INTEGRATED PEST MANAGEMENT (IPM)

J.H. Nderitu, University of Nairobi,
Department of Plant science and Crop Protection
Email: huria@uonbi.ac.ke/hurianderitu@gmail.com
Te;+254722308581
Nairobi, Kenya

There are various options for control of pest insects, namely cultural control, host plant resistance, biological control, genetic control, legal control and insecticidal control. Two or more of these control techniques may be combined to form an Integrated Pest Management (IPM) strategy. Integrated Pest Management is defined as the management of insect populations by the utilization of all suitable techniques in a compatible manner, so that damage is kept below economic levels,

Sole reliance of insecticides for control of pests in 1950s and 1960s lead to the following problems:-

1. Selection of resistance to insecticides in pest populations.
2. Resurgence of treated populations.
3. Outbreaks of secondary pests.
4. Residues on food and forage products.
5. Destruction of beneficial predators, parasites and pollinators.
6. Hazards to applicators, domestic animals, fish and wildlife.
7. Expense on pesticides, involving recurrent costs of equipment, labour and material.

In the 1970s and upto present, IPM as a control strategy and an approach to developing technologies has been emphasized. The strategy is based on four fundamental principles:-

(i) Integration of all appropriate measures to control any pest.
(ii) Use of biological measures (including plant breeding, agronomic practices and biological control by natural enemies) to create an environment which discourages the build-up of pests and diseases. Pesticides are used only as a last resort, when all other measures fail, to prevent pests from exceeding pre-determined threshold levels.
(iii) The objective is to keep pest and disease levels below economically damaging levels (as determined by regular monitoring and surveillance) not to eradicate them and
(iv) Control measures are selected and implemented to minimize hazards to human health and the environment.

IPM is based on gathering the following information:-

1. Proper diagnosis of the pest.

2. Assessment of the pest found and natural enemies to get information on population dynamics.
3. Pest infestation and yield loss relationship.
4. Cost/benefit ratio of the intended control measures with a view to deciding on the selection of the best remedial measure.
5. Development of surveillance and forecasting systems.
6. Development and use of control options, preferably use of natural control, when they are most effective.
7. Ecological analysis, interpretation and continued monitoring and identification of key factors which should be manipulated to minimize pest damage.

Integrated Pest Management Approaches in Africa

The IPM approach is feasible for and relevant to African agriculture. It can:-

(a) Promote stable and higher food production in subsistence agriculture.
(b) Prevent the escalation of pest problems and dependence on chemical control in the process of intensifying agriculture and
(c) Reduce costs and negative ecological environmental and health impacts associated with excessive or inappropriate use of pesticides in high-input systems.

For **subsistence level agriculture**, the aim is to determine just whether pests represent an important production constraint relative to other factors. The most appropriate technologies for pest management are those which minimize the need for external inputs such as chemical fertilizers and pesticides are compatible with the overall farming systems (e.g. labour constraints, agronomic requirements of other crops) and are made simple enough to be disseminated without the need for highly specialized extension works and to be used by relatively poorly educated farmers. The emphasis should thus be on varietal resistance, biological control , intercropping and cultural practice to pests. IPM should be regarded as part of an overall program to address basic constraints which hamper agricultural production such as poor soil fertility, unavailability of improved seeds and in adequate crop husbandry practices.

For **intensive agricultural systems**, usually crops grown in monoculture with relatively high levels of inputs including pesticides, the aim is usually just to rationalize pesticides use by stressing the concepts of cost effectiveness i.e. introducing methods for rational use of pesticides through pest monitoring and forecasting and use of economic threshold levels. Included in improved pest management is reducing ecological environment and health hazards by replacing broad spectrum or highly toxic pesticides with less hazardous or descriptive ones and by improving pesticide application methods. The second objective of IPM in these systems is to develop non-chemical control methods to maintain pests at below threshold levels or replace at least some of the pesticide use.

The primary focus of agricultural development is to raise agricultural production from a **subsistence level to a higher yielding level** to produce income for poor farmers and food and fibre for the country. For such **intensifying systems**, the aim is to help famers increase production levels without becoming dependent on higher and higher levels if pesticide use. Appropriate control technologies are similar to those for already intensive systems, but with some important differences:-

(i) There is less history of pesticide dependence, so both the ecosystem and farmers are likely to be more adaptable to non-chemical methods early on and
(ii) Existing levels of famers' knowledge, extension services and infrastructure are likely to be lower, so both pest monitoring and pest control methods must be adapted accordingly.

There is great opportunity to promote IPM more effectively in Africa. The word "integrated" in IPM should be understood to refer not only to the integration of all available control methods for a given pest but also integration of pest-management into the whole farming system and farmers' economic technologies. IPM is a strategy and an approach to developing technologies. Implementation of the IPM approach requires on-site research and extension and building the requisite human and institutional capacity may take a long time compared to the usual expectation for straight technology transfer.

Development and Implementation of IPM in Africa

The following areas are needed in the development and implementation of IPM.

1. Extension

(a) IPM training courses for extension worker (on its principle and application to specific crops or cropping systems).
(b) Methods and devices for easy monitoring of plant damages, pest and natural enemy populations and rules for decision making in pesticide use).
(c) Field guides, pamphlets, information bulletins e.t.c. to help extensionists and farmers identify pest and natural enemies.

2. Research

Increasing farmers input into research, to ensure relevance of research and feasibility and acceptability of research recommendations by:-

(a) Development philosophy and mechanisms to support 2-way communication between researchers and farmers.

(b) Emphasizing use of on-farm research and verification trials conducted in partnership with farmers.
(c) Emphasizing on multi-disciplinary research teams addressing problems in the context of the farming systems.
(d) Training technical assistance and financial support to strengthen research capacity and support for specific research relating to:

- Pest identification and causes of crop damage.
- Basic ecology of the agro-ecosystems and biology of pest organisms (e.g. population dynamics of pest and biological control agents).
- Crop loss assessment (economic importance of specific pests under different conditions and at different times in the season and in relation to other production constraints) i.e. economic threshold levels (ETLs).
- Determining Action Threshold Levels (ATLs) i.e. pest levels and conditions under which intervention is needed to prevent pest reaching ETLs.
- Analyzing conventional pest control verses IPM, in terms of maximum economic benefits for farmers (not in terms of yield maximization).
- Identifying, evaluation and releasing biological control agents.
- Determining impact of agronomic practices on status of pests.
- Developing non-chemical control methods (varietal, resistance, cultural controls and agronomic practices and biological controls).
- Research on pesticides oriented towards rationalizing and optimizing pesticide use for long-term environmentally, economically and socially sound production.

(e) Adaptive research and on-farm evaluation of IPM methods used elsewhere to determine whether they can be adapted to local conditions.
- Strengthened research management to: organize international cooperation needed for classical biological control.

3. Farmers Education, training and organization

(i) Education materials (written and other media).
(ii) Training opportunities for farmers on:-
- Implementation of recommended agronomic practices, including cultural practices which help to suppress pest populations (e.g. inter cropping, synchronization of planting and harvesting , crop rotation phytosanitary measures).
- Scouting for pests and natural enemies and decision-making for pesticide use.
- Education regarding correct selection of appropriate pesticide (active ingredients and formulations) and training in use of pesticide application and equipment, introducing calculation of dosage rates and safety precautions.
- Training in basic farm management (e.g. cost-benefit principles).

- Site visits for farmers (as well as researchers and extensionists) to areas where IPM is being successfully applied.
- Educational campaigns to inform famers of biological control programs being implemented in their area.

Constraints to developing and implementing of IPM in Africa.

(a) IPM is not high in the list of government priorities.
(b) Research and extension services do not provide enough training in IPM to farmers.
(c) Thinking on pesticides is conventional and there is little knowledge of ecological interactions.
(d) Diversity of crops and pests in Africa is enormous.
(e) Manipulation of environment in diverse parts of Africa is difficult.
(f) Much research input is required.
(g) Growers lack of acceptance of sub-economic levels of pests.
(h) Requires expertise for its implementation.

DESIGNING AN IPM PROGRAMME

Design an IPM programme in a chosen crop/pest(s) system with the following outline:-

1. Title

2. Objective

3. Strategy farmer

   (i) Define the target group i.e. who should use the method.
   (ii) Describe the social economic situations of the potential user and their possible constraints for the application (including their psychology, economic situation and goals).
   (iii) Define the sampling unit and sample size.
   (iv) Determine the most suitable sampling method.
   (v) Defining sampling techniques and equipment needed e.g. traps.
   (vi) How should sampling be organized? Give a detailed description of the sampling e.g. when, how often and at what intervals samples should be taken and other useful or necessary instructions.
   (vii) Give a control threshold (action threshold) and source or describe how obtained otherwise.
   (viii) What control methods are to be used?
   (ix) In a case forecast is included, what predictors or rules would you use?
   (x) Assess the economics of crop protection of your crop/pest(s) problems, financial inputs and other resources needed.
   (xi) Is training needed, if so, who is going to do it, and who is to be trained?

(xii) What kind of scientific back-up is needed, or cooperation intended?
(xiii) How shall the flow of information to the target persons, and to the database and/or scientific back-up to be organized?