to the region with the exception of *Parthenium hysterophorus* L. which is an exotic weed. The major insect pests and diseases of coffee in the region are summarized in Table 1. These pests cause high yield losses and/or affect the cup quality of coffee either individually or in combination. Yield losses of up to 30% (Griffiths 1969) have been associated with the coffee berry disease (CBD) in Kenya and of 90% on arabica coffee in Tanzania (E. Koinange personal communication). Infestation by antestia bug and the berry borer directly lowers the bean and liquor qualities of coffee (Wanjala 1980). Attack by the berry borer has been reported to cause up to 80% damage in Kenya and Uganda and 90% in Tanzania (Waterhouse and Norris 1989). The African coffee root-knot nematode, *Meloidogyne* spp., can cause in excess of 20% yield loss in Tanzania (Bridge 1984) but its pest status in Kenya and Uganda has not been determined although it is known to exist (Bridge 1992). A wide range of weeds are associated with the coffee systems and these vary between and within the region depending on agronomic and cultural practices.

## Current recommended pest control practices

Researchers over the years have tried to develop effective, economic acceptable and sustainable pest control measures. As a result of such efforts, a combination of cultural practices (pruning, sanitation, mulching, etc.), resistant/ tolerant varieties (e.g. Ruiru 11), chemicals (insecticides, fungicides and herbicides) and biocontrol, e.g. the successful biological control of the Kenya coffee mealybug, have

**Table 1.** Summary of the major insect pests and diseases of coffee in East Africa and recommended control methods

| Pest | Common name | Status | Control measures |
|---|---|---|---|
| Insects | CBB, *Hypothenemus hampei* | Major in all the countries | Insecticide sprays and cultural practices |
| | Antestia bugs, *Antestiopsis* spp. | Major in all the countries | Insecticide sprays and cultural practices (*biocontrol Kenya) |
| | Coffee leaf miner, *Leucoptera meyricki* | Major in Kenya and Tanzania | Insecticide sprays |
| | Coffee green scales, *Coccus* spp. | Major in Kenya | Insecticide sprays and biocontrol |
| | Coffee root mealybug, *Planococcus ireneus* de Lotto | Major in Uganda | No control measures available |
| | Fried egg scales, *Aspidiotus* sp. | Major in Kenya | Insecticide sprays |
| | Berry moth, *Prophantis smaragdina* | Major in Kenya | Insecticide sprays |
| | Giant looper, *Ascotis selenaria reciprocaria* | Major in Kenya | Insecticide sprays and *biocontrol |
| | Coffee stem borer, *Bixadus siericolla* | Major in Uganda | Stem banding with suitable insecticides |
| | Coffee lacebug, *Habrochilla* spp. | Major in Uganda | Insecticide sprays |
| Diseases | CBD, *Colletotrichum kahawae* | Major in all the countries | Broad-spectrum, copper-based and organic fungicides<br>Resistant/tolerant varieties<br>Sanitation |
| | CLR, *Hemileia vastatrix* | Major in all the countries | Broad-spectrum, copper-based fungicides<br>Triazoles<br>Resistant/tolerant varieties |
| | BBC, *Pseudomonas syringae* pv *garcae* | Major in Kenya | Copper-based bactericides |
| | Red blister disease, *Cercospora coffeicola* | Major in Uganda | No control measures have been developed |
| | Root rot, *Armillaria melea* | Major in Uganda | Use of trenches to separate infected from the healthy<br>Ring barking of trees when clearing new land |
| Nematodes | African coffee root-knot nematode, *Meloidogyne* spp. | Major in Tanzania | Cultural, sanitation, clean seedlings and destruction of old coffee trees |

*, control measures experimental.

been recommended to coffee farmers (Table 1). However, recommended measures for pest control have been developed for individual pests rather than a pest complex.

This lack of an holistic approach to the coffee pest complex and the continued use of broad-spectrum chemical pesticides has led to a number of problems. These include the following.

(1) Heavy reliance on chemical pesticides for control of coffee pests and pests of coffee companion crops.
(2) Increased environmental contamination as a result of excessive use of chemical pesticides.
(3) Increased pest pressure and more frequent outbreaks of secondary problems, e.g. the coffee leaf miner, CBD, coffee leaf rust (CLR) and bacterial blight of coffee (BBC) (Table 3).
(4) Development of pesticide resistance to the cheap commonly used pesticides e.g. resistance of CBD to benzimidole compounds in Kenya and leaf miner to organophosphate insecticides in Tanzania (Table 3).
(5) Increased health risks to humans and livestock.
(6) Reduced coffee production due to increased production costs notably the higher pest control expenses without a corresponding increase in cash-return sales.

## Implications of heavy reliance on chemical pesticides

### *Pesticides and pest management in coffee*

Pesticides (fungicides, insecticides and herbicides) have been used by coffee farmers in the region to control the major pests of coffee for many years. Fungicide application of 75% copper-based, broad-spectrum fungicides in Kenya has increased from just few sprays in 1914 (Trench and Melelland 1932) applied for a tonic effect for leaf retention (Crowe 1964), to 10–13 sprays per season mostly to control CBD, CLR and BBC (Maroko 1991, Anon 1994). The situation is not much different in other countries. In Tanzania, only two sprays of copper-based fungicides were recommended for the control of CLR by the end of the 1940s (Swynnerton *et al.* 1948). However, this had increased to nine sprays per season by the end of 1983 (Kullaya 1983).

Insecticide use has also increased in recent years and although treatment thresholds have been recommended by researchers, few farmers, if any, use them. For example, to control the coffee leaf miner, farmers are advised to apply the first spray when the mines are being formed in appreciable numbers but before the point of economic damage is reached. There is a need to make the recommendation simple enough for farmers to use it in order to achieve optimum control of the target pest. Because farmers cannot use such complicated recommendations, insecticide sprays are often applied on calendar schedules. Calendar (blanket) sprays are easy to apply but sometimes can be wasteful and/or miss the target pest. Added to this, insecticides and fungicides recommended for use on coffee are also used on the coffee companion crop, particularly vegetables, thus intensifying the pesticide problem at the farm level. In a study done in 1994 to assess pesticide use by small-scale vegetable growers in the coffee cropping systems in the Central and Eastern Provinces of Kenya, it was found that many of the farmers use the same pesticides on several crops on the same farm (S. Michalik unpublished; Table 2).

Herbicides are also becoming increasingly popular although they are being used less frequently particularly at the smallholder level due to prohibitive prices.

## Effects of pesticides on pests of coffee

*Outbreak of new pests and increased pest pressure*

The increased frequency of spraying with copper-based fungicides has been cited as one of the major factors contributing to the development and increase in the severity of the coffee leaf miner, CBD, CLR, BBC and the African coffee root-knot nematodes (Crowe 1964, Furtado 1969, Griffiths 1972, Bridge 1984, Kairu *et al.* 1985, Masaba *et al.* 1993). This is because copper is toxic to a wide range of the natural biocontrol agents including pathogen antagonists, thus allowing the pest population to build up to damaging levels without their indigenous natural enemies.

The insect pest and disease complex occurring on coffee is subject to a wide range of natural biocontrol agents. Much of the damage caused by these pests on coffee is due to a disturbance of these natural biocontrol agents caused either by direct reduction in populations of the natural enemies or to the cultural conditions under which coffee is grown in ways favouring pests relative to natural enemies. The use of pesticides can have significant negative effects on natural enemy populations. In Kenya the incidence of CBD on unsprayed coffee can be lower than that on sprayed coffee, in particular if fungicide applications are poorly timed. This is because the use of fungicides for disease control reduces the activity of the natural systems which operate through the antagonistic effects of the natural microflora growing on the surfaces of coffee plants (Pimentel *et al.* 1992, Masaba and Waller in press).

Despite the wide range of arthropod natural enemies of the insect pests of coffee that have been recorded in East Africa (Notley 1948, 1956, Crowe and Greathead 1970, Greathead 1971, Abasa 1975, Ndungi 1994) and, more recently, the antagonistic microorganisms of the major coffee pathogens recorded in Kenya (Masaba 1991, Masaba and Waller in press), pest problems still persist.

*Development of pest strains resistant to some pesticides*

In recent years some strains of the major pests have developed resistance to the commonly used pesticides (Table 3). The development of resistance to the cheap and common pesticides has contributed significantly to the increased costs of plant protection at the farm level, which needs immediate attention to prevent a crisis happening in the coffee cropping systems.

## Environmental and health implications

The increased frequency of coffee spraying with copper-based fungicides has been a subject of major concern to the coffee industry, environmental groups and the health sector because of the possible negative economic, environmental and health implications of such practices.

**Table 2.** Insecticides and fungicides used by vegetable small-scale farmers in Central and Eastern Provinces of Kenya in 1994

| | | Percentage of farmers growing the vegetables | | | | |
|---|---|---|---|---|---|---|
| Pesticide used | Chemical name | French beans | Tomatoes | Cabbage/kale | Total percent of farmers | Recommended for use on coffee? |
| Insecticide | Cypermethrin (Cyambush®/Ripcord®) | 62.9 | 57.4 | 82.8 | 68.3 | Yes |
| | Lambda cyhalothrin (Karate®) | 33.9 | 14.9 | 25.9 | 25.7 | Yes |
| | Carbosulfan (Marshal®) | 17.7 | 14.9 | 15.5 | 16.2 | Yes |
| | Deltamethrin (Decis®) | 17.7 | | 1.7 | 7.2 | Yes |
| | Endosulfan (Thiodan®) | | 17.0 | | 4.8 | Yes |
| | Fenvalerate (Sumicidin®) | 3.2 | 4.3 | 5.2 | 4.2 | Yes |
| | Fenitrothion (Sumithion®) | 1.6 | 6.4 | 1.7 | 3.0 | Yes |
| | Fenthion (Lebaycid®) | 1.6 | 2.1 | | 1.2 | Yes |
| | Chlorpyriphos (Dursban®) | 1.6 | | | 0.6 | Yes |
| Fungicides | Cupric hydroxide (Kocide®) | 39.6 | 55.1 | 11.8 | 41.2 | Yes |
| | Triadimefon (Bayleton®) | 15.1 | 4.1 | | 8.4 | Yes |
| | Chlorothalonil (Daconil®) | 1.9 | | | 0.8 | Yes |

*Copper residues in soils and plants*

With the increased spraying frequency of copper-based fungicides, there is evidence of high copper accumulation in soils and plants in Kenya and Tanzania (Dickinson *et al.* 1984, Kullaya 1983, Kairu *et al.* 1985, Maroko 1987, 1989, 1991). In Kenya, copper-induced phytotoxic symptoms were observed on light soils with low organic matter after only 2 years of copper sprays to control BBC and CBD (Kairu *et al.* 1985). In Tanzania, results of coffee leaf analysis showed that 75% of the samples had excessive copper levels, while the results of soil analysis showed that the soil copper content ranged from 30 to 490 p.p.m. with a mean of 231 p.p.m. in the top 20 cm of the soil profile and, in the subsoil (40–60 cm), copper residues ranged from 30 to 120 p.p.m. with a mean of 90 p.p.m. (Kullaya 1983). However, in both case studies no effort was made to assess the effect of such high levels of copper residues in the soil on coffee companion crops.

Small-scale farmers in East Africa traditionally intercrop coffee with a wide range of food and fodder plants including trees and, therefore, it would be appropriate to consider the effects of such findings on the overall coffee farming systems in the area. The coffee farmers practice intercropping to optimize the microeconomy of the farm as well as being self-sufficient in food production. The continued use of copper-based fungicides is likely to cause more harm to the environment and may make the coffee soils less productive.

*Effect on non-target organisms*

High copper levels are known to have negative effects on the beneficial soil microorganisms e.g. earthworms and other biocontrol agents (Bridge 1984, Christensen 1991). Exceptionally high soil copper levels in Kilimanjaro coffee growing areas has been given as one of the major causes for high nematode attacks on coffee and bananas because copper kills off the nematode-antagonistic microorganisms (Bridge 1984). Similarly, evidence emerging from Kenya shows that the incidence of CBD and CLR is more severe in fields regularly sprayed with copper-based fungicides because copper is also toxic to the natural antagonistic microflora on coffee leaf surfaces, thus allowing the pest population to develop without a natural check mechanism (Masaba 1991).

The insecticides sprayed on coffee are broad spectrum and therefore kill many insects including crop pollinators, honey bees and arthropod natural enemies. Effective pollination is very important to ensure both high yields and a quality crop. To sustain crop production in the coffee systems there is a need to identify more environmentally friendly pesticides and other pest management strategies that will eventually minimize the use of pesticides.

*Health risks*

Human pesticide poisoning and ill-health are clearly the highest price paid for pesticide use (Pimentel *et al.* 1992). In Kenya, a report from the Kenyatta National Hospital indicated that there are 730 cases of pesticide poisoning annually, 7% of whom are agricultural workers (Mwanthi and Kimani 1990). In financial terms, this amounts to a loss of US$15 million a year for the country (Mwanthi and Kimani 1990) which is tremendous when the overall economy of Kenya is considered. This high level of pesticide poisoning is due to inadequate safety standards, insufficient enforcement, poor labelling of pesticides, illiteracy, inadequate protective clothing and washing facilities and insufficient knowledge of pesticide hazards by users (Pimentel *et al.* 1992, Mwanthi and Kimani 1990).

**Table 3.** Summary of pesticide-induced pest of coffee in East Africa

| Pest | Common name | Causes | Effects |
|---|---|---|---|
| Disease | CBD, CLR and BBC | Excessive use of broad-spectrum, copper-based fungicides | Increased incidence and severity of CLR, CBD and BBC<br>Development of CBD strains resistant to benzimidole compounds in Kenya (Furtado 1969, Okioga 1976, Javed 1980, Kingori and Masaba 1991) |
| Insects | Coffee leaf miner | Excessive use of broad-spectrum copper-based fungicides and broad-spectrum insecticides | Frequent severe outbreaks of the pest in Kenya and Tanzania<br>Development of strains resistant to OP-insecticides in Tanzania (Bardner and Mcharo 1988, Nyambo 1993) |
| Weeds | *Bidens pilosa* and *Parthenium hysterophorus* | Prolonged use of paraquat | Development of strains resistant to paraquat in Kenya (Njoroge 1991) |
| Nematodes | The African coffee root-knot nematode | High levels of copper in soils due to prolonged and excessive use of copper-based fungicides on coffee to control CBD and CLR | Increased severity of attack on coffee and bananas in Tanzania (Bridge 1984) |

According to Mwanthi and Kimani (1993), 60% of the farmers in Kenya do not understand the labelling or the instructions on pesticide containers. Cases of chronic poisoning, either due to direct exposure to pesticides and/or through inhalation of toxic fumes from sprayed coffee farms and/or through the consumption of contaminated fruits, vegetables and other foods, is difficult to substantiate due to lack of data. However, it is a common practice among coffee farmers to spray without protective clothing (personal observations). Pesticide containers are often recycled and used for other purposes in the house, e.g. as water containers, etc. (Mwanthi and Kimani 1990). Coffee pesticides are often used on non-target crops particularly on vegetables (Michalik 1994) and it is doubtful if the farmers observe the recommended safety periods and/or the recommended application rates. Some of the pesticides may leach into water sources. Where farmers plant fodder in their coffee farms they run the risk of feeding their livestock with pesticide-contaminated forage through drift effects. The list of possible sources of health risks to the coffee farmer, their family and livestock is very long and, hence, the need to develop alternative pest control methods that will reduce heavy reliance on chemical pesticides particularly at the smallholder level.

## Economic implications

The monetary cost of pest control in coffee at the farm level in Kenya has been estimated to vary between 25 and 30% of the total cost of production (Abasa and Malinge 1972, Masaba 1991). A large proportion of these costs are on fungicides (Table 4). The mean cost of fungicides alone as a percentage of the total spraying cost at the smallholder level in the period 1988–1993 in Kenya was 18.7% (Table 4) and for Tanzania in 1993 it was 19.2% (E. Koinange, personal communication).

Increased pesticide prices without parallel increases in cash returns from coffee sales have forced many small-scale farmers either to apply too few sprays and/or low dosages, resulting in unsatisfactory pest control, and reduced yields and coffee quality (Table 4). In addition, many of the small-scale coffee farmers have been forced to divert their meagre resources towards alternative cash-generating crops, e.g. high-value crops such as vegetables (Michalik 1994). To lure these farmers back to improve coffee management and production, measures to cut down on the production costs are needed, particularly with regard to pest control.

## The need for integrated pest management (IPM) for small-scale coffee farmers

There is a need to address the whole pest complex and the coffee cropping system so as to be able to develop economically viable, sustainable and practical pest management practices. A holistic approach to the coffee pest complex and its agro-ecosystem with the farmer as a partner in the process of developing appropriate farmer technologies is the most likely means of addressing the farmer's coffee production problems.

In East Africa, coffee is traditionally intercropped with a wide range of food crops (bananas, beans, leafy vegetables, root and tuber crops, fruit trees) shade and timber trees and fodder. However, pest research recommendations often consider individual pest problems of coffee and ignore their implications for the farmer and the coffee companion

**Table 4.** Contribution of pest control to total cost of coffee production in Kenya: cost of fungicides, herbicides and insecticides as proportion of the total cost of production and coffee productivity at the smallholder sector, 1988–1993

| Year | Input | Cost (Ksh per ton of clean coffee) | % of total cost of production | Mean yield (ton of clean coffee per hectare) |
|---|---|---|---|---|
| 1988–1989 | Fungicides | 4660.0 | 12.6 | 0.65 |
| | Insecticides and herbicides | 620.0 | 1.7 | |
| | Total cost of production | 37 000.0 | | |
| 1989–1990 | Fungicides | 7960.0 | 16.6 | 0.57 |
| | Insecticides and herbicides | 760.0 | 1.6 | |
| | Total cost of production | 48 033.0 | | |
| 1990–1991 | Fungicides | 2276.70 | 5.5 | 0.61 |
| | Insecticides and herbicides | 770.60 | 1.7 | |
| | Total cost of production | 45 500.00 | | |
| 1991–1992 | Fungicides | 8477.75 | 18.00 | 0.42 |
| | Insecticides and herbicides | 758.80 | 1.60 | |
| | Total cost of production | 47 091.00 | | |
| 1992–1993 | Fungicides | 3767.96 | 5.02 | 0.32 |
| | Insecticides and herbicides | 916.70 | 1.22 | |
| | Total cost of production | 75 025.00 | | |

Labour, fuel and spraying machinery not included.

crops. This could be just one of the reasons why farmers do not adopt many of the research recommendations. We all know that coffee farmers practice intercropping because they need to produce their own food as well as optimizing the microeconomy of their land and therefore they divide their limited resources between coffee and the other crops. It is for this reason we need to look at the way we approach the coffee pest problems, not from the perspective of the individual pest but from the farm or farming systems level.

## Constraints to the development and implementation of IPM for small-scale farmers in East Africa

IPM provides an option as an approach that will address the coffee agro-ecosystem pest problems holistically and, hence, lead to increased coffee production and cash returns from coffee sales, reduced environmental and health risks and ensure a sustainable crop production system for small-scale farmers. However, the development and implementation of economically acceptable, viable and sustainable IPM practices is likely to be hampered by the following constraints.

### *Farmer acceptance*

The coffee farmers of East Africa have been used to a pest control system which is both narrow and prescriptive, i.e. use of broad-spectrum chemical pesticides applied on a calendar schedule. To enable the farmer to make more rational decisions in response to specific and/or pest complex pressures on coffee will require investment in the development of local-specific IPM practices and also in farmer training. The challenge here is that coffee in East Africa is grown in diverse agro-ecological zones with different cultural practices. Many of the cultural practices are influenced by the land tenure systems and national policies. In Kenya, it is illegal to intercrop coffee with any other crop plants whereas in Tanzania and Uganda coffee is traditionally intercropped with a wide range of food crops, trees and fodder.

The land ownership and, in retrospect, the coffee crop belong to men whereas crop management and pest control is carried out by women. At the farm level, women are the labourers and the agricultural managers (Malena 1994) and to develop appropriate pest control measures it is imperative to involve women at all levels of technology development. However, it may be some time before it would be acceptable in principal that women be fully involved in IPM training and technology development in a male-dominated economy.

There is also a need to train farmers to understand and appreciate the pests complex in the coffee systems for them to be able to make rational decisions on pest control measures on coffee and its companion crops. Training in IPM technologies is imperative for successful implementation of IPM.

### *Extension systems*

Overall, the extension system in the region is ill-equipped in terms of adequate trained personnel in IPM technologies and lacks efficient transport to reach the farmers. In addition, many of the extension officers have many assignments and cannot afford to be very specialized. Perhaps adequate training in IPM methods may help to facilitate implementation of IPM practices if this is supported by farmer field schools (P. Kenmore personal communication). Already the KIOF (Kenya Institute of Organic Farming) has demonstrated the value of farmer field schools in Kenya for teaching low-input smallholder farming system practices.

### *Research*

To date, many of the pest control recommendations are based on individual pests of coffee mostly due to lack of systems and an interdisciplinary approach to the coffee pest complex. Consequently, many of the recommendations are impractical and/or antagonistic at the farm level, resulting in poor adoption, increased pest pressure, increased production costs and reduced coffee production and profits. The coffee farmers practice intercropping because they need to be self-sufficient in food production as well as to optimize the economy of their land. For this reason farmers divide their limited resources between the coffee crop and the companion crops.

### *Research–extension–farmer linkage*

A lot of the required information on coffee pest management practices in the region is available at research institutions, but only a small proportion of it has filtered through to the extension service and the farmer. This is partly because the information has not been translated into a form which is meaningful to the farmer and partly because the technology does not address the farmer's problems due to a lack of interaction between the farmer and the researcher. An attempt has been made to establish research–extension liaison officers in the different countries but this is not enough. Adoption of new technologies will be enhanced by a close understanding of farmers perceptions, motivations and attitudes and therefore their active involvement at every stage of the technology development process is essential (Malena 1994). Therefore, a deliberate effort is needed to establish a favourable environment to facilitate farmer–research–extension dialogue and interaction to (1) develop appropriate on-farm trials to address farmer needs, (2) be able to discuss with farmers how to package the IPM technologies for ease of adoption and sustainability and (3) to identify further research areas to address the farmer's problems. This approach is likely to be the key to developing appropriate IPM practices for small-scale farmers.

### *IPM policy*

Use of chemical pesticides to control coffee pests has been accepted by the farmers, the policy makers and the general public as the best and quickest means of fighting pest problems but little, if anything, is known about IPM in the current coffee management practices. IPM was recommended and widely practised at the farm level in East Africa up to the late 1940s before effective pesticides became easily available to farmers (Trench and Melelland 1932, Swynnerton *et al.* 1948).

The benefits of IPM are gradual and need to be practised over wide areas to be realized. Lack of good national IPM policies will delay the implementation of integrated pest management in East Africa because political support is needed for successful implementation. To facilitate the development and implementation of IPM technologies there is a need to (1) sensitize and educate policy makers, donors, the general public and farmers to the benefits of IPM so as to formulate good national IPM policies and (2) educate policy makers and the general public about the long-term benefits of IPM practices. This can be achieved by developing appropriate training and publicity materials for the different target groups.

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