

# Training Format for IPM in Mango Production in East Africa

by

**Brigitte Nyambo**



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Brigitte Nyambo  
Head, Technology Transfer Unit, ICIPE  
E-mail: [bnyambo@icipe.org](mailto:bnyambo@icipe.org)

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The International Centre of Insect Physiology and Ecology (ICiPE)  
P.O. Box 30772-0100, Nairobi, Kenya  
Tel: +254 (0)20 365 2000  
Fax: +254 (0)20 365 2997 and 365 2998  
E-mail: [icipe@icipe.org](mailto:icipe@icipe.org)  
Home page: <http://www.icipe.org>

Funded by



BIOVISION Headquarters: Am Wasser 55  
CH-8049 Zurich, Switzerland  
Tel: +41 (0)1 341 9718  
Fax: +41 (0)1 341 9762  
E-mail: [info@biovision.ch](mailto:info@biovision.ch)  
Home page <http://www.biovision.ch>

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# Training format for integrated pest management in mango production in East Africa

Mango is one of the most important fruit crops in the tropical and subtropical lowlands. It is a fruit growing in popularity worldwide and well suited to East Africa as a commercial crop.

These guidelines are for farmer-to-farmer leaders of a training programme. They are accompanied by a field guide, *A guide to IPM in mango production in Kenya* and a poster.

## General guidelines

### *Course participants*

The course is meant for mango growers. Participants should be practising mango producers ('telephone farmers' would not be suitable). It is anticipated that farmers will have well-established fruit-bearing trees.

### *Group size*

15–20 participants.

### *Time scale*

Four months (season-long, hands-on training) divided into four parts. Each session adds value to the previous, and all are interrelated and essential.

### PART 1

*Flowering to pinhead fruit size* (annex). Four weekly sessions. This is the most crucial stage in mango production. Diseases, especially

powdery mildew and anthracnose, can be devastating at this stage. Early-season disease control is of utmost importance. Without good fruit set, it would be uneconomical to control late-season pests.

## PART 2

*Young fruit stage* (annex). Six weekly sessions. A series of problems are likely at this stage. Good management is essential to attain optimal fruit set.

## PART 3

*Immature fruit stage* (annex). Two sessions, meeting once every 2 weeks.

## PART 4

*Mature fruit and harvesting stage*. Three to four visits, once every 2 weeks. This is a suitable time for assessing post-harvest handling and quality. The last visit should include a wrap-up discussion.

### ***Number of trees***

The number of trees to be monitored will depend on the number of experimental treatments to be used. Generally one tree per treatment will do.

### ***Expected output***

Course participants will understand and appreciate the role and significance of integrated crop management in mango production systems.

### ***Approach***

The field school approach should be used. It emphasizes facilitation of learning by discovery using non-formal education methods. Trainees are expected to be active learners through discussion, field

visits and analysis of real field situations.

## Course content

Emphasis is on integrated crop management, and all aspects of good crop husbandry for quality mango production must be covered. Remember:

- It is always beneficial to establish participants' knowledge on any subject. The idea is to *add value* to their knowledge.
- Begin training sessions at least one week ahead of the flowering stage (before the first inflorescences are formed) to prepare participants and to allow for proper planning of experimental material and plots (annex).
- Make use of live specimens as much as possible.

*REMEMBER: I see I remember, I touch I remember,  
I hear I forget.*

- Avoid scientific names and jargon. Use local names for all insect pests, diseases, disorders. Use the poster and training manual as guides.
- Let course participants plan, carry out and analyse all experiments, because the experiments are all meant to provide solutions to key issues in the particular production area.
- To build confidence among course participants and community members, facilitate organizing and convening open field days (at least two sessions). Hold these field days on days when course participants can share what they have learned with other farmers (farmer-to-farmer learning) and identify additional knowledge gaps. Integrate into the training curriculum material to close the knowledge gaps. During an open field day take a back seat as the course facilitator but be prepared to provide technical support as necessary.
- Use a language that all participants have in common in all

discussions.

- Make sure all planned activities are carried out well and in a timely manner.

The following sessions identify and manage individual problems (insect pests, diseases, water management, nutritional and agronomic aspects, quality assessment, etc.) at different stages of crop growth (annex).

### ***Session 1 (week 1): Plan the training with the community***

Plan well in advance to give the community adequate time to plan also. Allow at least four weeks before the first inflorescence appears (flushing period is best) on the early-flowering varieties.

- *Introduce the training programme.*
  - Explain the purpose of the training and the concept of good agricultural practice (GAP) for quality mango production.
  - Explain how the training will be conducted.
- *Briefly discuss the mango seasons, flowering to harvest.* Modify and adapt schedule shown in annex to suit local conditions, and use it as a guide to develop and structure the training programme.
  - List the varieties commonly grown in the area.
  - Explain key production problems and management practices.
  - Emphasize farmers' knowledge and practices.
- *Discuss and agree on the group to be trained (how many and who).* Give the community the chance to nominate the persons to be trained.
- *Select the training site or venue.* Ideally, this should be a mango orchard that is accessible to all course participants but more importantly, a field with many of the common problems in the locality, so participants get the most out of the course.
- *Set frequency of training.* Experience shows that the flower-

ing and young fruit stages (annex) are critical in the production cycle. Most diseases, particularly powdery mildew and anthracnose, can lead to complete fruit loss if not well managed. Relax the training programme as the fruiting season advances.

- *Set date for the first group class.* Always plan to begin the first training session at least 2 weeks before the first inflorescence is set. It is best to start at the mature leaf stage to allow time for preparation for exchanging ideas, planning the experiments and organizing materials.

### ***Session 2: Plan the hands-on season-long training with course participants***

Hold this meeting at least 2 weeks before the early-flowering varieties give the first inflorescence.

- Recap discussions done in session 1.
- Discuss group dynamics issues.
  - Set duration (when to start, when to finish) for each training session.
  - Set the do's and don'ts for the group.
  - Discuss roles and responsibilities of course participants and the facilitator.
  - Facilitate nomination of group leaders if not already selected (important for contact and follow-up).
  - Form subgroups for specific tasks to enhance participation and sharing of responsibilities.
- Brainstorm on the significance and role of frequent crop scouting as a key to good integrated crop management (to prepare participants).
  - How to carry out good scouting for different problems.
  - What to scout for.
- Discuss how to make intelligent decisions. For pests, it is essential to assess the level of attack and damage to rational-



- ize the kind of action to be taken or intervention made.
- Carry out thorough crop scouting for all the trees and keep a record of problems and phenological stage (refer to the mango manual and poster). *This is vital. The information will form the basis for deciding how the group will intervene during the training sessions.*
  - Discuss and prioritize problems, emphasizing potential pest problems at the flowering stage (annex) and control options. Diseases, notably powdery mildew and anthracnose, are key pest problems during flowering and fruit setting. Emphasis should be on the following:
    - Biology and ecology of the causal organisms
    - Possible control options, including farmers' experience
    - Action plan (what experiments, materials are needed, how to conduct the experiments, data collection and analysis)
    - Relevant aspects of good agronomic practices, notably plant nutrition and sanitation, have to be integrated in all action plans
  - Develop appropriate action plan.
  - Stress the importance of keeping good farm records.
  - Select training trees and mark them, taking care to integrate different varieties into the experiments as much as possible. Make labels visible and durable for the whole season. *Monitor each plot and treatment up to harvesting.*

## PART 1: FLOWERING TO PINHEAD SIZE

### *Session 3*

Session 3 should take place when the first inflorescence is visible on the early-flowering varieties.

- Recap the work plan drawn up in session 2.
- Carry out scouting of the whole block. Facilitate proper problem identification and recording (refer to the mango manual and poster).
- Brainstorm and discuss the significance of proper pesticide application
  - Which pesticide to select and why, when and how to apply
  - Mixing
  - Coverage
  - Appropriate equipment
  - Use of protective gear
- Brainstorm and discuss the role and significance of field sanitation.
- Set experiments as planned. It is possible that flowering for the selected trees and varieties will not all happen at once. Should this be the situation, prioritize the experiments and trees and use those trees that begin to flower first. To enhance learning and participation, participants should organize themselves into subgroups, each responsible for certain experiments and trees.
- Develop a work plan for the next session.

### *Session 4*

- Recap the work plan done in session 3.
- Recap the significance of keeping good farm records.
- Carry out crop scouting. Make use of the mango poster or field manual when in doubt.
- Assess progress of the experiments set in session 3. This step

will involve collecting and analysing data and suggesting additional activities.

- Introduce study of the mango seed weevil.
  - Importance
  - Biology
  - Possible control measures
- Role of field sanitation revisited
  - Should off-season mangoes be available, these should be collected, allowed to ripen and analysed for potential problems (such as diseases, insect pests or quality). A minimum of 20 mangoes of different varieties will be required for this work. Many farmers have limited knowledge of the shelf life and appearance, including post-harvest pest problems, of mangoes because the fruits leave the farm green and hard, and possibly they are convinced that they sell the best fruits to their customers.

*REMEMBER: Make use of live specimens as much as possible.*

*I see I remember, I touch I remember, I hear I forget.*

- Based on the results, develop a work plan (follow-up activities) for the next session. Integrate aspects of mango seed weevil control measures.

## Session 5

Early-formed inflorescence should be at the blooming stage.

- Recap the work plan done in session 4.
- Carry out crop scouting.
- Analyse mango specimens collected in the previous week and look for post-harvest quality aspects
  - Appearance, shelf life, disease symptoms, insect pest damage (type and nature of damage). Depending on the results, it may be possible to recap the biology and control aspects for mango seed weevil, fruit fly and anthracnose.

*REMEMBER: Make use of live specimens as much as possible.  
I **see** I remember, I **touch** I remember, I **hear** I forget.*

- Assess progress of the ongoing experiments (data collection, analysis and recommendations) and development of inflorescence and blooms. Emphasize the role of good integrated crop management.
- Identify and discuss key learning points (take-home messages).
- Based on trend of results, discuss and agree on follow-up activities. This is a continuous process. The records from previous observations and trends must be taken into account in each session to improve farmers' understanding of biological processes and integrated crop management. Each session should add value to previous sessions. Farmers should be able to see the connection and the value of the different sessions and experiments.

## PART 2: YOUNG FRUIT STAGE

### Session 6

If nutrition is inadequate at the pinhead stage of fruit, the young fruits will abort and fall. Just like during the flowering stage, excessive and unnecessary fruit fall should be minimized. During fruit development, various diseases and insect pests may damage or scar the fruits (refer to the mango poster or field manual section). Unfavourable environmental conditions and poor plant nutrition can also lead to fruit fall.

- Recap the work plan done in session 5.
- Carry out crop scouting (whole plot).
- Assess progress of ongoing experiments (data collection, analysis and recommendations).
- Analyse flowering and fruit setting in the experimental plots.
  - Lack of florescence and blooms could be caused by a number of factors: discuss, analyse and suggest an action plan.
  - Fruit fall or failure could be the result of a number of factors: analyse, discuss and make suggestions.
  - Develop an action plan on how to optimize flowering and fruit setting.
- Recap on the role and significance of proper pesticide selection and application.
- Recap on the significance of keeping farm records.
- Review major problems identified and possible solutions (learning points).
- Based on trend of results, discuss and agree on follow-up activities.

### Session 7

Fruits the size of a soya bean begin to be seen (annex)

- Recap the work plan done in session 6.

- Review major problems identified and possible solutions (learning points).
- Assess progress of the ongoing experiments.
- Revisit fruit fall. If there are many fallen fruits, pay more attention to plant nutrition and water. Too much or too little water can lead to fruit fall. Too high or too low temperatures can also lead to fruit fall. Have course participants analyse the situation, identify key factors (taking into consideration their knowledge and experience) and recommend actions to be taken.
- If pest problems—insects, weeds, diseases—are observed, integrate how to handle them in the training programme. Discuss the importance of field sanitation.
- Based on the results of the analysis and discussion, develop a follow-up action plan.

### **Session 8**

- Review issues covered during session 7.
- Carry out thorough routine crop inspection of the whole experimental plot.
- Monitor progress of ongoing experiments and document key learning points.
- Based on the results of the analysis and discussion, develop a follow-up action plan.

By this time, course participants will have acquired a large amount of knowledge and skills on key problems and management options at the florescence, blooming and early fruit-setting stages. Participants should now be able to take home whatever information they think is useful to them.

They can also share the information with other members of the community. Since seeing is believing, the group could organize an open day for other interested mango growers in the community to visit the experimental plots and share the results. This will also be an opportunity for the course facilitator to get feedback from the

community.

- Facilitate planning of the open field day. This should be the farmers' day (farmer–farmer training session). Its main objective is to encourage course participants to share their new knowledge about key problems at this critical phenological stage in mango production with other farmers. Decide on
  - Whom to invite
  - Programme and roles
  - Date and timing
  - Logistical support

### ***Session 9***

First fruits are visible, the size of a pea.

Open field day (farmer–farmer training). The facilitator should take a back seat and give technical back-up as necessary. It is also a day for the facilitator to learn from the farmers.

### ***Session 10***

Review critically the open field day and ongoing experiments during the session.

- Review the open field day.
- Scout the orchard thoroughly. Consider key pests and formulate a discussion agenda.
- Recap the biology, ecology and control options for mango seed weevil, mango fruit fly and anthracnose.
- Monitor and evaluate progress of ongoing experiments (data collection, analysis and discussion).
- Based on results, develop an action plan.
- Set date for the next group training.

## Session 11

- Recap the work plan and activities carried out in session 10.
- Generally scout out the training plot (subgroups are likely to be more participatory and also provide more information on the status of the trees).
- Monitor and evaluate the progress of the experiments. Collect data, analyse and discuss results. To get the trends, always encourage participants to keep good records and to integrate previous results.
- As fruits grow, fruit flies may become an additional threat to them. If fruit flies were among the pests identified in session 6, it is time to revisit the problems identified, emphasizing fruit flies.
  - Biology of the pest
  - Potential threat to fruit
  - Available control options (analyse and discuss farmers' experience and practices)
- Based on trends from experimental results and discussions on fruit flies, facilitate development of appropriate additional experiments or action plan. Make sure all planned activities are carried out well and timely.
- Set date for the next meeting for group training.

## Session 12

At this time, the early-forming fruits will be growing larger and possibly be attacked by a variety of pests such as the cashewnut mosquito that leave scars on the growing fruits.

- Recap activities and work plan from session 11.
- Scout the whole training block and keep records.
- Monitor and evaluate progress of ongoing experiments.
- Brainstorm about new problems that participants have identified in the training block. Use this as an agenda for the next session or formulate an action plan.



- Revisit aspects of field sanitation. Brainstorm on the role and significance of field sanitation, particularly if there are many fallen fruits (refer to the mango manual for more information).
- Based on scouting and experimental results as well as general discussions, develop an action plan.
- Ask participants to suggest additional issues on mango production that they would specifically like to have covered.

### **Session 13**

- Recap the action plan developed in session 12.
- Carry out overall scouting of the orchard and keep records.
- Monitor progress of any ongoing experiments.
- Discuss the results and develop an action plan.
- Set date for the next session.

Course participants organize another open day. The date for it should be set at the stage when fruits are the size of a chicken egg. Remember, it is the course participants who must take the lead. Give technical support as needed.

### **Session 14**

First fruits the size of a chicken egg are visible (annex).

- Farmer–farmer training day.

### **Session 15**

A week after the open field day:

- Recap issues raised in session 14.
- Carry out overall scouting of the orchard, keep records, and discuss the results.
- Identify a topic or an issue for discussion or to be addressed.
- Monitor progress of all experimental plots (trees).
- Discuss possible harvesting dates for the early-maturing varieties and plan post-harvest and quality-assessment

activities.

- Set dates for next sessions; 3–4 sessions and replications may still be required:
  - Pick mature mangoes for quality assessment (the mangoes must be allowed to ripen under normal storage or holding conditions before they can be assessed)
  - Carry out joint quality assessment of the ripened mangoes and discuss the results with course participants.

*Remember: Make use of live specimens as much as possible:  
I see I remember; I **touch** I remember, I **hear** I forget.*

- Based on discussions and results of the experiments, develop a plan of action.

## THIS MARKS THE END OF PART 2

Course participants should take into consideration that group training will take place every 2 weeks instead of weekly. Participants should apportion activities and responsibilities among members accordingly. For example, if spraying or foliar feed has to be done mid-week, make it clear what and how it will be done and who will do it.

## PART 3: IMMATURE STAGE

### *Sessions 16–17*

- Recap issues raised under session 15.
- Do routine crop scouting and decision making.
- Prompt participants to suggest issues for further discussion or action.
- Plan what to be done next (how/who/when).
- Set date for next session.

## PART 4: MATURE FRUIT AND HARVESTING STAGE

### *Sessions 18–19*

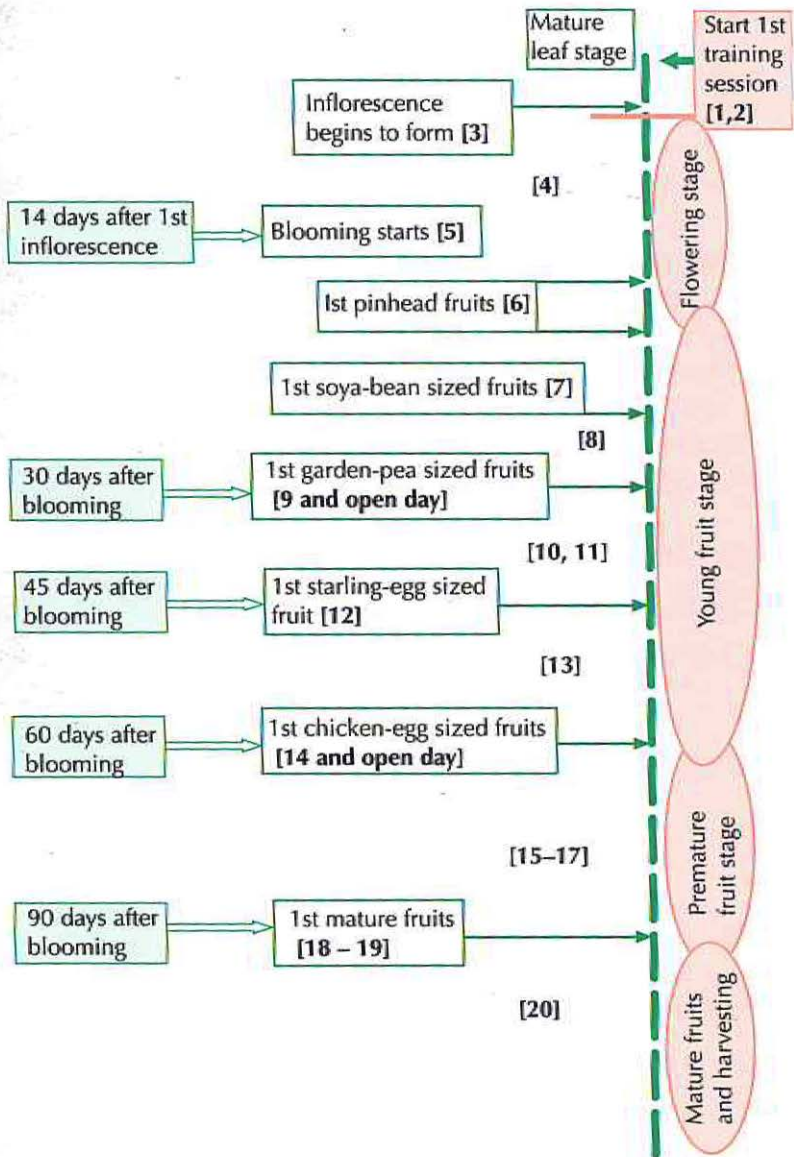
- Recap work plan from session 17.
- Scout the whole orchard.
- Monitor progress of fruits in each experimental block.
- If fruits are mature, pick at least 10 per treatment, mark them, and hold them under normal conditions until they are all ripe (this will take a week).
- Take the mangoes for group analysis, taking care to document all information that comes up.
- Carry out an exercise on post-harvest handling to reduce some of the problems identified and to improve on fruit quality.
- Take another sample to repeat quality assessment.
- Set date for the next session.

### *Session 20*

- Group discussion of fruit quality.
- Wrap up.



## Annex. Training session time scale coordinated with the mango fruiting season





**Pests and diseases of mango:** fruit fly (1), mango weevil (2), powdery mildew on panicle (3), and anthracnose (4).

**Natural enemies:** ladybird beetle adult (5) and lacewing larva feeding on a mango aphid (6).

Farmer training in Kenya (7-10).

