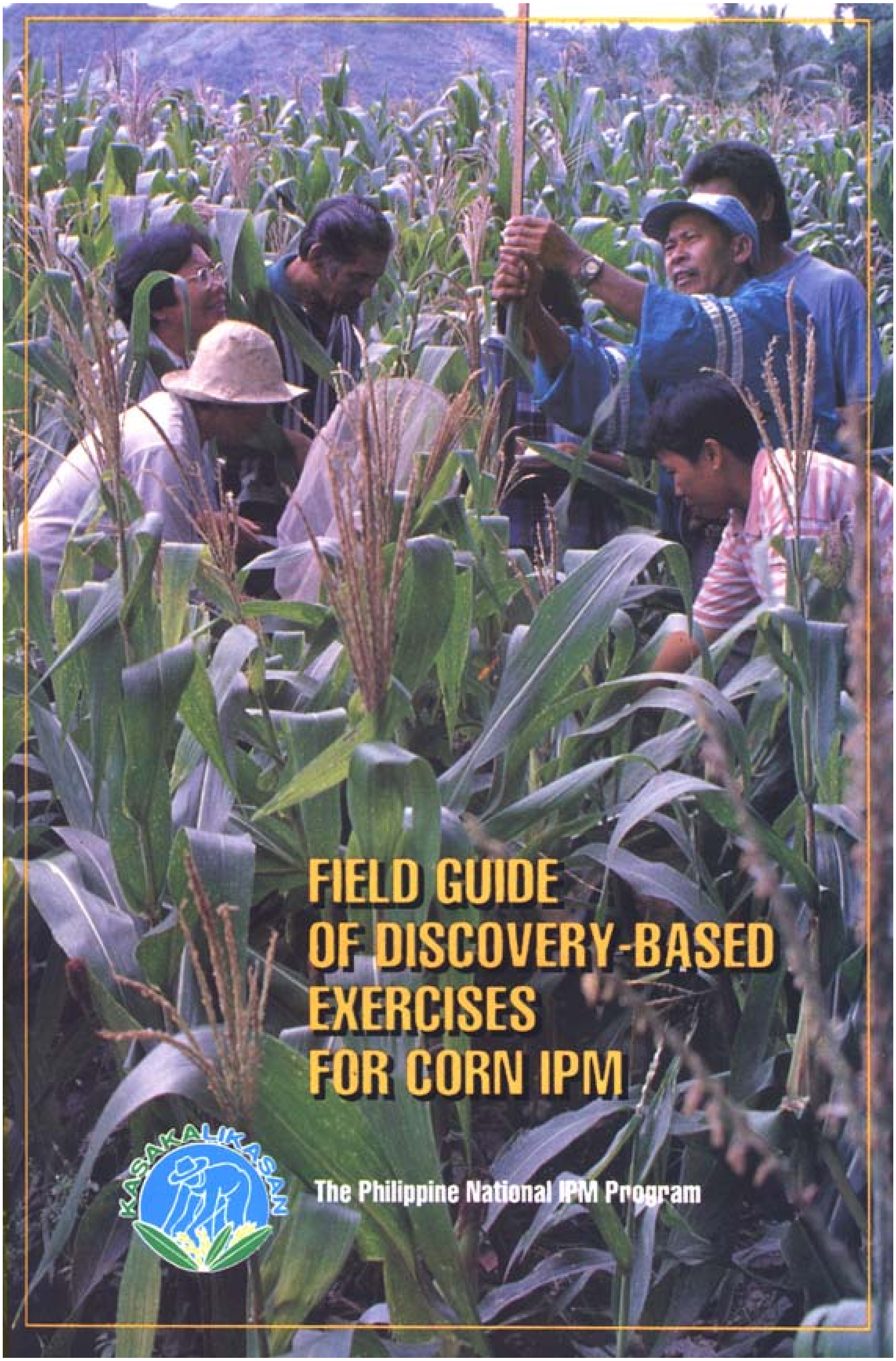

FIELD GUIDE OF DISCOVERY-BASED EXERCISES FOR CORN IPM

KASAKALIKASAN

The Philippine National IPM Program

From the **Secretary**

IPM IS BY FARMERS, NOT FOR FARMERS. IPM makes our farmers experts in their own corn fields by developing their ability to make critical and informed decisions that make their farming more productive, profitable and sustainable.

The ***Field Guide of Discovery-Based Exercises for Corn IPM*** is a valuable tool for farm technicians and extension workers in **KASAKALIKASAN**. This manual invites discovery, comparison and analysis that help our IPM field trainers stimulate the learning processes of farmers, sharpen their decision-making skills, and strengthen their capacity to apply IPM principles in corn production.

This Field Guide grew out of the experiences of our IPM field trainers from local government units and non-government organizations gained in the conduct of Farmer Field Schools nationwide. This manual has likewise been enriched by our IPM Specialists from the Department of Agriculture through the conduct of Training of IPM Trainers Courses.

We are pleased to note that **KASAKALIKASAN** is making a valuable contribution to the human resources development program of the Department of Agriculture, especially, in the empowerment of our farmers. We hope that this book will provide tangible help in guiding the country towards the path of sustainable agriculture.

SALVADOR H. ESCUDERO III
Secretary of Agriculture

FIELD GUIDE OF DISCOVERY-BASED EXERCISES FOR CORN IPM

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1 *Introduction*

ABOUT THE FIELD GUIDE

This *Field Guide of Discovery-Based Exercises for Corn IPM* is designed for use in corn IPM farmers' field schools (FFSs). The exercises in this field guide were based from the experiences shared by participants of the Corn Specialist Training (CST) Course on IPM conducted at USM in Kabacan, North Cotobato from May to September, 1995 and the IPM National Technical Workshop conducted at Baguio City in March 1996. Approppriate exercises were also adapted from the outputs of a series of Technical Refresher Workshops for Rice IPM conducted nationwide in October to November 1995 with rice FFS facilitators and a 4-day Technical Refresher Workshop for Vegetable IPM conducted at Sayangan, Atok, Benguet in June 1995 with vegetable FFS facilitators from the Cordilleras and Canlaon City and resource persons from the Philippines' KASAKALIKASAN and FAO Intercountry IPM Programme.

In the aforesaid workshops, we shared experiences from all IPM farmers' field schools that have been conducted in the Philippines so far. Together we used our resources to build the foundations of the exercises that are documented in this field guide. Some of these exercises are updated versions of exercises that we feel work well already, others are totally new.

This field guide is a collection of discovery-based exercises that facilitators like us, can use and adapt, when and where we judge them to be useful. We involved as many FFS facilitators as was possible in the design of these field exercises. So, the exercises belong to us and our farmers' field schools. This field guide will achieve nothing until our farmers' field schools start to put these ideas into action.

The field discovery-based exercises contained in this field guide are divided into several sections: (i) general; (ii) soils and agronomy; (iii) insects and natural enemies; (iv) rodents and rodent management; and (v) diseases topics.

With ownership comes responsibility. It is our responsibility to update and modify the field guide with the experiences and new ideas that come out of our own FFSs. Some additions had to be made to the exercises, because we did not have time to fill all gaps and refine all the steps. This means that for sure we will need to revise and redesign what is written here, based on your experiences and feedback.

What is a discovery-based exercise?

During our workshops we returned again and again to the questions "What do we really mean by a discovery-based exercise?" and "How can we make this exercise more discovery-based?".

There were no *ultimate* answers to these questions, but a number of patterns and ideas did emerge from our design sessions. These are described below. We hope that they give you some idea of what we were aiming for:

Go to the field

> The 'learning-field' provides the main learning-material for the farmers' field school and other fields in the barangay provide us with an extra resource when needed. Any exercise that we design should have its roots in the fields. This means that we need to go out to the fields and observe *before* we start any discussions or activities.

What is happening in the field today?

If the activities are rooted in the field, they are also based on what is happening in the field at this time. We can not generally discover something now if it either happened in the past, or will happen in the future. So, the activities described in this field guide are designed to be used in response to what is happening in the field NOW!

Share our experiences

We must never forget that farmers may already have plenty of experiences on the topic. We need to listen to and learn about farmers' experiences. We will gain new ideas and insights from local practices, as well as having a better idea of the areas where farmers are lacking in technical information or understanding.

What do farmers want and need?

The people who are discovering in the FFS are first and foremost the FARMERS!

People remember : **20% of what they HEAR**
40% of what they SEE
80% of what they DISCOVER FOR THEMSELVES.

Some of the things that the FFS group discovers will also be new to us. But the aim of the 'discovery-based' exercises is to help participants to remember more of what they are learning. So, we must choose the exercises based on what the FARMERS want and need to discover for themselves!

Discover, evaluate and understand!

We do not want to start any exercise with the assumption that there will be a *correct* answer or outcome. If we do this, then we can not expect participants to learn from what they have observed. Instead, they will just tell us what they think we want to hear, based on what we told them to say !

An example: If we want to run a session on Record Keeping, we can not start the session by saying "*Record keeping is important*, so what records do you think we should keep?" Even if this seems participatory, it is not discovery-based, because we have started by instructing the farmers that record keeping is important! Instead we need to guide farmers to *discover* that record keeping may be useful for them.

By discovering information ourselves and then evaluating if and how it could be useful, we can start to look more critically at what we observe or hear.

By thinking *critically* we are not being NEGATIVE, we are actually being *POSITIVE*. We do not just think what people *tell* us to think anymore. We are starting to build skills in *analyzing* what we observe. We can then base our decisions on our *own experiences and understanding*.

These skills of critical *questioning, discovery, analysis* and *evaluation* are what farmers take away from the FFS to use in tackling new problems on their own farms.

Thus, building farmers' DISCOVERY-BASED skills
WITH farmers' DECISION-MAKING skills
is what makes IPM farmers field school SUSTAINABLE!

Format for the exercises

Each of the exercises in this field guide has been arranged in a standard format of sub-sections. We hope that this will make it easier for you to find the specific information that you want to use. The various sub-section headings are listed below with a short description of the content :

Main topic, sub-topic and type of excercise

This gives a short description of the exercise, which we hope you can understand in an instant (e.g., when skimming through the book).

When is the exercise most approriate?

Some guidelines as to what might be happening in the learning field, and what experience the FFS group needs to have before starting this exercise.

How long will the exercise take?

An estimate of how long is the time between starting and finishing the exercise. Plus, how much time the exercise will take during FFS meetings and what extra time inputs are needed outside the FFS meetings.

Learning objectives

What we aim to discover from the exercise.

Materials

What equipment you will need to collect in advance.

Steps

A numbered list of steps that you will take to complete the exercise.

Some suggestions for processing discussion

Every exercise needs a processing discussion to evaluate observations and results, and to draw out a common agreement on what has been discovered. This section gives some suggestions for questions and ideas that your group may like to explore during your processing.

If the exercise is based on a guided discussion, the processing may already be included in the STEPS section.

2 General Topics

KASAKALIKASAN AND FFS ORIENTATION

MORE THAN ONE IDEA :
APPROACH AND CONCEPT

We had 2 different ideas about how you could start a discussion on the concept of KASAKALIKASAN. We concluded that there has to be some inputting in the discussions from the facilitators because farmers can not discover all of the ideas that we need to discuss. The two introductory activities are : (I) mental mapping; and (ii) the ‘9-dots’ game.
These activities are both followed by a guided discussion with explanations. The emphasis of each exercise is slightly different :

- The *mental map exercise* compares farmers experiences and ideas of the old IPM with the new KASAKALIKASAN concept and approach;

- The *‘nine-dot’* game emphasizes how the KASAKALIKASAN concept and approach aims to help farmers solve the most important field problems they face, and how this compares with our past IPM experiences.

You can use BOTH methods in one session. You will need to do the mental map exercise first to hear farmers ideas about IPM, then follow this with the nine-dot game and inputting from the facilitators. A final discussion is done to compare old ideas and experiences about IPM, with the new KASAKALIKASAN concept.

Exercise No. 2.01

MENTAL MAP EXERCISE : APPROACH AND CONCEPT

When is this exercise most appropriate?

- At the first FFS meeting.

How long will this exercise take?

- 1 - 2 hours of the FFS meeting.

Learning objectives

- To become aware of the concepts, objectives and approach of the KASAKALIKASAN program.
- To compare the KASAKALIKASAN concept, objectives and approach with farmers' previous ideas and experiences on IPM.

Materials

- manila paper for each group
- pencils, pens and crayons for each group
- tape

Steps

1. Ask the participants in their 5 working groups. Each group will work together to make a 'mental map' of any ideas that they have about what IPM is. They can write words, draw pictures, put down any ideas that they have about IPM. At the same time the facilitators make a mental map of the KASAKALIKASAN concept and approach.

2. Each group makes a presentation to explain their mental map. The facilitators are the last group to present.

3. Facilitate a discussion comparing farmers' past experiences and ideas about IPM with the KASAKALIKASAN concept and approach.

Some suggestions for the processing discussion

- Do you think these ideas that we put in the KASAKALIKASAN mental map are any different from the ideas and experiences that you put in your mental maps? Why? How?
- Which things in the KASAKALIKASAN mental map do you think are not about pest management? Why is this?
- Which things about IPM do you think are missing in the KASAKALIKASAN way? Why is this?

Exercise No. 2.02

NINE-DOT GAME :
APPROACH AND CONCEPT

When is this exercise most appropriate?

- At the first FFS meeting.

How long will this exercise take?

- 1 - 2 hours of the FFS meeting.

Learning objectives

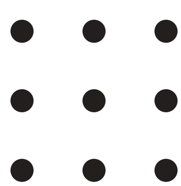
- To become aware of the concepts, objectives and approach of the KASAKALIKASAN program.
- To relate the KASAKALIKASAN concept, objectives and approach to the problems and issues of farmers in the local area.
- To compare KASAKALIKASAN IPM with our past experiences of IPM.

Materials

- Manila paper, tape and pens

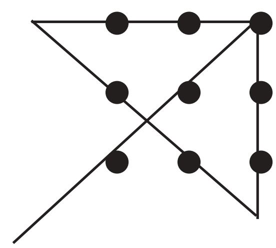
Steps

1. Draw 9 dots up on a piece of manila paper like this:



Ask the participants to try to join all of the 9 dots with only 4 straight lines, and without lifting the pen from the page.

2. Ask the farmers to share their results. The solution will be something like this:



3. Ask the farmers: Why was it difficult to find the way to do this at first? How did we overcome the problem? Discuss how this relates to solving other problems - very often we need to look outside the things that we think are the problem, to understand the real causes before we can go about solving them. In this game we had to look outside the square to find the solution.

4. Tell the farmers that the 9 dots can represent the 9 most important problems of farmers in this area. All of the problems begin with 'P'. Ask them to help you list them. Adapt what is discussed to fit it into 9 categories beginning with 'P' that are something like this:

   - Pests and diseases
   - Poverty (profits are low)
   - Pesticides (poisoning)
   - Program (that are no good)
   - Politicians (do not help us)
   - Public health
   - Pollution
   - Provision of water
   - Protection of forests

5. The facilitators then use each of the 9 problems to lead into an explanation of some of the central concepts and approaches of KASAKALIKASAN IPM. Here are some of the ideas that we talked about in our design session:
   - In the FFS, we explore ways to solve the problems of pests and diseases, low profits, pesticide resistance and pesticide poisoning.
   - The program is based on what farmers need and want to learn - farmers decide what we will do in the FFS.
   - The field school is based in farmers' fields and looks at the real problems that are happening now.
   - We learn by exploring the problems together as a group. By working together we can discover how to start to work on problems that are too big for 1 person, the group can do much more than one.
   - By becoming a strong group we will be able to get more support and attention from the local government or other organizations that we may want to influence.
   - The fields are a part of the local environment and the community, so we also look at the effects our actions have on things that are outside our fields.

6. The facilitators guide is a discussion on how this KASAKALIKASAN IPM differs from our past experiences and ideas of IPM.

Some suggestions for the processing discussion

- Do you think that these ideas about KASAKALIKASAN IPM are any different from our past experiences and ideas about IPM? How? Why?
- Which things in the KASAKALIKASAN IPM do you think are not about pest management? Why is this? Which things about IPM do you think are missing in the KASAKALIKSAN way? Why is this?

Exercise No. 2.03

ROLE PLAY :
GROUNDWORKING FOR FARMER FIELD SCHOOLS

Groundworking is a collective term for activities conducted at the barangay or municipal level with the end view of preparing or paving the way for the introduction of a new concept or program in the area. Ideally, the activities should begin a season before or at least a month prior to a planned farmer field school (FFS). The task of groundworking should be carried out by the local IPM team as a pre-training exercise. One of the primary objectives of groundworking is to determine the actual needs of the area, which will ultimately be the basis in developing an IPM program at various levels. To a great extent, the success of a local IPM program is directly related to the quality of groundworking activities conducted.

When is this exercise most appropriate?

- Ideally, a season before or at least a month prior to a planned farmer field school (FFS).
- It is suggested that this exercise be done towards the end of the course or when the participants in the TOT and CST are about to do groundworking activities.

How long will this exercise take?

- At least 1 whole week during the TOT and CST sessions.

Learning objectives

- Define groundworking.
- Explain the importance of groundworking.
- Discuss guidelines for groundworking.

Materials

- Briefing kit
- Guidelines
- Record book , pen

Steps

1. Ask for a group of 4-5 volunteers 1-2 hours before the session. Give the group instructions to do a role play presenting groundworking activities.

2. Start the discussion by drawing up a working definition of 'groundworking'. Elicit definitions from the group and list down whatever ideas are contributed. When there are no more ideas, try to come up with one working definition by combining ideas together. This will be the group's own working definition of 'groundworking'.

3. Ask who among the participants have done groundworking. Ask them why they did groundworking and what purpose their activity served. If no one in the group has done groundworking, ask people to refer to the working definition to explain the importance of groundworking.

4. Present the role play. Draw guidelines on what to observe for effective groundwokring from the presentation.

During the actual groundworking, the following activities may be considered:

1. Brief the local agricultural office heads regarding the IPM program and the mechanics of implementation at various levels;

2. Conduct courtesy call on local government officials, with the local agricultural office heads, to discuss the program, the mechanics of implementation, as well as the needs and possible commitments;

3. Conduct dialogue with barangay officials, leaders of farmers' organizations and non-government organizations, and selected farmers to explain the IPM program and to validate information gathered from the local agricultural offices and government units;

4. Consult with more farmers regarding the local needs and possible commitments in the implementation of the program;

5. Negotiate for field sites, shade or hall for processing of field activities and other necessary preparations, as part of the community's commitments, to implement a local IPM program; and

6. Invite and select the participants and facilitators.

Some suggestions for the processing discussion

Since one of the primary objectives of groundworking is to determine the actual needs of the area, then we should facilitate the discussions to point out that any data or information which will later help us plan the specific activities for our local IPM program should be considered as important. As such, the data or information to be gathered should be able to answer the question, "Do we need to conduct a TOT or an FFS?"

- Before we can answer the above question, we will need to facilitate the discussions to answer several other questions like, *"Do we have enough agricultural technologists or extensionists to train in a provincial TOT? Do we have enough corn farmers in a barangay to compose an FFS?"*

- For us to answer the above questions, we will need to facilitate the discussions for the participants to consider the following points as their guide in planning : (a) we will need at least 25-30 agricultural technologists or extensionists as participants within a province to implement a provincial TOT; (b) we will need at least two (2) agricultural technologists or extensionists within a municipality to participate in a provincial TOT; and (c) we will need at least 25-30 interested farmer-participants in a barangay or sitio to operationalize an FFS.

- Above all, we will need to facilitate so that the participants will have a better understanding of the pest management problems in the locality, as well as a clear picture of the support and commitments from the local communities to insure the sustainability of the program once it is implemented.

Exercise No. 2.04

BRAINSTORMING AND PARTICIPATORY DISCUSSIONS : MANAGING FARMER FIELD SCHOOL

When is this exercise most appropriate?

- In the TOT and CST sessions
- At least 1 week before the first FFS session

How long will this exercise take?

- 1 hour night time reading of handouts
- 1-2 hours of brainstorming in small group and participatory discussions in big group

Learning objectives

- Conduct brainstorming and participatory discussions on how to manage an FFS.

Materials

- Handouts on *Guidelines in Organizing an FFS*
- Note book and pen

Steps

1. Distribute handouts on *Guidelines in Organizing an FFS* the day before the schedule for the session to give enough time for the participants to read the material.

2. During the session, ask the participants to count off by 10's and get into their small groups. Ask a representative from each group to pick one guide question for brainstorming in their small group.

3. When all the groups are ready, participatory discussions in the big group may start with the presentation of ideas by the small groups.

Some suggestions for the processing discussion

- If your team is to organize an FFS, how would you go about it?
- Explain training strategies employed in an FFS.
- Why is an FFS necessary? What should an FFS aim to achieve?

Exercise No. 2.05

PARTICIPATORY DISCUSSIONS : HOW TO ESTABLISH IPM PARTICIPATORY NORMS

When is this exercise most appropriate?

- During the first week in the FFS, TOT and CST sessions

How long will this exercise take?

- 1-2 hours of participatory discussions in big group

Learning objectives

- Identify participatory norms for the training program/farmers' field school

Materials

- Manila paper
- markers
- masking tape

Steps

1. On the manila paper, present the illustration that will depict a situation or scenario in an FFS.

2. Facilitate participatory discussions by asking the following questions:

   - In this kind of set-up, how would the participants feel?
   - How will the group participate?
   - What kind of group leader would there be?
   - What kind of behaviors may take place?

3. Present the second illustration depicting another situation or scenario in an FFS.

4. Lead a participatory discussion again using the same set of questions asked above.

Some suggestions for the processing discussion

- Expect participants to express their ideas on difference between facilitators' roles.

- Expect them also to express their feeling about participants' behaviors as well as expected results based on the illustrations presented.
- Ask them what situation they would prefer.
- Ask them if they were placed in a non-formal, participatory situation, what they should do to get the most benefits on results.
- Lead them into the discussion of participatory norms (i.e., standards they would like to adopt to get the training program/farmers' field school going on smoothly).

Exercise No. 2.06

THE BALLOT BOX EXERCISE :
EVALUATING KNOWLEDGE AND SKILLS IN IPM

When is this exercise most appropriate?

- In the FFS, TOT and CST as a pre- and post-training evaluation of the participants' ability in identifying crop growth stages, diseases, weeds, insect pests, the damage they cause and their natural enemies.
- It becomes meaningful because actual field situation or problems are presented.
- Participants need not know how to write to be able to participate in the activity. In cases where some participants cannot read, facilitators must make it a point to walk with those concerned and assist them by reading out the questions to them.

How long will this exercise take?

- At least 1 hour for collection of specimen (*e.g.*, as part of field regular activities)
- At least 2 hours for preparation, mounting, and set-up of the exercise (*e.g.*, during vacant periods)
- At least 1 hour for processing and participatory discussions on the results of the exercise

Learning objectives

- To measure participants' knowledge and skills in identifying crop growth stages, diseases, weeds, insect pests, the damage they cause and their natural enemies.
- To develop participants' skills in the preparation of Ballot Box questionnaires.

Materials

- pieces of cardboard or folders
- vials, rubber bands, marking pens, thread, thumb tacks
- bamboo sticks
- actual, live or preserved specimens

Steps

1. Collect live, actual specimens and preserve insect pests and natural enemies in vials and mount the same on pieces of cardboard or folders.

2. Prepare questions focused on identification of crop stages, plant parts, diseases, insect pests, the damage they cause and their natural enemies. The questions should be in the dialect or vernacular.

3. Write the questions on the cardboard or folders. They should be of a selection type where participants only choose the letter of the correct answer. Questions may be as follows :
   - What insect causes this damage?
   - Which of these insects is a pest?
   - Which of these insects is a friend?

4. Mount the cardboard or folder on bamboo sticks with the thumb tacks and set up the "ballot boxes" in the field. Use corn plants in the field showing actual insect damages for the exercise.

5. During the exercise, the participants select only their answers by dropping a piece of paper with their assigned number in a corresponding "ballot box" attached to the cardboard or folders.

6. Process the activity to determine participants' performance and to solicit comments on how to improve the exercise for future use.

Some suggestions for the processing discussion

- How useful is the exercise to you? Will it be useful for farmers?
- Are there substitutes for using actual, live or preserved specimen if these are not available? Do you think it will be as effective as using actual specimen?
- Do you think writing the questions in the vernacular will help improve the effectiveness of the exercise? What if farmers do not know how to read and write?
- Can you share some ideas on how to improve the exercise?

Exercise No. 2.07

PARTICIPATORY TECHNOLOGY DEVELOPMENT : THE PROCESS OF COLLECTIVE AND COLLABORATIVE INQUIRY

Participatory Technology Development (PTD) is the process of collective and collaborative inquiry with the purpose of initiating community actions on solving local problems. PTDs on Integrated Pest management (IPM) are being implemented to empower participants (both facilitators and farmers) with analytical ability and skills to investigate into the cause-effect relationship of problems in farming practices and thereby stimulate them to design a set of actions for solving their problems.

As a team, the participants learn from other farmers response at each stage of intervention and draw lessons for future IPM program implementation strategies. In addition, the participants develop analytical skills and attitudes in working within participatory framework in planning, organizing and evaluating development activities.

PTD means that all relevant stakeholders do what only researchers usually do. It can be seen primarily as a learning strategy for empowering participants and only secondarily as producing research results in the conventional sense.

PTD as a learning process empower in three ways : (a) it empowers because of the specific insights, new understanding and new possibilities that participants discover in creating better explanation about their social world; (b) participants learn how to learn; and (c) it liberates when participants learn how to create new possibilities for action.

When is this exercise most appropriate?

- In FFS, TOT and CST sessions before the participants design and plan activities in their learning fields.
- In the first two weeks of sessions

How long will this exercise take?

- 3-5 planning sessions of 1-4 hours alternately in the barangays and in the ‘classroom’.
- Season-long exercise with weekly field checking and decision making.

Learning objectives

- To identify local field problems that will be the basis for designing and planning activities in the learning fields.
- To initiate community action to solving local field problems.
- To improve individual and group decision making skills for crop management

Materials

- FFS farmers
- Baseline Survey Forms
- Manila paper, pentel pen, notebooks, ball pens

Steps

Introductory Activities :

1. One or two days before the session, distribute the handout : *"Considerations in establishing PTD activities in CST, TOT and FFS sites"*

2. Conduct participatory discussions regarding the topic and document on manila paper all interactions in the big group for later reference. You can consider the following as useful guide questions :
   - What is the purpose of doing PTD?
   - What are the ways of identifying farmers' problems and needs?
   - Can you address all farmers' problems and needs during the FFS? How do we do it? Do we prioritize our activities? How?
   - What is the next logical step after the problems are identified and prioritized? Who will be involved in the problem solving process? Will the process be sustainable in the long run?
   - After designing and planning the PTD activities, what is the next logical step? Who will be involved? How will it be implemented?
   - After implementing the PTD activities, what is next?
   - Will the PTD end after data collection and interpretation?

3. Conduct a group exercise to draft a procedure to be followed in designing, planning and implementing PTDs in the FFS, TOT and CST sites based on the results of earlier participatory discussions.

4. Conduct a participatory discussion to determine which can be done now.

Identify local problems :

5. Before entering the barangay, let participants come up with a concrete list of things they want to do. This can include the following :
   - Establish rapport in the barangay by doing a courtesy call to officials, meeting and consulting with farmer-leaders, etc.
   - Identify varieties (why?), cropping pattern, and sequence
   - Know their area planted per cropping season, their production and income
   - Identify their pest problems and control strategies
   - Obtain information on soil fertility and fertilizer management
   - Know their source of financing, marketing strategies, handling, packing, transport
   - Know their sources of information on farming strategies (e.g., radio, technician, co-farmers, sales representative of chemical company, etc.)
   - Find out their land tenure (e.g., owner, tenant, etc.)
   - Know the type of irrigation or source of water system
   - Get information of labor arrangements (e.g., hired, family, etc.)
   - Know their harvest and post harvest activities and facilities

6. Design an appropriate Baseline Survey Form and conduct survey so that a more specific information in the area can be obtained on pest control strategies, fertilizer management and other cultural management practices.

7. Go to the barangays as often as possible in small groups for at least half day a week until all the information are finally gathered.

Validate initial information gathered :

8. Consolidate initial data gathered per small group and present them to the big group for validation.

9. Conduct participatory discussions to get all possible reactions from the big group. This activity is very important for :
   - Identifying lacking information that need to be gathered.
   - Prioritizing field problems in the community.
   - Determining the next activities to be undertaken in succeeding barangay visits.

10. List down all the major issues that came out during the participatory discussions with the big group for consideration as possible PTD activities.

11. Decide on when and what missing or additional data to gather for immediate designing and planning of succeeding PTD activities?

Gather additional barangay information :

12. Go back to the barangay in small groups and gather additional or missing data needed for immediate designing and planning of succeeding PTD activities.

Prioritize problems and design activities :

13. Consolidate additional data gathered per small group and present them to the big group for validation.

14. Conduct participatory discussions to get all possible reactions from the big group. This activity is very important for :
    - Completing lacking information needed for designing and planning of final PTD activities.
    - Validating priority field problems in the community.
    - Determining the PTD activities to be set up in the FFS, TOT and CST sites.

15. Plan and conduct additional visits to the barangay if needed.

16. Update initial data earlier consolidated per small group and present them to the big group for final validation.

17. List down again all the major issues that came out during the participatory discussions with the big group for final consideration in designing and planning of PTD activities in the FFS, TOT or CST sites as follows :
    - Crop Protection Trials (CPT), where Integrated Pest Management (IPM) and Farmers' Crop Protection (FCP) practice is compared, will be established in all the sites (FFS, TOT or CST). The FCP practice, which will be followed throughout the cropping season in all the sites, must be clearly defined during the groundworking activities. The IPM strategy is a decision making tool and not a package of technology. Farmers will usually be tempted to follow some of the new IPM strategies in the FCP plot if treatments are not well defined from the beginning. A clear definition of the treatments (IPM vs FCP) will secure a good comparison between old and new practices in crop protection.

- Other PTD activities, such as the Cultural Management Trials (CMT) are designed based from the outputs of the previous activities. Some examples of the CMT activities are as follows : (a) Fertilizer management (e.g., rate, kind, method, organic or inorganic materials); (b) Seedbed management; (c) Crop establishment; (d) Planting distance and method; (e) Varieties; (f) Soil Conservation.

18. Decide with the group how many corn varieties you are going to work with. Will it be the same number in the FFS, TOT and CST sites?

19. Conduct workshop in small group to draft a design and plan of their individual PTDs. Finalize the design and plan for the PTD activities in the TOT or CST through participatory discussions in the big group.

20. Draw a layout of the PTD and list down what data will be gathered throughout the season. Be very detailed! Present it to the big group for additional suggestions and comments.

    Note :
    Although this whole exercise is primarily conducted to establish the PTDs in the TOT or CST learning fields, at the same time, it serves as a preparation for the establishment of PTDs in the FFS sites where farmers will be more directly involved. It will be nice also to consult with the TOT or CST participants when designing, planning and implementing the PTDs in the FFS sites with farmers.

Some suggestions for the processing discussion

- Is PTD learning or research? How big the plots do you need? Do you need replication?
- How can PTD empower farmers?
- What is the difference between groundworking and barangay immersion?
- What are the criteria for prioritizing field problems?
- Does IPM means no spraying? Is IPM a package of technology?
- Can IPM be done for all types and varieties of corn?
- Do you have to know all technologies before doing IPM with farmers?
- Explain the following IPM terms . How are they related to PTD?
  a) Grow a healthy crop
  b) Observe fields regularly
  c) Conserve natural enemies
  d) Make farmers experts in their own fields
- How can PTD be community oriented?
- Can you teach farmers to teach themselves?
- What are the advantages and disadvantages of growing more than one variety?
- Can you design participatory technology development activities even if seedbeds are prepared before the start of the training?
- How can you then address seedbed problems?
- What are the disadvantages of giving pre-designed activities in the TOT and FFS?
- Are the designed PTD activities too complicated for you? For TOT? For FFS?
- Can you simplify the PTD activities to give clearer results?
- Can we do an economic analysis based on the PTDs conducted?

Exercise No. 2.08

THE FOLK MEDIA :
A SIMPLE WAY TO CONVEY IPM MESSAGE

Local songs, dances, poems, proverbs, stories, tales, legends and drama are forms of folk media. Folk media makes it possible to convey a developmental message using a medium which is familiar to a group of people. By doing so, the message becomes more easy to understand.

Folk media can be used in various ways. The extensionist can use it to explain complex concepts. Weaknesses in a culture or group may be approached in a non-threatening situation through a folk media presentation. It can create an awareness and lead to analysis of problems by the people in a community.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions, at the latest, a month before the schedule for presentation (e.g., field day or graduation ceremonies) to give the participants ample time to prepare for the activity.
- This activity should be taken up as part of the module on extension communication.

How long will this exercise take?

- At least 30 minutes for brainstorming and participatory discussions
- At least 1 hour planning on respective folk media presentation
- At least 1 hour practice every week before presentation

Learning objectives

- Define '*folk media*'
- Discuss some forms of folk media
- Explain the advantages of using folk media
- Plan on respective group's media presentation

Materials

- Video tape presentation on folk media
- Manila paper, pentel pen, masking tape, etc.
- Props during actual presentation

Steps

1. Present an example of folk media. This may be done either by viewing a tape or asking a member of the group who has the knowledge and skill to present one.

2. Start the discussion by framing up a working definition of folk media. Elicit definitions from the group and list down whatever ideas are contributed. When there are no more ideas, try to come up with one working definition by combining the ideas together. This will be the group's own working definition of folk media.

3. Using the earlier presentation, ask what people think are the advantages of using folk media.

4. Refer to the earlier presentation again. Ask the group what they call the form of folk media that was presented. If they are familiar with it, how do they do it in their respective regions.

5. Ask participants to move into their respective small groups and plan on the folk media they will present during the field day.

6. Practice and present the folk media during a field day or graduation ceremonies.

Some suggestions for the processing discussion

- What are the advantages of using folk media in conveying IPM messages over the other forms of media?
- What other forms of folk media do they have in their respective regions? When and where are they most appropriate to use to convey IPM messages?

Exercise No. 2.09

THE FIELD DAY : HOW TO CONVEY IPM MESSAGE BY RESULT DEMONSTRATION

The field day is an occasion when farmers and trainers show other people or the community what they have learned and the results from their participatory technology development (PTD) activities. The best time to have a field day is when there is still a standing crop, nearing maturity. That is, unless there is an emergency situation and there is no choice but to harvest early.

The field day is the training-participants' affairs. This means that they plan for and implement the activity. For the farmers' field school (FFS), the farmer-participants may choose to invite co-farmers from the same or neighboring barangays. For training-participants, they may choose to invite their local chief executives or direct supervisors with the end view of orienting them on the program.

The field day may include such activities as field tour and a program where local officials deliver speeches. In the Philippines, the participants and the community also jointly prepare food as part of the event. The atmosphere a field day takes is a festival. Folk media prepared by farmers complete the celebration.

When is this exercise most appropriate?

- In the FFS, TOT and CST sites, at the latest, a month before the schedule for the activity to give the participants ample time to prepare.
- This activity should be taken up as part of the module on extension communication.

How long will this exercise take?

- At least 1 hour devoted each week for three weeks on planning, brainstorming and participatory discussions prior to the last week of preparation.
- At least 1 full week of whole day preparation before the schedule for the activity

Learning objectives

- Define *'field day'.*
- Discuss the reasons for holding field days.
- Discuss activities during a field day.
- Plan, conduct and evaluate the field days in the FFS, TOT or CST sites.

Materials

- 'Learning field' at least 2 weeks before harvest
- Video tape presentation on field day
- Props, preserved and live specimens, graphs of initial results, field labels, etc.
- Other supplies and materials for field day preparation

Steps

1. Present a video tape on a field day conducted in any FFS, TOT or CST group. On the basis of the presentation discuss the following with the group the following :
   - What is a field day?
   - What are the reasons for holding a field day?
   - What happens during a field day? (What are the parts of a field day?)

2. Write down the answers particularly to question #3 and make use of them as basis for planning the group's field day.

3. Plan the field day activities in the FFS, TOT or CST sites.

4. Conduct and evaluate the field days in the FFS, TOT or CST sites.

Some suggestions for the processing discussion

- Who should we invite in the field day? Why?
- How do we solicit the involvement and commitments of local leaders in the community through the field day?
- How do we sell our local IPM programs to our concerned government officials and politicians through a field day?

Exercise No. 2.10

THE FOLLOW-UP PROGRAM : HOW TO SUSTAIN IPM PROGRAMS IN LOCAL COMMUNITIES

The first phase of the IPM program focuses on capability and capacity building. This comes with the season-long training of specialists, trainers and farmers in farmers' field schools (FFSs). However, before the end of the first season, trainers must already look towards the direction of sustaining IPM in local communities. This means that after the initial activities in the FFS, farmers must already start planning for follow-up IPM activities in their communities. In so doing, barangay-based IPM organizations are strengthened. This is the goal of the follow-up program.

The following sessions walk trainers through some follow up activities. The activities may be considered both in the CST, TOT, as well as in farmer field schools.

Exercise No. 2.10A

ORGANIZING THE FFS FARMERS

When is this exercise most appropriate?

- The best time to discuss the topic is towards the end of the season when farmers start to think about what comes after the farmer field schools season.
- Discussions about IPM clubs or organizations should be done both in the FFS, TOT and CST sessions. Ideally, training-participants should go through the exercise first so that they can turn around and do the same exercise with farmers in the FFS.

How long will this exercise take?

- At least 1 hour brainstorming and participatory discussions with the TOT or CST participants
- At least 2 hours of the last two weeks sessions with FFS farmer-participants

Learning objectives

- Go through the exercise of organizing FFS farmers so that the participants can turn around and do the same exercise with farmers.
- Organize IPM trained farmers who will carry on sustaining IPM activities in their respective barangays after the initial FFS season.

Materials

- farmer-participants in an on-going FFS.

Steps

1. From the start of the training, it should be made clear with the farmers that they are expected to pass IPM on to other members of the community and to other farmers. To facilitate this process participants in the on-going FFS should sit together to plan what they will do upon completion of the season-long IPM training program. This activity is best done during the 12th week of the FFS session.

2. During the activity, IPM farmers are expected to discuss about getting organized into a club (e.g., select leaders and plan out activities), if they have not been formally organized yet. There are various reasons for organizing the group.

3. Among others, the farmers will identify a personality who can eventually transact business for their group. If the farmers belong to a cooperative or any existing group, they may already made plans for IPM which their group may implement. In the process, it should be emphasized that more important than structuring the organization is keeping the group alive. This is only possible if the members are serious about carrying on IPM related activities. Some suggested activities that IPM clubs can carry out are:
   - technical backstopping through home and field visits to IPM and non-IPM farmers;
   - networking of trained farmers in the different barangays in the community;
   - conduct of participatory technology development (PTD) activities to discover new management options;
   - conduct of farmers' field school (farmer-to-farmer); and
   - preparation and circulation of IPM newsletter to disseminate new and localized technologies and management strategies.

Some suggestions for the processing discussion

- How do we ensure the sustainability of the farmers' group that we organized in a barangay?
- What participatory technology development (PTD) activities will they start to work on? How will they go about these activities?
- What role will the local IPM team play to sustain local IPM program in the community?

Exercise No. 2.10B

FARMERS CONDUCTING FARMER FIELD SCHOOLS

When is this exercise most appropriate?

- Discussions about farmer-run field schools should be conducted both in the FFS, TOT and CST sessions.
- Ideally, trainers should go through the exercise first so that they can turn around and do the exercise with farmers.
- The best time to discuss the topic is towards the end of the season when farmers start to think about what comes after the farmers' field school season.

How long will this exercise take?

- At least 1 hour brainstorming and participatory discussions with the TOT or CST participants.
- At least 2 hours of the last two weeks sessions with FFS farmer-participants

Learning objectives

- Discuss the advantages and disadvantages of IPM farmer-graduates conducting farmer field schools;
- Brainstorm on how IPM farmer-graduates can organize farmer field schools; and
- Discuss on how to further equip IPM farmer-graduates to become IPM farmer field school facilitators

Materials

- farmer-participants in an on-going FFS.

Steps

1. Divide the group into two. Ask Group A to sit in the inner circle and Group B in the outer circle. While Group A discusses the advantages of FFS run by IPM farmer-graduates, Group B is supposed to listen and take down notes. Give the group fifteen minutes to discuss. After fifteen minutes Group B takes its place in the inner circle to discuss the disadvantages of FFS run by IPM farmer-graduates while Group A observes and takes down notes. List points being raised while presentations are going on.

2. Using the same groupings, ask members to discuss their experiences in organizing farmers' field schools. Ask each group to summarize their outputs for reporting to the big group. While they are presenting, note down the issues and concerns. After all groups have presented, check if there are common activities that the two groups went through. Summarize these. This process will give you and the group some common steps in organizing farmers' field schools.

3. Solicit suggestions from the big group on how IPM farmer-graduates can be further equipped to become farmers' field school facilitators.

Some suggestions for the processing discussion

- What will be the role of the local government unit (LGU) -based IPM training teams once an IPM farmer-graduate group is in place to do IPM training of farmers?
- How do we ensure training quality and standard once an IPM farmer-graduate group is utilized to do IPM training of farmers?

THE ECOSYSTEM

Exercise No. 2.11

WHAT IS THIS? WHAT IS THAT?
(LEARNING TO ANSWER QUESTIONS WITH QUESTIONS)

The goal of discovery-based learning is to provide a more enlightened educational opportunity for participants. The methodology of learning is very important for achieving the goal of education. One important method is to ask questions that allow the participants to develop their own analysis and understanding. You are stealing an opportunity for education if you reply directly with an answer. Ask questions. Lead the participant to the answer by asking questions. In the corn field, a common question is: 'What is this'? (*Ano kaya ito?*).

There are many ways to answer the question : 'What is this'? For most of us, the natural response is to give the name of the object, often in a foreign language (Taglish or Latin). The question is often answered by saying 'Oh that is *Lycosa psuedoannulata'* or 'This is *Xanthomonas campestris'* ? The result of this answer is that an educational process has been stopped.

A better way to answer the question is to ask a question : "Where did you find it? What was it doing? Were there many of them? Have you seen this before?" The idea is promote learning by discovery and to lead the person toward their own analysis.

When is this exercise most appropriate?

- In the TOT and CST sessions
- Before introducing the concept of an ecosystem and agro-ecosystem
- Before conducting the first AESA in the FFS

How long will this exercise take?

- 45-60 minutes

Learning objectives

- To facilitate learning by discovery among farmers in the FFS.
- To guide farmers to critically analyze and make better decisions on their field problems

Materials

- corn field
- plastic bags
- notebook and pen

Steps

1. Go into a corn field in groups of two or three person per group.

2. In the group, take turns in the following roles :
    - The “farmer” should take anything in the corn ecosystem (pests, natural enemies, weeds, others) and ask, ‘What is this’? The other member will act as a “recorder” and must write down questions and responses. The “technician” should respond with one of the following type of responses : ‘That is a good question’. ‘Where did you find it’? ‘What was it doing’? ‘Did you ever see it before’? ‘What do you think it is’? (Keep asking questions). Use this especially when you know what the specimen is. Try not to give the answer!

- If the question is to be answered, the "technician" should avoid answers which give more emphasis to identification. Rather, the function of the organism should be emphasized. 'This is an insect that feeds on the plant'. 'It is not actually a problem insect until there are very many'. 'There are many organisms which eat this insect, including spiders and parasites'. OR, 'This is a spider that eats insects and is a friend'. 'It happens to be called a hunter because it moves around the field searching for insects'. OR, some other responses that only give biology/ecological information.

- NEVER GIVE THE ANSWER WITH A NAME. THAT ONLY KILLS THE QUESTION. THE QUESTION IS A CHANCE TO LEARN!

3. After the members had taken their turns, return to session hall/shade and process experiences.

Some suggestions for the processing discussion

1. How often do you usually give just a name for an answer? Do you think it is helpful in training to ask questions to assist in learning?

2. In your usual job, is helping farmers learn an important aspect in day to day work? Do you think it would be useful to answer questions with questions to help farmers?

3. Many field workers think they have to be smarter than farmers, even though the farmer is much older and more experienced. Do you think this method can help you in working with older farmers by facilitating educational process? Can you also learn from farmers by asking questions? Do farmers think respect, a desire to learn, or an instant answer is most important for a government worker?

Exercise No. 2.12

ROLE PLAY :
TROPIC LEVELS IN THE CORN ECOSYSTEM

Different insects and other organisms play different roles in a certain tropic level in the ecosystem of corn. The corn plant, which is at the producers level, provides food for the herbivores like the insects, diseases and rats which in turn provide food for the detritivores, the natural enemies and microorganisms. The absence of some of these elements will greatly affect the balance of the ecosystem.

When is this exercise most appropriate?

- After discussion on the concept of AESA and at dough stage.

How long will this exercise take?

- 10-15 minutes for the game
- 30-60 minutes for processing

Learning objectives

- To create awareness and understanding of the ecological function of each tropic level.
- To aid facilitators in assessing the level of knowledge of the participants regarding the ecosystem.

Materials

- 30 specimens or 1 specimen per individual participant, broken down as follows :
  * 12 insect pests
  * 14 natural enemies (spiders, wasps, etc.) and neutrals (cranefly,

mosquitoes, etc.)
* 1 fertilizer material preserved in vial
* 1 weed species
* 1 potted corn plant
* 1 animation of the sun

Steps

1. Place prepared specimens in a box or any suitable container.

2. Let all participants randomly pick one specimen for others to see.

3. Instruct the participants to position themselves in accordance to their perceived function within the ecosystem by touching the shoulder of the next level participant. Freeze movement after 30 seconds.

4. Facilitators check the positions of the participants and say “unfreeze” to allow the participants to make sure that their positions are correct. Freeze movements after 10 seconds.

5. Let the participants explain their individual perceived position in the ecosystem.

6. Process and discuss in big group.

Some suggestions for the processing discussion

- Ask about the feelings of the participants on the game in relation to the ecosystem.

Exercise No. 2.13

FIELD WALK AND BRAINSTORMING : INTRODUCING THE IDEA OF AN ECOSYSTEM

In the activity, 'What is this'? learning to answer questions with questions was emphasized. The response could be any questions about the specimen. In the corn ecosystem, however, everything has a function, and the function is more important than the name. There are different levels of functions in all ecosystems.

The first level is the producer of organic materials : the plants. Plants include the corn and the weeds. The weeds have an additional function in the corn field. Weeds are also competitors for water, nutrients (N, P, K, and others), sunlight and space. "Weeds" are defined many ways, but one good definition is "a producer that is not wanted by mankind at that time and place".

The second level are organisms that feed on the plant. These include insects, rats and diseases. These are usually referred to as "pests". But "pests" are defined by their populations, not by their function. For example, when a population of planthopper reaches a high level that damages the corn plant, then the planthoppers are a "pest". If the population is low, then they are not "pests". In fact, if there are no planthoppers at all, then the spiders would have less food and spider populations would be low. In this case, planthoppers at low populations are important to keep spider populations high.

The third level are organisms that feed on the second level. These include spiders, insects (predators and parasites), virus that attack plant fungi and bacteria, owls, cats, and other predators of rats. These organisms are usually called "natural enemies" or "friends of the farmers" because they attack things that could become pests. Preserving these organisms is important to keep the second level from increasing.

The fourth level in the context of the corn ecosystem are the decomposers. These include bacteria, fungi, and insects that feed on the dead plants, insects, spiders, rats, etc. that are in the corn system. These organisms cycle the nutrients in the system back into the soil.

In this activity, we will practice identifying the function of the organisms found in the corn ecosystem. This is a good introductory activity for the study of ecology by farmer groups or facilitators as well.

When is this exercise most appropriate?

- 1 week before the first observation and decision-making of the 'learning-field' agro-ecosystem.

How long will this exercise take?

- 1.5 to 2 hours of the FFS meeting

Learning objectives

- To build awareness of the relationships that exist between so many of the living and non-living things that are found in our environment.
- To appreciate that if one thing in this network of interactions is changed, it can influence all of the components of the ecosystem.
- To become more aware of the things and interactions that make up the ecosystem of our fields - the 'Agro-Ecosystem'.
- To start to use our understanding and observations of the Agro-Ecosystem as a basis for decision-making about crop management.

Materials

- notebooks for each group
- manila paper for each group
- pens and crayons for each group
- tape

Steps

1. Ask the participants to divide into their working groups. The groups go outside and into the fields, making sure that they have a notebook and pen. Each group working together will : (i) Look around as far as the eye can see, and as close as the eye can see; (ii) List all the living and non-living things they see; (iii) and discuss how they are connected or how they affect each other. Facilitators move between groups to help in discussions where there are any problems. Guide the farmers to observe the crop as well as the wider environment.

2. After 10 minutes of observation, discussion and note-taking ask them to return to the 'classroom'.

3. Each group now makes a picture showing all the things that they observed and draw lines to show which things are connected or affect each other. Facilitators move between groups to guide participants to explore more connections if and when they see it is needed.

4. Each group makes a presentation in which they explain what they have drawn to the big group.

5. After all presentations have been made the facilitators guide a big group discussion on the connections and relationships that have been observed by the group. How these links will affect the way the ecosystem changes, and why we need to be aware of this when we start to make changes in the ecosystems of our fields.

Some suggestions for the processing discussion

- How many connections did we find?
- What would happen to all the things if we started to remove one thing (e.g. trees, water, sunlight, birds, etc.)?
- What things do we often try to change in our fields?
- What other things in the environment would each of these changes affect?
- How often do we think of these connections and effects when we are deciding what to do in the field?
- We call all the things in the environment and the way they affect each other the 'ecosystem', what do the 2 parts of this word, 'eco' and 'system', mean?

Exercise No. 2.14

FIELD WALK AND BRAINSTORMING : INTRODUCING THE IDEA OF AN AGRO-ECOSYSTEM

Integrated Pest Management (IPM) is based on ecological interactions between the environment, plants, hervibores (diseases, insects, and rats), and natural enemies of herbivores (spiders, parasites, snakes, etc.). The health of the plant is determined by the environment (weather, soil, nutrients) and the herbivores. The herbivores are balanced by their natural enemies.

The adoption of input intensive agriculture has greatly influenced the interactions of the different components of the agro-ecosystem. For example, the indiscriminate use of pesticides has lead to resurgence of minor pests. We need to begin looking at the corn ecosystem from the viewpoint of maximizing profits without destroying the system. We need to understand the interactions and components. In this exercise, we will look at the interactions of the different components of the ecosystem.

When is this exercise most appropriate?

- Before the first observation and decision-making of the ‘learning-field’ agro-ecosystem.

How long will this exercise take?

- 1.5 to 2 hours of the FFS meeting

Learning objectives

- To build awareness of the relationships that exist between so many of the living and non-living things that are found in our environment.
- Be aware of the existence and balance of components of the corn agro-ecosystem.
- To appreciate that if one thing in this network of interactions is changed, it can influence all of the components of the agro-ecosystem.
- To become more aware of the things and interactions that make up the ecosystem of our fields - the 'Agro-Ecosystem'.
- To start to use our understanding and observations of the Agro-Ecosystem as a basis for decision-making about crop management.

Materials

- notebooks for each group
- manila paper and photocopy paper for each group
- pens and crayons for each group
- tape, glue and scissors

Steps

1. Go to the corn field for 30 minutes as small groups and record all kinds of plants, insects, and spiders seen in the field. Use a net to catch smaller insects and see the smallest wasps.

2. Return to 'classroom' and write the names of things seen in the field on the photocopy paper: make paper 2 cm X 5 cm.

3. Add papers with names “sunshine”, “rain”, “high fertilizer”, “low fertilizer”.

4. Discuss with the groups how the parts interact. Paste the names of ecosystem components on the manila paper and draw lines between all components which interact. Explain what the lines means and present to the big group.

Some suggestions for the processing discussion

- Discuss the outcome of the following situations. Discuss what happens to each component over one season (the questions could be assigned to groups beforehand) :
  a) A spray is used that kills all insects and spiders. Then pests migrate to field
  b) The plant is resistant to all pests, so that no pest is in the field.
  c) The plant has high fertilizer and sunny conditions
  d) The plant has high fertilizer and cloudy conditions
  e) The plant dies
- What is the relevance of these questions to a field crop and a farmer?

Exercise No. 2.15

AGROECOSYSTEM ANALYSIS (AESA) : MAKING A CROP MANAGEMENT DECISION

Each week during the season, you will study the components of the corn agro-ecosystem. You will study the plant morphology and agronomy, herbivores, and natural enemies of the herbivores. You will look at diseases and rats.

Agro-Ecosystem Analysis (AESA) is a way of assembling what we are studying and placing into a process useful for decision-making based on many factors. Old IPM practices relied on economic threshold levels (ETL) to make decisions. ETL's however, are extremely limiting and do not include the other factors in the agro-ecosystem or farm management.

The following activities will lead you through weekly set of questions and drawing. In the beginning, the analysis will take a lot of time. By the end of the season, however, you should be able to do a complete analysis while standing in the field.

When is this exercise most appropriate?

- As soon as there is a decision to make in the field for example one week after sowing the seedbed

How long will this exercise take?

- 2 hours of the FFS

Learning objectives

- Improve decision making skills through a field situation analysis by observing, drawing and discussing.

- Improve decision making skills by presenting small group decisions for critics in the large group.

Materials

- Corn field
- Notebook, ball pen
- Manila paper
- Crayons, pentel pens

Steps

1. If the participants are a little familiar with AESA, ask why they do AESA?

2. If they are unfamiliar with AESA, ask what sort of information they need to get in the field to make crop management decisions?

3. Discuss how many plants it is necessary to choose and how they should be chosen?

4. *Insects.* Discuss how the crop should be examined for insects, insect symptoms, egg masses, in plant, on plant, above plant, etc. How should this be recorded? Bring the specimens back for drawing. How shall they appear on the drawing? (pests, natural enemies, others, 'do not knows')

5. *Disease.* Discuss how the crop should be examined for disease, its symptoms, etc. How should this be recorded? How shall it appear on the drawing?

6. *Plant morphology and growth stage.* What is useful to record about the crop stage (*e.g.,* height, number of leaves, etc.). How shall it appear on the drawing?

7. *General observations.* What else is important to notice (e.g., weeds, water, fertilizer, weather influence)? Is it generally a healthy crop or not? How should this appear on the drawing?

8. Go to the field for 30 minutes and collect the data.

9. Go to the 'classroom'/shade and draw the plant with the correct average number of leaves. Write the number of leaves and average height and other agreed information somewhere on the paper. The drawing of the plant could also show the situation of fertilizer, water, insect and disease symptoms, etc. Use color crayons to make it look real.

10. Draw the insect and non-insect pests looking at the actual specimens brought back from the field. They could be drawn, for example, on the left side of the plant. An arrow can clarify where on the plant they were found. Write how many of each were found on the sample plants and calculate the total. If local names are known they can be added for the insects.

11. Draw the natural enemies or friends on the other side of the plant as above.

12. Indicate the weather conditions, for example, by drawing a sun, clouds, rain, strong wind, etc.

13. Indicate with drawings or words the treatment and activities in the field since last week (fertilizer sacks, spray nozzles, watering, etc.).

14. At the bottom could be made a list of important observations and recommendations.

15. Each group present their poster to the large group. That can lead to sharing of experiences and discussion of any topic involved in decision-making. This sharing with other groups can make the group feel more

comfortable with the decisions or might guide them to change it. The main thing is that all relevant aspects are taken into account. The poster should be kept for comparison when the AESA is conducted the following week. Remember to agree who is responsible for implementing the decision.

16. The poster can represent one or two treatments. Two treatments if the group is doing both AESA's, for example, IPM and farmers practice. That can help in comparing the different treatments.

Some suggestions for the processing discussion

- This is very difficult to generalize. It is different from crop to crop, from season to season, from stage to stage and from place to place. It could include some of the following questions and a lot more :

  Seedling Stage

  1. Do the plants have a good start?
  2. Is there any damping-off disease?
  3. If there are problems, will they follow the plants when they get older?
  4. Is there any yellowing? Is it fertilizer deficiency or disease?
  5. What is the effect of weather on the plant growth now?
  6. What kinds of natural enemies are present in the field?
  7. What are the numbers?
  8. Where did they come from?
  9. What do they eat or what did they eat before there were pests?
  10. Are there egg masses of pests? Are they parasitized?
  11. Are there egg masses of friendly insects?
  12. How does the natural enemy population compare with previous week? Was the field sprayed with insecticide or other pesticides?
  13. What is the importance of many natural enemies now?
  14. What kind of pests are seen?
  15. What is their average population density in the field?

16. What is the main pest seen? Are there seedling maggots?
17. What sort of damage do the pests do at this stage
18. Is there any way to prevent these from increasing in numbers in the field?
19. What is the condition of other fields in the area?
20. Do other fields influence your field?
21. How many pests can one spider eat in one day?
22. Are there any signs of rats? Any damage of rats? What can be done?
23. How does the condition of the field compare with the previous week?
24. What do you expect will happen next week?
25. Are there any specific pests to monitor more carefully?
26. Considering the density of friendly insects and the density of pests, is there a need to apply insecticide? If yes is there an alternative?
27. Are there many weeds? When is the right time to do weeding?
28. What is the management plan for the next week?
29. Is it generally a healthy crop?
30. Are any incidence of downy mildew now? If there are, what management strategy will you employ? How can spreading of the disease be prevented?
31. What records will you keep for future use?
32. If you have different treatments, compare. What treatment would you recommend in the future?
33. Were last weeks decisions made effective?
34. Based on your observations, what experiments like insect zoo or disease culture would you make now to learn more?

Early and Late Vegetative Stages

1. Have the plants recovered from pest damages during the seedling stage?
2. Is there anything you will do different in the next season?
3. Are there missing hills?

4. Is the plant development as expected? (how many leaves, height, etc.)
5. Are some leaves dying? Why? Is this natural?
6. Are there defoliators? Can the plant compensate these?
7. Would defoliation studies be relevant in this crop now?
8. How is the color of the plant? Are there yellow leaves?
9. Is there a fertilizer deficiency?
10. What kind of fertilizer was applied? How much?
11. What was the method of application? (broadcasting, drenching, basal, plant specific, etc.)
12. Is there any disease in the field now? Are there mosaic and stunt diseases?
13. How can it be managed or controlled?
14. How can spreading be prevented?
15. Does it influence yield qualitatively or quantitatively?
16. What is the effect of the weather on the growth of the plant?
17. Is the rain needed now?
18. What kinds of natural enemies are present in the field?
19. What are the numbers?
20. Where did they come from?
21. What do they eat or what did they eat before there were pests?
22. Are there egg masses of pests? Are they parasitized?
23. Are there egg masses of friendly insects?
24. How does the natural enemy population compare with previous week? Was the field sprayed with insecticide or other pesticides?
25. What is the importance of many natural enemies now?
26. What kind of pests are seen?
27. What sort of damage do the pests do at this stage?
28. What is their average population density in the field?
29. What is the main pest seen? Are there already corn borers?
30. Is there any way to prevent these from increasing in numbers in the field?
31. What is the condition of other fields in the area?
32. Do other fields influence your field?

33. How many pests can one spider eat in one day?
34. Are there any signs of rats? Any damage of rats? What can be done?
35. How does the condition of the field compare with the previous week?
36. What do you expect will happen next week?
37. Are there any specific pests to monitor more carefully?
38. Considering the density of friendly insects and the density of pests, is there a need to apply insecticide? If yes is there an alternative?
39. Are the pest and natural enemy populations increasing or decreasing compared to previous weeks?
40. What is the management plan for the next week?
41. Is it generally a healthy crop?
42. What records will you keep for future use?
43. If you have different treatments, compare. What treatment would you recommend in the future?
44. Were last weeks decisions made effective?
45. Based on your observations, what experiments like insect zoo or disease culture would you make now to learn more?

Silking and Tasseling Stage

1. Is the plant development as expected? (No. of leaves, height etc.)
2. Are some leaves dying? Why? Is this natural?
3. How is the color of the plant? Are there yellow leaves?
4. Is there a fertilizer deficiency?
5. Is there any disease in the field now?
6. How can it be managed or controlled?
7. How can spreading be prevented?
8. Does it influence yield qualitatively or quantitatively?
9. What will happen if one plant is less vigorous?
10. Can neighbor plants compensate for that?
11. What is the effect of the weather on the growth of the plant?
12. Is the rain still needed now?
13. What kinds of natural enemies are present in the field?
14. What are the numbers? (increasing, decreasing or the same?)
15. Where did they come from?

16. What do they eat or what did they eat before there were pests?
17. Are there insects that are neither pest nor natural enemies?
18. What are they doing?
19. Are there decomposers that eat dead material in the soil?
20. Are there egg masses of pests? Are they parasitised?
21. Are there egg masses of friendly insects?
22. How does the natural enemy population compare with previous week? Was the field sprayed with insecticide or other pesticides?
23. What is the importance of many natural enemies now?
24. What kind of pests are seen?
25. Are there more parasitized larvae now?
26. What sort of damage do the pests do at this stage
27. What is their average population density in the field?
28. What is the main pest seen? Are there corn borers and corn earworms?
29. Is there any way to prevent these from increasing in numbers?
30. What is the condition of other fields in the area?
31. Do other fields influence your field?
32. How many pests can spiders, ladybird beetles, parasitoids, hoverfly larvae and others eat in one day?
33. What does that say about balance?
34. What if the field is sprayed and all natural enemies die, and then there is an immigration of pests? What would happen?
35. Are there any signs of rats? any damage of rats? What can be done?
36. How does the field condition compare with the previous week?
37. What do you expect will happen next week?
38. Are there any specific pests to monitor more carefully?
39. Considering the density of friendly insects and the density of pests, is there a need to apply insecticide? If yes is there an alternative?
40. Are the pest and natural enemy populations increasing or decreasing compared to previous weeks?
41. Will spraying of insecticide be too close to harvest now?
42. What is the management plan for the next week?

43. Is it generally a healthy crop?
44. When is the expected harvest time?
45. How can you see that on the crop?
46. If you have different treatments, compare. What treatment would you recommend in the future?
47. Were last weeks decisions made effective?
48. Based on your observations, what experiments like insect zoo or disease culture would you make now to learn more?

At Maturity and Harvest

1. Select relevant questions mentioned above
2. How do you determine the right time for harvest?
3. What is the level of insects and diseases?
4. What can you do in your field from now on to prevent insect problems next season?
5. What can you do in your field from now on to prevent disease problems next season?
6. What can you do in your field from now to prevent weed problems next season?
7. Will you use the same variety next season?
8. If you have different treatments, compare. What treatment would you recommend in the future?
9. After harvest what will happen to the natural enemies?
10. What will be done different to rats next season? Is there a good community action program planned and ready to start after harvest?
11. What could you do different to improve yield next season?
12. What could you do different to improve profit next season?
13. From your agro-ecosystem analysis, can you do an economic analysis?
14. From your agro-ecosystem analysis, can you do an environmental impact analysis?
15. What records will you keep for future use?
16. How can you assist other farmers next season?

Exercise No. 2.16

COMING UP WITH A DECISION MAKING GUIDE :
WHAT ASPECTS ARE IMPORTANT FOR DECISION MAKING?

When is this exercise most appropriate?

- Towards the end of the training, to review experiences and systematize how to make a decision
- This is a brainstorming 'classroom' exercise. It is expected that everybody have experience doing weekly AESA for almost a season.

How long will this exercise take?

- 1-2 hours of the TOT or CST session.

Learning objectives

- To improve decision making capabilities
- Improve understanding of the components of the ecosystem in relation to IPM
- To develop a decision making tool

Materials

- Manila paper, pentel pens

Steps

1. Ask the large group to brainstorm: What do we need to know about to make a crop management decision?

2. Keep in mind that it is not planning the next season, it is about the situation and options you have when you are doing your weekly AESA.

3. Write each major topic as a headline on a manila paper, for example:
   - Natural enemies
   - Pests
   - Diseases
   - Weather
   - Crop
   - Weeds
   - Cultural practices
   - General

4. Then, expand by asking "What do we need to know about natural enemies?" and add it on the manila paper.

5. Each comment should be supported by a field related example about when that is the case arising from the participants experience (see examples below).

6. In TOT or CST, ask whether it would be a good exercise in FFS? Does it need adjustment there?

Some suggestions for the processing discussion

- The comments should as much as possible come from the participants. The examples relevant in this exercise will be different from crop to crop and from location to location.

- *Natural enemies :*
  a) Are there many or few? Helps to estimate if they are sovereign to the pests.
  b) What is their prey? Ladybird beetles can better control aphids than corn borer larvae.
  c) Consumption rate? One spider can eat many corn borer adults.
  d) Stage? Adult lacewings do not eat leafhoppers while their larva does, meaning that the predator effect comes in next generation.

- *Insect pests :*
  a) Number of pests : If there are few aphids at the base of the corn stalk, it might not be a problem. If many, it is a problem.
  b) The life stage : The adult moth is not a pest while the larval caterpillar is.
  c) The age or size : A small larva does not eat as much as a large one, but many small larvae might soon grow big and then eat a lot.
  d) Kind of pest : Cutworms eat corn leaf but seldom to an extent that needs control
  e) Consumption rate : Could we afford to loose that for some days and then observe again?
  f) How does the pest eat : Sucking pests, like moth, can not make holes in the leaves like biting caterpillars. Observing mouth part can tell us about the potential damage.
  g) Disease vectors : Sucking piercing scale insects do more damage as virus vectors than by sucking the sap, for example in mosaic susceptible corn varieties.

- *Disease :*
  a) Host plant resistance : Some corn varieties are less susceptible to downy mildew fungus than others. Open pollinated corn varieties are less affected by cornborers than the hybrid corn varieties.
  b) Extent of damage : A few Cercospora leaf spots are not severe in dry season but may be in wet season.
  c) Part of plant : On mature corn plants, leaf spots are not a problem on older leaves but they are if on the leaves nearest to the cob.
  d) Way of spreading : Some fungicides can prevent wind borne diseases like downy mildew when it is present in the area, while spraying is useless for soil borne diseases.
  e) History : Is it a field where the disease usually cause problems?
  f) Stage of crop : Mosaic and other corn viruses can be yield reducing if they come early but the plants get more resistant with age.

- *Weather :*
  a) Temperature : Hot weather slows down occurrence of diseases.
  b) Rain : Daily rain can suppress aphids. Foliar fungicides loose effect after rain.
  c) Field inspection : If it is late in the day when checking the field, many insects will not be seen, therefore observe early in the day.
  d) Humidity : Leaf spots are more frequent in wet and humid conditions.
  f) Wind : If there will be typhoon tomorrow, harvest today
  g) Clouds : Many clouds means less photosynthesis.

- *Crop :*
  a) Growth stage of crop : 100 aphids is a lot on a corn seedling, but not much on a mature corn crop.
  b) Part of the plant : Leaf spots in the younger active leaves is worse than on older leaves.
  c) Extent of damage : Phosphorus deficiency can affect the corn plant severely but often only few plants are affected.
  d) Healthy crops can compensate : This involves right amount of fertilizer, water, cropping system, rotations and a lot more. Healthy kids recover faster from disease than skinny ones.
  e) Age of plant : Old corn plants are more resistant to virus. Newly established crops should be insecticide free so NE's can establish also.
  f) Variety : In some corn varieties, leaf spots are not so threatening since they develop less than in other varieties.
  g) History of the previous crop or field : Cyst nematode disease of corn is soil borne, if it was not controlled since last time, it will appear severely in the field again if you use a susceptible variety.

- *Weeds :*
  a) Competition : Weeds steal too much water and fertilizer during *the critical period of competition.*
  b) Alternate host : Weeds can have negative effect when they host pests and diseases. Positive effect when they maintain the populations of natural enemies in or near the field.

- *General :*
  a) Calendar spraying : Avoid pesticide resistance by too frequent and unnecessary spraying.
  b) Price : Can influence time of harvesting. With high price, more management or control is profitable.
  c) Is it too late before harvest to spray safely?

Exercise No. 2.17

LIFE CYCLES AND FOOD WEBS

Life cycles of plants, insects and natural enemies are well known to us. The development from egg or seed to adult insect, spider or plant has been seen in the field and in the Insect Zoo.

Food chains are the interactions between plants, herbivores and natural enemies of the herbivores. The energy from one level of the ecosystem (plants) moves to another level (herbivore) along a chain of interaction.

As a facilitator working with farmers, you must begin to integrate these two motions together into a smooth acting dynamic ecosystem. Seeds germinate to be eaten by insects that lay eggs that are parasitized.

In this exercise, you will have to put the two systems together so that they are functional. This will help you to understand that interactions have a time frame. For example : the life cycle of leafhoppers all begin with an egg stage inside the plant. In the next stage, the nymphs feed on the stem or leaves by sucking. Finally, adults mate and lay eggs on the same plant or migrate to other fields. During each stage, different natural enemies attack the leafhoppers. During the egg stage, parasites complete their own egg/larva/pupa/adult in the leafhoppers' eggs and kill the eggs, and mirid bug predators suck on the eggs. During the nymphal and adult stages, hunting spiders, lady beetles, and other predators feed on the leafhoppers. Parasites and other natural enemies act the same.

This combination of interacting life cycles of the plant, leafhoppers and natural enemies is a good view of the dynamic system of the corn field. It shows also that balance is needed in the system to make each life cycle possible. For example, a spider life cycle depends on the leafhopper. If there are no leafhoppers then there will be no spiders to protect the field. In this system, insects such as leafhoppers at low population are actually very beneficial to the farmer because they are spider food; and spiders are what protect the beneficial insect from large population changes. Did you ever think that a leafhopper might be a beneficial insect to the farmer? It all depends on how many are in the field. This can be explained now by looking at how the system interacts.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions
- After at least one AESA had been conducted

How long will this exercise take?

- 1-1.5 hours of the FFS, TOT or CST time

Learning objectives

- Develop a concept of the food webs and food chains.
- Understand the importance of the food webs and food chains in relation to ecosystem and pest management.

Materials

- 'learning field'
- paper, pen, crayons and pentel pen (colored)

Steps

1. Each group should choose a guild to analyze: aphids, leafhoppers, corn borers, corn earworms, white grubs, seedling maggots, leaf feeding caterpillars, silk beetles, rats, etc.

2. Draw a large circle and write in the general stages for insects of the guild around the circle.

3. On one side, make a list of the stages of the insects in one column. In the next column, make a list of natural enemies (by guild) which attack each stage. (Show that at each life stage of a pest, there is a corresponding natural enemy with its own life cycle.)

4. On the drawing, draw a circle for each natural enemy which attacks a particular stage of the insect. On the natural enemy circle, write the stages of the natural enemy's life cycle. If there are natural enemies of the natural enemies (example, a spider that eats another spider) then make a third level of circles for these natural enemies. Follow the chains until the last organism dies and its nutrients return to the soil and is consumed by the plant.

5. After finishing the diagram, do a short role play on natural enemies and insect pests, if possible, working through whole life cycles and describe parts of predators that are important for their function as killers!

Some suggestions for the processing discussion

- Explain life cycle, food chain and food web.
- How does food web relate to biodiversity?
- How do you group different organisms involved in a food web in relation to the amount of energy consumed?
- What will happen to natural enemies if there are no insect pests?
- What is the effect of pesticide application to the ecosystem?

Exercise No. 2.18

BUILDING A WALL-WEB : SUMMARIZING OBSERVATIONS FROM LIFE CYCLES AND FOOD WEBS

When is this exercise most appropriate?

- The activity should start as soon as you have results from the first agro-ecosystem analysis (AESA) or insect zoo and/or disease culture.

How long will this exercise take?

- About 1 hour of the first FFS, TOT and CST meeting and 1 hour for the final discussion meeting, plus a few minutes each week.

Learning objectives

- To reinforce our appreciation of the way that all living things in the ecosystem are linked.
- To become more aware of how our weekly discoveries in the field, in insect zoo and in disease culture, link into the whole ecosystem.
- To discover that if one thing is absent, or is changed, all of the other components of the ecosystem may be affected via the web of interactions.

Materials

- 15 sheets of Manila paper, tape
- pens, crayons, pencils for all groups.
- drawings that were made when recording insect zoos and disease culture.
- past Agro-Ecosystem Analysis presentations

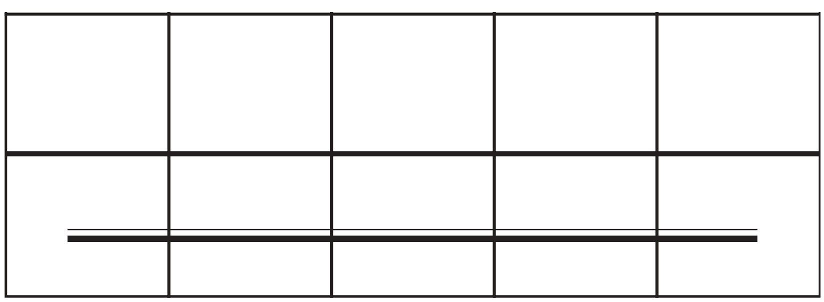
Steps

If you have wall space that you can leave the poster on :

1. Ask the group if they would like to make a big record of all the living things that we have discovered in our AESA, insect zoo and disease culture, showing all the links and relationships that we have observed.

2. Gather together all the results of the insect zoo and disease culture. Have the AESA drawings available for the group to get information from.

3. Ask one small group to cover a wall with up to 10 sheets of manila paper to make a “wall-web sheet” (as many as you have space for!). Ask them to draw a level for the soil with pen and brown crayon - something like this:



4. Ask the other small groups to make large drawings of a corn plant (1 in seedling stage, 1 early vegetative stage, etc., as many stages as you have already observed in the ‘learning-field’).

5. Get the groups to stick the corn plants on the ‘wall-web sheet’, on the soil level, in a row starting with the youngest stage. Space them out along the whole length of the ‘wall-web sheet’

6. Ask the participants to cut out the pictures of the animals and diseases that have been observed in insect zoo and disease culture:
   - Stick the drawings onto the wall-web at the stage that they first found them, try to put them near the thing that they eat (or another way if the group can find a better way to decide where to place them).
   - Use the AESA reports as a reference for information that the group needs, such as when it was observed in the field and what part of the plant it is found on.
   - The group may like to put the different stages of one animal or disease in a row or circle to show the order of development.
   - The group could even put information about feeding rates, e.g. by putting a drawing or numbers to show how much each predator has been observed to eat in a day.
   - Get the participants to use their imaginations and creativity to work out how to show the information in a clear way.

7. Draw lines on the wall-web to show the connections between the things. Get the group to discuss whether they want to use arrows : they could point from the food to what eats it, to show which stomach it goes into, or they could point from the insect-feeder/plant-feeder/pollinator, etc. to the thing that it eats. Get the group to discuss and decide.

8. As the group discovers more about the crop ecosystem, new information and drawings can be added to the wall-web. You could do this with all insect zoo and disease culture results, and any observations that have been made in the field. Facilitate the group to include only real discoveries, not guesses or speculations (*Yung segurado at hindi seguro lang!* If only *siguro lang* set up an observation to find out).

9. After around 8 weeks of AESAs, and insect zoo, and disease culture, when the crop is near maturity make the final discussion. The facilitators guide a discussion on the patterns that have been observed in the food webs of the crop ecosystem.

Some suggestions for the processing discussion

- Why do we call it a web?
- How many interactions did we discover in the web?
- What interactions did we leave out of the web? (people, animals, etc.)
- Take some examples of different things in the wall-web and see how many things would be affected if we removed it? (e.g., one small group could take 1 example each)
- How many things will be affected if we kill one stage of an insect?
- How many things would be affected if we sprayed the corn plant with a fungicide: Today? Later on in the season? Next season? (do not forget the helpful fungi, the ones which kill insects and the decomposers)
- How many things would be affected if we sprayed the corn plants with a pesticide: Today? Later on in the season? Next season?

Exercise No. 2.19

FOOD WEB OF PESTS AND NATURAL ENEMIES : BUILDING A FOOD WEB FROM OUR FIELD OBSERVATIONS AND INSECT ZOO DISCOVERIES

When is this exercise most appropriate?

- When participants are interested in starting to make a summary of their discoveries so that they can see all the linkages between insects in the ecosystem.
- The first session should be made when each group of participants has already made 2 or 3 discoveries about natural enemies and pests in their insect zoo and field observations.
- The final summary session should be as near as possible to harvest. It could be just before the field day or graduation, so that the outputs can be used as an exhibit.

How long will this exercise take?

- 1 to 2 hours for the first session.
- A few minutes each time a new insect zoo or field observation discovery is added to the web.
- 1 to 2 hours for the final summary session.

Learning objectives

- To encourage participants to make more insect zoo and field observations so that they can build a more complete ‘picture’ of the crop agro-ecosystem.
- To discover the complexity of the ‘food web’ (e.g., to see how many linkages there are between all of the insects in the ecosystem).
- To build awareness of how disturbances will affect the whole ecosystem.

Materials

For the first session :
- Manila paper, tape, pencils, pens and crayons for each group
- white paper (long or short size, 10 sheets per group)

For the final session :
- plenty of string
- tape
- drawing pins
- around 20 sheets of cartolina in 2 different colors

Steps for the first session

1. Explain that the objective of this exercise is to make a summary of all the linkages that we discover among all the insects in the ecosystem - we will do this by building a diagram called a ‘food web’ which shows what each thing is eating by connecting it with an arrow to its food. It is called a ‘food web’ because it looks a bit like a drawing of a spiders web.

2. Get the big group to make a list of all the common pests for the crops that you are growing in the FFS, TOT or CST.

3. Ask the groups to choose which pests they will work on so that all pests are shared between groups (if you have 2 or more crops you may want each group to work on the pests in one crop instead).

4. Each group makes a poster for each of their pests showing information they have collected about the ecology of the pest and natural enemies which kill it. Make the drawings of the insects on white paper so that the colors can be more realistic. The suggested format for each ‘pest poster’ is - encourage the groups to improve on this with their own ideas:

- Make a drawing of the pest on the plant, showing where it feeds and what damage it makes. Place this in the center of the poster (Reminder: it is better to draw from a specimen using a hand lens to check details of the shape and color)
- Add pictures of any other stages of the insect you have discovered - be careful to show which stages are feeding on the crop, and what other stages are doing.
- Add any information about the ecology of the pest (life cycle, feeding rate etc.) in small boxes close to the drawing of the pest.
- Add pictures of natural enemies that feed on the pest (draw from a specimen!) - if you have seen it feeding, make the drawing showing what it looks like when it is feeding on the pest.
- Draw an arrow to the pest to show that the natural enemy is feeding on the pest - show which particular stage(s) of the insect it feeds on by drawing the arrow to those stages.
- Add any information about the natural enemy (feeding rate, life cycle, preferred environment etc.) in small boxes close to the relevant drawing.
- Ask other groups if they have any additional information to add - add these by making more drawings and boxes of information where appropriate.

5. Each group presents their outputs to the big group.

6. Any additional discoveries of new natural enemies or pests or natural enemy ecologies, made in field observations or insect zoo, should be added to the poster as the season progresses. This should not take much time each week, because you can use the drawings made for insect zoo in the poster and write in details little by little.

Steps for the final session

1. Explain to the group that in this session we will join all of the parts of the food web together by linking the parts that have the same pest or the same natural enemy.

2. Pin up all of pest posters on a wall or a large board.

3. Make a cartolina label for each type of pest and each type of natural enemy that occurs in MORE THAN ONE poster. Make the pest labels in one color and the natural enemy labels in a second color.

4. Pin each of these labels onto the wall and use string to make connections from the label to all of the pictures of that insect.

5. When the web is complete, have a processing discussion.

Some suggestions for the processing discussion

- How many different natural enemies are killing each kind of pest?
- What things might we do that could disturb the food web? What parts of the food web would be affected by this disturbance?
- How many links are there between the different crops on the farm : through shared pests? through shared natural enemies?
- How many links are there between the crop ecosystem and other types of environment on the farm? (Think back to the mapping exercise on environmental preference of natural enemies)
- How many links does the web have to other animals and plants that we find in the crop ecosystem? (Think about decomposers, pollinators, non-pests, plant-feeders, weeds, the soil ecosystem...we could go on for ever!)

THE HAZARDS OF CHEMICAL (AND BOTANICAL) PESTICIDES TO HUMANS, NATURAL ENEMIES AND OUR LOCAL ENVIRONMENTS

THE HAZARD OF SPRAYING

This exercise is generally used to be followed by an extensive inputting from facilitators: Giving details of the % absorption of pesticides by different parts of the body, discussion of 'safe-use' of pesticides, discussions on types of pesticides and what they kill, even pesticide calculations.

The central learning objective in this exercise is the HAZARD. That we cannot spray without getting contaminated; and that pesticides are POISONS, so there is NO 'safe-use' only HAZARD. Thus, it is felt that we need to redirect the discussion after the spraying exercise.

In the processing discussion on contamination, it is felt that giving details of % absorption by different parts of the body is very lecture oriented. It will be more experiential if we encourage farmers to share their own experiences of contamination and sickness. There are many examples in every FFS group.

Exercise No. 2.20

NEW DESIGN FOR INSECT EXPERIMENTS

Many facilitators have found that the old procedure for observing the effects of pesticide on natural enemies is too complicated for farmers field schools. There were so many things to observe and discuss, that it was difficult to focus on the main learning objective of the exercise.

The previous method in widespread use was to use up to 5 different pesticides of different color labels. The problem with this is that many people start to think that the pesticide label color tells us how safe the pesticide is for natural enemies. In fact the labels tell us which ones are relatively less poisonous to warm blooded animals and humans.

A much simpler exercise is presented here, which focuses on the most important learning objective of the insect experiment, that is:

"To discover that pesticides kill natural enemies."

The exercise uses a green-label insecticides to show that even though it is less toxic to humans and warm-blooded animals, it is designed to kill insects, and so it kills insect natural enemies!

The comparison of the effects of pesticides on pests and natural enemies is deleted, because the comparison is not really appreciated by farmers. They already know that pesticides kill pests!

Fungicide and botanical pesticides are also added to the exercise as test materials, to allow farmers (and some facilitators!) to discover that fungicides and botanical pesticides can also kill insect natural enemies. It also helps us to remember that fungicides kill helpful fungi. If the farmers in your area also use herbicides on a regular basis, add HERBICIDE as a fourth treatment in the experiment.

When is this exercise most appropriate?

- When farmers are interested to discover more about pesticides (including botanicals) or where farmers use them or express interest in using them.
- When the group has already discovered in insect zoo that a number of insects are natural enemies.

How long will this exercise take?

- 3 hours of an FFS meeting, plus 5 minutes observation daily until the next meeting.

Learning objectives

- To discover how much pesticide we are contaminated with when spraying pesticides and botanicals.
- To share experiences and build awareness of the effect that these chemicals have on the health of farmers and their families.
- To discover that pesticides kill natural enemies.

Materials

Preparation (Collecting Insects for the Experiment) :
- 1 or 2 aspirators per group (do not forget the tissue in the base of the pot to stop the insects from being concussed!)
- fine hair paintbrush per group
- collection pots
- sugar solution soaked into small balls of tissue (for feeding parasites)

Part 1 (Spraying Exercise Using Dye) :
- knapsack sprayer
- water-based dye
- water

- container to mix dye and water in
- crepe paper & tissue paper
- tape
- manila paper and pens (for processing discussion)

Part 2 (Insect experiment) :

- 15 plastic pots (large brittle jar size) with cotton/ rubber bands covers (this is in addition to the insect collecting pots)
- 3 hand-held sprayers (or 4 if you will include herbicide treatment)
- 2 pairs of gloves
- 2 protective aprons
- 2 eye masks
- 1 green-label pesticide that is commonly used by the farmers
- 1 fungicide botanical preparation that is commonly used by the farmers
- 1 herbicide that is commonly used by farmers (if they use herbicides)
- 1 milliliter (1 ml) dropper (bought from a pharmacy)
- an empty 1 liter bottle (coke or similar)
- plenty of water and detergent soap
- manila paper and pens (for processing discussion)

Steps before you do anything

1. Collect insects in preparation for the insect experiment during the weekly observation of the 'learning-field'.

2. Each group needs to collect 15 individuals of 1 kind of natural enemy. Arrange it that each group collects a different kind of natural enemy.

   Reminders :
   - Be gentle when collecting insects!
   - Use aspirators for small delicate insects like parasites and fine hair paint-brushes for handling small soft insects like worms (caterpillars) and whorl maggot larvae.

- For crawling insects like lady bird beetles, the best way to collect is to knock them gently from the plant into a container.
- Do not forget to provide some food for the insects: Sugar solution for parasite adults, prey for the predators and fresh leaves for the plant feeders.
- Keep the insects in a cool place while you do the spraying exercise, or they will all be dying by the time you start the experiment!

Steps for spraying exercise using dye (Part 1)

1. Start this exercise in the field. Ask for 1 volunteer, who is happy to spray some water-based dye in some plants, and 2 others to help him or her. All that the other participants have to do is to observe carefully at all stages.

2. Cover the volunteer participant with white crepe paper and tissue from head to foot (including his or her face, hands and feet). Have a bit of space to breath and see through. Leave the hands as mobile as possible.

3. Get another participant to help the volunteer prepare the dye in water, and to fill the sprayer tank.

4. The ‘mummified’ volunteer sprays the dye onto some plants, first on the base of the plants to simulate sprays on corn borer, then on the upper portion of the plants to simulate sprays on leaf feeding insects. Ask the spray volunteer to act just as if spraying a real pesticide, walking up and down, even to pretend that the nozzle is blocked, and to clear it. Make sure the whole tank of dye is used up before the spraying is stopped.

5. Get the observers to inspect the sprayer carefully and to note all the places where the dye has colored the paper. Take note also of the precautions observed by the volunteer during spraying.

6. Return to the ‘classroom’/shade to process the groups’ observations.

Some suggestions for the processing discussion (Part 1)

- Where did the dye contaminate the farmer who was spraying?
- At what stages of the spraying did the farmer get contaminated?
- What ways do local farmers use to protect themselves from the spray? Does this work?
- Is it possible, in practice, to protect yourself from contamination?
- Is ‘safe-use’ of pesticides possible?
- How do we feel after we have been spraying pesticides? Share as many experiences as possible.
- What effect does this pesticide contamination have on our health in the long term? (Are their any local experiences?)
- Who else is at risk of being contaminated by the pesticide when you spray the fields?
- Do any of the women in this area spray when they are pregnant? What effect could this have on the baby that she is carrying?
- What other ways can we think of that pesticides might be contaminating people or animals (e.g., drinking water, drifting sprays, etc.)?
- What effects do pesticides have on pigs, chickens and other warm blooded animals? (It may be appropriate to discuss the labeling of pesticides here : that the color banding tells us which ones are most dangerous to warm blooded animals and humans)
- What effects do pesticides have on other animals that we would like to conserve (e.g., fish, birds, etc. and natural enemies)? This leads us into the insect experiment to discover the effects of pesticides on natural enemies.

Steps for insect experiment (Part 2)

Important to Note : Please do this experiment outside in an open place with plenty of air movement to prevent the group from getting headaches and nausea as they may be poisoned by the fumes of the pesticides!

1. Ask the group if they want to do an experiment to see what happens when we spray the insects.

2. Ask each group to take 3 brittle jars. Put 5 individuals of their natural enemy species into each jar.
3. Each group labels 1 jar each: INSECTICIDE, FUNGICIDE, WATER plus the group name, and the type of natural enemy that is in the jar.

4. Get the big group to design a simple table in which they can note for each jar:
   - What kind of insect was put in the pot?
   - How many insects?
   - What they were sprayed with?
   - How long after spraying the insects are being observed?
   - How many are alive and healthy?
   - How many are alive but look sick?
   - How many are dead?
   - Any other observations.

5. All the groups need to do the water treatment first to prevent contamination with the pesticides. Simply spray the insects with the water, then put in an unsprayed dry leaf (so that the insects have somewhere dry to rest while they dry off) and some food (prey or sugar solution on a ball of tissue).

6. Now, prepare the insecticide and fungicide solutions. Remember to take extreme care with these poisons!!

Get 2 volunteers (or facilitators if you have no volunteers) to be the 'Poison Handlers'. They should wear gloves, a protective apron and a mask when handling the pesticides. Have plenty of soap and water for them to wash in afterwards. Keep the pesticides and pesticide contaminated water away from water sources and irrigation.

Note that a simple way to work out the dilution for the pesticides might be :

- Ask the farmers how much of the pesticide they usually add to a 16 liter spray tank OR use the rate given on the pesticide bottle. You can let the group decide.
- Take the 1 liter bottle and fill it 1 quarter full with water. It now contains 250 ml water.
- The amount of pesticide to add to the hand sprayer is calculated by dividing the amount for a 16 liter tank by 64 (because there are 64 times 1 quarter liters in a 16 liter tank).
- Use the 1 ml dropper to measure the small volume of a liquid chemical.
- Make sure you wash the dropper very well before using for a second chemical.
- For powder chemicals 1 gram can be approximated to a heaped pile of powder about 1 cm x 1 cm on the base.

8. Get the 'Poison Handlers' to spray the FUNGICIDE labeled insects with fungicide. Then put in an unsprayed dry leaf and some food (prey or sugar solution on a ball of tissue).

9. Lastly, do the insecticide treatment. Get the 'Poison Handlers' to spray the INSECTICIDE labeled insects with insecticide. Then put in an unsprayed dry leaf and some food (prey or sugar solution on a ball of tissue).

10. Wash all poison-contaminated equipment, protective clothing and hands very carefully with detergent soap and water.

11. Observe the insects after 5 minutes, 1 hour and then after every hour until the FFS ends. At each monitoring time observe and note the following :

    - How long after spraying the insects are being observed?
    - How many are alive and healthy?
    - How many are alive but look sick?
    - How many are dead?
    - Any other observations.

12. Discuss what happened to the insects.

Some suggestions for the processing discussion (Part 2)

- What effect did spraying with WATER have on the natural enemies?
- What effect did spraying with FUNGICIDE have on the natural enemies?
- What effect did spraying with INSECTICIDE have on the natural enemies?
- Why did we look at the effect of the water spray as well as the chemical sprays? (to check that it really is the chemical that had the effect, rather than the way we handled the insects, or the effect of the water spray)

Exercise No. 2.21

GUIDED DISCUSSION AND SHARING ON THE 'WHY' AND 'WHAT' TO RECORD : KEEPING RECORDS OF FARM ACTIVITIES

The usual way to do this exercise in past FFSs was to start by asking farmers what records they think would be useful to keep. Although this is very participatory, it is not discovery-based, because the exercise starts by *assuming* that record keeping is useful.

In this exercise we try to start with the questions of what profit farmers made last year, this allows the farmers to share what records they usually keep. The sharing discussion allows farmers to decide whether they might find it useful to keep more records than they currently do.

When is this exercise most appropriate?

- Early in the FFS, so that farmers are aware of why they keep careful records of production and labor costs in the learning field experiments.

How long will this exercise take?

- 1 - 2 hours of an FFS meeting

Learning objectives

- To build awareness of the value of keeping records of production costs and market price, when they are used as a basis for calculating profit or loss, to see the results of your decisions.
- To agree on a list of inputs and costs to record in the learning field experiment, for use in assessing and comparing the profits from the 2 treatments (e.g., IPM and Farmers' Crop Protection).

Materials

- examples of records kept by the farmer participants (Note : Ask farmers to bring in any examples of records that they keep for their farm)
- manila paper
- pens and tape

Steps

1. Arrange the participants in a circle for sharing.

2. Start a discussion that explores how farmers estimate how much profit they make. Here are some suggested guide questions :
   - Who made a good profit last year?
   - How did you know that you made a profit?
   - Do you keep any written records of what your spending, earnings and profits? What kind of records do you keep?
   - How much money and time do you spend on production?
   - How do you calculate what you spend (e.g., by counting the PESOS or by counting the sacks of fertilizer and bottles of pesticide)?
   - How much did each of you get for your produce last year?

3. Guide the discussion to explore what profits might have been made if farmers had made different decisions about the amount of inputs they used. Here are some suggested guide questions :
   - How many kilos of corn grains did you have to sell to pay for the pesticides or fertilizers that you bought?
   - What else could you have used that money for?

4. Guide the discussion to explore what information the group will need to record in order to compare the profit that is gained for the IPM and the Farmers' Crop Protection (FCP) practice plots of the 'learning-field'. Make a list of all the information that the group wants to record.

Some suggestions for the processing discussion

- There is no extra processing, because the exercise is a discussion.

3 Soils and Agronomy Topics

Exercise No. 3.01

LAND PREPARATION :
THE 'HOWS', 'WHYS' AND 'WHATS' OF LAND PREPARATION

One of the factors that affect plant growth is land preparation. Properly prepared fields promote good root development and better weed, pest and disease management.

Thorough land preparation is a key to good crop establishment . It allows decomposition of plant residues, prevents weed growth and improves soil tilth for better root development and absorption of nutrients.

When is this exercise most appropriate?

- During the first three week of the FFS, TOT and CST sessions.

How long will this exercise take?

- 30 minutes for field observation
- 2 hours for hands-on exercises on land preparation
- 1.5 hours for brainstorming and participatory discussions in small and big groups.

Learning objectives

- To have a feel of how land preparation is actually done in the field;
- To improve understanding of land preparation in relation to growing a healthy crop; and
- To know advantages and disadvantages of land preparation practices.

Materials

- Field ready for land preparation
- Tractor, carabao, plow and harrow
- Manila paper and marker pens

Steps

1. Each participant should individually do plowing or harrowing by the use of carabao or tractor-drawn implements to have a feel of the activity before proceeding to the succeeding activities.

2. Brainstorm in the big group about important things to observe on land preparation in the field. Make an agreement and write it down. It may include, but not limited to, the following :
   - How is the presence of weeds?
   - Is seed germination even?
   - Is the crop healthy? Is it well established ?
   - Is the field prepared in beds?
   - Does land preparation have influence on irrigation and drainage?
   - When was it prepared? Why at that time?
   - Is the weed, pest and disease management considered when planning for land preparation?

2. Go to the field and observe a newly planted area. Different groups might be assigned to different crops and areas.

3. Ask the farmers about their practices in land preparation.

4. Give 30 minutes to prepare a presentation of the output.

5. Present the results to the big group and discuss it.

Some suggestions for the processing discussion

- What is good land preparation? What are the importance of thorough land preparation? What are the characteristics of a well prepared corn field?
- When is the best time to do the first plowing and succeeding harrowing? What is the importance of straight furrowing?
- What are the advantages and disadvantages of frequent or intense land preparation?
- How does land preparation influence the growth of weeds?
- How does land preparation influence crop germination?
- How does land preparation influence crop establishment?
- How does land preparation influence drainage?
- How does land preparation influence irrigation?
- How does land preparation influence soil erosion?
- What will timing of land preparation influence?
- How can land preparation help in weed management?
- How can land preparation help in pest management?
- How can land preparation help in disease management?

INTEGRATED NUTRIENT MANAGEMENT

Exercise No. 3.02

HANDS-ON AND SHARING :
SOIL SAMPLING AND ANALYSIS

Correct soil sampling and accurate soil analysis would help in attaining the right amount of fertilizer to be applied to have good yield. However, this is not usually done by farmers because of its complexity. Hence, this exercise would let them know and acquire skills in proper soil sampling and soil analysis through rapid and reliable test like the soil test kit (STK).

When is this exercise most appropriate?

- In the FFS, TOT and CST sites before land preparation or at least before the last harrowing in the learning field.
- In the FFS site, where soil analysis has not been conducted during the last five years or when farmers want hands-on exercise on such activities.

How long will this exercise take?

- 1.5 hours for brainstorming and participatory discussions in small and big groups.
- 30 minutes sampling in the field and 1 hour analysis in the shade

Learning objectives

- To acquire knowledge, skills and experience on how to collect soil samples and analyze by using soil test kit (STK).
- To determine and compute fertilizer requirement in the area.
- To be able to know the right amount of fertilizer needed by a particular crop.

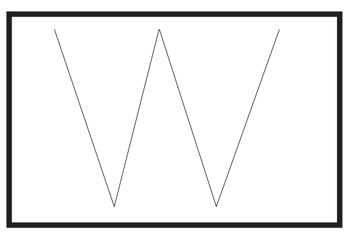
Materials

- soil test kit (STK) and soil samples
- bolo and shovel
- plastic pail and plastic bags
- pentel pen and ball pen
- manila papers , etc.

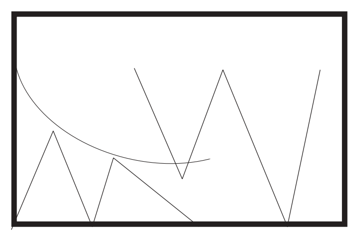
Steps

1. Each group will go to the field and randomly collect 20 sub-samples following the illustration. Get 1 kg. composite sample.

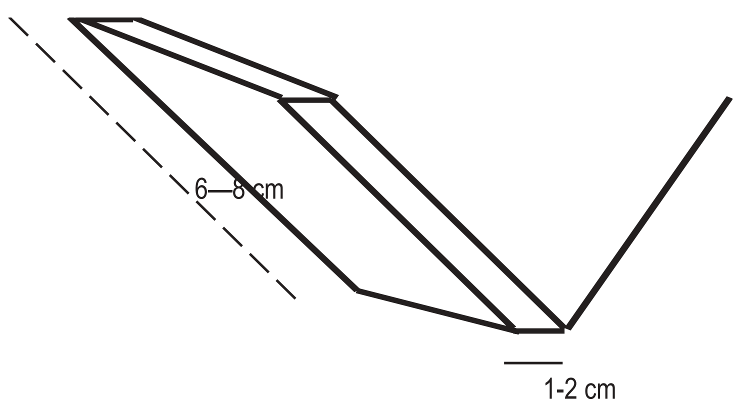
a. Flat area



b. Undulating area



1.0 Ha. = 20 samples to make 1 composite sample of 1 kg.



Notes on Soil Sampling :

- Conduct first a participatory discussion on how to get soil sample (steps, do's and don'ts). Ask the participants about how they are going to do the activity.
- Go to the field and have an actual exercise in getting soil samples.

2. Analyze the composite sample through soil test kit (STK). Refer to STK guide.

   Notes on Soil Analysis :

   - Each group will be given a soil test kit (STK) to be used for soil analysis
   - Follow the procedures as indicated in the guide
   - Compare the results to the colored chart in order to determine the result
   - Present the result for big group discussion3. Compute the fertilizer requirement in bags per hectare based on soil analysis.

4. Present result to the big group.

Some suggestions for the processing discussion

- What are the steps in collecting soil samples?
- What are the materials needed?
- What is the importance of collecting soil samples?
- What are the do's and don'ts in collecting soil samples?
- How will you get sample in an area having different slopes?

Exercise No. 3.03

HANDS-ON AND SHARING : USING THE SOIL TEST KIT AND UNDERSTANDING THE DIFFERENT TYPES OF FERTILIZERS

When is this exercise most appropriate?

- Early in the FFS season before the learning-field land preparation is started.
- When the farmers want to learn more about how they could decide how much fertilizer their soil requires.

How long will this exercise take?

- About 2 hours of an FFS meeting

Learning objectives

- To share experiences of using different types of fertilizers.
- To understand that different types of fertilizers contain different nutrient elements and have different effects on soil structure.
- To build awareness that different fields may have different fertility or acidity, so they would need different amounts of fertilizers or lime.
- To experience using the soil test kit to analyze the fertility and acidity of the soil.

Materials

- farmers' samples of different types of fertilizers that they use. (Note : Ask farmers to bring some samples of different types of fertilizers that they use)
- digging tools (e.g., shovel/bolo/grab hoe)
- 6 large plastic bags

- 5 Soil Test Kits
- manila paper and pentel pens

Steps

1. Ask farmers to show the samples of fertilizers that they have brought to the meeting. Get the farmers to share their knowledge about the different kinds of fertilizers. You could do this by small group discussions with presentations, or perhaps the Round-Robin technique (e.g., go around the circle of participants asking each farmer in turn if they want to say something). Some suggested guide questions :
    - What different kinds of fertilizers do we have? (The group could do this by sorting the fertilizer samples on some sheets of manila paper laid on the floor in the middle of the circle of farmers).
    - What nutrient elements do you get from each kind of fertilizer?
    - What are the differences between the natural (organic) and the chemical (inorganic) fertilizers?
    - How does the soil look after using chemical fertilizers? How does the soil look after using inorganic fertilizers?

2. Go on a field walk. Visit a number of different fields with different crops and different types of soil. Share farmers ideas and experiences of deciding how much fertilizer to use. Some suggested guide questions :
    - How much fertilizer would you use for this field?
    - How do you decide how much fertilizer to use?
    - Do different people use different amounts of fertilizers? Why?
    - Would you use a different amount of fertilizer for the same variety in different fields? Why?
    - Which of the soils that we have seen today is the most fertile?
    - What things did you look for to assess the fertility of the soil?
    - How much does fertilizers cost? How much money would you save if you found that you could use less fertilizers?

3. Ask the farmers if they want to try using the Soil Test Kit (STK) to find out how fertile their soil is, and to use this as a basis for deciding how much fertilizers to use.

4. Go to the 'learning field'. Explain that you will take a sample of soil from the field to measure the amount of fertility and acidity of the soil. Show the group how to take a sample, then let each group take their own samples for the whole 'learning-field' (If they prefer, the groups could take samples from different field so that they could see if there is any variation in fertility between fields).

5. Return to the 'classroom'/shade. Copy the steps for the soil analysis onto a manila paper. Distribute 1 Soil Test Kit (STK) to each group.

6. Facilitators guide the small groups to do the soil analysis by carefully following the steps from the manila paper or from the STK instruction leaflet.

7. Each group prints their results on a manila paper to share with the big group.

   <u>Reminder on how to take a soil sample :</u>

   a) You need a large plastic bag and a shovel.
   b) Dig a V-shaped hole, as deep as the shovel head.
   c) Cut a 10 cm thick slice of undisturbed soil at one side of the V.
   d) Remove the side of the slice so that you keep only the middle portion of the sample.
   e) Remove any large bits of stone and organic matters (e.g., twigs, leaves, roots, etc.).
   f) Put your sample into the plastic bag.
   g) Take 4 or more samples spread randomly across the whole field and put them into the same plastic bag.
   h) Mix the soil samples thoroughly.
   i) Label the plastic bag so you can remember where the samples came from.

Some suggestions for the processing discussion

- How much of each nutrient is found in the soil of the 'learning-field'? Is the soil acidic (low pH) or alkaline (high pH)?
- If you went to another field do you think you would find the same result or a different result?
- Do you know what rate of fertilizer DA recommends for different types of crops? Show the group the list of nutrient requirements for different crops. Explain that now we know the amount of nutrient in the soil, we can work out how much extra to make up the total amount of nutrients that the recommendation says is needed by the crop. This will be done in the following week.
- If the soil is acidic or alkaline, what cultural or amelioration practices will you undertake? Facilitate farmers to share their own experiences in addressing soil acidity and alkalinity problems. Make a list of the aggravating factors leading to soil acidity and alkalinity based from farmers' experiences and your own technical knowledge about the problem. Make also a list and agree on possible corrective measures that farmers can implement in their own farms.

Exercise No. 3.04

SIMPLE POT EXPERIMENT AND SHARING WITH FARMERS ON N, P, AND K FUNCTIONS : NUTRIENT AND PLANT HEALTH

When is this exercise most appropriate?

- After the exercises on different types of fertilizers and the use of the Soil Test Kit.
- When the farmers are interested to discover more about what plants use the nutrients for and what nutrient deficient plants look like.

How long will this exercise take?

- On the first FFS meeting, I hour for the field walk plus 1 hour to set up the pot experiment.
- A few minutes every day, for 2 or 3 weeks, to care for the potted seedlings.
- 1 hour of an FFS meeting for the final processing.

Learning objectives

- To familiarize farmers with the way in which plant health is affected by the nitrogen (N), potassium (K) and phosphorous (P).
- To familiarize farmers with the appearance (symptoms) of plants when they have sufficient or insufficient nutrients.

Materials

- Fields with healthy crops that have sufficient nutrients and other fields where the nutrients are deficient (try to find a corn field planted to several varieties or cultivars for this exercise). Facilitators will need to scout for suitable fields in advance of the FFS meeting.

- 25 healthy corn seedlings, similar in sizes as is possible.
- 25 small plant pots or plastic bag/fun-juice bags suitable for growing seedlings in.
- Enough sand to fill the 25 pots. (You could choose to use an N, P and K deficient soil if you prefer, but you will probably find it difficult to find a K-deficient soil in the many corn growing areas).
- 5 pails or other containers to hold water for washing the seedlings.
- 5 containers to keep washed seedlings with their roots intact.
- 25 small plastic or bamboo sticks, to make labels for the pots.
- Pentel pens

Steps

1. Go on a field walk to the different fields.

2. In each of the fields that you visit : Ask the participants to work in small groups for 10 minutes, discussing and recording what they can observe about the health of the plants (color, size, texture, other comments). After the observation, have a sharing of what the farmers observed. Some guide questions:
   - How healthy are the plants?
   - What things did you observe to help you decide how healthy the plants are?
   - Do you think the plants have enough nutrients?
   - If yes, what kind of fertilizer do you think the plants need?

3. When you have visited all of the fields and finished the sharing of farmers knowledge and experience, ask the group if they want to find out what a plant looks like if it does not have enough of a particular kind of nutrient?

4. Return to the FFS 'classroom'/shade to set up an experiment in which seedlings are grown in sand with one of the 3 main nutrients missing. Each group sets up one treatment. There will be 5 treatments :

- seedlings potted in sand with P and K but no nitrogen
- seedlings potted in sand with K and N but no phosphorous
- seedlings potted in sand with N and P but no potassium
- seedlings potted in sand with all nutrients (N, P and K)
- seedlings potted in sand with no nutrients (total starvation)

5. Set up the pots with sand and fertilizers. You can use the recommended fertilizer rate in your locality as the basis for calculating the amount of fertilizer for your pot experiment. Simply calculate the amount of fertilizer required per plant using the standard distance of 25 cm x 50 cm between hills so that you can calculate the amount of fertilizer required per pot or plant.

6. Dig the seedlings up very carefully. Try not to disturb the roots too much. Clean the roots by washing gently with clean water. Keep the seedlings with their roots until you are ready to plant them in the sand. Do not forget to label the pots!

7. Start assessing the growth response of the potted plants to the fertilizer treatment once a week until substantial observations are obtained to compare differences among the treatments.

8. Care for the seedlings can be done by either asking 1 volunteer farmer-participant (if not the cooperator) to look after all the seedlings at the FFS site (better experimental design), or each one to take home and care for potted plants (more participatory).

9. Process the results by letting the groups bring their plants and putting them at the center of the circle. Group the seedlings for each treatment. Make a visual assessment while the plants are in the pots. Compare the color of the seedlings, the size and the stage of development. Rather than doing a lot of complex measurements and spending much time calculating means, get the group to come up to a consensus about their assessment. If there are disagreements, let participants explain

and discuss their ideas. Make a list of the group's observations on a manila paper that everyone can see.

10. Making a consensus about the big differences that we can see is often more useful than making lots of measurements and calculating averages. This is because it is the BIG differences we are interested in and not whether there is an average of 1 millimeter difference between the treatments. Some suggested guide questions :
    - Which treatments have the greenest leaves? Which treatments have the least greenness in the leaves?
    - Which treatments have the largest leaves? Which treatments have the smallest leaves?
    - Which treatment has the most leaves? Which treatment has the smallest number of leaves?
    - Which treatment has the thickest stems? Which has the thinnest stems?
    - Which treatment has the tallest plants? Which treatment has the smallest plants?
    - Which treatment has the most juicy/firm leaves and stems? Which treatment has the least juicy/firm leaves and stems?
    - Can you see any other differences between the appearance of the plants in the different treatments? What are these? It may be that for some of the questions, all of the treatments look the same. If so, then do not try to say which treatment is more or less, just note that they are 'ALL THE SAME'.
    - Similarly if there are 2 treatments that are highest or 2 treatments that are lowest, then write down both of the treatments.

- You might find it useful to put the results in a table like this:

TREATMENT / OBSERVATION	Without N	Without P	Without K	Without N, P and K	With N, P and K
SIZE OF LEAVES	big	big	small	small	
GREENNESS	least green		least green		most green
STEM THICKNESS		all the same			
OTHERS	-	-	-	-	-

11. Carefully remove the plants from the pots and gently wash the sand from the roots. Lay the plants in rows on manila paper - label the treatments. Again, make a visual assessment by group consensus and list the group's observations.

    Some suggested guide questions:

    - Which treatment has the longest roots? Which treatment has the shortest roots?
    - Which treatment has the most 'bushy' roots? Which treatment has the least 'bushy' roots?
    - Which treatment has the most juicy/firm roots? Which treatment has the least juicy/firm roots?
    - Can you see any other differences between the appearances of the plants in the different treatments? What are these?
    - Use the table or list of observations in a summary/processing discussion.

Some suggestions for the processing discussion

- What was the appearance of the plants which had none of the 3 elements?
- What was the appearance of the plants which had all elements?
- What was the appearance of the plants which had no nitrogen? What does this tell us about what the plant is using the nitrogen for?
- What was the appearance of the plants which had no phosphorous? What does this tell us about what the plant is using the phosphorous for?
- What was the appearance of the plants which had no potassium? What does this tell us about what the plant is using the potassium for?
- How could we use these discoveries when we are monitoring the health of the plants in our fields?

Additional notes :

We could include micro-nutrients in this experiment, too. Perhaps by adding some compost or liquid compost extracted from composted materials (mix compost with water in a bucket and let it stand for a week). Then, the treatments would be :

- with compost, P & K but no nitrogen
- with compost, K & N but no phosphorous
- with compost, N & P but no potassium
- with N, P & K but no compost
- with all nutrients (compost, N, P & K)

The problem is working out how much compost to use, and knowing if the N, P and K in the compost are sufficiently low to see an effect of low N, P & K.

Exercise No.3.05

FIELD WALKS AND EXERCISES ON SOIL CONSERVATION : PREVENTING SOIL EROSION AND CONSERVING SOIL ECOSYSTEM, STRUCTURE AND FERTILITY

When is this exercise most appropriate?

- In the FFS, TOT and CST Courses
- As a component of INM topic

How long will this exercise take?

- 30 minutes fieldwalk, 30 minutes small group discussion and another 1 hour big group discussion. Another 1 hour and 30 minutes may be utilized for follow-up exercises.

Learning objectives

- To build awareness of how we can conserve the soil fertility, soil ecosystem, and soil structure and prevent soil erosion.

Materials

- A number of different fields:
  a) Where you can see that the soil is being eroded in the field (e.g. where the plots are not contoured).
  b) Where large scale erosion can be seen (e.g., where you can see big slides and gully erosion, like valleys cut into the soil by the water).
  c) Where soil erosion is prevented (e.g., where the plots are contoured).
  d) Where soil structure is poor.
  e) Where soil structure is good.

f) Where composted weeds, stubbles or rice straws are utilized as source of soil nutrients.
g) Where there is very little organic matter in the soil.

- Notebook and pen

Steps

1. Go on a field walk and ask the participants to observe the soil in a number of different fields.

2. Assign each small group to brainstorm and summarize observations in a field or several fields.

3. Present to the big group all observations by the small groups in each field for further brainstorming and additional inputting.

4. Summarize all observations.

5. Design discovery-based exercises on soil conservation :
    - Simple percolation experiment in plastic cups with soil to measure the time taken for a fixed volume of water to percolate through and thus, show that better soil structure will holds more water).
    - Soil ecosystem observation to compare the diversity of living and non-living things of a well and not well conserved soils.
    - Green manuring and other organic fertilizer observation tour to understand their effects on erosion and soil ecosystem?

Some suggestions for the processing discussion

- Why is there soil erosions in some of the areas and there is none in some areas?
- Aside from contour farming, what other practices have you observed that can minimize or prevent soil erosion?
- What is soil fertility? Why are some soils very fertile and others are less fertile? What cultural practices did you observe that improved soil fertility?
- In your observation, how can the soil ecosystem contribute to conservation of soil fertility?

MORPHOLOGY AND GROWTH STAGES OF CORN PLANT

Morphology (or anatomy) and function are closely related. A nose has holes (morphology) so that air can enter the body (function). A corn plant's morphology is important to study to understand the function. The vessels in the leaf (morphology) are important for transport of water, nutrients and systemic pesticides (functions). Each week during the crop growth, you will collect, observe and draw plants. Use a magnifying glass (or microscope if readily available) for better observations. The micro view of the leaf surface is fascinating as are all other parts of the plant. Drawing is a tool to assist in observation, remembering and for recording what you have seen. Try to spend time to make detailed and well labeled drawings.

You will find that a deep understanding of the morphology and growth stages of the corn plant is the first step in understanding the effects of disease and insects on the corn plant. You will also find out why not all injury caused by diseases, insects and rats results in yield loss. Plant compensation is important for reducing the effects of injurious organisms (including farmers walking in the field).

Exercise No. 3.06

FIELD WALK AND BRAINSTORMING : OVERVIEW OF THE MORPHOLOGY AND GROWTH STAGES OF THE CORN PLANT

When is this exercise most appropriate?

- Before the conduct of the first agro-ecosystem analysis (AESA)

How long will this exercise take?

- One to one and a half hour of the CST, TOT or FFS meeting

Learning objectives

- To provide the participants an overview of the morphology and growth stages of the corn plant.
- To provide the participants general ideas on changes that occur on the corn plant at various stages of growth and development.

Materials

- Field with different growth stages of corn plant
- Manila paper, pentel pens, and crayons for each group.
- Meter stick and magnifying lens for each group

Steps

1. Each group will be assigned a distinct crop growth stage to observe and collect in the field.

2. Brainstorming in small groups will be done on observations regarding a particular growth stage.

3. Each group lists down their observations and draw all recognizable plant parts from the collected specimen.

4. Each small group presents their output to the big group to compare and consolidate observations for each growth stage.

5. Facilitate a discussion on understanding the changes in plant parts at different growth stages of the corn plant and relate to cultural management practices.

Some suggestions for the processing discussion

- Collect specimens of corn plant at seedling and tillering stages and discuss their growth and development. Collect corn plant specimens at stem elongation and ear shoot initiation and discuss their growth and development.
- Collect corn plant at flowering, milk, dough and mature grain stages and discuss their growth and development.
- At what stage of the corn plant is most sensitive to stress such as low and high temperature? Why?
- What are the pests that are commonly observed during the different growth stages of the corn plant?
- What is the importance of knowing the morphology and growth stages of the corn plant?

Note

The different plant parts at various stages of crop growth will be discussed in general including topics on critical phases of its growth and development. This field exercise will be reinforced by detailed discussion at the learning fields while the participants are exercising the weekly agro-ecosystem analysis (AESA).

Exercise No. 3.07

FIELD OBSERVATION AND SHARING :
THE CORN SEED AND CORN PLANT AT SEEDLING STAGE

Under adequate field conditions, the planted seed absorbs water and begins growth. The first root (radicle) is the first to begin elongation from the swollen seed (kernel) followed by the first leaf (plumule) and then the three to four lateral temporary (seminal) roots. Emergence is finally attained by rapid elongation the false stalk (mesocotyl) which pushes the first leaf to the soil surface. Under warm, moist conditions, plant emergence will occur within 4-5 days after planting (DAP).

Upon emergence and exposure to sunlight, the rapidly developing leaves then grow and development of the above-ground parts follows. The first set of more permanent (nodal) root system begins elongation from the first node, and progressively up to 7-10 nodes during the succeeding leaf formation. This root system becomes the major supplier of water and nutrients to the plant up to the sixth leaf stage.

At the third leaf stage, the growing point (stem apex) is still below the soil surface and that very little stalk (stem) elongation has occurred. Root hairs are growing from the nodal roots by this time. All the leaves and ear shoots are being formed now. At about the fifth leaf stage, leaf and ear shoot initiation will be completed and a tiny tassel is initiated at the tip of the growing point just under or at the soil surface.

The early growth of the corn plant has several characteristics which reduce the effect of leaf damage. Leaf growth is rapid but the leaves die and are replaced quickly. The benefit of quickly changing of leaves is that leaves infected with disease or damaged by insects early in the season are quickly replaced. During the first few weeks after seedling emergence, damage to the plant will not create a substantial yield loss. The plant 'recovers' because new leaves are being formed quickly.

However, good management is important to insure rapid and strong leaf development. For faster germination and emergence during the wet seasons, shallow planting takes advantage of the more favorable soil temperatures near the soil surface. During the dry season, soil temperatures are generally more favorable at deeper planting and soil moisture content becomes the limiting factor for rapid growth. Seedlings should have strong stems at emergence. This can be insured by good seed, an optimum density of seed at planting, sufficient fertilizer and water. After emergence, soil fertility from basal or sidedress fertilization and good water supply are needed to maintain continuous growth. Growing a healthy crop reduces the effect of damage by diseases and insects.

When is this exercise most appropriate?

- Best time is before planting in the mainfield.
- When seed and seedling morphology exercises are to be done.
- When seeds of questionable quality are to be used.

How long will this exercise take?

- One and a half to two hours for setting-up, presentation and participatory discussions.
- Daily 15 minutes for observations for one week

Learning objectives

- Explain the importance of the parts of the seed and seedling
- Explain why leaves grow and die quickly during the early vegetative stages of the corn plant.
- Explain how rapid growth of leaves and replacement of all leaves reduces the effect of insect and disease damage.
- Determine by observation and sharing the good management practices that will lead to rapid and strong growth early in the season.

Materials

- Corn seeds
- Corn seedlings at 5, 20 and 30 days after planting (DAP)
- Manila paper, pentel pens, and crayons for each group
- Ruler and magnifying lens for each group
- Pair of forceps, razor blade or scalpel

Steps

1. Collect corn seeds from stock and seedlings from newly planted fields. Take note of the number of leaves formed during at emergence and seedling stages.

2. Carefully observe the development and draw the changes in morphological structures of the corn seed and corn seedlings at different stages.

3. Make a label for the parts of the corn seed and corn seedlings (e.g., the roots, stem, Ist leaf, 2nd leaf, etc.). Cut the seed crosswise with a razor blade to observe and draw also what is inside the seed.

4. Ask the group to give a short presentation. Do not give the names of the different parts of the seeds yet. The facilitators might be able to do it later when they observe the germinating seeds.

5. Ask the participants to observe, present and discuss weekly the drawings and the observations.

Some suggestions for the processing discussion

- What is seed morphology? What morphological structures can you identify in the corn seed? Are there differences in size and shape?
- How long time did it take to for the seeds to germinate? What is the relationship between the seedcoat and the time to germinate (thickness)? Are the seeds dormant?
- Can you distinguish the endosperm and the embryo? What are their significance in seedling development?
- How many leaves are there on the plants at different ages? Are there any leaves that are dying? Is it usual for the leaves to die? If leaves are damaged, what action should be taken for each age?
- What is a good seedling? If a healthy seedling is able to recover from damage, why is the management at early seedling stages important? Why does growing a healthy, strong crop help reduce the effect of insect and disease damage?
- Is this exercise relevant in an FFS? How would you do it there?

Exercise No. 3.08

HANDS-ON AND RESULT DEMONSTRATION : SEED QUALITY DETERMINATION

Seed is the foundation of a good crop. The use of high quality seed is a must in the production of high quality corn especially in commercial grains. Low quality seeds create production problem like population density, non-uniformity of crop stages, harvesting problem and the like. To minimize these problems, farmers should be equipped with technique in seed quality determination to guide them in seed selection.

When is this exercise most appropriate?

- Best time is before planting the seeds in the mainfield
- When seed of a questionable quality are used
- When seed, and seedling morphology exercises are done

How long will this exercise take?

- 1 hour for preparation and setting-up of the exercise
- daily 15 minutes for observation
- 1 hour for presentation and participatory discussions

Learning objectives

- To be able to determine the characteristics of high quality seeds.
- To conduct purity, germination and vigor tests.
- To improve knowledge on factors needed for seed germination
- To familiarize with simple methodology to determine the germination ability of seeds.
- To learn how to compensate for reduced germination
- To determine whether there is sufficient seeds for the area

Materials

- Polyethelene bag, plastic box and germination paper
- Tissue paper, rubber bands, crayons, pencil and manila paper
- Corn seed lots
- Water
- Pair of forceps, weighing scale and magnifying lens

Steps for purity test

1. Segregate the good seeds from inert materials and other seeds in 500 gms per seed lot.

2. Weigh the above separately, and compute for the % pure seeds.

Steps for germination test

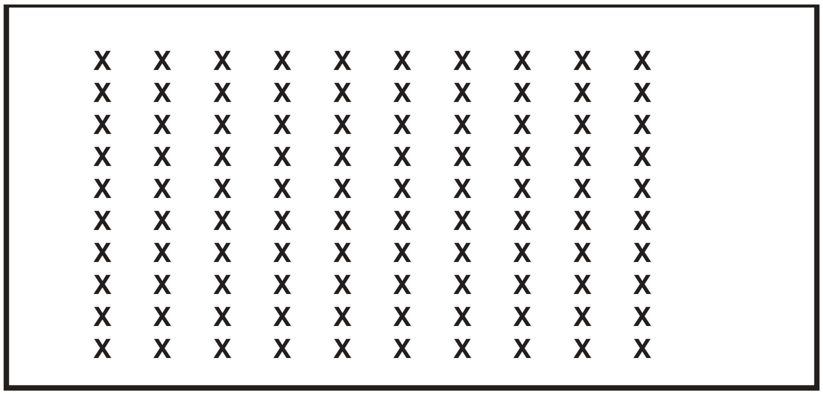
1. Ask the large group what is needed for seeds to germinate (e.g., temperature, moisture, oxygen and medium are some of the important issues).

2. Ask for suggestions to test the germination of seeds.

3. Introduce tissue paper and polyetheline bags as the available materials and do the following steps :

   a) Soak germinating paper in clean water.
   b) Spread germinating paper on top of the table and scatter 100 seeds per germinating sheet. Make 2 sets per seed lot.

Germinating paper with seeds (x)



c) Cover with another sheet of germinating paper, roll and tie both ends with rubber bands then dip or soak in clean water, place inside plastic sheet bag and incubate at room temperature.

d) Initial evaluation will be done after 4 days of incubation. Count normal seedlings and remove moldy seeds or seedling.

e) Final evaluation will be done after 7 days of incubation. Count normal seedlings, abnormal seedlings and dead seeds.

f) Compute for the % age germination using the formula below :

$$\text{\% GERMINATION} = \frac{\text{TOTAL NO, OF NORMAL SEEDLINGS X 100}}{\text{TOTAL NUMBER OF SEEDS SOWN}}$$

4. After one week, each small group presents the results including germination percentages to the big group and conduct participatory discussions to level of the perceptions of the participants.

Steps for vigor test

1. Measure the length (cm) of plumule and radicle of 10 normal seedlings.

2. Compare measurements with different seed lots. Seedlings with longer plumule and radicle indicates higher vigor.

Some suggestions for the processing discussion

- Each group will perform all the above mentioned tests using 3 contrasting seed lots and presentation of outputs will follow.
- Conduct participatory discussions on the importance of testing for purity and vigor in relation to crop management especially at the early stages of growth of the corn plants.
- Conduct participatory discussions if the tissue paper, water and polyetheline bag was able to provide the requirements mentioned in Step 1 for Germination Test.
- If germination is different from 95-100, conduct participatory discussions on how and when to compensate for that. [1]
- Conduct participatory discussions on what are the decisions if germination percentage is 95%, 80%, 40%?
- Conduct participatory discussions on what determines the germination percentage (e.g., age of seeds, maturity at harvest, small or deformed grains, grade of seeds, storage, diseases, selection)
- If 5 kg of corn seeds is needed for 0.25 ha., how much is needed for 2.25 ha? [2]
- If 20 kg is needed for 1 ha., how much is needed for 578 sqm? [3]
- If the weight of 1000 seeds is 120 g, the plants population per per ha is 80,000 and the germination percentage is 90%, how many g of seeds are needed for 700 sqm? [4]
- In the TOT or CST, ask if the exercise is relevant in the FFS and when. Does it need modification?

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1 Exact compensation can be done like this: (seedrate / germination %) X 100. If the recommended seeding rate is 20 kg per ha and the germination % is 85%, the new seeding rate will be : (20 kg / 85) X 100 = 23.5 kg seeds per ha. Exact compensation is not always necessary since the seeding rate is not always very exact in the field, but it can show that by increasing seeding rate, a lower germination percentage can be compensated. Compensation is usually more relevant in direct seeded than in seedbeded crops and when germination percentage is very low.

2 If 1 ha is 10.000 sqm, then 0.25 ha is 2.500 sqm. If what is need per ha is : (5 kg/ 2.500) X 10,000 = 25 kg corn seeds per ha. Thus, the need per 2.25 ha is : 20 kg X 2.25 = 45 kg/ha.

3 The seed requirements for 578 sqm is : (578 sqm / 10,000 sqm) X 20 kg = 1.16 kg seeds.

4 The seed requirements for 700 sqm is : 80,000 plants/ha X (120g/1,000 plants) X (90/100) X (700 sqm/ 10,000 sqm/ha) = 604.8 g

Exercise No. 3.09

HANDS-ON AND BRAINSTORMING EXERCISE ON SEED TREATMENT : THE LAST ALTERNATIVE FOR THE CONTROL OF DOWNY MILDEW IN CORN

When is the exercise most appropriate?

- In FFS, TOT and CST sessions.
- Before planting of corn only in high pressure areas for downy mildew.

How long will the exercise take?

- 1-2 hours of an FFS, TOT and CST sessions.

Learning objectives

- To learn how to treat corn seeds with fungicide when it is the last alternative to control downy mildew of corn.
- To understand when and how seed treatment can ensure the growing a healthy corn crop.

Materials

- container
- corn seeds
- slurry water
- chemicals

Steps

1. Conduct a participatory discussion by using the following guide questions :

- Where is the source of seed materials?
- Do farmers normally treat seeds against downy mildew? Why?
- Is seed treatment the most practical way of controlling downy mildew disease of corn? If yes, design a simple field exercise that will compare the performance of treated and untreated seeds.

2. Discuss and agree on what data to collect, and how often.

3. If the decision is to treat the seeds, follow the following steps :
   a) Place the seed in a container.
   b) Add slurry water and mix the seeds thoroughly.
   c) Treat the seeds with chemical at the rate of 3-5 g/kg seeds.
   d) Mix the seeds thoroughly to distribute the chemical coat equally.
   e) Place the treated seeds in a close container and store it at ordinary room temperature.

4. Establish the field exercise comparing fungicide treated and untreated seeds.

5. Conduct participatory discussion regarding the result of the exercise at the end of the activity.

Some suggestions for theprocessing discussion

- In which treatment did you have the best germination percentage?
- In which treatment did you have the most downy mildew infection?
- Are there also non-chemical seed treatments?
- What diseases can be managed by seed treatment?
- What insect pests and or diseases were affected by seed treatment?
- Is there any side effect resulting from seed treatment to the environment?
- How can that be measured?
- Is there a side effect of seed treatment to man?

- How can it be avoided?
- Can you buy treated seeds?
- For what crops or in what environment can we recommend seed treatment?
- Is the exercise appropriate in the FFS? How will you go about it?

Exercise No. 3.10

FIELD OBSERVATION AND SHARING :
THE CORN PLANT AT TASSEL DEVELOPMENT AND STALK ELONGATION STAGES

At the sixth leaf stage, the growing point and tassel are above the soil surface and the stalk is beginning a period of greatly increased elongation. Below ground, the nodal roots is the major functioning root system with sets of roots elongating from the 3-4 lowest nodes. Some ear shoots (suckers), which initially look very similar, are visible at this time. The suckers will generally form at nodes originating below the soil surface, but may never show advance development.

Degeneration or loss of the two lowest leaves may have already occurred by the eighth leaf stage. By the ninth leaf stage, many ear shoots are already visible upon dissection. A potential ear will develop from every above-ground nodes below the tassel. Initially, each ear shoot develops faster than the ear shoots originating above it on the stalk. However, growth of most lower stalk ear shoots eventually slows , and only the upper one or two ear shoots ever develop into a harvestable ear. The tassel begins to develop rapidly now and the stalk is continuing rapid elongation. By the tenth leaf stage, the time between the appearance of the new leaf stages will shorten, generally occuring every 2-3 days.

Precise fertilizer placement is less critical now because the root system is well distributed in the soil. However, watch for signs of nutrient deficiencies on the plant and treat accordingly. Sidedressing of nitrogen may be performed up to the eighth leaf stage if the fertilizer is placed in moist soil and if excess root pruning is avoided. At about the tenth leaf stage, soil nutrient and water supplies are in greater demand to meet the needs of the rapid growth rate at this stage.

When is this exercise most appropriate?

- When the corn crop is at this stage in the FFS, TOT and CST sites.
- Before starting exercises on crop compensation from early defoliators and plant feeders

How long will this exercise take?

- 30 minutes to 1 hour of the FFS, TOT and CST weekly meeting.

Learning objectives

- To enable the participants to describe the development of tassel and stalk elongation from the sixth to the tenth leaf stages of the corn plant.
- To familiarize the participants with the differences in morphological structures of the corn plants at tassel development and stalk elongation stages.

Materials

- corn plants (sixth to tenth leaf stages)
- magnifying lens, knife, pencil, crayons
- manila paper and newsprint.

Steps

<u>Do the following for each age of plant :</u>

1. Find fields at sixth to tenth leaf stages. Observe and collect plants. Wash all the soil from the plants. Take note of the number of leaves formed during these stages.

2. Take the plants to a shady place and observe the plants more closely. Begin by removing all the roots from the bottom so that the very bottom of the stalk is easily seen. Wash all soil from the base. Notice how the roots emerge from the nodes and internodes of the stalk.

3. Find out and make an illustration of the arrangement of the leaves in relation to the nodes and internodes of the stalk. Carefully remove the leaves and note where they emerge. Continue this process until you have a map of the tillers on the plant.

4. Count the number of leaves on the stalk. Count the number that are dead. Notice if there are new leaves emerging.

5. Each person in the group should take a turn to explain the structure of one of the plants to the group using a map.

Some suggestions for the processing discussion

- Describe the pattern of root and leaf development from seedling emergence through the vegetative stage?
- Why is continuous root and leaf development important?
- What will happen when some leaves are removed from the plant?
- What is the effect of cornborers on the plant in the early phase?
- What is happening with the leaves at the different growth stages? Are there dead leaves and newly emerging leaves? Why is this important?

Exercise No. 3.11

RESULT DEMONSTRATION :
THE ROOTS AND PLANT VESSELS

Fertilizers and systemic insecticides, such as carbofuran, are often applied to corn plants. How do these nutrients and insecticides get into the plant and then move through the plant? To enter the plant, the chemicals must be dissolved in water. Without water, the compounds will not be able to move either in the soil from the surface to the roots, or from the soil into the roots. Once the chemical are dissolved in the water, they are absorbed into the plant with the water. Once the chemicals are inside the plant, the chemicals are able to move through the plant through a system of hose-like vessels between the roots and the top of the plant. Water moves up these vessels and sugars move down the vessels.

After the systemic insecticide moves to the leaves of the corn plant, water from the vessels is exuded each evening. This is the small droplet of water found on the tips of the leaves early in the morning. This drop of water on each leaf contains the systemic pesticide. The drop falls back in the water and often on natural enemies or natural enemies drink from the drop of water and they will be killed by the systemic pesticides.

This exercise will show how water solutions move through the plant.

When is this exercise most appropriate?

- In the FFS, where farmers are regularly using granular pesticides (e.g., herbicides or insecticides)
- In the FFS, TOT and CST, to demonstrate the role of the roots and plant vessels in the uptake and movement of nutrients and water in plants.

How long will this exercise take?

- 30 minutes to collect specimen and set up exercise, 1 hour observation and small group discussion and 30 minutes presentation. (Whole time is not used. Best to run activity while doing another activity).

Learning objectives

- To demonstrate the role of the roots and plant vessels in the transport of water and nutrients in the corn plant.
- To describe how systemic insecticides move through plant.
- To explain why insects pests (e.g., sucking or chewing on vessels) and natural enemies (e.g., plant moisture feeders) are controlled by systemic insecticides.

Materials

- water, red ink or dye, 4 cups and 4 straws per group
- plants (e.g., corn seedlings, weeds and other plants)

Steps

1. Go outside by group and find many kinds of plants including corn seedling, kangkong, celery, grasses and other plants.

2. Add water to the 4 cups and place several drops of the red food coloring. The water should be dark red.

3. Place the plants in the 4 cups with the stems in the cups. Also place the 4 straws in the cups. Two straws should be flattened first. Place two of the plants in a bright place and the other two in a shaded area (with one flattened and one unflattened straws per treatment)

4. Wait 90 minutes and observe the plants. Observe the plants again the following early morning.

Some suggestions for the processing discussion

- What has happened to the color of the leaves? How has the red coloring moved in the plants?
- What do you think happens with corn in the corn field when systemic insecticides are used? Where is the insecticide in the plant? What kind of insects suck on the fluid in the plant vessels? What kind of insects chew on the plant vessels? What about insects that feed on the leaf edge? Do they also feed on the main vessels?
- What happens after the solution reaches the tip of the leaf? Have you noticed the water on the leaf tips in the morning? Where does this water come from and what does the solution contain? How might the solution affect natural enemies in the field? How about farmers walking in the early morning field?

Exercise No. 3.12

FIELD OBSERVATION AND SHARING : THE CORN PLANT AT EAR DEVELOPMENT AND TASSELING STAGES

Although the potential ears were formed just before tassel formation (fifth leaf stage), the number of potential grains (kernels) on each ear and the size of the ear are now being determined at twelfth leaf stage. Because grain (kernel) number and ear size are now being determined, moisture or nutrient deficiencies at this time may seriously reduce the potential number of seeds and size of ears harvested.

The fifteenth leaf stage (approximately 10-12 days from silking) is the beginning of the most crucial period of plant development in terms of seed yield determination. Upper ear development has surpassed that of the lower ear shoots and a new leaf is formed every 1-2 days. Silks are just beginning to grow from the upper ears at this time. By the seventeenth leaf stage, the upper ear shoots may have grown enough that their tips are visible without dissection at the top of the leaf sheaths that surround them. The tip of the tassel may also be visible at this stage.

Higher yield loss will result from water stress occurring between about two weeks before to two weeks after silking than similar stress at any other period of growth. Greater yield reduction will result from stress at silking with lesser losses resulting the further away from silking that the stress occurs.

At eighteenth leaf stage, the corn plant is about one week away from silking and ear development is continuing rapidly. Stress during this time delays ear and ovule development more than tassel development. If stress is severe enough, it may delay silking until pollen shed is partially or mostly through. The ovules that silk after pollen shed is finished will not be fertilized and will not contribute to yield.

The tasseling stage is initiated when the last branch of the tassel is completely visible and the silks have not yet emerged. Tasseling begins approximately 2-3 days before silk emergence, during which time the corn plant will almost attain its full height and pollen shed begins.The time between tasseling and silking can fluctuate considerably depending on the hybrid and environmental conditions. Under field conditions, pollen shed usually occurs in the late mornings and early evenings. Pollen shed period will extend for 1-2 weeks. During this time, each individual silk must emerge for pollination if a (grain) kernel is to develop.

When is this exercise most appropriate?

- When the crop is at these stages in the FFS, TOT and CST sites.
- Before the application of appropriate cultural practices at this stages

How long will this exercise take?

- 30 minutes field and small group activity
- At least 1 hour big group presentation and participatory discussions.

Learning objectives

- To familiarize the participants with the ear development and tasseling stages of the corn plant.
- To observe the differences in morphological parts and understand the relevance of applying appropriate cultural practices during the ear development and tasseling stages of the corn plant.

Materials

- Corn plants at ear development and tasseling stages.
- Knife or blade and magnifying glass
- Pencil, paper, manila, paper, crayons

Steps

1. For each of your field plots, observe corn plants that are already at ear development and tasseling stages. Take note of the number of leaves formed during these stages.

2. Select and pull out some sample corn plants at ear development and tasseling stages.

3. Detach the ears from the sample plants, remove the husks until the kernels are exposed.

4. Detach the tassels from the sample corn plants.

5. Observe closely the differences in morphological structures. Use magnifying lens if necessary.

6. Brainstorm in small group on what and how to present the output in the big group.

7. Draw and label the whole plant and show the different morphological structures at ear development and tasseling stages.

8. Present output of the small group and conduct participatory discussions in the big group.

Some suggestions for the processing discussion

- Did the corn plants attained the tasseling stage at the same time? If not, why?
- Are the development of ears the same for all the sample plants collected? Why is this so?

- At what time of the day did the pollen shed from the tassels? Are there insect pests attracted to the tassles? If so, are they damaging? What management strategy can you employ against the pest?
- What kind of environmental conditions or management problems could hinder or slow down the development of the tassel and ear of the corn plant?
- What important cultural practices should we employ during the ear development and tasseling stages of the corn plants?

Exercise No. 3.13

HANDS-ON AND BRAINSTORMING EXERCISE : DETASSELING IN CORN TO MAINTAIN SEED QUALITY AND MINIMIZE CORN BORER DAMAGE

Detasseling is a very important cultural management practice in corn production. It is done at tasseling stage of the corn crop, usually before the pollens are shed from the tassels, to prevent contamination of the silking corn plants from unwanted pollen grains and to reduce the infestation of corn borers.

Farmers planting corn for commercial purposes are therefore more interested in detasseling as a management strategy against the corn borers. However, farmers planting corn for seed purposes conduct detasseling to prevent their crop from being contaminated by pollen grains coming from another varieties.
What ever is the purpose for detasseling, farmers need to share ideas and do the most efficient and effective way of doing it, hence this exercise.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions when the participants want to know the most efficient and effective way of detasseling corn fields.
- In the FFS, when farmers want to try it as a management strategy for corn borers or as a method of maintaining the quality of their own produced seeds.

How long will this exercise take?

- 60 minutes

Learning objectives

- To demonstrate the process and acquire skills in the technique of detasseling corn fields.
- To know the importance of detasseling in the management corn borers and maintenance of the quality of farmers' produced seeds..

Materials

- corn field at tasseling stage
- mask, scissors, knife and pruning shear
- notebook, pen and tags

Steps

1. Conduct brainstorming sessions about the importance of detasseling including its limitations.

2. Come to an agreement on what will be the purpose of the detasseling exercise (e.g., as a management strategy for corn borers or as a method of maintaining the quality of their own produced seeds).

3. Design the methodology for conducting the detasseling exercise based on the agreed purpose of detasseling.

4. Decide on where the 'learning field' will be and implement the detasseling exercise.
    - Detassel the 'learning field' before pollen shedding.
    - Detassel either by pulling out the tassels or cutting the tassel using a pair of scissors, knife or pruning shear.
    - The tassels removed must be taken out from the field and can be fed to livestock.

5. Process the results immediately after implementing the exercise and then conduct again a participatory discussions at the end of the season to determine how practical (effective and efficient) the exercise was.

Some suggestions for processing discussion

- Did detasseling help reduce corn borer infestation? Did it reduce yield loss due to corn borer? Is it a practical management option?
- Was there lesser varietal contamination or impurities as a result of detasseling?
- When is the best time to detassel to reduce corn borer infestation? To avoid varietal contamination and impurities?
- Can you suggest a more practical cultural management option of reducing corn borer infestation/ Of reducing varietal contamination or impurities?

Exercise No. 3.14

FIELD OBSERVATION AND SHARING :
THE CORN PLANT AT THE SILKING STAGE

The silking stage begins when any silks are visible outside the husks. Pollination occurs when the falling pollen grains are caught by these new moist silks. A captured pollen grain takes about 24 hours to grow down the silk to the ovule where fertilization occurs and the ovule becomes a kernel. Generally, 2-3 days are required for all silks on a single ear to be exposed and pollinated. The silk will grow from 2.5-3.8 cm each day and will continue to elongate until fertilized.

The number of ovules that will be fertilized is being determined at this time. Ovules that are not fertilized will not produce kernels and will eventually degenerate. Environmental stress at this time causes poor pollination and seed set, especially moisture stress which tends to desiccate the silks and pollen grains. Stress will usually result in an ear with a barren tip.

When is this exercise most appropriate?

- When the crop is at this stage in the FFS, TOT and CST sites.
- In the FFS sites, where farmers need to understand which cultural management practices is most appropriate during this stage.

How long will this exercise take?

- 30 minutes field and small group activity
- At least 1 hour big group presentation and participatory discussions.

Learning objectives

- To familiarize the participants with the morphology of the crop at silking stage.
- To describe the process of pollination and fertilization during the silking stage.
- To understand which cultural management practices are most appropriate during the silking stage.

Materials

- Corn plants at silking stage.
- Crayons, pentel pen, newsprint and manila paper
- Knife and magnifying glass

Steps

1. For each of your field plots, observe corn plants that are already at silking stage. Take note of the number of leaves formed during these stage.

2. Select and pull out some sample corn plants at silking stage.

3. Detach the ear from the sample plants, remove the husks until the silks attached to the kernels are exposed.

4. Observe closely the differences in morphological structures. Use magnifying lens if necessary.

5. Brainstorm in small group on what and how to present the output in the big group.

6. Draw and label the whole plant and show the different morphological structures at silking stage.
7. Present output of the small group and conduct participatory discussions in the big group.

Some suggestions for the processing discussion

- Did the corn plants attain the silking stage at the same time? If not, why?
- Are the ovules in the ears pollinated at the same time? Why is this so?
- How long will the a pollen grain reach and fertilize the ovule?
- Are there insect pests attracted to the silks? If so, are they damaging? What management strategy can you employ against the pest?
- What kind of environmental conditions or management problems could hinder or slow down the development of the silks and fertilization of the ovules in the ear of a corn plant?
- What important cultural practices should we employ during the silking stage of the corn plants?

Exercise No. 3.15

FIELD OBSERVATION AND SHARING : THE CORN PLANT AT THE KERNEL DEVELOPMENT STAGES (BLISTER, MILK, DOUGH AND DENT STAGES)

The kernel development consists of the blister, milk, dough and dent stages. The kernels at blister stage (10-14 days after silking) are white on the outside and resemble a blister in shape. The endosperm and its now abundant inner fluid are clear in color and the tiny embryo can now be seen upon careful dissection. Starch has just begun to accumulate in the watery endosperm and the kernels are beginning a period of rapid steady seed filling. The kernels are now about 85 percent moisture and their moisture percentage will gradually decline from here until harvest.

The kernel at milk stage (18-22 days after silking) displays yellow color on the outside and the inner fluid is now milky white due to accumulating starch. The embryo is growing rapidly now and is easily seen upon dissection. The kernels are now well into their rapid food accumulation and are about 80 percent moisture. Cell divisions within the endosperm are essentially complete so growth is mostly due to cell expansion and filling of the cells with starch. Although not as severe as at silking stage, stress now can still have a profound effect on yield. As the kernel mature, the amount of potential yield loss due to stress becomes less.

At dough stage (24-28 days after silking), continued starch accumulation in the endosperm has now caused the milky inner fluid to thicken to a pasty consistency. The reduced fluid and increased solids within the kernel at this time produce a doughy consistency. The embryo continues to develop very rapidly through this stage. The kernels are now about 70 percent moisture and have accumulated close to half of their mature dry weight.

At dent stage (35-42 days after silking), all or nearly all kernels are dented or denting. The kernels are drying down now beginning at the top where a small hard white layer of starch is forming. This starch layer appears shortly after denting as a line across the kernel when it is viewed from the opposite embryo side. With maturity, the hard starch layer and line will advance toward the base of the kernel. Stress encountered at this stage will reduce yields by reducing kernel weight, not kernel number. At the beginning of the dent stage, kernels have about 55 percent moisture content.

When is this exercise most appropriate?

- When the crop is at these stages in the FFS, TOT and CST sites.
- In the FFS sites, where farmers need to understand which cultural management practices are most appropriate during these stages.

How long will this exercise take?

- 30 minutes field and small group activity
- At least 1 hour big group presentation and participatory discussions.

Learning objectives

- To familiarize the participants with the morphology of the crop at blister, milk, dough and dent stages.
- To understand which cultural management practices are most appropriate during the kernel development stages.

Materials

- corn plants at blister, milk, dough and dent stages
- manila paper, newsprint, pencil, crayon
- knife and magnifying lens

Steps

1. For each of your field plots, observe corn plants that are already at blister, milk, dough and dent stages. Take note of the number of leaves formed during these stages.

2. Select and pull out some sample corn plants at blister, milk, dough and dent stages.

3. Detach the ears from the sample plants, remove the husks until the kernels are exposed.

4. Observe closely the differences in morphological structures. Use magnifying lens if necessary.

5. Brainstorm in small group on what and how to present the output in the big group.

6. Draw and label the whole plant and show the different morphological structures at blister, milk, dough and dent stages.

7. Present output of the small group and conduct participatory discussions in the big group.

Some suggestions for the processing discussion

- Did the corn plants attain the kernel development stages at the same time? If not, why?
- Are the ears and kernels of uniform color, sizes and shapes? Why is this so?
- Are there undeveloped, underdeveloped and deformed kernels?
- Are there insect pests attracted to the corn plants at these stages? If so, are they damaging? What management strategy can you employ against the pest?
- What kind of environmental conditions or management problems could hinder or slow down kernel development of a corn plant?
- What important cultural practices should we employ during the kernel development stages of the corn plants?

Exercise No. 3.16

FIELD OBSERVATION AND SHARING : THE CORN PLANT AT PHYSIOLOGICAL MATURITY STAGE

The physiological maturity stage (55-65 days after silking) is reached when all the kernels on the ear have attained their maximum dry weight or dry matter accumulation. The hard starch layer has advanced completely to the cob now and a black or brown abscission layer has formed. This black layer formation occurs progressively from the tip ear kernels to the basal kernels of the ear. It is also a good indication of maximum dry weight and signal the end of kernel growth for this season. The husks and many leaves are no longer green although the stalk may be.

The average kernel moisture content at physiological maturity is 30-35 percent. however, this can vary considerably between varieties and environmental conditions. The grain is not yet ready for safe storage, which requires 13-15 percent moisture level for shelled corn. Harvesting at physiological maturity stage or shortly after would be costly because drying the crop is expensive. It may be advantageous to let the crop partially dry in the field after physiological maturity stage before harvesting, as long as field losses do not become a problem. The rate of field drying depends on the variety and environment.

At harvest time, there is a need to standardize yields so that the yield of one variety and the yield of another variety can be compared ever though one crop is dry and one is wet. To do this, we need to determine the moisture content. Moisture content is the amount of water in the kernel. One way to measure the amount is to weigh the kernel before drying. After the kernel is dried, the weight is measured again. The difference in the weight is the water lost. The moisture content is computed as follows :

$$\text{Percent (\%) moisture} = \frac{100 \times \text{original weight - dried weight}}{\text{original weight}}$$

To standardize reporting of yields, it is most common to report the yield at 14% moisture content (MC). To compute the yield as though it were 14%, use the following equation:

$$\text{Weight at 14\% MC} = \frac{\text{100-measured MC)x weight at original moisture}}{86}$$

At lower sun dried moisture levels, corn seed will store for several months. Storage moisture is ideally less than 10% moisture so that insects will not attack the corn seeds. However, it is somewhat difficult to achieve 10% moisture in humid climates.

When is this exercise most appropriate?

- When the crop is at these stages in the FFS, TOT and CST sites.
- In the FFS sites, where farmers need to understand which cultural management practices are most appropriate during this stages.

How long will this exercise take?

- 30 minutes field and small group activity
- At least 1 hour big group presentation and participatory discussions.

Learning objectives

- To familiarize the participants with the morphology of the crop at physiological maturity stage.
- To understand which cultural management practices are most appropriate during the physiological maturity stage.
- To determine if the corn plant is ready for harvest.
- To practice converting the measured moisture content using a moisture meter and maintaining a 14% standard moisture content.

Materials

- corn plants at physiological maturity stage
- manila paper, newsprint, pencil, and crayons
- knife and magnifying glass.

Steps

1. Go to a physiologically mature corn field and choose five hills per group. For each hill observe the following :
   - Hills where the kernels in the ear are still in the milk and dough stages.
   - Hills where the kernels in the ear are already at dent and physiologically mature stages.
   - Number of leaves formed during these stages.

2. Determine by counting and computing the percentages of hills that are in the milk, dough, dent or physiologically mature stages :

HILL NUMBER	% FLOWER	% MILKY	% DOUGH	% MATURE	TOTAL
1					
2					
3					
4					
5					
TOTAL					

3. Select and pull out some sample corn plants at physiological maturity stage.

4. Detach the ears from the sample plants, remove the husks until the kernels are exposed.

5. Observe closely the differences in morphological structures. Use magnifying lens if necessary.

6. Harvest some mature ear, remove husk, shell, clean and try to compute for the moisture content of the kernels, as follows :
   - Pull out 5 physiologically mature ears from the field and take to the 'laboratory'.

- Remove the husk and shell. Separate developed, underdeveloped and deformed kernels. Use only developed kernels for moisture testing. Divide the sample kernels into 5 sub-samples of even amounts.
- Measure the weight of the 5 sub-samples of kernels using the balance. Write down the weight.
- Place enough kernels in the moisture meter to cover the bottom of the moisture meter well. Screw and press until the kernels break.
- Read the percent moisture.
- The weight of the sample at 14% can be computed using the equation given above.

7. Brainstorm in small group on what and how to present the output in the big group.

8. Draw and label the whole plant and show the different morphological structures at physiologically mature stage.

9. Present output of the small group and conduct participatory discussions in the big group.

Some suggestions for the processing discussion

- Did the corn plants attain the physiological mature stage at the same time? If not, why?
- Are the ears and kernels of uniform color, sizes and shapes? Why is this so?
- Are there undeveloped, underdeveloped and deformed kernels?
- Are there insect pests attracted to the corn plants at these stage? If so, are they damaging? What management strategy can you employ against the pest?
- What kind of environmental conditions or management problems could hinder or slow down the physiological maturity of a corn plant?

- What important cultural practices should we employ during the physiological mature stage of the corn plants?
- Will there be any more investment need in pest control during the physiological mature stage? What are the costs to the farmer until the end of this season?
- Is the field ready to harvest? What indicators will say that the crop is ready for harvest? Are the kernels in the ear mature enough? Is the soil drained and somewhat dry?
- What is the difference in days to maturity between the early and late maturing corn varieties?

CORN VARIETIES AND SEED PRODUCTION

Exercise No. 3.17

FIELD EXERCISE AND PARTICIPATORY DISCUSSIONS : CHOOSING THE MOST APPROPRIATE CORN VARIETY

Farmers are particular about choosing varieties. Corn varieties differ in resistance to pests and diseases, length of maturity, adaptability, etc. There are traditional varieties and high yielding varieties produced by research institutions. There is no perfect guarantee that varieties that have passed the screening requirements of seed laboratories will be of the best quality and give the highest profits. Choosing the most appropriate variety for one's field will be determined by a farmer's understanding of the ecosystem.

When is this exercise most appropriate?

- Before planting and harvesting in the FFS, TOT and CST sessions.
- When the participants want to have a better understanding of how to go about selecting the most appropriate varieties for their localities.

How long will this exercise take?

- At least 30 minutes participatory discussions before conducting a 1 hour field observation and hands-on exercises.
- At least 1 hour sharing of ideas and experiences before planting and harvesting of the learning fields.

Learning objectives

- Conduct field observations and hands-on exercises on choosing the most appropriate variety for a locality.
- Conduct participatory discussions and sharing of ideas and experiences on selecting varieties for a locality.

Materials

- Standing crops of different varieties at early vegetative stage
- Standing crops of different varieties at physiological maturity stage
- Record book, pen and meter sticks

Steps

1. Divide the group into four and assign them to the following corn fields :
    - corn field planted to certified seed of an open pollinated variety
    - corn field planted to certified seed of a hybrid variety
    - corn field planted to a farmers selection of an open pollinated variety
    - corn field planted to a farmers selection of an F2 of a hybrid variety

2. Small groups conduct field observations, collect samples from the field and interview farmers about their preference for varieties in the areas they are assigned.

3. Big group conduct participatory discussions and sharing of ideas and experiences on selecting varieties for local conditions.

Some suggestions for the processing discussion

- How do varieties differ from each other? What is the difference between an open pollinated and hybrid varieties?
- When is it more appropriate to use an open pollinated variety over a hybrid variety and vice versa? Explain.
- What factors are considered by farmers in choosing the most appropriate variety in their locality?
- Why do farmers resort to using their own seed selections? (e.g., F2 seeds of hybrids or seed selections from open pollinated varieties)
- Are there differences in yields and incomes between using certified seeds and the farmers' selections?

Exercise No. 3.18

SELECTING A MATE :
HOW DO WE MAKE DECISIONS FOR IPM?

Selection is the essence of plant and animal improvement and has played an important role in the history of living beings. From the day the potential of certain crop species as food source was recognized, selection has been practiced for more productive plant types. It is the oldest way and one of the most effective methods of variety maintenance and improvement if properly executed.

Selection of appropriate variety for a locality require certain decision making process. A set of criteria is often required to arrive at a decision. In this exercise, the participants define some criteria they use for making decision in selecting a mate and then relate the same decision making process in choosing an appropriate variety for a local conditions.

When is this exercise most appropriate?

- The activity is most appropriate when used for in the TOT and CST sessions on decision making.
- The activity is also appropriate before starting a topic on : "Choosing the most appropriate corn variety.
- Do not use the exercise in Farmers' Field Schools.

How long will this exercise take?

- 1-2 hours of the TOT and CST session.

Learning objectives

- Practice making individual and group decisions

- Discuss factors that determine individual and group decision making.
- Relate the decision making process when choosing the most appropriate corn variety for a locality.

Materials

- male and female groups
- record book, notebook and pen
- manila paper and pentel pen

Steps

1. Divide the group into two : males and females (the groups sit in two separate areas).

2. Ask for five volunteers from each group to sit in the inner circle while the rest sit in an outer circle.

3. From the five female volunteers, the male volunteers each select a partner.

4. From the five male volunteers, the female volunteers each select a partner.

5. Each writes down the reasons for choosing the respective person as a partner.

6. The persons in the inner circle then discuss their individual decisions while those in the outer circle take note of the processes that take place.

7. On the basis of individual decisions, the entire group of women formulate a set of criteria for selecting partners. The group of men do the same.

8. The men and women then compare their process of setting criteria for decision making.

9. The facilitators summarize and record the criteria in a manila paper and the big group conduct a participatory discussions about the criteria set. At the end, the facilitators level off the discussions by relating it to the topic : Choosing the most appropriate corn variety.

Some suggestions for the processing discussion

Ask the following questions to process the activity as a structured learning experience for decision making :

- How did individuals arrived at their decisions? What were the steps the groups went through to arrive at their decisions?
- Did all the group members agree with the decision?
- What factors influence individual and group decision making?
- What are the differences and similarities between individual and group decision making?
- Can we apply the same decision making process when we choose an appropriate corn variety for our locality? Explain your answer.

Exercise No. 3.19

HANDS-ON AND PARTICIPATORY DISCUSSIONS : PRODUCING QUALITY SEEDS IN FARMERS' FIELD

Quality seeds are a must in crop production. However, in areas where a farmer can not avail of certified seeds or if he wants to be in another phase of rice production, he can use his harvest as source of seeds for the next crop. A farmer may try producing quality seeds in his farm by following some steps. Participants are encouraged to try it out in the following exercise.

Management practices in seed production field are in general similar to those used in commercial grains production. However, there are some additional requirements unique to seed production. *First*, remember that the value of good seeds is higher than that of the grain. Therefore, a seed crop warrants greater care than a grain crop. *Second*, recognize the goal of obtaining the maximum number of high quality seeds while minimizing the risk. *Third*, realize that care shown in the most uniform growing conditions possible will greatly facilitate identification of off-type (mixture) plants in future rouging operations.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions when the participants want to learn about the practical techniques of producing quality seeds in farmers' field.
- In the FFS, when farmers find the cost of certified seed very prohibitive or when farmers want to make use of their existing corn crop as seed source for the next cropping season..

How long will this exercise take?

- At least 30 minutes participatory discussions on the field procedure.
- At least 30 minutes weekly hands-on activities related to field maintenance for the duration of the season.
- At least 1 hour brainstorming session at the end of the season.

Learning objectives

- Conduct participatory discussions and brainstorming sessions on how to go about producing quality seeds in farmers' field.
- Conduct hands-on exercises in producing quality seeds in farmers' field.

Materials

- Existing farmer's field with standing corn crop.
- Bamboo sticks, plastic twine, etc. (for marking the field)

Steps

1. Lead a participatory discussion to determine the area for the farmer's seed requirements :
   - Ask for their regular seed requirement per hectare (e.g., 18-20 kg for open pollinated variety or 20-25 kg for hybrid variety, etc.)
   - Ask for their regular yield levels per season (e.g., 100 cavans during the wet season or 150 cavans during the dry season, etc.)
   - Ask participants to compute for the area needed to produce their seed requirements per hectare per season (e.g., if yield level is 100 cavans per hectare, then approximately 1 cavan seed is produced per 100 sqm, thus the area required is 40 sqm or 80 plants for 20 kg seed and 50 sqm or 100 plants for 25 kg seed)

2. Facilitate a participatory discussion in the farmer's field for the selection (from a farmer's field with standing corn crop) of an area where seeds can be sourced for the succeeding season :
   - Is the area near the source of irrigation water?
   - Is the area relatively flat and accessible?
   - Is the crop stand relatively uniform?
   - Is the area planted at least 2 weeks ahead or later than the surrounding areas?
   - Are there no pest and disease incidences?

3. Facilitate a participatory discussion in the field for the necessary considerations in maintaining the quality of the seeds to be sourced from existing farmers standing crop :
   - Are there any off-types or varietal mixtures?
   - Are there any differences in plant height, plant vigor, prolificness, color of the base, etc. during the early stages of the corn crop?
   - Are there any differences in plant height, leaf length and angle, ear length, shape, color and size of kernels, date of tasseling and silking?
   - Are there weeds at various stages of the corn crop?
   - Is there a need to do rouging? When do we start to rogue?

4. Facilitate the group to conduct hands-on exercises regarding the results of all the participatory discussions conducted in the 'classroom' and in the field :
   - Actual identification of the seed source site from existing farmer's standing corn crops.
   - Actual measurement and marking of the boundaries of the seed source site.
   - Actual roguing at various stages of the corn crop.
   - Actual maintenance of the seed source site until the corn crop is finally harvested and stored.

Some suggestions for the processing discussion

- Why is site selection important in corn seed production?
- What is the importance of planting at least 2 weeks before or after planting in the surrounding areas?
- Can we do seed selection from F2 of hybrid varieties? When is this appropriate?
- Why is rouging necessary?
- Why should the grains be harvested when 80% are in physiological maturity stage? Why is it necessary to harvest ahead of the surrounding fields?
- What is the role of sanitation in shelling, drying and storage to produce quality seeds?

WEEDS AND WEED MANAGEMENT IN CORN

Exercise No. 3.20

HANDS-ON AND PARTICIPATORY DISCUSSIONS : IDENTIFYING, CLASSIFYING AND MANAGING WEEDS

Weeds reduce corn yields by competing with the corn plants for sunlight, moisture, and soil nutrients. Weeds may affect farming in many ways. For example, fertilizer applied my not increase yields in weedy fields because weeds absorb nitrogen more effectively than the corn plants. Also, weeds are harmful because they may be alternate hosts for insect and disease pests of corn, and provide shelter for rodents. Usually weed problem is more serious in uplands than in lowlands. If weeds are left to grow in corn field, they can reduce corn yields by as much as 50-80%.

When is this exercise most appropriate?

- In the first two weeks of sessions in the FFS, TOT and CST sites.
- During the first two week from seed emergence.

How long will this exercise take?

- 30 minutes field activity and brainstorming in small groups
- 1 hour presentation and participatory discussions in the big group.

Learning objectives

- Classify weeds according to economic significance.
- Identify factors that contribute to severe occurrence of weeds in the field.
- Develop management strategies for weeds.

Materials

- Different kinds of weeds
- pentel pen, crayon, pen
- Manila paper and notebook

Steps

1. Each group should assess weed population in different areas in the corn fields.

2. Each group should collect as many different species of weeds from the corn fields.

3. Each group should classify weeds collected according to their gross morphology (e.g., grass, sedge and broadleaf weeds) and other qualifying characteristics (e.g., perennial or annual) and distribution.

4. Process data.

5. Distribute discussion question to each group.

6. Present and discuss answer with the big group.

7. Consolidate output and design weed management strategies.

Some suggestions for the processing discussion

- How did you classify the weeds you collected? Among the weeds collected, which weeds are difficult to control? Why?
- Based on your experiences, on what stage of the corn crop is critical to weed competition?
- What weed management practices can you recommend for corn?
- What are your general considerations in designing your weed management strategies?
- How will you justify that weeds are also useful to farmers?

Note :
Each participant can be required to submit a herbarium to reinforce their knowledge about weeds.

Exercise No. 3.21

FIELD OBSERVATIONS AND BRAINSTORMING :
WEED CHARACTERISTICS IN RELATION TO WEED MANAGEMENT

Weeds are more effectively controlled by a combination of practices than by one practice employed singly. The type of combination depends on the weed species present (weed characteristics), availability and comparative cost of labor for a particular practice in the farms.

Good cultural practices will produce healthy, vigorous and uniformly-spaced seedlings that compete well with weeds. The canopy of such plants interlaps earlier thereby depriving weeds growing between the rows with sunlight. Uprooting or burying the weeds reduces the weed density thus avoiding or minimizing its competition with the crop.

Inter-row cultivation is the most common and the cheapest method of controlling weeds because it utilizes only farmer's labor. However, this cannot control weeds between the rows which can reduce yield by 33%. To control weeds between the rows, square planting (dama-dama) may be used. This enables farmers to do off-barring (turning the soil away from the base of the plant to cover the weeds in the row) twice. The second off-barring is done at the right angle to the first. This practice increases yield by as much as 20%. Off-barring should be done 14-18 days after planting and hilling up, 26-34 days after planting. As much as possible, do not delay the cultivation that can result to luxuriant weed growth. Late removal may seriously damage corn roots.

High yielding corn varieties require adequate fertilizer for proper nutrition and high yields. Large amounts of fertilizer applied to corn go to waste if weeds are left uncontrolled. Consequently, good weed management improves fertilizer efficiency. Thus, weeding the field prior to fertilization maximizes the benefits from fertilizers.

When is this exercise most appropriate?

- In FFS, TOT or CST sessions
- When it is time for weeding in the ‘learning field’
- When participants want to learn about weeds

How long will this exercise take?

- 30 minutes in the field
- 1 hour for processing and participatory discussion

Learning objectives

- To brainstorm on the advantages and disadvantages of different weed management strategies.
- To understand how weeds are spreading and relate it to management strategies
- To encourage participants to observe the characteristics of weeds and practice skills in exploring how knowledge of their way of spreading can be used in weed management
- To familiarize with “critical period of corn-weed competition”

Materials

- Plastic bags
- Magnifying lens
- Pen and manila paper

Steps

1. Go to the field and ask participants to collect at least 10 different weeds per group.

2. In the TOT and CST sessions, interview farmers about which weeds they find most difficult to manage and why.

3. Go to the 'classroom'. Observe each weed and see how it spreads or completes its life cycle (e.g., by seeds, by runners, by rhizomes)

4. Brainstorm in small and big groups on when will weeds usually multiply (e.g., cast the seeds or produce runners) to an extent that they will cause problems (e.g., during cropping season or rest period) and when will be the best time to control them or how do we manage them to prevent economic loss.

Some suggestions for the processing discussion

Can be done as guide questions for initial discussion in small groups and then followed up in the big group. Or it can be done as a brainstorming in the big group :

- What is your definition of weeds?
- What is the critical period of corn-weed competition?
- Is weed management easiest in corn or rice? why?
- How can we manage or control weeds?
- What is the difference between management and control?
- Suggest a way of classifying weeds that is most practical for farmers

Exercise No. 3.22

SIMPLE WEED DENSITY EXPERIMENT : WEED SEED BANK

Weeds reduce corn yields by competing with corn for factors necessary for growth, primarily sunlight, nutrients and water. Studies on corn-weed competition show that it is not necessary to keep corn fields entirely weed-free during the season to avoid yield reduction due to weeds. Optimum yields can be obtained by keeping corn fields weed-free during the first 40 days after planting. Few weeds present in the field during the critical stage of corn growth can still reduce yield considerably. In an experiment, for example, one aguingay per sqm germinating at the time the corn was planted reduce yield by 5%. When the weed density was increased to 13 plants per sqm, yield was further reduced to 25%. On the other hand, weed that grow after this critical period of competition cannot reduce yield significantly.

When is this exercise most appropriate?

- During discussion on land preparation in the FFS, TOT and CST sessions.
- One week before the special topic on weed management.

How long will this exercise take?

- 1 hour for set-up
- 30 minutes observation per week for 6 weeks
- 1 hour final for processing (e.g., brainstorming and participatory discussions

Learning objectives

- To create awareness that the soil is a weed seed bank.
- To determine the volume of weed seeds per unit area before crop establishment.
- To emphasize the importance of a well-prepared land in reducing weed density.
- To create awareness that heavy weed seed deposit will breed serious corn-weed competition.
- To identify predominant weed species for a particular environment.

Materials

- soil samples (20x20x15 cm)
- spade or shovel
- plastic sheet
- wooden frame (2x2 cm border)
- water sprinkler (optional)

Steps

1. Get soil samples from an undisturbed field in the site. Secure also soil samples from soils frequented by a stray animals and children.

2. Spread the soil samples on plastic sheets at 2 cm thickness.

3. Sprinkle the samples with water as needed to keep the soil moist.

4. Allow weeds to germinate for two weeks. Observe, identify, count and record germinating weeds.

5. Pull out the weeds which have been identified after every observation.

6. Observe weekly until 6 weeks after emergence.

7. Report and discuss the results in small and big groups.

Some suggestions for the processing discussion

- What is the importance of having a well prepared corn field in the reduction of corn-weed competition?
- What are the factors in the dispersal of weed seeds?
- What are the predominant weed species? Why?
- What are the factors which hasten the germination of weeds?
- How does heavy weed deposit relate to corn-weed competition?
- What is the estimated weed population density per unit area?

4 Insects and Natural Enemies Topics

Exercise No. 4.01

COLLECTION AND SORTING EXERCISE : INSECTS AND NATURAL ENEMIES IDENTIFICATION AND RECOGNITION

When is this exercise most appropriate?

- When the participants already have 3 or 4 weeks experience of observing insects in the field.
- When participants want to know more about "how to identify" insects and other small animals.

How long will this exercise take?

- 30 minutes for collecting animals in the field
- 1 to 2 hours for sorting and discussions

Learning objectives

- To build skills used in observing and recognizing the shapes, colors and functions of the insects that we find in the crop ecosystem.
- To encourage participants to look at 'unknown' insects and to practice skills in exploring what they look like and what they do in the field.

- To build awareness that for IPM decision-making, it is most important for us to be able to discover what does the animal DO in the ecosystem (its function), and to remember how it looks, rather than to learn details of scientific names and traditional entomology identification.

Materials

- collecting equipment per group (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush)
- alcohol to kill insects
- white plates or trays to spread insects on for sorting
- hand lenses, at least 2 per group
- manila paper and pentel pens
- enough candies for all participants (as prizes)

Steps

1. The groups go to the field to observe and collect small animals in the crop and weedy areas. Observe and note what the small animals are DOING for later sorting into groups. Have a COMPETITION with prizes for the group that can collect :

    - the largest number of different kinds of animal
    - the biggest animal
    - the smallest animal

2. Return to the 'classroom'. The groups kill the insects by putting in a bag with a little alcohol and quickly sort them on the white trays/plates into groups of different types of insects.

3. While the groups are sorting the animals, the facilitators draw up a matrix/table on manila paper for the competition results :

GROUP	HOW MANY KIND	LARGEST	SMALLEST	TOTAL
1				
2				
3				
4				
5				
TOTAL				

5. Fill in the competition results and give candies to the winning groups and all other groups for working so hard.

6. Facilitate the group to make a list of all the different ways that we could group the insects that are useful when we are observing the crop ecosystem and making decisions about management :

   - What does it eat? (e.g., plant-feeders, insect-feeders, nectar-feeders, decomposers)
   - Where is it found? (e.g., on leaves, stem, fruits, soil, weeds)
   - What stage is it? (e.g., egg, larva, nymph, pupa, adult)
   - How does it feed? (e.g., chewing, sucking, piercing, rasping)
   - How does it move? (e.g., flying, jumping, crawling)
   - How many are there? (e.g., in groups, single)
   - What type of insect/animal? (e.g., spider, fly, beetle, butterfly, bug, wasp, frog, slug, etc.)

7. Each group makes a table/matrix with all the different ways of grouping listed like this :

WAYS OF GROUPING	GROUPS	TALLY/CHECK	TOTAL NUMBER
what does it eat?	unknown	IIIII	
plant-feeder	IIIII-IIIII-IIIII-III		
insect-feeder	IIIII-IIIII-IIIII-IIIII-IIIII-III		
decomposer etc.	IIIII-I		
unknown	IIIII-I		
what stage is it?			
egg	IIII		
larva	IIIII-IIIII-III		
etc.			
etc.			

8. Each group takes each animal that they have collected, goes down the list and makes a check against each group that it belongs to.

   VERY IMPORTANT! The facilitators must go from group to group and GUIDE the participants as they observe and explore the animals that they have found. Use the ‘What is this’? questioning process to help this exploration.

Some suggestions for the processing discussion

- How many insects did we have difficulty in grouping? How many 'unknowns'?
- What characteristics did we use to be able to group the small animals that we DID know? If we did not know the animal, how did we find out if it has that characteristic? Draw up a table and fill in with big group discussion :

way of grouping group	characteristics used to decide its group	how to discover if it has this	characteristics
e.g. what it eats	plant feeder	it feeds on plants	field observation and/ or insect zoo
field observation and/ or insect zoo	it feeds on insects	field observation and/ or insect zoo	

- Which way of grouping do you think is most useful when you are trying to make IPM decisions?

ASSORTED EXERCISES: NATURAL ENEMIES OF CORN INSECT PESTS

There are so many indigenous natural enemies of corn insect pests present in the farmers' fields. Very often, these farmers' friends are taken for granted or worst, are even considered pests of corn. The inability of the farmers (and even field extension workers) to identify and appreciate these animals always lead to the indiscriminate use of pesticides. This unwarranted action causes imbalance in the corn ecosystem and eventually lead to more serious problems, such as pest resurgence and pesticide hazards to humans and the environment.

By familiarizing the participants (and eventually the farmers) with the characteristics of these tiny animals and understanding their contribution in maintaining a balance corn ecosystem, then the problems mentioned above will be avoided and a more sustained corn production system will be realized.

When is exercise most approriate?

- In the TOT and CST sessions when the participants want to improve their knowledge and skills in identifying and classifying corn pests and their natural enemies.

How long will exercise take?

- 1 hour per week for 14 weeks

Learning objectives

- To familiarize the participants with the different natural enemies of corn pests.
- To familiarize the participants with the different natural enemies attacking the different life stages of corn borer.

- To enable the participants to classify the different natural enemies of corn pests.

Materials

- corn pests and their natural enemies
- rearing jar (ball jars, nescafe glass, etc.)
- alaskin cloth, cutter, sweep net, magnifying lens.
- rubber band, pentel pen, masking tape, denatured alcohol
- notebook, record book, pen

Steps

For Parasitoids :

1. Collect different stages of insect pests of corn plant suspected to be parasitized.

2. Place the collected specimens in rearing jars to observe parasitoid emergence.

3. Classify parasites as to whether they are egg, larval or pupal parasitoids.

4. Preserve other specimens using denatured alcohol in vials and ampules.

For Predators :

1. Collect predators of insect pests of corn.

2. Preserve other specimens using denatured alcohol in vials and ampules.

For Insect Pathogens :

1. While collecting specimens on parasitoids and predators, collect also dead insect pests infected with pathogens (e.g., fungus, bacteria and virus).

2. Place the specimens in vials or test tube, petri dishes for observation.

For All the Natural Enemies :

1. Describe the characteristics of the natural enemies and draw.

2. Brainstorm in small groups on the observations made regarding the characteristics of the natural enemies.

3. Present the results to the big group and conduct participatory discussions to clear gray areas during observations.

4. Conduct insect zoo follow-up activities in small groups if necessary and share results to the big group.

Some suggestions for the processing discussion

- How many different natural enemies did you collect and observe in the field? How many are parasitoids? Predators? Insect Pathogens?
- What insect pests did they attack? What stage of the insect pest did they attack?
- Are the natural enemies host specific (attack only one specific pest)? Are they non-host specific or polyphagous (attack many kind or species of pests)?
- Are there natural enemies that are pest also at the same time? Explain how.
- What will happen if pesticide is sprayed on them in the corn field? How do we conserve them in the field? Do you think they can be mass-reared at farmers' fields? Can you offer some suggestions on how to do this?

Exercise No. 4.02

FIELD RELEASE OF TRICHOGRAMMA

When is this exercise most approriate?

- In the FFS, TOT and CST sites when the area is historically a corn borer infestation area.
- In the neighboring corn fields in the FFS area if there are impending early corn borer infestation as evidence by the presence of unparasitized corn borer eggmasses in the field.

How long will this exercise take?

- A least 30 minutes field monitoring every week for at least 14 weeks.
- At least another 30 minute trichocard releasing every week depending upon the result of field monitoring.
- At least 30 minutes brainstorming sessions at the start and end of implementation.

Learning objectivs

- To actually experience and understand the technique of Trichogramma release using the trichocards in corn fields with impending corn borer infestation.
- To acquire skills in close monitoring of parasitized and unparasitized corn borer eggmasses and use the result as basis for mass release of Trichogramma in corn fields.

Materials

- Trichogramma in trichocards
- corn field (e.g., start monitoring and releasing at least at 20-25 DAP).
- Record book and pen

Steps

1. Brainstorm in big group on how to go about monitoring of corn borer eggmasses and mass releasing of Trichogramma in trichocards.

2. Go to the field, conduct monitoring and decide on whether to release to delay the Trichogramma parasitoids.

3. Prepare about 20-100 trichocards for release in at least one (1) ha corn field.

4. Release the Trichogramma parasitoid following the procedure agreed upon in the brainstorming session. Normally, the following steps are followed :
   - Hang trichocards on the strongest leaf of corn plant (e.g., usually 2nd or 3rd leaf from the base).
   - Fold trichocard before hanging to protect the Trichogramma from sunlight and rain.

5. Closely monitor the field one (1) week after the first release and determine the percentage of parasitization.

6. Release another 70-100 trichocards per ha if parasitization is less than 25%.

7. Monitor one (1) week, thereafter and undertake 3rd release if necessary.

8. Consolidate the results in small groups, present and conduct participatory discussions in big group and come up with an improved system of monitoring and mass releasing of parasitoid based from the lessons learned from the exercise.

Note :

Each participant must actually experience the releasing of trichocards and monitor the percentage (%) parasitization to them to actively participate in the discussions.

Sharing of experiences in small groups must be followed by a participatory discussion in big group.

Some suggestions for processing discussion

- Is the monitoring system employed effective? Was the released Trichogramma able to bring down the population of corn borer? Was it practical (effective and efficient)?
- Is there any initial Trichogramma population in the field at the time of release of the parasite through the trichocards? What was the initial level of parasitation at the time of release of parasite through the trichocards?
- What was the level of parasitization one week after the release of parasitoids through the trichocards? After 2 weeks? After 3 weeks?
- How many times did you release Trichogramma? Why?
- Can farmers develop their own corn borer eggmass monitoring and Trichogramma field releasing system with lesser dependence from RCPCs and RFUs? Can you propose an alternative?

ASSORTED EXERCISES : UNDERSTANDING THE MOST COMMON PESTS IN CORN

Pest occurrence regardless of density is the major factor that lead to indiscriminate spraying among farmers. A persistent belief among farmers without IPM knowledge is to use prophylactic sprays with the thinking that it will minimize pest problems.

It is very important for extensionists as well as farmers to know the role of insects referred to as "pests" from an ecological point of view. It is observed that in most cases, 90 percent of insecticide use are not necessary. Studies have also shown that indiscriminate use of pesticides does not accrue economic benefits. Rather this phenomena has led to pest resurgence, pollution of the environment, bad effects to non-target organisms, and cases in poisoning among corn farmers.

Knowledge on the life cycle, function in the ecosystem and ecology of a particular pest is essential for selecting an effective pest management strategy.

Exercise No. 4.03

FIELD EXERCISE FOR CORN BORERS

Infestation of the corn borer starts four weeks after planting and continues almost up to the maturity of the corn ears. Young corn plants up to four week old are resistant to the corn borer because of the presence of a chemical substance known as DIMBOA. Two overlapping generations seem to occur during the growth stage of the plant. The first , starting after four weeks from planting and the second, at tasseling stage. The borer usually attacks near the node of the stalk and is characterized by the presence of granular feces collected at the opening of the tunnel. The corn borer may also feed on the ears. It is thus important to know and understand the corn borer behavior, biology and ecology to manage them effectively, hence this exercise.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions earlier than four weeks after planting.
- In the FFS sites , where corn borer is historically a pest problem and therefore a potential release area for theTrichogramma parasitoids.

How long will this exercise take?

- About 30 minutes field activity and small group discussions
- At least 1 hour preparation, presentation and participatory discussions in the big group on the outputs of the small groups.

Learning objectives

- To know and familiarize the participants with the life stages of the corn borer.
- To familiarize the participants with the damages caused by the corn borer.

Materials

- rearing jar (ball jars, nescafe glass, etc.)
- alaskin cloth, , cutter, sweep net, magnifying lens
- rubber band, pentel pen, masking tape
- denatured alcohol

Steps

1. Conduct a field walk and collect live specimen of different stages of corn borer (egg, larva of the different instars, pupa and adult).

2. Collect also corn plants showing active and inactive corn borer damage.

3. Place the collected specimen in rearing jars for observation :
    - egg to first and succeeding instars
    - last instar to pupa
    - pupa to adult

4. Preserve other specimens using denatured alcohol in vials and ampules.

5. Distribute guide question to each of the small groups.

6. Brainstorm in small group, illustrate and describe the different damages caused by corn borer.

7. Present observations of the small group to the big group and conduct participatory discussions.

Some suggestions for the processing discussion

- In what part of the corn plants did you actually observe the different life stages of the corn borer?
- At what growth stage of the corn plant did you find each life stage of the corn borer?
- Are all the life stages of the corn borer damaging to the corn plant? At what growth stages of the corn plant is the corn borer most damaging? Can you characterize the damage?
- How long is the time from one life stage of the pest to the next?
- Can you propose an alternative management strategy for the corn borer that will avoid the use of pesticide?

Exercise No. 4.04

FIELD EXERCISE AND SHARING OF EXPERIENCES : THE ORIENTAL MIGRATORY LOCUSTS

Locusts is an endemic pest in the country. For the last decade, locusts have inflicted tremendous damages as they reach swarming and migratory stages.

In the Philippines, there are identified hotbeds or areas where breeding occurs regularly and or occasionally, depending on their classification as primary or secondary areas. Among the more important regions are Northern, Southern and Central Mindanao, as well as the Bicol and Cagayan Valley Regions in Luzon.

It was observed in previous outbreaks that sometimes, locusts occur simultaneous in all these areas as in 1984, following a long drought. The infestation may last for a short or long duration, depending on control strategies and efforts. These could drag longer to a point that financial resources are exhausted and cause considerable damages on cultivated crops.

The oriental migratory locust is considered the most important among the twenty-four (24) grasshopper species, because of their capability to inflict extensive damage to crops. As their common name implies, they are recognizable by their big hind legs which enable them to hop and jump. In time when they have completed a phase change, their wings become well-developed, thus enabling them to endure long migratory flights. In subsequent and succeeding generations, physical and behavioral changes also take place. They form swarms and develop behavior and habits of voracious feeding and long migration. This occurs mostly among immature adults.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions, when there is an existing locust infestation or when the locality is historically an outbreak or breeding area.
- In the FFS session, when the farmer-participants want to learn or understand what to do when there is a locust infestation.

How long will this exercise take?

- At least 1 hour of field activity
- At least 1 hour of participatory discussion
- At least 30 minutes for role play

Learning objectives

- To be able to discuss the two phases of migratory locust.
- To determine the pre-disposing factors of the oriental migratory locust outbreak.
- To be able to distinguish the characteristics of solitary and migratory phases of locust.
- Organize and formulate action plans on locust management.

Materials

- killing jar, magnifying lens and sweep net
- rubber band, pentel pen, masking tape and denatured alcohol
- insect pins, insect box and styrofoam

Steps

With existing locust infestation :

1. Each group should conduct a field walk in corn or grassy areas.

2. Observe and analyze the area and note the vegetation, insects present (e.g., locust, other insects, natural enemies, soil type, etc.).

3. Collect locust, natural enemies and other insect specimen.

4. Classify collected specimens as to life stages.

5. Determine the phase of collected specimen.

6. Compare collected specimens with old preserved reference specimen.

7. Preserve and mount collected locust and natural enemy specimen.

8. Preserve all the other specimen using denatured alcohol.

With or without existing locust infestation :

1. Divide the participants into small group and provide them with guide questions.

2. Facilitate the participants to answer the guide questions by sharing their individual experiences regarding locust infestations in their respective areas.

3. Present output of the small group to the big group.

4. Conduct participatory discussion and formulate action plans on locust management.

5. Conduct a role play to depict the following scenario :
   - Solitaria (random distribution). What happens when there is drought or other favorable environmental conditions?
   - Congregation (group of 3 or 4 couples). What happens when food become scarce?
   - Migratory (congregar fuse to form bigger group). What happens when there is no more food? How and why do the insects transform into fliers? How and why do the insects transfer to area with food and lay eggs?

Some suggestions for the processing discussion

- Are you familiar with the biology and life cylce of the oriental migratory locust? Which stage of its life cycle is most destructive to agricultural crops?
- Why and how does the behavior of oriental migratory locust change from phase solitaria to phase migratoria?
- Can you describe the feeding habit of the oriental migratory locust?
- Can you suggest an efficient and effective monitoring and surveillance system that can be utilized by local communities in deciding for an appropriate management strategy?

THE INSECT ZOO

Insect zoo exercises can be one of the Participatory Technology Development (PTD) activities that may be done by participants in the FFS, TOT and CST sessions to help them learn about insects and their natural enemies by direct observation and manipulation. Insects and spiders are more interesting when seen alive and active. Imagine a spider sucking the juices from a first instar cornborer larva or leaffeeding by a leaffolder. A living organism is much more than what is seen in an alcohol filled jar.

In fact some things can only be recognized when living, the small water strider, is an example. The ripples on the water as the water strider glides across the water surface is its most distinguishing characteristic. The activity and behavior of insects and natural enemies can only be seen in live specimens. The insect zoo will give you many living specimens for demonstration that will keep farmers more involved (while watching spider females eat their mating partners) and help them remember better something about the message that predators and parasites are friends in the field.

The insect zoo will also help you learn about the biology of the animals. Life cycles, egg laying, feeding, mating, growth and behavior can be learned directly through the process of rearing insects and their natural enemies.

There are many ways to rear insects and their natural enemies. Many parasites can be obtained directly from their host by collecting eggs, mature larvae, and pupae from the field and placing them in any plastic, glass or paper container. Place the collected specimens in the container and merely watch. If the specimens were parasitized, small wasps will emerge. Preying mantis egg cases, cornborer eggmasses, large caterpillars, and hopper eggs are the easiest and most often parasitized specimens to rear.

For other insects and spiders, collecting young hopper nymphs, adult moths or spiders is the best way to begin rearing. However, for nymphs and for adult moths, you must have prepared plants ahead of time. For spiders, it is best to have lots of insect prey in a rearing cage before beginning to rear.

For parasites that are not collected from hosts, it is sometimes possible to put "sponge plant" in the field. This means that from reared insects you have plants in pots with egg masses or larvae. These plants with the host are placed in the field for up to four days to attract the parasites. The parasites will lay their eggs in or on the host. The "sponge" is then brought back to the pot and kept in a cage.

When is this exercise most appropriate?

- In FFS, TOT and CST courses
- When agro-ecosystem analysis (AESA) is started as a regular activity

How long will this exercise take?

- Each week at least two hours is needed specially for the Insect Zoo. Each day, however, some time must be spent caring for plants and collected insects and spiders.

Learning objectives

- Observe parasitization, predation habits of natural enemies.
- Observe life cycle of pests and natural enemies.
- Observe infection rate of pathogens of pests.

Materials

- corn plants
- mylar film, tulle, scotch tape
- pots of varying sizes, aspirator, scissors, bamboo sticks
- plastic bags, rubber band, small bottles

Steps

1. With the given materials set up insect zoos.

2. Let each group decide on what to study for the week. This should coincide with the different stages of the crop.

3. Each group should follow rearing procedures, observations and recording of results.

4. Results of the insect zoo activities are to be reported to the big group.

5. For other activities, the following rearing methods maybe observed :
   - Bottles and plastic bags are very useful rearing tools. If eggmasses, larvae or nymphs are found in the field, collect and place in the bottle or plastic bags. The bottle should have a piece of netting over the mouth of the bottle. Add plant material daily for hervibores. Transfer to larger cages if necessary. Try to collect older larvae that will quickly pupate. Parasites will also emerge from eggmasses, larvae and pupae.
   - Simple cages can be made using waste materials such as transparent grass or plastic bottles. Place leaves and stems in the bottles with insects and cover with netting.
   - Field Cages are useful to cover infestations of large larvae, hoppers and other insects. Make cages from large plastic bags, or netting materials. Use bamboo sticks to hold cages above the plant.
   - Potted plants and cages are useful especially for demonstrations and exhibitions. Grow your own plant in the pot, or transplant from field grown plants. For cages use netting suspended string or frames, or use plastic bags with netting glued over one end. Expensive thick stiff plastic is also very useful.

Some suggestions for processing discussions

- What is an insect zoo? What are the uses of the insect zoo?
- Can you describe the most appropriate activity for each type of insect zoo you prepared?
- Are these the most practical set-up for FFS? Do you have any other idea of how to improve each type of insect zoo you prepared?
- Which among these set-up is most appropriate for studying parasites? For predators? For insect pests?
- Which among these set-up is most appropriate for 'classroom' exercises? For field exercises?

Exercise No. 4.05

INSECT ZOO DESIGN :
'TAKING CARE OF A BABY' (A MENTAL MAP EXERCISE TO HIGHLIGHT ALL THE THINGS THAT INSECTS MAY NEED)

When is this exercise most appropriate?

- In FFS, TOT or CST Courses
- When participants have some experience already of the insect zoo.
- When participants want to make their insect zoo more successful.

How long will this exercise take?

- 30 minutes to 1 hour of an FFS, TOT or CST meeting.

Learning objectives

- To build awareness of all of the different things we can do to make an insect zoo in which the animals are as happy and healthy as possible. Thus, making insect zoo more likely to be successful.

Materials

- Manila paper
- 1 black pentel pen
- 1 colored pentel pen (e.g., different color from black)

Steps

1. Post the manila paper in a place where the participants can all gather around and see easily.

2. Ask one of the participants to quickly draw a baby in the center of the manila paper using the black pen.

3. Ask all other participants to think of all the things that we need to provide for a baby so that it will become as healthy and strong as possible. All ideas are accepted. Any person who has an idea is asked to take the black pen and add a picture or some words to represent their idea.

4. Continue adding ideas until the group feels that they have completed the mental-map.

5. Take the colored pen. Lead the group to discuss and evaluate which of these things are also needed by insects. Highlight those things that are needed by insects with the second color.

6. Make a summary list of what your group has recommended for keeping a healthy insect zoo.

Some suggestions for the processing discussion

- Are there any extra things that we might need to do which are particular to keeping insects?
- What different kinds of environment do we collect insects from? How can we provide these different kinds of environment in our insect zoo?
- Which of these things did we remember to provide in the Insect zoo that we made before?
- Which of these things did we forget to provide in the insect zoo that we made before?
- When taking care of a baby, we generally keep records (e.g., photos, height, weight, etc.). What kinds of records might be useful to keep for our insect zoo?

Exercise No. 4.06

INSECT ZOO DESIGN : 'KEEPING A FIGHTING COCK' (A MENTAL MAP EXERCISE TO HIGHLIGHT ALL THE THINGS THAT CAGED INSECTS MAY NEED)

When is this exercise most appropriate?

- In FFS, TOT or CST Courses.
- When participants have some experiences already of the insect zoo.
- When participants want to make their insect zoos more successful.

How long will this exercise take?

- 30 minutes to 1 hour of an FFS, TOT or CST meeting.

Learning objectives

- To build awareness of all of the different things we can do to make an insect zoo in which the animals are as happy and healthy as possible. Thus making insect zoo more likely to be successful.

Materials

- Manila paper
- 1 black pentel pen
- 1 colored pentel pen (e.g., a different color from black)

Steps

1. Post the manila paper in a place where the participants can all gather around and see easily.

2. Ask one of the participants to quickly draw a fighting cock in the center of the manila paper using the black pen.

3. Ask all other participants to think of all the things that we need to provide for a fighting cock so that it will become as healthy and strong as possible. All ideas are accepted. Any person who has an idea is asked to take the black pen and add a picture or some words to represent their idea.

4. Continue adding ideas until the group feels that they have completed the mental-map.

5. Take the colored pen. Lead the group to discuss and evaluate which of these things are also needed by insects. Highlight those things that are needed by insects with the second color.

6. Make a summary list of what your group has recommended for keeping a healthy insect zoo.

Some suggestions for the processing discussion

- Are there any extra things that we might need to do which are particular to keeping insects?
- What different kinds of environment do we collect insects from? How can we provide these different kinds of environment in our insect zoo?
- Which of these things did we remember to provide in the insect zoo that we made before?
- Which of these things did we forget to provide in the insect zoo that we made before?
- When keeping a fighting cock, we generally keep records. What kinds of records might be useful to keep for our insect zoo?

Exercise No. 4.07

CAN WE REALLY DO INSECT ZOO WITH FARMERS? (A DEBATE ON THE REAL POSSIBILITIES OF A DISCOVERY-BASED APPROACH)

When is this exercise most appropriate?

- In TOT and CST Courses
- When participants have already had some experiences of making insect zoo with farmers.
- When some participants are asking whether it is really useful to try to get farmers to make insect zoo.

How long will this exercise take?

- 1 hour

Learning objectives

- To give participants a chance to voice their concerns about facilitating farmers to conduct insect zoo.
- To help participants to share experiences and feelings about how farmers in their FFSs have reacted to making insect zoo.
- To build further awareness of the value and practicalities of using a discovery-based approach.

Materials

- none

Steps

1. Spit the group into 4 small groups representing the following :

    - farmers who don’t like to make insect zoo
    - farmers who do like to make insect zoo
    - trainers
    - bosses of trainers

2. Allow the groups to discuss what their group ‘feels’ about the question : *Is it appropriate and practical for farmers to make insect zoo?* Remind them that this is a role play, so they should forget personal views for now!

3. Hold the debate :

    - Each group elects one member to make a short presentation of their views to the big group.
    - 0ne facilitator acts as the chairman who introduces each speaker formally.
    - After all 4 presentations are finished the debate is ‘open to the floor’. Participants can make comments and questions to any other group.
    - The chairman is responsible for making sure that participants speak in turn. They must raise their hand and wait until they are signaled to speak.

4. Let the debate continue until all views have been explored and discussed.

5. Ask each group to make a short final summary of their ideas.

6. Close the debate formally by thanking all speakers and participants.

7. Process the discussion.

Some suggestions for the processing discussion

- Did anybody change their views during the debate? How?
- What general conclusions could we make about the value and practicality of using a discovery-based approach with farmers?

Exercise No. 4.08

INSECT ZOO FOR PARASITOIDS :
PARASITIZATION OF CORN BORER EGGMASSES
BY TRICHOGRAMMA

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions when the participants need to understand how Trichogramma parasitizes the egg masses of corn borer.
- In the FFS to familiarize the farmers with the actual appearance in the field of Trichogramma parasitized corn borer egg masses.

How long will this exercise take?

- At least 30 minutes small group discussions and field activity.
- At least 30 minutes output preparation by the small groups and 1 hour presentation and participatory discussions in the big group.

Learning objectives

- To actually see and understand how Trichogramma parasitize corn borer egg masses.
- To familiarize the participants with the actual appearance in the field of Trichogramma parasitized corn borer egg masses.

Materials

- rearing jar (ball jars, nescafe glass, etc.)
- alaskin cloth, rubber band, pentel pen, masking tape, cutter
- trichogramma stock and freshly laid corn borer egg mass

Steps

1. Collect freshly laid egg masses of corn borers (shiny white).

2. Put inside the rearing jars or test tubes (e.g., 2 rearing jars or 1 for parasitization and 1 for control).

3. Introduce Thrichogramma (e.g., 10 Thrichogramma : 1 egg mass)

4. Cover rearing jars with alaskin cloth and secure with rubber bands

5. Preserve other specimens using denatured alcohol in vials and ampules.

6. Describe and illustrate how the Trichogramma actually parasitized corn borer egg masses.

7. Describe and illustrate also the actual appearance in the field of Trichogramma parasitized corn borer egg masses.

9. Brainstorm and prepare presentation in small group.

10. Present output to the big group and conduct participatory discussions in the big group to consolidate learning experiences.

Some suggestions for processing discussions

- Did you actually see how the Trichogramma wasp parasitized a corn borer egg mass? Did you observe how long it took to parasitize an egg mass?
- Did you collect field Trichogramma parasitized corn borer egg masses? How did they look like?
- Did you try to observe what came out of the suspected field Trichogramma parasitized corn borer egg masses? Are they wasps or larvae?

- Can the Trichogramma wasps really control corn borers?
- Is it practical for farmers to mass rear and release parasites in the field to control corn borers? Can you offer better alternatives?
- Can we conserve the Trichogramma wasps in the field? What will happen if we spray insecticides in the field?
- What happen to the Trichogramma wasps if there are no corn plants in the field? What happen to the wasps during the dry season?

Exercise No. 4.09

INSECT ZOO FOR PREDATORS :
IS IT A PREDATOR OR PLANT FEEDER?
(SMALL GROUP DESIGN TASK)

When is this exercise most appropriate?

- In TOT and CST Courses
- When participants already have some experiences in making insect zoo.
- When participants want to make more insect zoo to discover which insects are predators.
- When the facilitators feel that participants need to become more aware that predators can often eat a wide range of different prey types.
- When participants want to design insect zoo that they can use with farmers in the FFS to help them discover more about predators.

How long will this exercise take?

- 1 hour collecting insects in the field
- 2 to 3 hours designing and making and presenting designs of insect zoo
- 1 hours reporting results of insect zoo a few days after the design session

Learning objectives

- To encourage participants to think about what they need to observe to be sure that an insect is a predator.
- To build awareness of the fact that predators are often able to feed on many different types of prey.
- To practice and build awareness of the steps that we will need to explain when guiding farmers to make an insect zoo.

Materials

- equipment for collecting insects for each group (plastic bags, containers with gauze covers, sweep nets, aspirators, fine hair paint-brushes, hand-lenses, etc.)
- jars, with fine-gauze covers for each group to make insect zoo (at least 5 jars per group)
- tissue paper for lining insect zoo
- sugar or honey (to make ‘nectar’ solution for feeding adult insects such as moths, wasps and hover fly adults)
- pens and tape for labeling insect zoo
- manila paper and pentel pens for each group presentation

Steps in planning and collecting insects

1. Have a planning meeting with the participants - ask them to list as many different insects that they have seen in the field which might possibly be predators.

2. Ask each group to choose 2 different insects which they will test.

3. Give the following instructions for the collection of insects :
   - Each group needs to collect 10 of each of the 2 types of predators they have chosen.
   - For each type of predator, they need to collect at least 20 individuals of each of 3 different kinds of insects that it might prey on (if the prey are very small you will need to collect a lot more than 20 individuals!)

   So, each group will collect :

   - 10 individuals of predator A plus 20 individuals of each of 3 different kinds of prey that they think predator A will eat

- 10 individuals of predator B plus 20 individuals of each of 3 different kinds of prey that they think predator B will eat
- Each group should also collect fresh healthy plant materials for plant-feeding insects

Steps in the design session

1. Make insect collections after AESA or similar morning field activity.
   REMEMBER TO HANDLE INSECTS VERY GENTLY!
   Protect insects from hot sunlight, use brush for small worms, and do not pick delicate insects by hand.

2. Each small group designs and makes insect zoo to answer the question: "Is it a predator or a plant-feeder?" , using each of their 2 predators and the 6 kinds of prey that they have collected.

3. Each group prepares the following for presentation :
   - Answer the question : "Why did you think that the predator would eat these 3 kinds of prey?"
   - Each group makes a set of step-by-step instructions which any other participant could use to guide a farmer to make each of their insect zoo (include the question that the zoo will try to answer, *how to make the zoo, how to care for it, what to observe, and when to observe*)

4. Groups present their outputs and the big group discuss the areas for clarification.

Steps in the presentation of insect zoo results

1. Make time for presentation of insect zoo results 3 or 4 days after they have been made.

2. Ask the group to suggest any improvements that they would make to the insect zoos.

Some suggestions for the processing discussion

- Most of the points for discussion should come from the small group presentations. Some things to look out for are :

    1. Did any group remember to include a test to check that ‘predator’ does not eat plants, even when it is starving?
    2. Did the groups give clear instructions about what should be observed and when to make the observations?
    3. Did the group remember to make a suggestion about where would be a good place to keep the insect zoo?
    4. Did the groups remember to provide plant-feeding ‘prey’ insects with fresh food regularly?
    5. Did the insect zoo ask a clear question, and would the proposed observations really answer that question?

Exercise No. 4.10

INSECT ZOO FOR SPIDERS

There are many insects and spiders found in the corn plant and on the bunds and irrigation ditches. Most of the insects are not pests or even potential pests. In fact they are beneficial to the corn farmer because natural enemies such as spiders feed on these non-pest insects. This is how spiders can survive even when pest populations are low.

In this activity, we will search for spiders and their prey. You should be able to explain where and spiders are living in and around the corn field, and what kind of spiders can be found.

When is this exercise most appropriate?

- When at least one agro-ecosystem analysis (AESA) has been conducted in FFS sessions

How long will this exercise take?

- 1 hour and 30 minutes

Learning objectives

- Describe spiders in and around corn fields.

Materials

- Spiders
- Newsprint, pentel pens, test tubes

Steps

1. Each group counts spider population in a square meter area of a :
   a) seedling emergence
   b) early vegetative
   c) late vegetation
   d) silking
   e) denting
   f) canal
   g) side of the bunds
   h) grassy area near the corn field (2 meters from the corn field)
   i) stubble

2. Identify the kinds of spider species seen.
3. Consolidate and present data to the big group. Use the matrix below :

SPECIES	LOCATION						TOTAL
	SEEDBED	TASSELING	SILKING	MATURE STAGE	CANALS	BUNDS	

Some suggestions for the processing discussion

- Where can you find the highest spider population in the 4 areas and why? The lowest, why?
- What are the kinds of spiders found in the different areas?
- What will happen to spiders when there are no pests present?
- In what part of a corn plant are spiders commonly found?
- How many insects does a spider eat in 1 day? (PTD)

- What are the characteristics of spiders?
- Differentiate spiders from insects?
- How does a spider eat insect pests? Do a role play.
- What is a pest? If at low populations, spiders survive on some insects, are these insects pests? Does 'pest' refer to an insect, a damage or an intensity of insect?
- Get the average no. of spiders in the different ecosystems surveyed and extrapolate population into per hectare basis. How many spiders are there in a hectare? If one spider can eat 5 - 10 pests in one day, how many pests will they eat in one day? For FFS activities seeds could be used to determine the dynamics of spider population using the following assumptions :

*	Ratio of male and female	=	50:50
*	Birthrate	=	30 spiderlings
*	Survival rates	=	
*	Group 1	=	0. 1 percent
*	Group 2	=	0.3 percent
*	Group 3	=	0.5 percent
*	Group 4	=	0.7 percent
*	Group 5	=	0.9 percent

- Compute for 3 generations. How many pests are consumed by spiders in each generation. Make a graph of the different survival rate data from each group.

Exercise No. 4.11

FIELD EXERCISE FOR LADY BEETLE

Most farmers perceive that predatory lady beetles (coccinelid beetles) are major pests of corn at tasseling and silking stages of the crop. This is one of the reasons why unnecessary sprayings are done at this stage. To disprove this claim a caged study may be done.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions.
- In the FFS, where farmers in the area generally perceive that lady beetle is a pest at tasseling and silking stages and it consequently reduces corn yield.
- When the corn crop is at tasseling and silking stages and there is high lady beetle population density.

How long will this exercise take?

- 1 hour setting up, with regular observations from flowering to harvest.

Learning objectives

- To demonstrate the predatory habit of the lady beetle.
- To determine the effect of coccinelid beetle population on the yield of corn.

Materials

- Corn field at tasseling and silking stages.
- Plenty of lady beetles
- Caging materials (e.g., tulle, bamboo sticks, etc.)
- Record book, pen

Steps

1. Cages with the dimension of 40 x 40 x 200 cm will be used in the study. The treatments will be done in two stages of the crop as below :

VEGETATIVE STAGE		FLOWERING STAGE	
TREATMENTS	NO. OF COCCINELID	TREATMENTS	NO. OF COCCINELID
1	0	1	0
2	20	2	20
3	40	3	40

2. Preferably, 3 replications per treatment will be established. Aphids should also be introduced to the treatments with coccinelids to serve as food.

3. Monitoring maybe done bi-weekly. Note defoliation, corn borer and disease damages. At the end of the season, measure yields.

4. Compare yields from the different treatments.

Some suggestions for the processing discussion

- Was there significant yield differences between treatments?
- What was the yield difference between treatments with coccinelid and the control? What general interpretation can you give about the experiment?

Follow-up activity

Each group conducts three pot studies (e.g., predation or parasitization, life cycles, damage symptoms) :

- Predation studies may be conducted in smaller pots.
- Life cycles should be done in standard pots. There maybe life cycles studies which require the pots to be in the field.
- Sensitive insect specimens such as aphids and others should be handled with extra care. Use sweepnet carefully and aspirator when introducing them to pots.
- In using spiders as predators, they should be starved for 2-3 days before introducing them to pots.
- Never handle spiders with bare hands. Use vials when catching or handling them.
- At FFS, be careful in setting up predation or parasitization studies. For example, lycosa and mature grasshopper may not be successful. Lycosa predates only 1st and 2nd instars of grasshoppers. If predator and prey combination is not given proper attention, farmers may lose interest in the activity that usually does not provide immediate results.

Exercise No. 4.12

INSECT ZOO DESIGN : THE CASE OF THE MISSING WORMS, WHAT CAN WE REALLY CONCLUDE? (SMALL TO BIG GROUP CASE STUDY)

When is this exercise most appropriate?

- In the TOT and CST sessions.
- When the participants already have some experience of making insect zoo.
- When the facilitators feel that participants could benefit from planning and analyzing the results of insect zoo more critically.

How long will this exercise take?

- About 30 minutes to 1 hour.

Learning objectives

- To build awareness of the range of possible conclusions we could make from a seemingly clear and simple insect zoo experiment.
- To encourage participants to plan carefully when designing an insect zoo, so that they are clear about what they need to observe in order to answer the questions that they are asking.

Materials

- Manila paper
- Pentel pen

Steps

1. Tell the participants that they will be detectives in 'The Case of the Missing Worms'. You will give them all the clues that they need to solve the case. They will have 10 minutes to discuss the evidence in small groups first, then there will be a big group sharing.

2. Outline and illustrate the following case on the manila paper :
   - A lady bird beetle and 20 worms were put into a jar with several nice fresh green corn leaves. The jar was covered with a fine-net and secured with a rubber band. The jar was put on the windowsill for 1 week.
   - After 7 days, the lady beetle was still living, the leaves were wilted and dry, there were just 5 worms left in the jar. All of these 5 worms were dead.
   - What can we conclude?

3. Ask each group to draw out their conclusions and list these on the manila paper.

4. Discuss any differences and addition to the conclusions of the small groups, and explore what warnings this exercise might give for other insect zoo that we make.

Some suggestions for the processing discussion

- How many different conclusions could be made from 'The Case of the Missing Worms'?
- What would we need to observe to be sure that the lady bird beetle did eat the worms?
- Do we have experiences in our own insect zoo where the conclusions were not clear?
- What suggestions can we make that would help us to avoid these problems in the future?

Exercise No. 4.13

DISCOVERING BENEFICIAL INSECT DISEASES WITH THE INSECT ZOO

This exercise is made up of 3 short insect zoo, which are best done one-by-one in sequence. They should be good for any kind of disease. Notes are made on differences where there is some variation in details for bacterial, viral or fungal diseases, or for the insects that they attack.

When is this exercise most appropriate?

- When insects killed by an insect disease are present in the fields.

How long will this exercise take?

- 30 minutes to 1 hour of an FFS meeting
- 15 to 30 minutes follow-up time at the next meeting
- Some follow-up time at the third or fourth meeting

Learning objectives

- To build awareness of the fact that there are diseases that are killing insects in the fields.
- To discover how the insects look as the disease develops and kills them.
- To discover which kinds of insects the disease can kill.
- To discover whether the development of the disease is favored by dry or wet conditions.

Materials

- 1 plastic jar per group for field collections and insect zoos
- hand lenses
- tissue paper
- net covers, rubber bands and plastic lids for jars

Steps

1. During the weekly field observation for AESA, the facilitators will point out insects that have died from disease by asking : "What do you think happened to this insect?" Do not tell them the answer!

2. Ask each group to collect some of the dead insects so that they can show to the big group and share in a participatory discussion after the AESA.

3. The facilitators collect healthy specimens of the kinds of insects that have been found with disease, and fresh healthy corn leaves for use in an insect zoo.

4. After the AESA discussions, facilitate the group to discuss what might have happened to the dead insects. Some suggested guide questions :
   - What could have caused this insect to die? One output of this discussion should be that the insects might have died of a disease.
   - If the insect died of a disease, how can we prove that it is a disease that killed it? (By contaminating another insect with the remains of the dead insect and seeing of it dies with a similar appearance)
   - Ask the group if they want to make an experiment to see if it is a disease.

5. To make the insect zoo, line the base of a jar with slightly damp tissue paper. Put in some fresh corn leaves for the healthy insects to feed on. Add 2 healthy insects and 1 insect that is suspected to have died from a disease.
   - *For diseases.* You only need to get the spores of the fungus onto the body of the insect but for viral and bacterial diseases, the insects will need to eat some contaminated corn leaves or part of the dead insect. You could try mashing the dead insect in water and sprinkling some of the contaminated water over the insect and the plant material.
   - *For plant sucking insects.* For aphids or planthoppers, you will generally need to use a potted-plant insect zoo instead of a jar zoo. This is because plant sucking insects will usually die within a few days if they are not kept on a live plant.
   - *Reminder.* Remember to use a dampened hair paintbrush for moving delicate insects like aphids and small worms.

6. Each group can make their insect zoo. Ask one volunteer per group to take the insect zoo home to check daily :
   - Remove waste (wilted plant material, insect deposit)
   - Replace wilted plant/leaves with fresh leaves
   - Observe and make notes on the appearance and health of the insects. it might be easier to make a drawing of the insects instead of describing color and shape in words.
   - Observe and make notes about the behavior of the insect. (How much has it eaten since yesterday? How much is it moving?)

7. At the next FFS meeting, ask the participants to share their observations and have a processing session.

Some suggestions for the processing discussion

- Did the contaminated insects die?
- Was the appearance of the insects that died different or similar to that of the 'suspected-diseased' insect? (e.g., the dead insect that we put into the insect disease zoo)
- How did the diseased insect look : a) before it died? b) after it died?
- What other information would we like to discover about the disease? Some suggestions for follow-up questions and explorations are given in the succeeding exercises on beneficial insect diseases.

Exercise No. 4.14

KNOW THE TYPES OF INSECTS KILLED BY BENEFICIAL INSECT DISEASES AND THE CONDITION THAT FAVORS INFECTION WITH THE INSECT ZOO

When is this exercise most appropriate?

- As a follow-up to the diseases of insects 1 exercise
- When participants are interested to discover : 'What different types of insects the disease can kill'? or 'What conditions favor infection by the disease'?

How long will this exercise take?

- A few minutes (5-10) to discuss the questions that participants would like to explore.
- A few minutes (5-10) to set up the insect zoo.
- A few minutes (5-10) observation and maintenance of the insect zoo daily.
- About 15 to 30 minutes reporting and discussion at the next FFS meeting.

Learning objectives

- To discover whether the beneficial insect disease can kill other types of insects (other than the type of insect it was originally collected on).
- To discover whether wet or dry conditions are more favorable for the disease infection.

Materials

- notebook, pens, crayons per group
- pentel pens and labels per group
- 1 jar per insect zoo per group
- tissue paper
- fine hair paintbrush for handling delicate insects

Steps

1. This is a follow-up to the exercise 'Discovering Beneficial Insect Diseases With the Insect Zoo', so the preliminary discussion is really a part of the processing discussion from that exercise. We can share what we have observed in the field about the question(s) that participants are interested to explore. Some suggested guide questions:
   - What have we observed in the field? Did any of the groups find any other insects that have died with a similar appearance to the diseased insects in our first insect zoo?
   - What have we observed in the field? In what conditions or environment do we see less diseased insects? In what conditions or environment do we see more diseased insects? Does the amount of moisture in the environment seem to affect the amount of infection in the field?

2. Set up insect zoo as described in 'Discovering Beneficial Insect Diseases With the Insect Zoo' with the following modifications :
   - Substitute the type of healthy insect used in the first beneficial insect disease zoo for other insects that are found in the field. You could try some more pests, and some natural enemies as well. Put just a few insects per insect zoo, and the same kind per insect zoo so that they do not eat each other. Remember to provide natural enemies with food (e.g., prey insects for predators, flowers and honey solution on cotton for adult parasites).

- Make 2 insect zoos for comparison with the same set-up as in the first beneficial insect disease zoo, but this time make one 'wet' condition and one 'dry' condition. The 'wet' condition insect zoo should have plenty of damp paper in the bottom (not too wet or your insects will drown). Make a small hole only for aeration. Cover the rest of the top of the jar with plastic. For the dry condition, a small amount of moisture can be provided from the fresh plant material and cover with tulle secured by a rubber band.

3. Ask volunteers to take the insect disease zoo home for daily observation. For the first exercises, the participants should make the same observations as listed in the first insect disease zoo. For the second exercise, the participants should observe and care for the insect zoo daily and make a note of when the insects became sick and how long it took for the insects to die.

4. In the next week's session, ask the participants to share their observations and have a processing discussion.

Some suggestions for the processing discussion

- Did the group have any further observations in the field on what type of conditions that favor the disease, or what different kinds of insects seem to be infected by the disease?
- What did we observe in the insect disease zoo?
- What do our observations and discoveries tell us about what the disease can do in the field ecosystem?
- Is there anything else that we would like to explore about the disease and what it does in the field ecosystem? See the succeeding exercise for some suggested field studies.

Exercise No. 4.15

SHARING OF EXPERIENCES AND HANDS-ON EXERCISE : FUNGUS AGAINST LARVAE OF CORN INSECT PESTS

There are naturally occurring predators, parasitoids and insect pathogens attacking eggs, nymphs and adults of corn insect pests. Among insect pathogens, the most common fungus attacking larvae of corn insect pests is the white fungus or *Nomuraea* fungus. It has been known to attack armyworms, cutworms, and semi-loopers, to name a few.

The white fungi can be easily conserved by not using chemical pesticides, which will normally kill them. The fungi can also be introduced to augment existing natural enemies in areas where they are not present.

When is this exercise most appropriate?

- In areas where lepidopterous pests are prevalent.
- At vegetative to physiological maturity stages of the corn crop when lepidopterous pests are presently prevalent in the area.
- In areas where fungus infected larvae of corn insect pests observed.

How long will this exercise take?

- 30 minutes set-up
- 15 minutes daily observation for one week
- 30 minutes participatory discussion after 1 week of observation

Learning objectives

- Create awareness on naturally occurring biological control agents against lepidopterous pests of corn.
- To assess the effect of insect pathogen (white fungus or *Nomuraea* fungus) on the population of lepidopterous pests of corn.

- To find out if white fungus or *Nomuraea* fungus concoction is effective against lepidopterous pests of corn.

Materials

- corn plants
- hand sprayer, water, bottle with cap, wide-mouth, transparent jar and petri plates
- white fungus- or *Nomuraea* fungus-infected and healthy lepidopterous pests of corn.
- insect zoo set-up

Steps

1. Set up insect zoo with different instars of different larvae of corn insect pests.

2. Collect white fungus- or *Nomuraea* fungus-infected and healthy lepidopterous pests of corn from the field.

3. Place white fungus- or *Nomuraea* fungus-infected lepidopterous corn pests in bottle with cap, add enough water and shake vigorously until water has whitish tint.

4. Pour suspension into hand sprayer through a sieve to separate solids.

5. Set up petriplates with healthy lepidopterous pests of corn.

6. Spray suspension on healthy lepidopterous pests of corn in petriplates to multiply the white fungus- or *Nomuraea* fungus.

7. Incubate for 1-2 days under room temperature.

8. Observe for fungal growth.

9. If exposed lepidopterous pests of corn are totally colonized by the fungus, repeat procedures 3 and 4.

10. Spray spore suspension from white fungus- or *Nomuraea* fungus-infected to healthy lepidopterous pests of corn in the insect zoo.

11. Observe daily until at least 1 week.

12. Present observation and conduct participatory discussions.

Some suggestions for the processing discussion

- What are the signs and symptoms exhibited by white fungus- or *Nomuraea* fungus-infected larvae of corn insect pests? Characterize.
- How long did it take to kill the host larvae of corn insect pests?
- Why do we need to do this exercise?
- Which of the stages was more affected by white fungus- or *Nomuraea* fungus? Explain.
- What was the effect of white fungus- or *Nomuraea* fungus on other insects?
- Are there any other biological control agent observed?
- If the method used is successful, can white fungus- or *Nomuraea* fungus be recommended to farmers?
- How can we relate it to the ecosystem?

Exercise No. 4.16

FIELD STUDIES :
ASSESSING THE IMPACT OF BENEFICIAL INSECT DISEASES AND HELPING IT SPREAD

When is this exercise most appropriate?

- These exercises are possible follow-up explorations from ‘Discovering Beneficial Insect Diseases With the Insect Zoo’ and ‘Know the Types of Insects Killed by Beneficial Insect Diseases and the Conditions that Favors Infection With Insect Zoo”.
- When participants are interested to discover more about : ‘How many insects the beneficial insect disease is killing in the field’? or ‘Can we help the beneficial insect disease to kill more insects in the field’?

How long will this exercise take?

- A few minutes (5-10) to discuss the questions that participants would like to explore.
- About 15-30 minutes field walk to discover new information about the beneficial insect disease.
- A few minutes (5-10) to set up the insect zoo.
- A few minutes (5-10) observation and maintenance of the insect zoo daily.
- About 15 to 30 minutes reporting and discussion at the next FFS meeting.

Learning objectives

Depending on what questions the group want to explore :

- To discover how many insects can be killed by the beneficial insect disease in the field.
- To discover how the beneficial insect disease is distributed in the field.

- To discover how many insects could be dying per week from infection of the beneficial insect disease.
- To discover whether we can manipulate the field environment to make it more favorable for the beneficial insect disease.
- To discover whether we can help the beneficial insect disease to spread by collecting and spraying it in the field.

Materials

Depending on the exercise :

- notebooks and pencils, manila paper or,
- sprayer (no chemical residues), water, notebooks, pencils, manila paper, and pentel pens per group or,
- jars for collecting diseased insects, sprayer (no chemical residues), notebook, pencils, manila paper and pentel pens per group

Steps

1. This exercise is designed to be a follow-up from earlier exercises, 'Discovering Beneficial Insect Diseases With the Insect Zoo' and 'Know the Types of Insects Killed by Beneficial Insect Diseases and the Conditions that Favors Infection With Insect Zoo', so that the preliminary discussion is really a part of the previous processing discussion(s).

2. It will be important to discuss questions that the participants would like to explore before doing a field walk to discover new information about the beneficial insect disease in the field.

3. When appropriate, follow the steps from the earlier exercises, 'Discovering Beneficial Insect Diseases With the Insect Zoo' and 'Know the Types of Insects Killed by Beneficial Insect Diseases and the Conditions that Favors Infection With Insect Zoo'.

4. Every week, process new information gathered in the field by brainstorming in small group and by participatory discussions in the big group.

5. At the end of the season, summarize all experiences and lessons learned from the exercises.

Some suggestions for the processing discussion

- Aside from the information gathered in the previous exercises, did you discover how many other insects can be killed by the beneficial insect disease in the field?
- Based from your observations in the AESAs and field walks, how is the beneficial insect disease distributed in the field?
- Can you have an estimate of how many insects could be dying per week from infection of the beneficial insect disease?
- What are the field conditions that favors the spread of the beneficial insect disease? Can we manipulate the field environment to make it more favorable for spread of the beneficial insect disease?
- Can you suggest a practical method of preparing spray material from the beneficial insect disease for field application?

Exercise No. 4.17

MAPPING EXERCISE :
ENCOURAGING NATURAL ENEMIES IN THE FARM
(WHAT ENVIRONMENTS DO NATURAL ENEMIES PREFER?)

When is this exercise most appropriate?

- When participants have already discovered a number of natural enemies through insect zoo observations and weekly Agro-Ecosystem Analysis.
- When participants want to discover more about how they can encourage natural enemies on the farm.

How long will this exercise take?

- 1 to 1.5 hours of the FFS, TOT and CST sessions.

Learning objectives

- To discover which type of environment favors different kinds of natural enemies.
- To build awareness that the field ecosystem can interact with the other parts of the farm environment.

Materials

- a field for observation of natural enemies
- manila paper, pencils, pens and crayons for each group

Steps

1. Ask each group to choose 1 kind of natural enemy to study (a different one for each group).

2. Each group spends 30 minutes in the farm area making a map which shows:

   - All of the different kinds of environment on the farm (e.g., weedy area, pond, canals, different crops, compost areas or other rotting vegetation, trees, under stones, in the soil, between plants, etc.).
   - Which of these places they found their type of natural enemy?
   - How many of their natural enemy they found in each place?

3. Return to the 'classroom' to brainstorm in small group draw the maps on manila paper.

4. Each small group presents their map to the big group.

5. The big group conduct participatory discussions on the findings.

Some suggestions for the processing discussion

- When there is a newly planted crop in the field, where do natural enemies come from?
- Which kinds of environment do the natural enemies prefer?
- Why do they prefer these kinds of environment? (e.g., adult parasites and lady beetles feed on nectar and pollen of flowering plants; hunting spiders, predatory earwigs and predatory rove beetles eat decomposed insects in composting areas; web spiders need suitable plants to build their webs between)
- What things that we might do that would reduce the numbers of natural enemies in these environment?
- What things could we do to increase the numbers of natural enemies in these environment?

Exercise No. 4.18

NATURAL ENEMIES PREFERRED ENVIRONMENT AND CULTURAL PRACTICES : CAN WE INCREASE NATURAL ENEMIES BY EMPLOYNG SUITABLE CULTURAL PRACTICES?

When is this exercise most appropriate?

- When participants have already done the exercise on mapping of natural enemy environment.
- When participants are interested to explore whether they can increase the numbers of predators in the crop (e.g., if farmers are suggesting that we should mass-rear and release predators, like what is done for the parasite, Trichogramma)

How long will this exercise take?

- 30 minutes to 1 hour planning discussion.
- Depends on the exercise, you may need to wait about 1 month before sampling and completing the exercise.
- 1 hour sampling in the fields.
- 1 hour processing.

Learning objectives

- To explore whether there are cultural practices (e.g., locally and or other alternatives) that can help to increase the numbers of natural enemies in the crop.

Materials

- *If the group decides to sample current farmers' fields.*
  Notebooks, pencils, hand lens, sampling materials (e.g., sweep nets, plastic cups for pit traps, depending on what the group decides to do)

- *If the group decides to make an experiment.*
  Materials for setting-up the cultural practice treatment will depend on the cultural practice that is chosen and the same materials as above can be used.

Steps

1. Facilitate the group to recap on the findings of the exercise on mapping natural enemy environment :
   - Which environment favored which kinds of natural enemies?
   - Why were the environment good for these natural enemies?
   - *If the farmers have been asking about the possibilities of mass rearing and releasing predators, you might also want to ask :* 'Which do you think would be easier and more economical, to mass rear predators for release, or to help them increase in numbers in the field by providing a favorable environment?'

2. Ask the group to brainstorm on what kinds of cultural practices we could use that would make these favorable environment in or near our fields. Make one list of *local practices* and another list of *any additional ideas* for both :
   - *When the field is empty.*
     That is, after harvest and before the next planting.
   - *When the crop is in the field.*
     That is, when mulching, planting flowering plants or crops, 'green manure's '[5], 'undersowing'[6].

5 e.g. Planting *Sesbania* between croppings. This harbors beneficial insects, helps to suppress weeds and fixes nitrogen. It is plowed-in before the next crop is planted.
6 Planting a non-competitive plant like *Sesbania* on the edges of the rows to harbor natural enemies like spiders and predatory beetles.

3. The next thing to do will depend on the suggestions that you have listed:
   - *Field Comparison.* If there are local fields with the suggested cultural practices, you can go to the fields and compare the number of natural enemies in an area where the cultural practice is being used versus the number of natural enemies in an area where the cultural practice is not being used. For example, you might compare the number of parasites and lady beetles in a field with flowering plants versus the numbers of these natural enemies in a field where there are no flowering plants. Another example is you might compare the number of spiders and predatory earwigs in a field where mulching is used versus the numbers of these natural enemies in a field where there is no mulch.
   - *Field Experiment.* If there are no fields in the local area where the suggested cultural practices are used, your group can discuss whether they want to make an experiment. For example, planting a fast-maturing flowering plant (such as pechay), or adding a mulch cover to bare soil, would not take much preparation time. After about a month, you can sample the area and compare with an area where the cultural practice is not used.

4. Get the groups to share the sampling by having each group do 2 samples in each area. This means that any differences in how different people sample with, will happen in both fields.

5. Make your samples representative of the whole field (e.g., spread samples randomly across the whole field and do not just concentrate in one area.

6. Use the same method in the 2 fields that you will compare. Here are some suggested sampling methods :

   - *FLYING INSECTS :* Use a sweep net. Sweep 10 times while walking along one plot of 5 meters length. Sample 10 areas in this way, in random places, that are spread across the whole field. Count the numbers of wasps and lady beetles caught after each sweep, release them before you start the next sample.

- *PREDATORS :* Choose 20 plants randomly, making sure that they are spread across the whole field. Count the numbers of predators on the plant and on weeds, or on/in the soil within a diameter of 50 cm around the plant. Remember that predator earwigs are most active at night, so they are usually hiding in the weeds or in small holes in the soil during the day. So you will need to dig around in the top few centimeters of the soil surface to look for earwigs.

7. When the sampling is complete, return to the 'classroom' and make a summary of the numbers of each kind of natural enemy in each type of field before the group tries to analyze the results.

8. Have a group discussion to analyze the results of the comparison.

Some suggestions for the processing discussion

- Did the cultural practice increase the numbers of natural enemies in the crop?
- If yes : How much time and money did it cost to use this cultural practice?
- Was it worth the effort and investment?
- What other benefits might this cultural practice have?
- What disadvantages might this cultural practice have?

Exercise No. 4.19

GAME AND INSECT ZOO :
PESTS-NATURAL ENEMIES INTERACTION
(CAN NATURAL ENEMIES CONTROL PESTS?)

When is this exercise most appropriate?

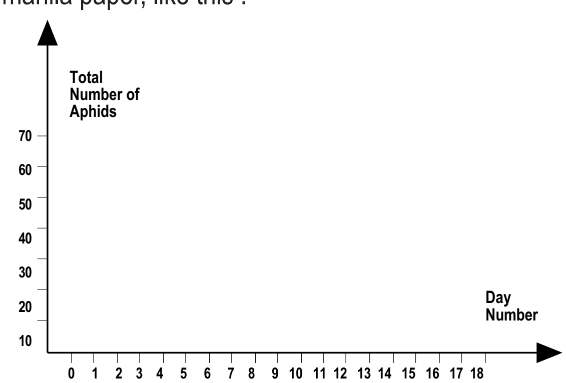
- When participants have seen aphids and predatory lady beetle larvae interacting in the field, and have done some observations of the lady beetle larva feeding on aphids.

Learning objectives

- To reinforce, or suggest the idea that natural enemies can control or reduce the numbers of pests in corn fields.
- To stimulate participants to make observations and experiments that will help them to understand how this process might work in real corn fields.

Materials

- 80 small wrapped candies, plus 1 big candy bar
- 1 rice tiller drawn in 1 sheet of manila paper.
- Pentel pens and tape
- 1 empty chart, drawn on I sheet of manila paper, like this :



Steps

1. Gather all the participants in a semi-circle. Put the corn tiller on the floor in the middle of the group, and put the graph on the wall where everyone can see it.

2. Explain the following to the group :
   - The big candy bar is a female aphid who has just arrived on the corn plant. Put it on the corn plant.
   - Every day the mother aphid will make 8 baby aphids. Show the group the small candies that represent the baby aphids.
   - After some time a predatory lady beetle larva will arrive and start to eat the aphids. The participant will take it in turns to be the predatory lady beetle larva.
   - The lady beetle larva eats a few aphids every day. Remember it can only eat baby aphids.
   - Everyone must be very careful to eat only as much as the you say, because the predatory lady beetle larva gets (full) after a certain number of aphids. Leave the empty candy wrappers on the corn plant because they looked like the empty skins that a lady beetle larva 'spits out' when it has finished sucking all the juices out of an aphid.
   - We will count the number of aphids that remain after each day of baby-making and aphid-eating. Record the total number on the chart.

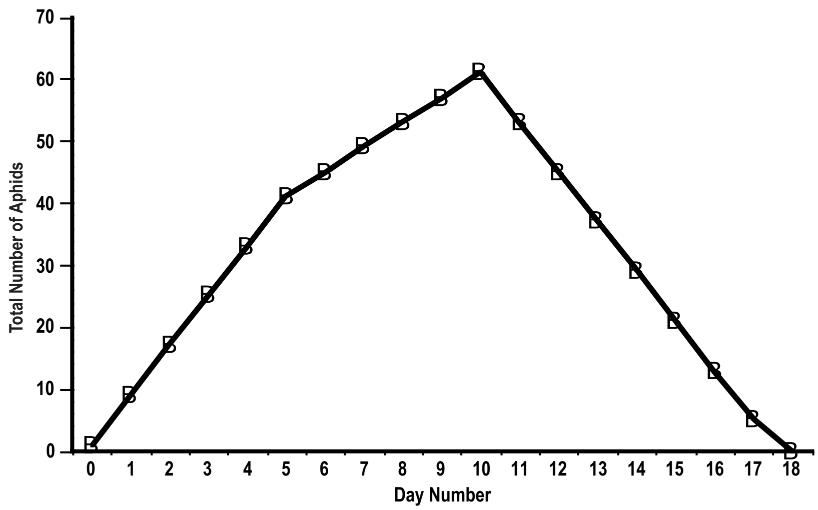
3. Ask for 2 volunteers to help count the aphids and put the daily total number on the chart.

4. Start the game! The number of baby aphids made, the number of aphids eaten, and the resulting total per day are given in the table below. As the game progresses, you will need to explain why the numbers of new and eaten aphids are changing.

DAY NUMBER	NUMBER OF BABY APHIDS HATCHED	NUMBER OF BABY APHIDS EATEN	TOTAL NUMBER REMAINING
0	the 'mother' aphids arrives	0	1
1	8	0	9
2	8	0	17
3	8	0	25
4	8	0	33
5	8	a small hungry lady beetle larva arrives and eats 4 aphids per day	41
6	8	4	45
7	8	4	49
8	8	4	53
9	8	4	57
10	8	4	61
11	the mother aphid dies (or is eaten by the lady beetle larva)	the lady beetle larva molts so it can now eat 8 aphids per day	53
12	0	8	45
13	0	8	37
14	0	8	29
15	0	8	21
16	0	8	13
17	0	8	5
18	0	the lady beetle larva eats 5 aphids, then it needs to find another group because it is still hungry!	0

Some suggestions for the processing discussion

- The chart that is produced during the game should look something like this :



- As for any exercise we need to share our observations and ideas about what we have done to clarify and emphasis the learning points. These are some of the main the main questions and discussions that may result from our processing :
   * What would have happened if the 'mother' aphid had died or been eaten by the lady beetle earlier? (The aphid population would have been reduced even faster).
   * How many other natural enemies do we know of that eat aphids? (For example : lady bird beetle adult, lady bird beetle larva, spiders, predatory ants, brown or pink fungi, all of which would help to reduce the number of aphids even faster).
   * What other things could affect the numbers of aphids? (Rainfall or 'rainbird' overhead-sprinkler watering washes or knocks the aphids off the plant. The population is reduced because aphids die before

they can get back onto the plant. This may be because they get eaten by ground predators such as hunting spiders, ground beetles, or rove beetles).

* Some predators do not eat the whole prey insects, they eat a bit and then move on. How would this affect the number of prey? (It might reduce even faster, because the predators could kill more prey each day).
* Are the numbers that we used in the game realistic? (We do not really know. Two participants in previous games have measured the feeding rate of a final instar lady beetle larva to be over 150 aphids in 12 hours. They were also seen eating small leaffolder larvae. We did not have any other information or experiences on aphid or lady beetle ecology).

- The group can make a list of insect zoo, that can be used to discover the other information that we wanted to know). For example :
  * How many babies can 1 mother aphid make in 1 day? Put 1 or 2 adult aphids on a single tiller of a potted plant. Use an aspirator to move them. Use a corn seedling because you will be able to move the leaves more easily to see your aphids. Count the number of baby aphids made each day. Try removing the new baby aphids after a few days if you find it too hard to count a big number. Do this observation a few times with different aphids in case 1 of the aphid is unusually fast or slow at hatching their youngs. Calculate the average number of aphids a mother aphid made in 1 day.
  * How long does it take for a baby aphid to develop into an adult and start hatching its own babies? Put 1 or 2 adult aphids on a small potted plant (as for 1). The next day, remove the adults and leave the babies. Now you have a group of baby aphids which you know were all born in the last day. Observe them every day to see how long it takes for them to start hatching their own babies.
  * What and how do predatory lady beetle larvae eat? In the game, the smaller lady beetle larva only ate smaller aphids, and aphids

were the only prey available for it to eat. It is very easy to observe the feeding habits of a lady beetle larva, even in the open, because when they are feeding they do not move far.

a) To observe a lady beetle larva feeding on aphids, put it on a corn leaf with some aphids and watch. Use a lens if you like. Watch the larva sucking the insides of the aphid out until only the skin remains!

b) Try feeding it some small leaffolder larvae or other small caterpillars. What else do you think it could feed on? Try it

c) Observe and describe how the lady beetle larva searches for the next prey. How different does it look when it is actually eating? Some people find it difficult to recognize the difference between a lady beetle larva and a small ground beetle larva. Compare the way the movement of the hunting lady beetle larva with the movement of other small predatory beetle larvae.

d) To see how much the larva can eat in 1 day, either : Put it in a pot with a known number of prey on several rice leaves, count how many prey are left after 24 hours; or : Watch one larva feeding for as long as you can (30 minutes, 1 hour, etc.) and see how long it takes to eat 1 prey, then calculate how many it could eat in 12 hours.

e) Do they feed more at night or day? Do the same observation described in d for a 12 hour daytime period and a 12 hour night-time period.

f) Try collecting lady beetle larvae of different sizes, and observe to see if their is any difference in what and how much they can eat.

* How long does it take for a predatory lady beetle larva to develop into an adult? Collect the smallest sized lady beetle larvae that you can find (using an aspirator when it is necessary to handle them). Rear them in separate pots (or they might eat each other). Add clean fresh food when needed. Handle the larva as little as possible. If you do need to handle them use aspirator. Observe the changes in size, color and shape as the larva develops. Note the changes every day in your notebook, draw anything new that you observed. How does the pupa look? What kind of animal is the adult? (HINT: look at the wings).

* How many aphids does it take to damage a plant? When the plant is nearing maturity and the aphids are on the lower leaves, there is no obvious damage to the plant. If the aphids get onto the younger plants before tasseling stage, they can cause 'aphidburn'. Nobody knew whether the plants could or could not recover from this kind of early damage. The group suggested in previous exercises that a field experiment could be designed to test this question.

Exercise No. 4.20

HUMAN PREDATOR GAME :
UNDERSTANDING ECOLOGICAL FUNCTIONS AND RELATIONSHIPS

Basic understanding on the ecological functions and relationships among organisms in the ecosystem would explain their behavior, distributions, and the fluctuation of their densities. The predator-prey relationship among organisms is one of the example that would explain these phenomena.

When is this exercise most appropriate?

- In the FFS, TOT and CST, when participants want to understand better some ecological functions and relationships.
- In demonstrating insect predator and food preference of insect predators.

How long will this exercise take?

- 1 minute for searching
- 5 minutes for set-up
- 60 minutes for participatory discussion

Learning objectives

- To demonstrate the searching behavior of predators in relation to their feeding capability.
- To create awareness on the population distribution of insects in the field.
- To create awareness on the population regulation of one species or another.
- To demonstrate the food preference of predators.

Materials

- one participant and one table
- handkerchief, watch with a second hand, thumbtacks
- different sizes of grains and pebbles
- goat droppings

Steps

1. Ask one volunteer from each group to act as a predator.

2. Instruct participants to use 2-3 fingers to pick up pre-arranged objects on the table. Emphasize that this is not a contest.

3. Blindfold each volunteer with a handkerchief.

4. Arrange 20-25 assorted objects (thumbtacks, pebbles, grains, etc.) in randomly positioned scattered and clustered groups.

5. Human predator searches and picks up objects for 1 minute while the rest of the group observes.

6. Process observation in big group.

7. Make one human predator report his experience while in blindfold.

Some suggestions for the processing discussion

- In what kind of distribution did the human predator pick up the most object from?
- What were the behaviors demonstrated by the human predator in handling the different objects?
- Is the exercise related to insect ecology? Explain.

- How is insect population density related to the searching and feeding capacity of a predator.
- How is the low or high population of pests related to predator population density?

Exercise No. 4.21

BIOLOGICAL PESTICIDES : *BACILLUS THURINGIENSIS* (WHAT DOES B.T. KILL AND DOES NOT KILL? HOW DOES B.T. KILL? WHAT CAN STOP B.T. FROM WORKING)

When is this exercise most appropriate?

- When farmers want to learn more about : "What B.t. kills?" "What B.t. does not kill?" "How B.t. kills?" and "What can prevent B.t. from working?"
- When farmers decide that they need to spray to reduce a large population of 'worms' (caterpillars); When they have already analyzed that plant recovery, natural-enemy control and hand picking will not be sufficient; When the group is unconvinced to try using B.t. instead of a chemical pesticide because they think it does not work.

How long will this exercise take?

- 1-2 hours of an FFS meeting, plus a few minutes observation every day until the next FFS meeting.

Learning objectives

- To discover that B.t. can kill many different kinds of 'worms' (caterpillars).
- To discover that hot, bright, sunlight can reduce the effectiveness of B.t.
- To discover that B.t. only kills 'worms' (caterpillars) and it does not kill not other types of plant eaters.
- To discover that we can make a simple test to see if B.t. can kill a type of 'worm' (caterpillar), when we need the information to make a decision about whether or not to spray B.t.

Materials

- B.t. of different brands and period of storage
- A potted corn plant at tillering stage (about 6-8 tiller stage would be ideal)
- Different kind and sizes of worms (caterpillars)
- Hands sprayer and water
- Notebook, pen, pentel pen and manila paper

Steps for the orientation

1. Ask the farmers to share their experiences of using B.t. Some suggested guide questions :
   - Who has used B.t.?
   - What insects did you use B.t. against?
   - How did you use the B.t.?
   - What did you observe after you sprayed the B.t.?
   - Did anyone ever experience that B.t. did not work? When was this? Why do you think this is?
   - When did the B.t. work? Why do you think this is?

2. Ask the farmers if they want to learn more about how B.t. works and what might stop it from working.

3. Ask the big group to divide into 2 small groups :
   - One group of 12 participants will find out what effect hot sunlight and cool shade have on the effectiveness of B.t. on either cutworms or armyworms (Group A).
   - All of the other participants will find out which other pests can be killed by B.t. (Group B).
   - Both groups (Groups A and B) will observe how B.t. kills pests.

4. Group A will follow STEPS FOR GROUP A with at least one facilitator guiding, while Group B will follow STEPS FOR GROUP B with another facilitator guiding.

Steps for Group A

1. Each of the participants cuts 4 clean fresh corn leaves, 4 cm in length, then washes the leaves with clean water and put them to dry on a piece of tissue paper (not in direct sunlight, or it will wilt).

2. Each participant takes a plastic jar and writes on the treatment that they will do :
   - 3 people do................. spray B.t. + expose to HOT SUNLIGHT
   - 3 people do ....spray WATER + expose to HOT SUNLIGHT
   - 3 people do..................spray B.t. + keep in COOL SHADE
   - the last 3 people do.....spray WATER + keep in COOL SHADE

3. The participants who will spray B.t. now make up 250 milliliters of water with B.t. Then the spray their own leaves on both sides using one hand sprayer. The other group fill their hand-sprayer with water and spray their own leaves on both sides also.

4. The sprayed leaves are air dried once again, in a cool shaded place.

5. The participants who will expose their leaves to HOT SUNLIGHT should each take a plastic jar to put in their leaves. Then they put them in a hot sunny place for a period of 30 minutes. The other participants put their leaves also in a plastic jar and put them in COOL SHADE for the same period of time.

6. During the 30 minutes waiting period, the facilitators guide the participants to design and draw up a simple table in which they can record what they observe. They will need to record the following :
   - How long is it since the insects were put in the jar?
   - How many insects are dead?
   - How many insects are alive and feeding or moving?
   - How many insects are alive and not feeding or moving?

- Describe the color and any other observations about how the insects looks like.
- Draw the leaves and show how much has been eaten and how much 'waste' (shit) there is.
- Make note if the leaves is eaten completely and so you add another leaves as necessary.
- Any other observations?

7. After the 30 minute period, each person carefully moves 5 armyworm or cutworm larvae into their jar. Choose smaller larvae, because we do not want the ones which are about to pupate. Use a wet fine hair paintbrush and be very gentle. Cover the jars with cotton covers and secure with rubber bands

8. Make the first set of observations 1 hour after the larvae were put in the jars. Do not poke the larvae, just observe. If you have to move them, use a wet fine hair paintbrush and be gentle!

9. The participants each take their own jar home and make an observation every morning until the next FFS meeting.

Steps for Group B

1. Participants pair up. Each pair chooses one type of plant-feeder to test. Facilitate it so that some groups test insects that are not 'worms' (caterpillars) to compare with all the tests with worms. Here are some suggestions for insects to test :
   - armyworms
   - corn borers
   - corn earworms
   - silk beetle
   - short-horned grasshoppers
   - semi-loopers
   - mole crickets

- big black cutworms
- small light cutworms
- big light cutworms

2. Each of the participants cuts 15 clean fresh corn leaves. For the large insects (large worms, bugs), prepare 10 clean fresh corn leaves, 10 cm in length. For the small insects (loopers, leaf folders and small worms), prepare 4 clean fresh corn leaves, 4 cm in length.

3. Each participant washes the leaves with clean water and put them to dry on a piece of tissue paper (not in direct sunlight, or it will wilt).

4. They then take 2 plastic jars and write on the 2 treatments that they will do. One person does treatment a (Spray B.t.), the other does treatment b (Spray water).

5. The participants who will spray B.t. now make up 250 milliliters of water with B.t., then spray their own prepared leaves on both sides using one hand sprayer. The other group fill their hand-sprayer with water and spray their own prepared leaves on both sides also.

6. The sprayed leaves are air dried once again, in a cool shaded place.

7. While the leaves are being dried, the facilitator guides the participants to design and draw up a simple table in which they can record what they observe. They will need to record the following :
   - How long is it since the insects were put in the jar?
   - How many insects are dead?
   - How many insects are alive and feeding or moving?
   - How many insects are alive and not feeding or moving?
   - Describe the color and any other observations about how the insects look.
   - Draw the leaves and show how much has been eaten and how much ‘waste’ (shit) there is.

- Make note if the leaves is eaten completely and so you can add some more leaves. Note also other observations.

8. Each person puts leaves into their jar and carefully moves 5 of their type of insects into the jar. For small worms use a wetted fine hair paintbrush and be very gentle. For leafhoppers, use an aspirator and again be gentle. Cover the jars with cotton covers and secure with rubber bands.

9. Make the first set of observations 1 hour after the larvae were put in the jars. Do not poke the insects, just observe. If you have to move them, use a wetted fine hair paintbrush and be gentle.

10. The participants each take their own jar home and make an observation every morning until the next FFS meeting.

11. For next week, facilitate each small group to put the results for their exercise together, and conduct some participatory discussion and general observations within the small group. Get each group to summarize their observations on one sheet of manila paper.

12. Organize the sharing of the results of the 'WHAT ELSE DOES B.t. KILL?' exercise so that it is presented and discussed completely before starting the presentations and discussion of the 'EFFECTS OF SUNLIGHT ON B.t'. exercise. This should help the group to focus more clearly on the objectives of the 2 exercises.

Some suggestions for the processing discussion on
'WHAT IS THE EFFECT OF SUNLIGHT/SHADE ON B.T.?' (GROUP A)

- How many larvae died in the water/shade and water/sunlight treatments? What does this tell us?

- How many larvae died when they had been fed on leaves with sunlight-exposed B.t.? How many larvae died when they had been fed on leaves with B.t. that was kept in shade? What does this tell us?
- We have discovered that B.t. is a living thing which can be damaged by heat and light. In the fields, it dies when it is exposed to heat and sunlight. What time of the day do you think would be best to spray B.t.?
- What other ways can we care for B.t. to maintain it's effectiveness? How do we store it? How do we transport it? How was it stored by the dealer? How long do you keep it once you have opened the packet?

The group may want to discuss whether or not cocktailing with chemicals could also stop B.t. from working. Cocktailing should not happen in IPM, because we do not need to cocktail. If you use B.t,. why spray another insecticide? What season will it be if you need to spray a fungicide? In which season are 'worms' a problem?

Some suggestions for the processing discussion on
‘WHICH INSECTS CAN B.T. KILL?’ (GROUP B)

- How many larvae died when they were sprayed with water? What does this tell us?
- Which plant-feeders did the B.t. kill? Which plant-feeders did the B.t. not kill? Why do you think this is? (B.t. can only kill larvae of moths and butterflies. B.t. can not kill beetles, leafhoppers or any thing that is not a caterpillar)
- When the B.t. kills a plant-feeder, how long after spraying does the insect stop feeding? How long does it take before it dies? Why do you think that it stops feeding some time before it dies? (It feels sick because the stomach is paralyzed by a poison from the B.t. bacteria)
- Did the appearance of the insects change when they are killed by B.t.? How?

Exercise No. 4.22

ROLE PLAY FOR INSECTICIDE RESISTANCE : UNDERSTANDING HOW RESISTANCE BUILDS UP

When is this exercise most appropriate?

- When one or more farmers share the experience that some pesticides stop working after sometime.
- When farmers are interested to know more about why pesticides ‘stop working’ or pests ‘become immune’ to pesticides after sometime.

How long will this exercise take?

- 1 hour of an FFS meeting

Learning objectives

- To understand how populations of insects become resistant to pesticides.

Materials

- 1 hand sprayer with water in it

Steps

1. Ask farmers to share their experiences of pesticides that have stopped working after sometime. Some suggested guide questions are as follows :
   - Who has had the experience of a pesticide working well in the first applications but it stops working after sometime? Why do you think this happened?

- Why did farmers start using 'cocktailed' insecticides to control thrips? How many different pesticides had stopped working for thrips? Why do you think this happened?
- How long did it take for the pesticides to stop working?
- Do you want to do an exercise which looks at how pesticides stop working?

2. Organize the group for the role play game. You will need the following volunteers :
   - 1 story teller
   - 1 farmer who will spray 'worms' with his 'poison-sprayer' (Do not worry if it only has water inside)
   - 7 farmers, to be Ordinary Worms, who wear short sleeved tops only.
   - 14 farmers, to be Super Worms, who wear long sleeved tops.
   - A group of Documentors (all the remaining FFS participants), who will observe and take notes of what happens.

3. Put the Ordinary Worms on one side of the 'classroom' and the 'Super-Worms on the other side. The middle of the room is the Farmer's Field. (You can draw a boundary around the edge of the field area with chalk if you like).

4. The game story starts. The story teller explains the story and gives instructions to the group with the help of the facilitators *(instructions are given in italics) :*

   - In the first week of the season, the farmer went to the field and he found 5 worms. He did not know it, but 1 of these, a Super Worm, was resistant to the pesticide that he usually use. All the rest were Ordinary-Worms.

     (1 Super Worm and 4 Ordinary Worms go into the field).

- The farmer was very worried that his crops would be eaten, so he decided to spray poison immediately. One lucky Ordinary Worm managed to escape the poison by hiding

  (The Farmer gets the water spray and sprays all worms except one its forearm).

- All but 1 of the Ordinary Worms died of poisoning, but the Super Worm lived because he/she was protected from the spray

  (Ordinary Worms die and Super-Worm shows his/her protection to the observers).

  Now the farmer was happy, so he went away for a week. In that week, the remaining worms pupated for a few days, became adults and then got down to their natural habit of baby-making. Each adult can make 3 babies. One of the adults was a Super Worm, and one was an Ordinary Worm. So in the next generation of worms, there were 3 Ordinary Worms and 3 Super Worms. After making babies, as is natural for many insects, the adults died.

  (Worms rest, emerge as adults and get babies, 3 Super and 3 Ordinary, then the adults die).

- The next week the farmer came to the field and found 6 worms. Again he was worried so he decided to spray. This time he mixed the poison spray a bit stronger, and took care to cover all areas of plants where the worms could be hiding.

  (Farmer looks carefully around the field and sprays all worms on their forearms).

- The Ordinary Worms died of the poison spray, but the Super Worms were protected and lived

  (Ordinary-Worms die and Super-Worms again show his/her protection to the observers).

- Again the remaining worms pupated and emerged as adults and got down to baby-making. As before, each adult makes 3 babies and then dies. This time the parents are all Super Worms. So there are 9 Super Worms in the next generation.

  (9 Super Worms come into the field and the adults die).

- The next week the farmer came to the field again. Now he found 9 worms. He sprayed again with stronger pesticide. But none of the insects died.

5. What should he do now?

6. Get the observers to report their observations to lead the processing by participatory discussions.

Some suggestions for the processing discussion

How many worms died out of how many in each generation?
How did this change between the generations? Why was this?
What will happen if the farmers continues spraying the same pesticide? Or a different pesticide?
Why did the numbers of Super Worms and Ordinary Worms change in each generation? (You might want to discuss how this is similar to selecting different characters in rearing animals like pigs and fighting cocks)

SIMULATION STUDIES ON CROP COMPENSATION

Exercise No. 4.23

CORN DEFOLIATORS SIMULATION STUDY

When is this exercise most appropriate?

- One week after transplanting in the FFS, TOT and CST sites.
- In the FFS, if and when the farmers perceived defoliators as a problem
- In the FFS, once we observe defoliators in early AESAs and in neighboring fields through barangay immersions.

How long will this exercise take?

- 1 hour participatory discussion on the design of the simulation study.
- 1 hour field work to set-up the exercise.
- 15-30 minutes weekly observation and data gathering (can coincide with the conduct of AESA)
- 1-2 hours data consolidation, preparation and presentation (at least once during the season and once at the end of the study).

Learning objectives

- Gain knowledge on plants ability to compensate for lost leaves at different levels of damage and at different growth stages
- To determine the critical growth stages of corn to defoliators and crop loss caused by defoliators.

Materials

- Corn plants
- Pair of scissors
- Manila paper, pentel pens
- Sticks and Labels
- Notebooks and ball pen

Steps

1. Design a simulation study in the 'classroom'. Answer the following questions that may lead us attain the learning objectives and thus, serve as our entry point to the exercise :
   - Why do you want to do simulation studies on crop compensation?
   - How can we learn about the effects of defoliators by simulation studies?

2. Brainstorm with the big group to define the procedures that will be followed in conducting the simulation study :
   - Ask how much we shall cut off the leaves. To find out, you could ask how much the participants have seen defoliators eat in the field based from their own experience. There could be 2-3 levels and one should exceed the realistic extent of damage. Remember to set aside some control plants.
   - Ask when we cut off the leaves. It could be at 15, 30, 45 and 60 days after planting or at vegetative, tasseling and silking stages of the corn crop.
   - Ask where we cut off the leaves. If they do not know, we can observed in the field. Often, the defoliators would cut off the leaves or leave only the midribs).
   - Ask how many we cut off the leaves. Do not make it too many and complicated. At least 3-4 treatments representing at least 3-4 growth stages also will be practical enough. The table below is an example of when to defoliate, what to simulate and the degree of simulation :

GROWTH STAGE	INSECT PEST	DEGREE OF SIMULATION
SEEDLING (10-15 DAP)	SEEDLING MAGGOT	10-25% OF THE YOUNGEST LEAF
MIDWHORL (25 AND 35 DAP)	EARWORM	1 AND 2 PUNCH LINEAR HOLE AT THE UNFURLED LEAF
MIDWHORL (25 AND 35 DAP)	CUT WORM	25% OF LEAF AREA OF 3 YOUNGEST LEAF
LATEWHORL-SILKING (35 AND 50 DAP)	ARMY WORM	25 % OF LEAF AREA OF 3 YOUNGEST LEAF
SEEDLING-MILKING	ALL DEFOLIATORS	REFER TO THE ABOVE MENTIONED DEFOLIATORS

- Ask what data we collect before, during and after the exercise to be able to make conclusions. The weekly plant assessment could include : plant height, number of leaves, number of kernels, number of ears, pest and natural enemies population dynamics, pest damages, yield data, and even economic data, etc.

3. Write down the agreed procedures on a chart or manila paper.

4. Go to the field and set-up the study. The following is a simple guide :
   - Select and assign the plots at random. At least two sample plots should be assigned per treatment. Remember to assign control plots.

- Cut off or punch the leaves with a pair of scissors or a puncher . Simply simulate the % total leaf area usually damaged by defoliators by cutting off, for example, 1/4, 1/2, 3/4 or 25%, 50%, 75%, etc., of the total leaf area.
- Label the plant with date and treatment.
- Make sure that the plants (the field) has enough water and the required fertilizer.

5. Observe plants and collect data weekly.

6. Brainstorm and consolidate reports in the small group for presentation to the big group. For the TOT and CST presentation, the following may be done :

- If possible, prepare bar or line graphs for each weekly observation. (e.g., x-axis is weeks after treatment and y-axis is number of leaves or tiller or plant height, etc.).
  - Each group presents their results to the large group and discus it for example at least once during the season and once after harvest.
  - Afterwards, the big group can brainstorm on how presentation and discussion should be carried out with farmers. Should they draw bar graphs also? Should they draw plants instead? Is discovering in the field enough? How can you then make sure that all of them discover and not only the one or two gathering the data?

Some suggestions for the processing discussion

- How is the plant development in different treatments?
- Is the crop able to compensate lost leaves?
- What species of defoliators is not damaging? why?
- At what level of attack by the defoliators can the plant compensate?
- At what stage(s) are defoliators most critical?
- Among the simulation studies, what defoliator is likely to cause highest yield loss? Why?
- Are there other important aspects than yield?

- How can crop management decisions be influenced by the plant's ability to compensate?
- Can conclusions be made on just counting leaves and measure plant heights?
- How useful can this exercise be with the FFS farmers?

Exercise No. 4.24

CORN SEEDLING MAGGOT SIMULATION STUDY

When is this exercise most appropriate?

- One week after transplanting in the FFS, TOT or CST sites.
- In the FFS, if and when the farmers perceive pests that damage the growing point of a crop as a problem (e.g., corn seedling maggot)
- In the FFS, once we observe corn seedling maggots in early AESAs and in neighboring fields through barangay immersions.

How long will this exercise take?

- 1 hour participatory discussion on the design of the simulation study.
- 1 hour field work to set-up the exercise.
- 15-30 minutes weekly observation and data gathering.
- 1-2 hours data consolidation, preparation and presentation (at least once during the season and once at the end of the study).

Learning objectives

- Gain knowledge on plants' ability to compensate when growing point is damaged at the early growth stages of the corn crop.

Materials

- Corn plants at one week after planting
- Knife
- Manila paper, pentel pens
- Sticks and Labels
- Notebooks and ball pen

Steps

1. Design a simulation study in the 'classroom'. Answer the following questions that may lead us attain the learning objectives and thus, serve as our entry point to the exercise :
   - Why do you want to do simulation studies on crop compensation?
   - How can we learn about the consequences of corn seedling maggot damage by simulation studies?

2. Brainstorm with the big group to define the procedures that will be followed in conducting the simulation study :
   - Ask how we shall simulate the pest damage at the growing point. To find out, you could ask them to go to the field and observe, or you could brainstorm from their previous experiences and observations. Remember to set aside some control plants.
   - Ask what growth stages will the corn seedling maggot damage the growing point. That will be the best time to do the simulation study. It could be at seedling emergence, at one week, two weeks or even three weeks after planting.
   - Ask how we can see that the growing point has been damaged. Observations on the degree of deadheart-like presence will be very important in drawing up the conclusions.
   - Ask for farmers practices when their corn crop has been damaged by corn seedling maggot. The idea is to discover that when the growing point is damaged, the crop can still compensate. In the early stages, corn seedling maggot damage are replaced by additional emerging seedlings. In the later stages, the damage is compensated by higher yield due to heavier kernels of the ears of the adjacent corn plants. Thus, we can demonstrate to farmers that the problem can be managed without insecticide.
   - Ask how many plants to simulate the damage on. Do not make it too many and complicated. At least 3-4 treatments representing at least 2 growth stages will be practical enough.

- Ask what data to collect before, during and after the exercise to be able to make conclusions. The weekly plant assessment could include : plant height, number of leaves, number of kernels, number of ears, pest and natural enemies population dynamics, pest damages, yield data, and even economic data, etc.

3. Write the agreed procedures on a chart or manila paper.

4. Go to the field and set-up the study. The following is a simple guide :
   - Select and assign the plots at random. At least two sample plots should be assigned per treatment. Remember to assign control plots.
   - Cut off growing points (shoot) with a sharp knife to simulate deadheart-like damages.
   - Simply simulate the % total deadheart-like damages normally caused by corn seedling maggots by cutting or pulling off the growing points , for example, 1/4, 1/2, 3/4 or 25%, 50%, 75%, etc., of the total plants.
   - Label the plant with date and treatment.
   - Make sure that the plants (the field) has enough water and the required fertilizer.

5. Observe plants and collect data weekly.

6. Brainstorm and consolidate reports in the small group for presentation to the big group. For the TOT and CST presentation, the following may be done :
   - If possible, prepare bar or line graphs for each weekly observation. (e.g., x-axis is weeks after treatment and y-axis is number of leaves or plant height, etc.).
   - Each group presents their results to the large group and discuss it, for example, at least once during the season and once after harvest.

- Afterwards, the big group can brainstorm on how the presentation and discussion should be carried out with farmers. Should they draw bar graphs also? Should they draw plants instead? Is discovering in the field enough? How can you then make sure that all of them discover and not only the one or two gathering the data?

Some suggestions for the processing discussion

- How is the plant development in different treatments?
- Is the plant zero value if the growing point is damaged?
- How does the crop compensate damaged growing points?
- At what growth stage will the pests not be able to kill the growing point?
- At what stage(s) are the pests most critical?
- If the damaged plants can still compensate, is there a yield difference compared to the control?
- Are there other important aspects than yield?
- How can crop management decisions be influenced by the plant's ability to compensate?
- Is the exercise useful to FFS farmers?

OTHER IMPORTANT INSECT TOPICS

Exercise No. 4.25

COLLECTION AND PRESERVATION OF INSECTS (AND SPIDERS) : A SEASON-LONG COLLECTION OF FIELD AND INSECT ZOO SPECIMENS

When is this exercise most appropriate?

- In FFS, TOT and CST sessions.
- When participants have started field monitoring.
- When participants would like to keep record specimens of the insects that they have discovered as future reference.

How long will this exercise take?

- 30 minutes to 1 hours in the FFS session, plus a little time each week throughout the season.
- 1-2 hours in the TOT and CST session, plus a little time each week throughout the season.

Learning objectives

- To help participants become more familiar with the physical appearances of different kinds of insects and spiders.

- To help participants record and remember what they have discovered about the biology and/or ecosystem function of the animals.

Materials

‘Farmer’ Method (For FFS, TOT and CST).

Materials to used will depends on the method chosen :

- field collecting equipment (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush)
- clear glass vials (at least 20 per group)
- denatured alcohol
- bamboo sticks or cartolina to attach vials to
- rubber bands
- 1 pair of scissors per group

‘Entomologist Method’ (For TOT and CST).

- field collecting equipment (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush)
- clear glass vials (at least 20 per group)
- denatured alcohol
- cartolina to attach vials to
- 1 cartolina, plastic or wood box per group (plenty of space for your collection, with lid that can keep ants out, and a sheet of polystyrene in the bottom for sticking pinned insects)
- 1 pack of tailor's pins per group
- 10 index cards (to make labels and triangles for mounting small insects)
- 1 pot of clear nail varnish per group
- 1 pair of scissors per group
- 1 pair of forceps per group
- 1 syringe per group (for filling vials with alcohol)
- 1 record book per group
- pentel pens, ball pens, pencils

Steps for preliminary preparations

1. Conduct participatory pre-discussions with the participants about why it may be useful to make a collection and preservation of insects and spiders. Some suggestions for the discussion are as follows :
   - Is the collection and preservation of insects/animals important?
   - What is the importance of having an insect/animal collection?
   - What kinds of insects/animals do you want to include in your collections?
   - Would you use the collection in the future? How?
   - What kind of information would you want to record about the insects that you collect?
   - How will you make this information easy to find and clearly presented?

2. Choose between the ‘FARMERS’ and the ‘ENTOMOLOGIST’ methods depending on the aims and needs outlined by the participants.

3. Secure the necessary materials.

Steps for 'Farmers' method

1. Ask the participants to collect insects and spiders regularly during the regular weekly field activities.
   - Before collecting animals try to observe and keep records of what they are doing in the field.
   - Also, observe and keep records of reared specimens in the insect zoo.

2. Kill the animals in a plastic bag or other container, with a small amount of alcohol.

3. Sort insects and spiders by grouping identical ones. Put one or a few samples of each type in a separate vial. Add alcohol until the specimen is completely covered and then close the vial.

4. Conduct small group participatory discussions on your observations of the animals :
   - Are they 'pests', or 'natural enemies'?
   - If you are unsure put them into a third group 'not yet known'

5. Attach the vials to a cartolina or bamboo sticks, one card or stick for each group of 'pests', 'natural enemies' and 'not yet known'. To attach vials to cartolina :
   - cut 2 slits in the cartolina
   - push rubber band through from the back to make 2 loops
   - secure the vial in the 2 loops

6. At the next session, add any new animals to the collection and have another look at the animals already in the collection :
   - Are there any new observations about the animals?
   - Are the animals in the correct groups? If necessary move the vials to a new group.

Steps for 'Entomologists' method

1. Make a killing jar by following these procedures :
   - Secure the following materials : a glass jar with a screw top lid, some potassium cyanide crystals, sawdust, cartolina, scissors and plaster of Paris mixed to a paste
   - Work outdoors in a breezy place.
   - Take the glass jar and put a cm layer of potassium cyanide in the base (DO NOT inhale the poisonous fumes)
   - Add 2 cm layer of sawdust.
   - Cut a circle of cartolina to fit the diameter of the jar and place on top of the sawdust layer.

- Seal the edges of the cartolina to the jar using plaster of Paris paste.

2. The participants collect insects and spiders regularly during the regular weekly field activities.
   - Before collecting animals try to observe and keep records what they are doing in the field.
   - Also, observe and keep records of reared insects and animals in the insect zoo.

3. After you have observed the live insects and animals, kill them carefully:
   - Kill soft bodied insects and animals (e.g., larvae, eggs, spiders) in a plastic bag or other containers, with a small amount of alcohol.
   - Kill moths and butterflies by gently but firmly squeezing the head and thorax.
   - Kill hard bodied insects by placing in a killing jar for 5 to 10 minutes, or by placing in a freezer for about at least 1 hour.

4. Preserve the insects/animals, either by placing in vials with alcohol or by pinning in appropriate containers, depending upon the kind and stage of the insects/animals :
   - Keep soft-bodied insects and spiders (which are all soft bodied) in vials covered with alcohol, put a cartolina label (not colored), written in pencil, inside the vial with the animals.
   - Large hard-bodied insects can be pinned directly through the body. Add a label with important information underneath the insects.
   - Small hard-bodied insects can be glued onto a small triangle of index card that have been put onto a pin. Place a small drop of glue (clear nail varnish) on the point of the card, leave to dry for a few seconds. Use forceps to put the insect on the glue, so that the middle part of the body sticks to the point, and insect is hanging off the point with all parts of the body visible. Add a label underneath the insect.

- Some large but slender insects can be more easily preserved by gluing them to the pin. Lie the insect on its side. Put a drop of glue on the pin. Lie the pin onto the insect so that the glue sticks to the middle part of the insect's body. Leave lying until the glue is dry. Add a label.
- To allow you to see wings of butterflies you might want to 'spread' them out as you preserve the insect. Make a v-shaped groove in a piece of polystyrene board and allow plenty of space on either side for spreading the wings. Push a pin through the middle part of the butterfly's body. Pin the butterfly onto the board with the body in the groove. Take a strip of paper and gently spread one of the wings out underneath it. Use the blunt end of a pin to move the wings ONLY pushing at the wing-base which is attached to the body. When the wing is spread, pin the paper strip down to hold the wing in position. Leave to dry for at least 1 week, in an ant-free area. When it is dry and firm, remove from the board and add a label.

Some suggestions for the processing discussion

- This exercise is not processed, it is an ongoing activity with discussions happening during field observations, insect zoos and sorting of insects.

Suggested TOT and CST evaluation breakdown

- 50% of points for the number of different kinds of insects/spiders in the collection. Take note that all the insects/animals animals should have been discovered in fields with crops that the group was working on.
- 25% on how clearly laid out, and how easy it is to find the information that you have discovered about the animals.
- 25% on how much information has been gathered in the field and insect zoo observations about the animals in the collection.

Exercise No. 4.26

NAME GAME :
'SCIENTIFIC' VERSUS 'COMMON-DESCRIPTIVE' INSECT NAMES
(WHAT IS MOST APPROPRIATE FOR IPM?)

When is this exercise most appropriate?

- In TOT and CST sessions.
- When some participants are insisting on using scientific (Latin) names during sessions.
- When facilitators feel that it would be good for the group to discuss what types of names can be appropriate to different types of situations.

How long will this exercise take?

- 1 to 2 hours of the TOT and CST session.

Learning objectives

- To build awareness that scientific names are very difficult to learn and pronounce because the words have no meaning for us and because they are not useful to farmers.
- To experience how much more easy it is to remember names that are either in a language that we speak or descriptive of something that we can observe about the animals.

Materials

- 1 picture per person (facilitators and participants) drawn on cartolina (about letter sized) with 2 names written on the back of each picture:
  a) 1st name is a Latin-sounding name; and the
  b) 2nd name describes what is drawn in the picture.

Steps

1. The participants sit or stand in a circle (split into 2 groups if there are more than 20 in the group).

2. Distribute one cartolina picture per person.

3. Explain the general process of the ‘Name Game’, which can be a fun way for the facilitators and the participants to learn the names of the members in a newly formed group :
   - The first person says “I am (e.g., DAMES), who are you?” to the person on his/her left........
   - The person on the left says “If you are (e.g., DAMES) and I am (e.g., LUZ) then who are you?” turning to the person on his/her left........
   - The next person says “If you are (e.g., DAMES) and (e.g., LUZ) and I am (e.g., JHUN) then who are you?” turning to the person on his/her left.
   - ....and so on until the last person in the circle has to say all of the names of the group before he/she says her own name.

4. Explain that in this version of the name game we will not use our own names, instead we will use the names written on the back of our picture:
   - for the first time around, we will use the ‘scientific’ names
   - for the second trial, we will use the ‘common-English’ names

5. Play the games. You may have to give up the ‘scientific’ name game after about 4 restarts and trials, because it will be so difficult. But let the group try enough times to get frustrated and worried.

6. Have a processing discussion.

Some suggestions for the processing discussion

- How did you feel when we were using the 'scientific' names?
- How did you feel when we were using the 'common-English' names?
- Why was it easier to use the 'common' names? (e.g., the words are in a language that we understand, the names describe what we can see in the picture)
- Which kinds of names would the group recommend for use in FFS, TOT and CST? Why? (e.g., often you do not need a name, you have a specimen anyway) But for general group discussions, names are easiest to remember if they describe the animal, and are in a locally understood language.)
- What happens if we find that a local name is the same for a number of different species which are doing different things in the ecosystem? (e.g., we need to make a new name, based on the local name but add another describing word to define which particular type of insect it is).

Some ideas for names

<u>Note :</u> These names are all made-up, the game is NOT designed as a way to learn names of animals. You could use the same 'scientific' names and change the English descriptive names if you prefer to draw some other kinds of animals.

- *Astra stellatus* - Starry apple bug
- *Praetalus grandipennis* - Squash leaf-miner
- *Viperus viperus* - Green snake
- *Scirus purpurea* - Purple cabbage worm
- *Crassipula pilipino* - Red predatory mite
- *Agorantha magnatha* - Red predatory ant
- *Homo americano* - American man
- *Dansota cremillata* - Crested field lizard
- *Vivita grandegnatha* - Big toothed beetle

•	*Canis happius*	-	Happy dog
•	*Lantora rufusnigra*	-	Black and red banana worm
•	*Macadenia veridula*	-	Green leaf beetle
•	*Cleptidia punctella*	-	Yellow-spotted black beetle
•	*Aspidastrum follicum*	-	Small purple ant
•	*Bovus locoloco*	-	Crazy cow!
•	*Colla tridetalinum*	-	Green predatory beetle
•	*Crispulantha caelescus*	-	Blue-backed mosquito
•	*Macripes calamansi*	-	Calamansi mealy-bug
•	*Maripuntha aurata*	-	Yellow bean moth
•	*Betulina poranta*	-	Pink carrot worm
•	*Brachyserestum bimasticus*	-	Brown praying mantis
•	*Lipulinus piscivorum*	-	Fish-eating dragonfly
•	*Poultra pilipina*	-	Native pilipino chicken
•	*Senturina rufuscus*	-	V-striped tomato moth
•	*Basticollis trifundata*	-	Brown hunting spider
•	*Arginopus atrifaces*	-	Black-faced jumping spider
•	*Scarabus viridis*	-	Green dung beetle
•	*Tsetses azulababoyus*	-	Blue pig fly
•	*Avispulatrum secundus*	-	Pink pollen beetle
•	*Rana blancofatis*	-	White-bellied frog
•	*Mesanthabroma carrota*	-	Purple carrot butterfly
•	*Blatta nigra*	-	Black cockroach
•	*Pollascus crinthula*	-	Yellow cut worm
•	*Musca balayensus*	-	House fly

5 Rodents and Rodent Management Topics

Rodents are one of the most consistent and serious pests of corn. The main problem of rodent control is that rodents must be managed through community action, and organizing communities is not an easy task. In this set of activities, we will study the rodent biology, different effects of rodenticides, baiting and rodent burrow digging, but mostly, we will learn activities that are helpful in organizing communities for more effective rodent management .

There are a few differences between rodents and insects that make implementation of management different. First, is the ability of rodents to stay in one area even though there is no crop. This means that we can use damage caused in one season to initiate controls in the next season. The other difference is the methods of management. Rodent management must be organized over a wide area to be very effective. Rodent drives, baiting, digging and any other method of control is most effective when done as a community action.

One last note, is that in many communities, rodent drive campaign success is determined by how many rodents have been killed. A large pile of rodents is considered a big success. In fact, the opposite is true. A large pile of rodents really means that there is a lot more rodents out in the fields ready to feed on the crops. The number of dead rodents is not very important.

The number of rodents alive and eating the crop is more important.

Exercise No. 5.01

RODENT POPULATION DYNAMICS : A GROUP DYNAMICS EXERCISE AS WELL

Rodent populations increase very rapidly because rodents have many offspring very often. Rodents can live for one year or longer. Females may reproduce up to 4 times a year and have an average of 6 offspring in a litter. This exercise is designed to visualize simple population growth for one year.

When is this exercise most appropriate?

- Immediately after crop establishment in the FFS, TOT and CST sites.
- In the FFS sites, where farmers in the area historically experience rodents as a problem.

How long will this exercise take?

- At least 30 minutes small group activity and another 30 minutes brainstorming and report preparations.
- At least 1 hour big group participatory discussions

Learning objectives

- To show rodent population growth over several months using nails, seeds or other items.
- To brainstorm about rodent populations and bring out two management points :
  (1) It does not matter how many rodents were killed, it only matters how many rodents remain in the field; and
  (2) continuous rodent management is important to keep populations always low.

Materials

- 2050 corn seeds per group (or any similar materials)
- manila paper, marker pen, pencil

Steps

1. On the manila paper, draw 12 lines to divide into 13 sections.

2. On the first section place 2 seeds. One seed represent one female rodent, and the other represents a male rodent.

3. Move to the first month. Add 6 seeds for 6 offsprings from the original pair of rodents. Three rodents are females and 3 rodents are male.

4. Move to the 4th month. Add 6 seeds for 6 offsprings from the original female, then add 18 seeds for the 3 females in first month (3 females times 6 offspring each). Half of the seeds are female rodents.

5. Move to the seventh month. Add 6 seeds for 6 offspring from the original female, then add 18 seeds in first month (3 females times 6 offspring each). Add 72 (12 females with 6 offspring each) for offspring from females in the fourth month. Half of the seeds are female rodents.

6. Continue this process for the l0th and 13th months.

7. Write on the manila paper the total number of rodents for each months, and the cumulative total from month to month.

Some suggestions for the processing discussion

- How many rodents are produced in one year? (e.g., one section is three months).

- If half of the rodents are killed in the seventh month, how many rodents will be produced by the end of twelve months?
- If there are 10 female rodents in the first month, how many rodents will be produced in the 13th month? If you organize a rodent drive and kill this many rodents, will you be very excited and call your rodent drive a success? How many rodents are remaining in the field? Do you think the rodent drive was a success still? How many rodents will be in the field considering reproduction? (Note that reproduction is even greater after many rodents are killed because of less competition for food and space)
- What is the meaning of the saying “It does not matter how rodents were killed, it only matters how many are left in the field to reproduce”.
- Many farmers say that if you kill rodents, they will bring their friends and completely destroy a field? Can you explain why fields are destroyed after one rodent drive? (e.g., remember reproduction, and that reproduction is faster when the population is lower).
- Why is it important to begin killing rodents at the early stage of the rice crop? Why is it important to keep killing rodents all season long? What would be the population of rodents after 6 months if only 1 female from each group of six offspring survived? (Totals by month; 1st month - 6; 4th month-24, 7th month - 96; I0th month - 384; 13th month - 1536. Total 2046).

Exercise No.5.02

HANDS-ON EXERCISE :
RODENT PREGNANCY INCIDENCE

Rodents are nocturnal animals which can cause heavy devastation in rice and corn crops. Evident signs of their presence are gnawings, nibblings, cut tillers and the presence of runways and burrows in the field. Rodents readily multiply in areas where there is abundant food.

Female rat specimen can be dissected to determine the incidence of pregnancy. This process can be used to predict probable rodent population outbreaks even before the establishment of the crop.

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions after discussing the special topic on rodents.

How long will this exercise take?

- At least 30 minutes brainstorming on the procedures
- At least 1 hour field activity
- At least 30 minutes ‘classroom’ activity
- At least 1 hour participatory discussion

Learning objectives

- To create awareness that the rodent pregnancy incidence can be used as an indicator to forecast rodent population build-up.
- To come up with an action plan for rodent management.

Materials

- traps, pail and empty sack
- scalpel or blade and alcohol
- live rodents
- paper, pen and record book

Steps

1. Brainstorm on the procedures to be followed for the exercise.

2. Collect and kill 10 live female rats before land preparation.

3. Dissect abdomen and assess incidence of pregnancy.

4. Count number of embryos per female rat being dissected.

5. Record and conduct participatory discussions.

6. Repeat activity at pre-silking stage if desired.

7. Develop an action plan for your community.

Some suggestions for the processing discussion

- How is the number of embryos related to the population build-up of rodents in the next cropping season?
- How is the incidence of pregnancy related to the stage of the crop?
- What are the factors that contribute to pregnancy? Enumerate and discuss.
- Develop an action plan for your Local Government Unit to create awareness and generate participation in rodent management activities.

Exercise No.5.03

HANDS-ON AND PARTICIPATORY DISCUSSION : RODENT DAMAGE AND CROP LOSS ASSESSMENT

When is this exercise most appropriate?

- When the participants want to have an idea of the extent of rodent damage in the field in terms of yield and cost.
- In the FFS, when there are actual rodent damage and we want to demonstrate to farmers the need to manage rodents by community actions rather than individual farmer's action.

How long will this exercise take?

- 30 minutes to 1 hour brainstorming sessions to define rodent damage and design crop loss assessment procedures;
- 1 hour field activity to observe rodent damage and assess crop loss; and
- At least 1 hour to brainstorm on the result of the field activity.

Learning objectives

- To observe and characterize actual rodent damage in a given corn field.
- To practice crop loss assessment of rodent damage in actual field condition.

Materials

- corn field with actual rodent damage
- meter stick, weighing scale and calculator
- manila paper, notebook, pentel pen and pen

Steps

1. Brainstorm in big group on rodent damage and develop procedures for crop loss assessment.

2. Go by group to your assigned field.

3. Observe and characterize rodent damage and conduct crop loss assessment following the procedure developed by the big group.

4. Return to the session area and compute for the crop loss due to rodent damage in your assigned area. Compute also for the percentage of damage due to rats.

5. Report data to the big group.

Some suggestions for the processing discussion

- What is the percentage of rodent damage in your area.
- What is the value of crop loss due to rodent damage in your area in terms of yield and cost?
- What would you recommend for rodent control for the next crop season?

Exercise No.5.04

HANDS-ON AND PARTICIPATORY DISCUSSION : RODENT MANAGEMENT

As previously discussed, effective rodent management requires a community effort. For the group to be effective, they must also learn how to identify presence of rodents, runways, understand rodent burrow structures and suggest practical rodent management strategies. Group sharing of experiences is very important in understanding rodent occurrences in different areas. In this exercise, the experiences shared by the group will be critically analyzed in coming up with options or strategies for rodent management.

When is this exercise most appropriate?

- In the FFS, TOT and CST sites, when existing rodent control strategies failed to bring down rodent population to manageable levels.
- In the FFS, when farmers already understand the population dynamics of rodents.

How long will this exercise take?

- At least 30 minutes field activity to identify presence of rodents, prepare rat baits, construct and install rat baiting stations, etc.
- At least I hour brainstorming activity to design a rodent management strategy based on previous activities.
- At least 10-15 minutes follow-up activities every week to refine the management strategy designed earlier.
- At least another 1 hour to assess the effectiveness of the rodent management strategy at the end of the season.

Learning objectives

- To practice identifying the presence of rodents by their runways, live rodent burrows, rodents caught by digging burrows, etc.;
- To practice preparing rodent baits, constructing and installing rodent baiting stations; and
- To design, refine and assess management strategies for rodents in the area.

Materials

- bamboo, bolo, crisscut saw
- rodenticides, rodent bait materials
- manila paper, marker pens
- corn field
- plastic pale, spade, sacks

Steps

1. Each group should prepare rodent baits, construct 2 rodent baiting stations and install them in strategic areas in the corn field.

2. Each group should do the following around the FFS, TOT or CST sites :

    - Practice identifying the presence of rodents by their runways, live burrows, etc.
    - Dig live rodent burrows to understand its structure.
    - Experience catching live rodents from the burrows.

3. Return to the session hall and process the field activity. Provide guide questions which each group should answer and report to the big group and thus, become the basis for participatory discussions.

4. Design a management strategy for rodent management and implement in the area.

5. Regularly assess and refine the management strategy during the cropping season and redesign a more permanent management strategy for implementation in the area in the next cropping seasons.

Some suggestions for the processing discussion

- The province of Sultan Kudarat has a rodent damage index which range from 5-17% last cropping season, as submitted by agricultural technologists. Draw up your management plan to protect the next cropping from the ravages of the pest. What if there is no available acute poison?
- Presently, the province of North Cotabato has a rodent outbreak. The neighboring province South Cotabato has a damage index which ranges from O. 1 to 1.2%. What are your indicators that there is an impending outbreak in the latter province? What are your recommendations to protect the crops in the said province?
- The provinces of Lanao del Norte and Lanao del Sur has an endemic problem of rats. What are your recommendations to contain such problem to lessen the population build-up?
- There is a confusion in the identification of rodents in Sultan Kudarat. Some said they are *Rattus rattus mindanensis* and *Rattus exulans*. Others said they are *R. norvegicus* and *R. argentiventer* that ravaged their crops. Due to this confusion, the Regional Director ordered the group to identify them. How do you identify those species of rodents by their physical appearance?
- Based on your field observations, draw up and explain your rodent management for the FFS, TOT and CST sites. Include farmers practices in your locality that can help in managing rodents.
- What stages of the corn crop are most susceptible to rodent damage? Why is this so?

6 Diseases Topics

UNDERSTANDING
COMMON DISEASES OF CORN

(GENERAL EXERCISES ON UNDERSTANDING ASPECTS OF PLANT DISEASES)

A disease is an abnormal condition that injures the plant or causes it to function improperly. Diseases are readily recognized by their symptoms (e.g., associated visible changes in the plant).

Various agents, acting either singly or in combination, cause diseases. The agents can be biotic (living) or abiotic (nonliving). Living disease-inciting organisms are called *pathogens*.

The pathogens of corn diseases are bacteria, fungi, nematodes, viruses, and mycoplasma-like organisms. These pathogens cause visible disease symptoms on the entire plant, or on individual plant parts such as leaves, stems, leaf sheaths, ears or kernels.

In this section, the general concept of a disease will be studied. The most common diseases that infect corn at different stages will be discussed. A number of diseases attack corn and reduce its yield and quality. About 112 infectious diseases of corn are recorded. However, only three of them are highly destructive. The others are potentially destructive only if conditions are right for their development.

Exercise No.6.01

SHARING OF IDEAS :
THE DISEASE TRIANGLE RELATIONSHIP

For the participants to effectively manage common diseases in corn, they must develop a conceptual definition of a disease. The concept of a disease and the factors associated with their occurrence are important tools in developing management strategies for diseases.

This activity is aimed at developing the participants' basic knowledge on diseases and their occurrence.

When is this exercise most appropriate?

- As a starting activity of the topic on diseases in the FFS, TOT and CST sessions.

How long will this exercise take?

- About 30 minutes sharing of ideas on the subject.

Learning objectives

- Develop a conceptual definition of a disease by sharing individual ideas.

Materials

- newsprint and pentel pen
- plastic bags and plant disease samples
- record book and pen

Steps

1. Each group collect diseased corn plants in the field at different stages of growth.

2. They should also note crop stand and surrounding factors that may have favored the occurrence of the disease.

3. Return to session area or shade and process observations.

4. Distribute discussion questions to each small group.

5. Present and discuss answers to the big group.

Some suggestions for the processing discussion

- What is a plant disease? Give specific disease of corn?
- Are signs and symptoms the same? Defend your answer by giving examples.
- Can a disease occur considering the following :
  a. presence of susceptible host;
  b. presence of pathogen;
  c. unfavorable environment.
- Is man a factor in the severity or development of a disease? Support your answer.
- Can you consider physiological disorder a disease? Explain.

Exercise No.6.02

ROLE PLAY :
THE DISEASE TRIANGLE RELATIONSHIP

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions after the exercise on defining and developing the concept on diseases
- When discussing a special topic on disease.

How long will this exercise take?

- At least 30 minutes preparation and conduct of the role play.
- At least 30 minutes for processing of the activity.

Learning objectives

- To show the relationship between the different factors that enhance the development of a disease.

Materials

- participants (8 volunteers)
- manila paper, masking tape and stapler
- water
- crayons and pentel pens
- chalk and black board

Steps

1. Get 8 volunteers to do a role play.

2. Prepare labels for every role of participants.

3. Do role play showing possible effects and reactions of the different factors in the development of a disease.

4. Process and discuss the results.

Some suggestions for the processing discussion

- What are the factors that enhances the development of a disease? Why?
- Can a disease occur in the absence of any one of the factors? Explain.
- How do climatic factors affect the development of a disease?

Exercise No.6.03

FIELD WALK AND BRAINSTORMING EXERCISE : INTRODUCTION TO PLANT DISEASE

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions when there are already diseases in the field.
- When the participants ask *"What is this?"* about disease symptoms.

How long will this exercise take?

- 15-30 minutes for field walk.
- 1-2 hours for processing and participatory discussion

Learning objectives

- To familiarize the participants with symptoms.
- To improve the participants' ability of interpreting symptoms.
- To realize that there are aspects where we do not yet have the correct answer readily available.

Materials

- Plastic bags
- Manila paper, pens, crayons, notebook
- Suspected diseased specimens

Steps

1. Brainstorm about all different methods to control diseases and document on manila paper

2. Ask the participants to collect diseases in the field

3. Write on manila paper what was found in the field. Each group could work on an group of diseases (e.g., fungal, bacterial or viral diseases) so all diseases will be dealt with.

4. Post a manila paper with guiding questions :

   - How can you identify the disease? What are the symptoms? Where are they located?
   - Where does the disease come from? How does it spread? How does it enter the plant?
   - At what stage of the plant can you identify the disease?
   - What factors stimulate or /inhibit disease development?
   - What damage does it do to yield or quality of the crop? Why? How?
   - How important is the disease for farmers? Why?
   - What additional information do you need to make a decision on control or management of the disease? How can you obtain this additional information?
   - If there are questions that you can not answer, how can you then find the answer?

5. Ask also each group to observe symptoms of at least one disease closely and make a color drawing of it with crayons.

6. Each group make a presentation to the big group and the facilitators try to summarize and integrate the outputs of the small group and arrive at one common understanding.

7. Facilitate the groups when they try to answer the questions. Make sure that they feel that they do not have to answer all questions if it is not possible by now. Ask how they can do to find out (interviews, disease cultures, etc.) and give the time in future sessions.

Some suggestions for the processing discussion

How can you identify a disease?
How do you know if it is a disease symptom or something else?
What are the symptoms you observed?
Where are they located?
Where on the plant do you have to look for symptoms?
At what stage of the plant have you observed the symptoms?
Is it important to know early symptoms? Why? or Why not?
How important is the symptom to you? Why?

Additional suggestions for the processing discussion

- The following could be discussed when it comes to sources of disease:
  a) soil, planting materials and seeds
  b) water (irrigation, rain, ground)
  c) insects, animals and people, wind, tools, etc.

- The disease triangle have to be there and favorable for disease to develop. This relationship can be explained :
  a) host
  b) pathogen
  c) environment

- What is the difference between control and management? Among control and management tactics the following could be discussed :
  a) sanitation, rouging, leaf removal, proper disposal, crop rotation, quarantine
  b) land preparation, fertilizer (amount, kind and method of application) and water (irrigation and drainage) management
  c) resistant varieties and fungicides

- In TOT and CST sessions, ask if the exercise would be appropriate in FFS or if it needs to be simplified or adapted.

Exercise No.6.04

DISEASE CULTURE : HOW TO LEARN MORE ABOUT CORN DISEASES

Disease culture is a simple method to identify disease, see how it can spread and understand how the climate influence the development of a disease.

Diseases caused by living organisms are hard to explain. Thus, this simple activity could make or help the participants to understand how diseases can spread or create problems in the corn crop.

When is this exercise most appropriate?

- When there are diseases in the 'learning' field
- When the participants have existing diseases in their own fields
- When disease symptoms are confused with other symptoms
- Making disease cultures is a continuous activity in the FFS. There should be regular sessions for presentation of results every 2-3 weeks.

How long will this exercise take?

- At least 30 minutes in the field
- At least 1 hour in the session hall
- At least 15 minutes daily for observations
- At least 1 hour for follow up presentations

Learning objectives

- To learn a practical and simple method to distinguish disease from nutrient deficiencies, mechanical or chemical damage.
- To discover that some diseases can spread through the air or direct contact.

- To discover what wet or dry, cold or warm climate has on development on disease.

Materials

- water
- plastic bags, tissue paper and hand lenses
- plants or leaves with suspected disease symptoms
- pen, paper and crayons

Steps

1. Go to the field and collect plants with abnormal leaves, spots or other symptoms. Or ask farmers to bring fresh leaves with suspected disease from their own fields.

2. Ask the farmers what they want to know about the disease. In disease culture, they can distinguish between some diseases, between diseases and other symptoms, and learn that some diseases can spread through air or physical contact.

3. Ask what is disease culture. (You subject the disease -infected plant to extreme conditions to speed up the process which will make you able to see what it is faster in the field)

4. Draw the symptoms as they appear on actual specimen.

5. The facilitator guides each group to work on one relevant study in the groups mentioned in the following pages:

Exercise No.6.04A

For identification

Is it disease or not? Is it fungal or bacterial?

a) Put the leaf with disease in a plastic bag or jar with some wet tissue paper
b) Put it in a warm dark place over night.
c) Observe for development of mycelia (white hair-like structures) on the symptoms, or wet plant tissues, or foul odor and observe if the symptoms have spread.

Exercise No.6.04B

For influence of climate

What climate favors this disease?

a) Ask farmers what climate you can make in a disease culture (e.g., wet, dry, warm or cold if a refrigerator is available).
b) Measure the size of the symptoms.
c) Prepare two or four plastic bags or jars. One jar with wet tissue paper and one (1) with dry tissue paper and a leaf with symptoms. One jar with wet tissue paper kept in a cold place another kept in a warm place.
d) After one night observe if there is any visible development of the disease and compare treatments.

Exercise No.6.04C

For spreading disease

Does the disease spread through air or contact?

a) Ask farmers how diseases can spread and how they can see that in a disease culture.
b) Put a healthy leaf and a leaf with symptoms in a jar or plastic bag with wet tissue paper without contamination.
c) Put a healthy leaf and a leaf with symptoms in a jar or plastic bag with wet tissue paper after rubbing them to each other.
d) First observation after one night . Has the disease transferred from sick to healthy leaf?

6. Continue observation for some more days if answer is not yet given. Success of disease culture can be compared to insect zoo. Keeping a fighting cock or taking care of a baby exercise

7. Each group present the result of the disease culture to the large group for participatory discussion. The short presentation should answer the following :

   - Why did we do the experiment?
   - How did we do the experiment?
   - What was the result and what did we learn?

Some suggestions for the processing discussion

- Discuss the general symptoms of fungus and bacterial diseases. Can virus disease easily be detected in disease culture?
- What if the leaf has fungus as well as bacterial diseases? How to interpret the result?
- What happens with symptoms over time?

- What is the difference between dry and wet and between warm and cold?
- How can you distinguish primary and secondary attack? Is the control leaf needed?
- What field conditions will favor development of disease?
- How does the disease spread? Is there more than one way?
- How does disease enter the plant ?
- How long did it take before spores or mycelia were visible (fungus diseases)?
- Can you now recognize disease at an earlier stage?
- Is it necessary to distinguish between fungus and bacterial diseases (in relation to control)?
- What diseases in your crop is it useful to be able to distinguish?
- Where on the plant do you find the symptoms?
- Is the disease a problem for the crop? Why? (quantity, quality)
- How can you get or discover additional information you need for decision making?

Exercise No.6.05

FIELD WALK AND SHARING OF IDEAS : THE VIRUS DISEASES OF CORN

When is this exercise most appropriate?

- In the FFS, TOT and CST sessions.
- When there are symptoms of virus diseases in the field.

How long will this exercise take?

- 1 hour for introductory discussion
- 1.5 hours in the field
- 2 hours for following discussion

Learning objectives

- To brainstorm on the proper symptoms identification of the virus diseases.
- To understand the factors that lead to the spread and development of virus diseases.
- To plan for an effective virus disease management strategies for corn.

Materials

- Corn plants suspected to be infected with virus diseases
- Manila paper, pentel pens, crayons
- Syringe without a needle
- 6 transparent glasses
- Strong dark coffee or other colorful liquid

Steps

1. Conduct a short brainstorming session on the following before going to the field :
   - Ask the participants to explain symptoms of virus diseases.
   - Ask what other symptoms it can be confused with.
   - Ask if there are simple methods to distinguish and why that could be useful[7].

2. Ask them to go to the field and collect specimens with the following instructions :
   - Before uprooting the specimens or breaking the leaves off, describe them. They will look different after a while when removed.
   - Note how are the plants with symptoms distributed in the field?

3. If not in FFS, look for farmers and interwiew them before leaving the field for:
   - The history of crop and the field,
   - Is it a new problem or a regular problem in the area?
   - Where was the seeds obtained?
   - When did the problem start to be visible?
   - Has there been sucking pests? If yes, what was done then?

4. Each group selects different plants that are suspected to be infected with virus. Make a drawing of the symptoms. Be specific about where on the plant the symptoms are located. Answer the following questions:
   - Where does the disease come from? (e.g., soil, air, other plants, etc.)
   - How does it spread?

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7 Virus disease is very difficult to deal with, to identify and to distinguish. It can easily be confused with some deficiencies and physiological disorders. The distributions of the symptoms could in some cases be a help. Deficiencies are usually not single plants but in plots. Virus could be single plants scattered over the field. Correct fertilizer can cure deficiencies at early stages.

- If you do not know how might it spread, based on the information you got from the farmer?
- How does it enter the plant?
- At what stage of the plant does it enter?
- At what stage will symptoms be visible?
- How important is the disease for the farmer?

Note :

Nobody knows all viruses. Nobody can distinguish between all viruses based on symptoms and different viruses have different lifecycles. Therefore, the above questions can only be answered by perceptions based on what have been observed and what information comes from the farmer. It is very important to realize that we might only guess some of the answers and we might be wrong. But the answers will help us develop a general knowledge and understanding of virus diseases. They can also help us design experiments that can confirm or disprove our perceptions.

5. While the participants prepare their presentations, the facilitator prepares one paper chart for each of the questions with the respective headings :
   - Conclude each group presentation by adding information on the charts. You will then end up with a description of different symptoms, different sources, different ways of spreading, etc.
   - After all presentations, ask the participants if they have something more to add to the charts.

6. Usually, farmers know that some sucking insects spread virus diseases. It may be useful to ask if they know how it happen. You can also illustrate how it, as follows :

   - Get 5 glasses filled with clean water to represent 5 healthy plants, 1 glass filled with dark strong coffee to represent a virus infected plant and 1 syringe without needle to represent an aphid (sucking insect).

- Then with the use of the syringe, suck on the virus infected plant (half-fill the syringe with coffee)
- Go to a healthy plant but now empty some of the coffee before sucking. The dark coffee (virus) will be clearly seen in the glass with clean water (healthy plant).
- Go to the next healthy plant and repeat again... and again. Usually, less and less coffee (virus) will be seen, but more than one glass (plant) will be contaminated with the coffee (virus).
- Discuss the nature of winged aphids. They move between several plants before they settle down. Before they suck, they first spit out what they have in the stylet (mouth parts).
- The facilitator should try the demonstration before the session to gain confidence with the experiment.

7. If there is time, one group or the facilitator group can role play the situation where aphids are sprayed with insecticide to control vectors :
   - First, the aphids sit permanently on one plant and will therefore not spread virus.
   - When they are sprayed, they try to get away from the insecticide and leave their previous host plant. While getting weaker, they suck on a couple of plants transferring the virus
   - The day after insecticide application, a few aphids from other fields come through the field, tasting a few plants.

8. Ask the participants what happened and whether they believe that insecticides will control spreading of virus.

9. If you feel tempted and in very high spirit (or need), you can ask how to set up an experiment to learn more about virus. For example , a pot experiment on :
   - One aphid safe cage with a healthy and a sick plant and with no aphid.
   - One aphid safe cage with a healthy and a sick plant and with aphids.

10. In the TOT and CST, ask the participants how they will do this exercise in the FFS.

11. At the end of the session, the facilitators should lead the big group to summarize, synthesize, and consolidate small group recommendations and to develop or plan management strategies for corn virus diseases based from these outputs.

Some suggestions for the processing discussion

Examples should support the answer for the questions below :

- Will sick plants always have symptoms?
- If one percent of the plants have symptoms, what will you do? If 50 percent of the plants have symptoms, what will you do?
- Do plants have resistance to virus? Which stage is more resistant, old plants or young plants? Explain.
- What pesticides can control virus? Does spraying of sucking insects help to control virus? Why not?
- Do aphids die immediately after spraying? What are they doing until they are dying?
- What aphids are most problematic, the many that are established in colonies on the plants or the few that are searchers and take a journey through your field sucking on different plants to find a good host?
- Can seeds carry virus? Is there any chemical treatment for seeds? Is there any physical treatment for seeds?
- Can virus survive in the soil? Can virus be soil borne? If yes, give examples. Can virus be wind borne?
- How can spread of virus by man be minimized?
- How long will a sucking insect have to suck a virus infected plant to be contaminated? How long does a contaminated aphid have to suck a healthy plant to infest it?
- What is a persistent, semi-persistent and a non-persistent virus? (with farmers no clear definition is needed but the understanding that not all sucking insects are equally problematic)

Exercise No.6.06

FIELD WALK AND DISEASE CULTURES : DIFFERENTIATING BACTERIAL (LEAF STRIPE) AND FUNGAL (DOWNY MILDEW) DISEASE SYMPTOMS IN CORN

Bacteria and fungi are minute forms of plant life. Those that cause diseases are called pathogens. Those that obtain food only from dead plant material are called saprophytes. Most fungi reproduce and spread by spores, which correspond in function to the seeds of higher plants. The right combination of moisture and temperature is necessary for the spores to germinate. The germinating spores grow into the living plant through natural openings or wounds. Fungi (though not bacteria) may also enter the plant directly.

When is this exercise most appropriate?

- In FFS, TOT and CST sessions
- When bacterial (leaf stripe) and fungus (downy mildew) disease symptoms wilt are present in corn fields.
- When farmers are interested to discover more about how they can recognize the differences in symptoms between bacterial and fungus diseases.

How long will this exercise take?

- 1-2 hours of an FFS meeting to start with and another 1 hour of the following FFS meeting for final discussions.
- 1 hour of observation by farmers on the day following the first FFS meeting.

Learning objectives

- To discover the differences in symptoms of bacterial (leaf stripe) and fungal (downy mildew) diseases of corn with the Disease Culture.
- To observe in detail the development of symptoms of leaf stripe and downy mildew diseases of corn.
- To demonstrate the role of high humidity and temperature the growth and development of bacterial and fungal diseases of corn.

Materials

- corn fields with suspected bacterial and fungal diseases (facilitators need to scout in advance of the FFS meeting).
- samples of plant parts exhibiting symptoms from suspected diseased plants.
- 50 plastic bags, 50 pieces of tissue paper and pentel pens to write labels on bags.
- manila paper, bond paper, pencils, pens and crayons
- water

Steps

1. Go for a field walk to corn fields with the FFS participants. During the field walk, ask the farmers to share their experiences about bacterial and fungal diseases of corn in their locality. Some suggested guide questions are :
    - What diseases can you recognize in this field? How do the symptoms of different diseases look like? Are there any diseases that are difficult to identify?
    - What caused the different diseases that we find here?
    - When do the diseases usually appear in the fields? When do they not appear?
    - Why do the diseases appear? Why do they not appear?

2. Ask the farmers to work in groups to collect a few samples of each kind of the corn diseases they can find. Have all facilitators take part and guide the groups in the exploration. Make sure that each group is able to collect examples of all the different bacterial and fungal diseases of corn.

3. Return to the FFS 'classroom' or shade. Ask each group to choose 5 examples of disease symptoms that they find difficult to recognize. Guide the groups to have at least 1 example of bacterial and fungal diseases. Split each sample into 2 sub-samples.

4. Ask the participants to draw and describe each pair of samples. Use hand lenses to look closely for the color and texture of the samples. Each participant should be responsible for 1 pair of samples. Ask them to record the following : the size, color, shape, texture, and smell of the samples.

5. Give each group 10 plastic bags and 10 pieces of tissue paper. Put 1 sample of each pair onto a piece of damp tissue in one plastic bag. Put the other onto a piece of dry tissue paper in the second plastic bag. Seal the plastic bags with a knot and label the bags with the name of the group and the treatment made.

6. Request each participant to take home their pair of samples and to keep them in a dark place until the next morning. Provide each with a piece of paper on which they can make a second drawing and description of each sample. Ask them to record the following : size, color, shape, texture, any growth of the disease symptom, any growth on the surface of the disease symptom or any distinctive smell or odor.

7. During the next weekly meeting, ask each participant to make a presentation of what they have observed. Discuss the observations.

Notes on Symptoms

After 12 hours in dark in 'wet tissue' Disease Culture the following characters should be observed for leaf stripe (bacterial) and downy mildew (fungal) diseases :

BACTERIAL (LEAF STRIPE)	FUNGAL (DOWNY MILDEW)
presence of chlorotic streaks or stripes at the base of the leaf blade; and whitish downy growth appears on the lower and uppersurfaces of the leaf	symptoms consist of narrow, irregular, elongated and water-soaked lesions; and lesions later become thin, papery, translucent and brown to straw colored

Some suggestions for the processing discussion

- How many different types of disease symptom did we find for each kind of disease?
- How did the different types of disease symptoms look (color, shape, texture) and smell?
- What changes were observed in the different types of disease symptom when they were put in the Disease Culture overnight?
- Was there any difference in these changes between the 'wet tissue' and the 'dry tissue' Disease Cultures? What can we conclude from these observations?
- Was it useful to make the Disease Cultures? Why?

Exercise No. 6.07

ROGUING AND SANITATION : WILL REMOVAL IN THE FIELD OF DOWNY MILDEW INFECTED CORN PLANTS WORK?

Yield loss due to downy mildew vary. Field surveys indicate that yield losses due to the disease range from 15-40 percent. In the early seventies, estimated national yield loss caused by downy mildew alone was eight percent, with corresponding yield reduction of 205,470 mt valued at PHP 173 million.

Seed treatment with fungicide has been very effective if treated seeds are planted not later than five months after treatment. A 100 percent control can be obtained if the right technique is employed and when the disease pressure in the area is not too high.

However, when farmers use their own seeds in the succeeding planting seasons, they normally do not treat their seeds with fungicide hence, the occurrence of downy mildew disease in their corn fields. Likewise, in areas where the disease pressure is relatively high, sporadic downy mildew infections are observed even when seed treatment with fungicide are practiced. Thus if left unabated, it may cause the spread of the disease in the community within a short period of time. In this case, rouging and sanitation will be very important in the proper management of the disease on a community-wide basis.

When is this exercise most appropriate?

- In the FFS, TOT and CST sites.
- When downy mildew infected corn plants begin to appear the field.
- When farmers practice rouging but do not properly dispose downy mildew infected corn plants from the field.

- When farmers are interested to learn and understand how rouging and sanitation contribute to the sound management of downy mildew disease in corn field.

How long will this exercise take?

- 1 whole cropping season

Learning objectives

- To gain knowledge and understanding of when to rogue and how to properly dispose downy mildew infected corn plants from the field.
- To demonstrate the effectiveness of right time of rouging and proper sanitation in the management of downy mildew disease on a community-wide basis.

Materials

- Corn fields (1 field seed-treated with fungicide and another 1untreated) of the same age and variety planted, where downy mildew incidence is observed
- Note book, ball pen

Steps

1. Brainstorm with the big group on how to go about the exercise. Ask the farmers about their usual practices in rouging and sanitation. Take note of the positive and negative aspects of their practices.

2. Design an improve system (IS) of rouging and sanitation for downy mildew infected corn fields based on the result of the brainstorming session (e.g., integrating all the positive points). Consider the improve system as a treatment in the exercise.

3. Agree on ONE usual farmers' system (FS) of rouging and sanitation for downy mildew infected corn fields in the community. Consider the agreed usual farmers' system as another treatment in the exercise.

4. Scout and agree as to whose farmers' corn field or corn fields will be used for the exercise. Try to find corn fields of the same age and planted to the same variety. It will be nice if one of the field was seed-treated with fungicide and the other was untreated.

5. Divide the corn fields into two, such that one area will be utilized for implementing the improve system (IS) and the other area for the farmers' system (FS) of rouging and sanitation for downy mildew infected corn fields.

6. Assign the treatments to small group and implement the exercise. Conduct weekly observations on the crop's development and compare yield and economic data after harvest.

7. Present results, conduct participatory discussions in the big group and design a more appropriate community-wide system of rouging and sanitation for downy mildew infected corn fields based on the experiences learned from the exercise.

Some suggestions for the processing discussion

- Is there a better yield in the field when an improved system of rouging and sanitation is employed?
- Is the quality of yield better when an improved system of rouging and sanitation is employed? If yes, is it profitable when the cost of improved rouging and sanitation is considered?
- Is there still a need to use fungicide even when an improved system of rouging and sanitation is employed?
- What will you do about your field if only 1% of the plants are infected? If 75% of the plants are infected?

- What happens to the disease inoculum when the infected plants are removed? Does it disappear or does it spread?
- Will it help if a resistant variety will be used? Explain.
- What would be your future recommendations about rouging and sanitation for downy mildew infected corn fields? Can it be implemented on a community-wide basis? How?

KASAKALIKASAN, the Philippine National IPM Program, aims to make IPM the standard approach to crop husbandry and pest management in major rice, corn and vegetable areas in the Philippines. The Program adheres to a common vision shared by farmers, extension workers and policy makers:

- *As an ecological approach,* **KASAKALIKASAN** promotes sustainability by helping farmers apply IPM principles in crop production while learning to optimize the use of resources through the management of the agro-ecosystem. Analysis and action revolve around three basic principles: (1) growing a healthy crop through the use of resistant varieties, better seed selection processes, efficient nutrient, water, soil and weed management; (2) conserving beneficial predators and parasites; and (3) observing fields regularly to determine management actions necessary to produce a profitable crop.

- *As a human resource development program,* **KASAKALIKASAN** seeks to assist farmers in developing their ability of making critical and informed decisions that render their farming systems more productive, profitable and sustainable. Training helps farmers to make their own decisions, to organize themselves and their communities, and to create a strong working network with other farmers, extension workers and researchers. Through season-long Farmer Field Schools, farmers become experts in their own fields. Training methods become tools for continued inquiry and improvement by farmers.

On May 3, 1993, President Fidel V. Ramos issued Memorandum Order No. 126 instructing the Department of Agriculture to implement **KASAKALIKASAN** in collaboration with Local Governments and Non-Government Organizations. **KASAKALIKASAN** is the Philippine Government's commitment to Agenda 21 of the United Nations Conference on Environment and Development in promoting sustainable agriculture and rural development.

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FIELD GUIDE OF DISCOVERY-BASED EXERCISES FOR CORN IPM