



Food and Agriculture Organization
of the United Nations

PARTICIPATORY ECOLOGY TRAINING

Field Guide for IPM Training



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The FAO Programme For Community IPM in Asia

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PREFACE

The intention of the book is to establish a stronger understanding amongst, training participants of ecological principles that underlay any agroecosystem. These activities will be useful in Training IPM trainers, Farmer, and Farmer IPM Trainers.

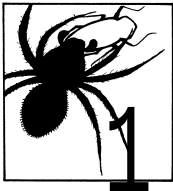
This book was inspired by the experience of the writer, who has conducted IPM training in four countries. It is not meant to be a “Cookbook” that must be followed, but rather, the book is intended to inspire critical and creative thinking. The activities found in these book is not lecture based. They are designed as structure experiences to help farmers discover their knowledge and ideas. To take advantage of the structured experiences, participants must be active and engaged in the process. The facilitators will needed to encourage participants to share their ideas, so that the training activities are effectiveness.

Each topic should begin with open discussion about the objectives, purpose, and the process of the topic. The topics presented here are integrated and build one upon the other. You will find that the order of their presentation makes ecological sense.

The facilitator should help participants to generalize from the activity to their own situations. This will help participants to be better able to apply what they have learned. Open-ended question, “what if” question and other kinds of question can greatly help the process.

Finally, we should remember the goal of IPM training is to provide an educational opportunity for participants. So that they might empower themselves through learning.

Suggestions for improvement in the book will be appreciated.

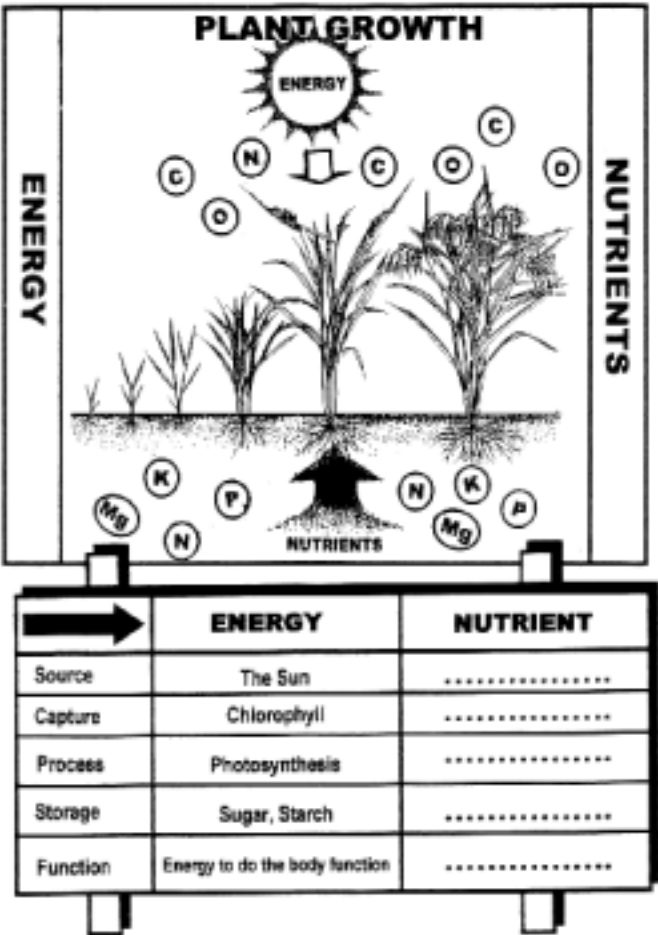


PLANT GROWTH, ENERGY, AND NUTRIENTS

Background

All living organisms need energy to do the work of growth and development. We can feel the heat from the sun. But only plants have developed the ability to capture and store this energy from the sun. All other creatures depend, either directly or indirectly on plants for this reason. Plants capture energy and then store it in the form of energy-rich molecules like sugars and starches.

In addition to energy, living organisms require input of matter to maintain their life functions. The matter in the form of nutrients containing a variety of important molecules for life is used to build cells and tissues and even more complex organic molecules, like hormones, required for cell and body functioning.



Objective

We should be able to explain the relationship among growth, development, energy and nutrients.

Time: 120 minutes

Materials: Rice plant, cricket, bamboo, black cloth, pot, box, large papers, pen.

Procedures

❑ Preparation

Start with an open discussion about ;

- What is characteristic of living organisms?
- What is the meaning of growth and development
- What is the living organism need to growth and develop?
- Where does energy for life on earth come from?

❑ Action

- Grow a rice plant in the pot and cover with the black cloth (make it look like a insect zoo)
- Rear a cricket in the box (plastic jar); give some dry leaves for food and then cover with the black cloth.
- Wait two days and observe the rice plant and cricket. What has happened to the rice plant and what has happened to the cricket?
- Discuss in small group about source, capturer, process, storage and function of energy and nutrient (the format see example below)

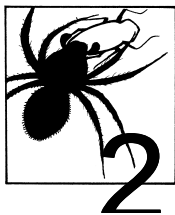
	ENERGY	NUTRIENT
➤ Source		
➤ Capturer		
➤ Process		
➤ Storage		
➤ Function		

❑ Discussion

- Why can only plants capture energy from the sun?
- How about other living organisms?
- What is the function of energy to plant growth?
- What is the function of nutrient to plant growth?

❑ Follow up

- Observe and compare texture of plant leaves that grow in an open place and in shadowed place.



PHOTOSYNTHESIS - ENERGY FLOW - NUTRIENT CYCLES

Background

We have started that energy comes from the sun and that only plants have developed the ability to capture and store this energy. The process whereby energy from the sun is captured and converted to sugar is called “*PHOTOSYNTHESIS*”.

Energy flow in one direction only through ecosystems from the sun to producers (plants) to consumers (animals that eat plants or animals that eat other animals). At each subsequent stage (Trophic level), some energy is captured through feeding, some is lost through waste and some is lost as heat and respiration. Finally, when a plant or animal dies that has not been eaten by a higher trophic level, its body goes into the soil and becomes part of a pool of energy stored in dead organic matter.

In contrast to the one way flow of energy in ecosystems, nutrients move in cycle through the biotic (living) components of an ecosystem to the abiotic (non-living) components, back again to the biotic and so forth.



Objective

We should be able to understand the photosynthesis process, energy flow and nutrient cycles

Time: 120 minutes

Material: Rice plant, plastic glass, food coloring, large papers, pen

Procedures

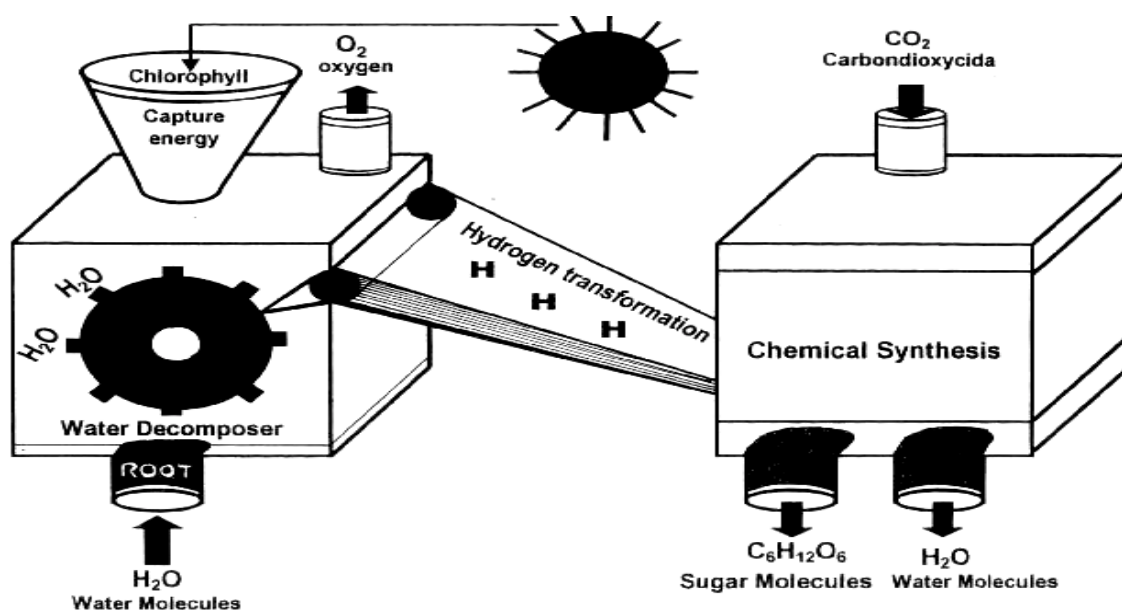
□ Preparation

Start with an open discussion about;

- The photosynthesis process
- What is the meaning of energy flow?
- What is the meaning of nutrient cycle?

□ Action

- Add water to the plastic glass and place several drops of food coloring. In the water should be dark red.
- Put sand in another plastic glass and place a rice plant with root and stems in the sand. Set it in open place.
- Wait three hours and observe the rice plant. What has happened to the color of the leaves? How has the red coloring moved in the rice plant?
- While we are waiting, discuss in small groups about the energy flow and nutrient cycle.
- Try to draw an energy flow and nutrient cycle diagram for the village. Try to be general, but as complete as possible. For example ;
 - Make a pattern of energy flow between electric source, lamp, egg and chicken
 - Make a pattern of nutrient cycle between soil, grass, cow, grass roots, cowdung.
- Draw a photosynthesis mechanism through imagine the plant like machine that produces sugar (see illustration below).



□ Discussion

- When a sheep or cow eats grass, what types of things does it take from the grass that is useful?
- What happens to dung in the soil?
- Does energy captured by the plant go on forever or does it eventually win down to zero?
- What happens to the crop yield after harvest and what happens to the remainder of the plants after harvest?

□ Follow up

- Try to draw an energy flow and nutrient cycle diagram for rice ecosystem.



PLANT PARTS, FUNCTION, AND BIOMES

Background

Plant anatomy and the function is closely related. Every plant has a unique nutritional process. The composition, texture and function of each principal part of the plant contributor to this process. The chlorophyll within leaves and green stems captures energy from the sun, roots take nutrients from soil and vessel transport water and nutrient to all body of plant.

This the physiological process creates energy and nutrients that help the plant to grow. The body of the plant stores energy and nutrient so that the plant can grow to be bigger and bigger body. All body of the plant still has energy and nutrients up to harvesting. But is not all part of plant are consumed by humans.



Objective

We should be able to promote discussion on the general topic of plant nutrition and the composition, texture and function of each principal part of the plant.

Times : 120 minutes

Materials: Rice plant, soybean plant, large papers, pen

Procedures

□ Preparation

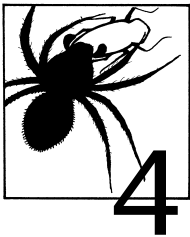
Start with an open discussion about ;

- The physical parts of the plants?
- The function of each part?
- What is the meaning of biomes?

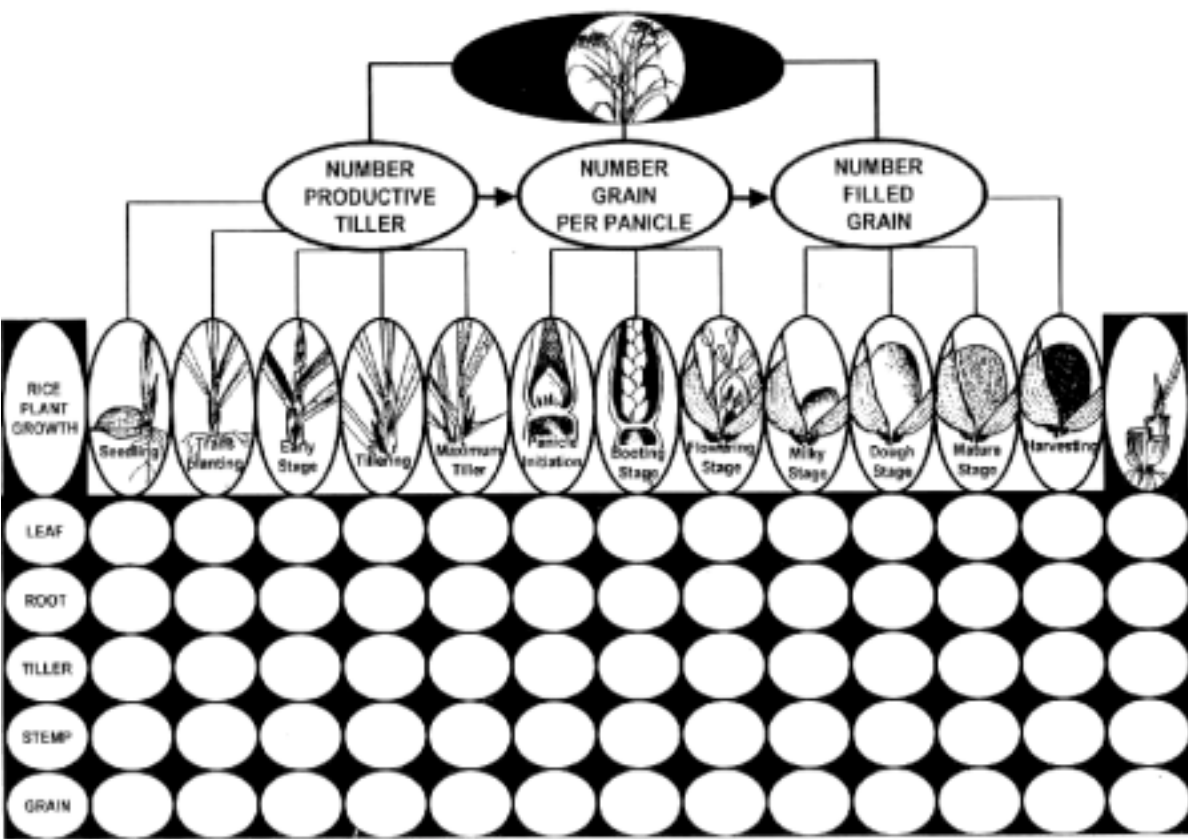
- Action
 - Collect a rice and a soybean plant that are almost ready to harvest.
 - Take a representative specimen of the plant and do an initial drawing.
 - Decide on what constitutes the principle sections or components of the plant (roots, stems, leaves, panicles or fruits, etc) and then cut and separate them.
 - Count the relative proportions for each parts of plant (if the entire plants is 100%)
 - Discuss in small groups about functions of plant parts, proportion, texture etc. To get easy discussion we can follow the format (see illustration below).

	Plant Parts	Textures	Proportions	Functions	Decompose Time
	 Leaves				
	 Stems				
	 Panicles				
	 Roots				

- Discussion
 - What are the relative proportions for each section?
 - What are the textures associated with each section? (fibrous, fleshy, starchy, etc)
 - What are the functions of each section in regard to the life of the plant? (Capture energy, water and nutrient transport, structural, storage, reproductive, etc).
 - How might the textures be related to the functions?
 - What percent would we harvest from the plant?
 - Which parts would decompose most quickly and which parts would take longer? Why?
- Follow up
 - Compare wet plant weight and dried plant weight or dried yield weight and dried plant weight.



RICE PLANT COMPENSATION IN RELATION TO GROWTH STAGE



Background

A fundamental aspect of rice IPM is “*Plant Compensation*”. When the rice plant is damaged by a pest, the rice plant can compensate for the damage in a number of ways so that it will not effect rice production. A healthy crop has a considerable ability to compensate for damage by pests. So it’s correct, the first principle of IPM is “grow a healthy crop”.

The capacity of a plant to compensate depends on the growth stage (vegetative phase has better compensation than generative phase), crop health and injury level (at vegetative phase, 30 % of rice plants leaves can be damaged without affecting rice production).

Objective

We should be able to explain how plant compensation works, how it is linked with each growth stage and why it is important to grow a healthy crop.

Times : 120 minutes

Materials: Rice plants (different stage), large papers, pen, ruler

Procedures

□ Preparation

Start with an open discussion about:

- How a plant responds to various types of damage by pests.
- The important physical components which determine overall rice production.
- The growth stages of rice and the potential for plant compensation in each stage in relation to the physical components of rice production discussed above.
- The physical parts of rice plant.

□ Action

Discuss in small groups about the compensation ability of each part of the rice plant at each growth stage. (See the format below.)

Rice plant part	Early stage	Tillering	Etc
Leaves	...	...	...
Roots	...	...	...
Tillers	...	...	...
Stems	...	...	...
Grains	...	...	...

□ Discussion

- How can the rice plant compensate if;
 - During Tillering stage, some tillers are damaged by pests?
 - During Booting stage, some leaves are damaged by pests?
 - During milky stage, some grains are damaged by pests?
- What is the meaning of plant compensation? Which growth stages have less capacity to compensate for damage? What can we do to ensure that rice plants have good compensation ability?

□ Follow up

Continue to observe the anatomy of rice plants at each stage.



SOIL STRUCTURE-ORGANIC MATTER-SOIL MICRO ORGANISMS

Background

The texture and structure of the soil influence the dimensions of the open spaces in the soil. The texture refers to the proportions of sand, silt and clay particles. Structure refers to the extent to which the soil particles are bound together.

Soil organic matter is actually comprised of two parts: the living and the dead. The living parts include the “microorganisms”. bacteria, viruses, fungi, plus a host of larger animals like worms, termites and beetles. For these animals and microorganisms are responsible for the majority of the processing that takes place when a dead animal or plant enters the soil system



Many of the fungi serve to breakdown and process dead organic matter into smaller and smaller components. These organisms are called “Saprophytes”. Many of the bacteria serve useful function in transforming nutrients into forms that are then able to be absorbed by the plant roots. Still other fungi and bacteria may act as predators and parasites to help protect the plant roots from attack by diseases and pest.

Objective

We should be able to explain the relationship among soil structure, organic matter, and soil microorganisms.

Times: 120 minutes

Materials: Sand, local farm soil, compost, soil, plastic bottles (at least 1 litter), rubber bands, sharp knife, clear plastic cup, large papers, pen

Procedures

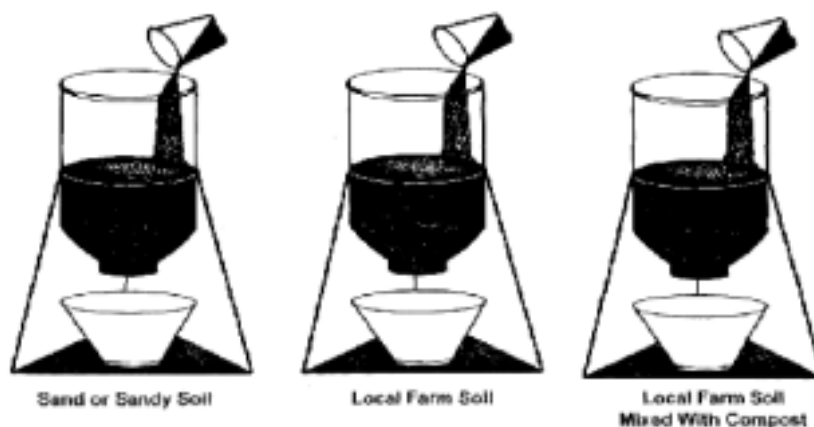
□ Preparation

Use the following question as discussion topics;

- What is the meaning of soil structure, organic matter, and soil microorganisms?
- What is the relationship among soil structure, organic matter, and soil microorganisms?
- What is the function of organic matter and soil microorganisms?

□ Action

- Take a quantity of soil and spread it out on a plastic sheet in the sun to let it air and dry for a day. Choose 3 samples (1) sand or sandy soil, (2) local farm soil, (3) local farm soil mixed with compost.
- Prepare three bottles to set up experiment (see sample below)
- Fill each inverted water bottle half full with the soil from three dried soil samples.
- Place each soil filled bottle in its own wire holder, suspended above the 3 plastic cups.
- Take the other plastic cup and fill it to the mark; then add it to the soil in first bottle. Do the same for the second and third bottles. Wait a few minutes and observe the waterfall down.

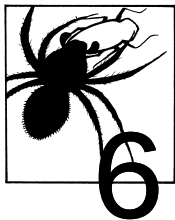


□ Discussion

- Which bottle can retain water for along time? Why?
- What do we think is the function of organic matter?
- What is the relationship of organic mater and soil microorganisms?

□ Follow up

- Choose 3 samples of field soil (from dike, rice field, and vegetable area that using organic manure) and put them in the sun to let it air dry for a day.
- Weigh the dried soil (volume of 3 samples are same) than burn the soil sample and weigh them again.
- Compare the 3 samples, whice one has lost more weight?



NUTRIENTS SOURCE AND BEHAVIOR

Background

All nutrients have a primary location where most of the nutrient is found in the plant. This is the “*primary reservoir*”. For carbon, nitrogen and oxygen, the atmosphere functions as the primary reservoir. This fact has important implication for the mobility of nutrients in the ecosystem.

In contrast, the “soil-based” nutrient elements are much less mobile. These include phosphorus, potassium, sulfur, calcium and most of the trace elements, which are taken up by plant roots, stored for a period of time in biomes and if not artificially removed by the action of human, returned to the soil within the same ecosystem. The distinctions among nutrient elements include how they are cycled, where they are stored and how they are lost from the system.



Objective

We should be able to understand the source of macro-nutrients, where they are stored and how they are lost from the system.

Times: 120 minutes

Materials: Fertilizers (N,P,K), plastic glass, rice plant, pot, large papers, pen

Procedures

□ Preparation

Start with an open discussion about ;

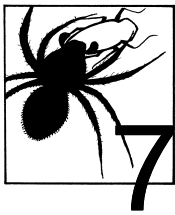
- The distinctions between macro-nutrient and micro-nutrient.
- The atmosphere and the soil as primary reservoir.
- Characteristics of nutrients from the atmosphere and the soil.

- Action
 - Put one small spoon of fertilizer in the plastic glass (each glass has a different kind of fertilizer)
 - Add water in each glass
 - Wait a view minutes and observe which fertilizer is the fastest to dissolve in the water?, Which fertilizer needs a long time?
 - Discuss in the small group about the function, source, and behavior of each nutrient. To get help discussion we are following format (see example below)

NUTRIENTS SOURCE AND BEHAVIOUR

	FUNCTION	SOURCE	BEHAVIOR	Plant parts most have	Symptom Deficiency
N Nitrogen					
P Phosphorus					
K Potassium					
Ca Calcium					

- Discussion
 - Considering the photosynthesis process, what is the function of phosphorus, potassium, and calcium?
 - How about the nitrogen cycle in the ecosystem?
- Follow up
 - Set up an Indoor study about the symptoms related to deficiencies of each nutrient



COLLECTING INSECTS AND SPIDERS

Background

Insects and spiders can be collected many ways. The best way is to sit in a field and watch the insects and spiders to observe their activity and behavior. Keep notes on what specimens are doing in the field. Collecting can be done by hand or with a small sweep net.

Insect collections are not for museums or art but to help us to identify and get more information about the characteristics, behavior, and activities of insects. One important aspect of insect collections is that it is an easy method to preserve insects and allow them to be carried anywhere.



Objective

We should be able to make a simple insect collection that can be brought anywhere.

Times: 120 minutes

Material: Playing cards, alcohol 70 %, transparent tape, scissors, small sweep net, plastic

Procedures

□ Preparation

- Open discussion about ;
 - The objective of collecting insect specimens
 - Several methods for collecting insects
 - The important points to consider in insect collections
- Facilitator should give an example of how to make materials to preserve insects with playing cards and transparent tape (see example below).

 Action

- Go to the rice field to observe the behavior of insects or spiders, try to catch the insect with a hand or small sweep net.
- Kill insects with alcohol (put into a glass for 15 minutes and then dry for another 15 minutes on an open place).
- Make a slide from playing card for holding the insect.
- Make labels that give the common name, function, habitat, and time of collection for each sample.

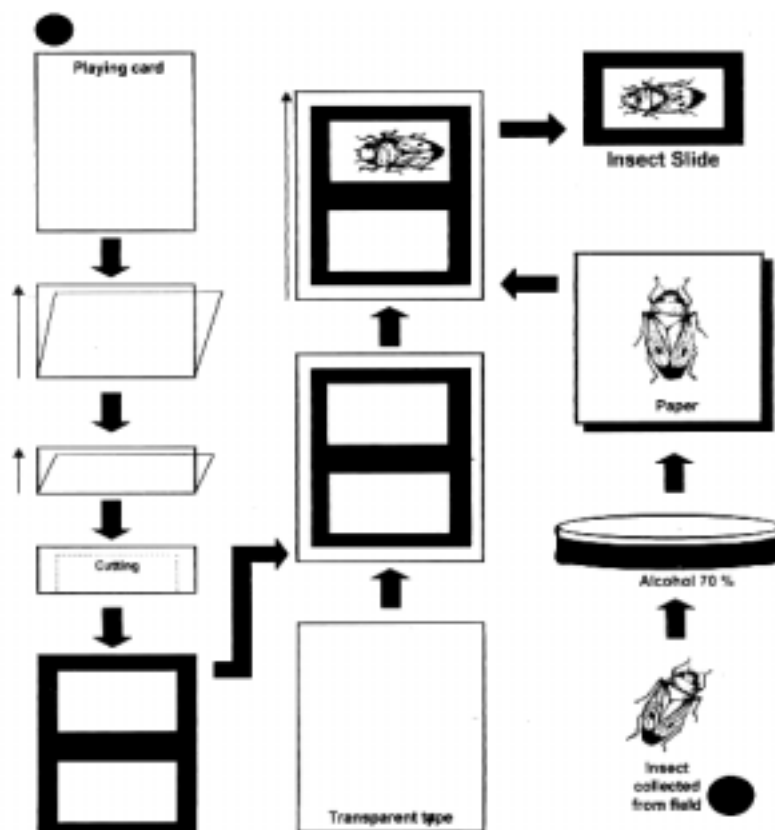
Discussion

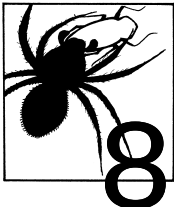
- Do we have other methods to collect insects that are easier, cheaper and can be kept a long time?

- Follow up

- Continue to collect and preserve insects during the season.

Diagram of how to make materials to preserve insects

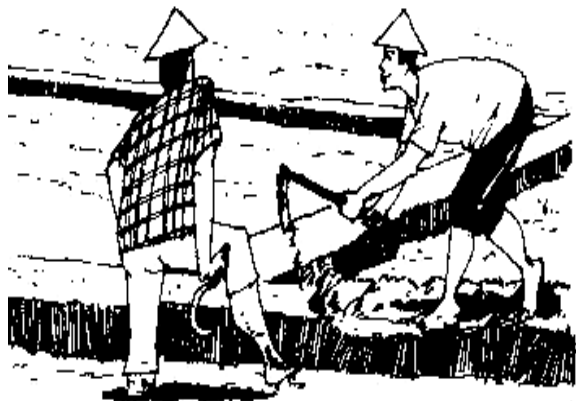




HABITAT STUDY IN FALLOW RICE FIELD

Background

We know that the development of natural enemies depends on herbivore populations which are the source of their food. So when rice plants have been harvested and the herbivore population is very low, what happens to the natural enemies?



Between two seasons there are fallow fields. This period we call the “*Transition Time*” because the time is like a bridge that connects the two seasons. Rice plants grow in the seed bed and grasses grow on the dikes, irrigation canals and surrounding rice fields. Fallow fields become important habitats for certain insects and spiders before the rice field is planted in the next season.

Objective

We should be able to understand the importance certain insect and spider of fallow fields habitat.

Times: 180 minutes

Material: Transparent plastic bag, netting, white paper, ruler, large paper, drawing pen

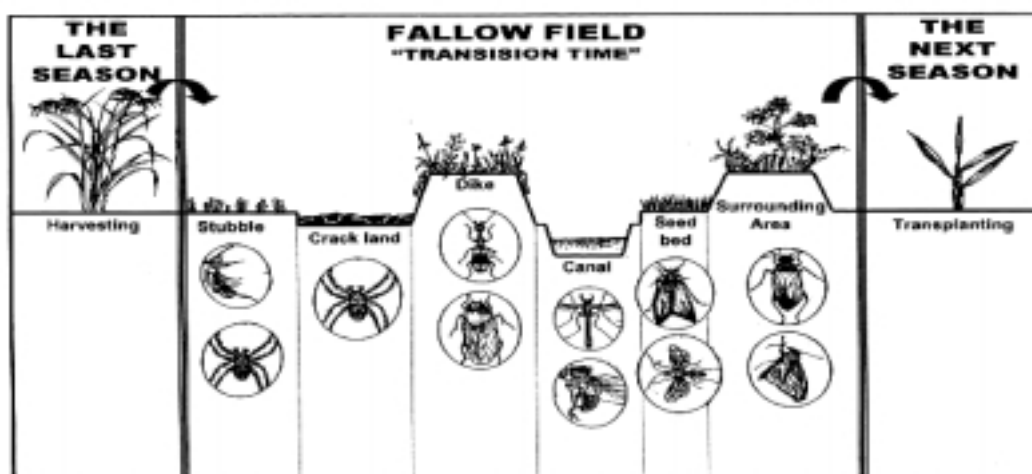
Procedures

□ Preparation

Open discussion about transition time between two seasons (last season and next season), how the habitats change, and the survival mechanisms of insects and spiders living there.

□ Action

- Go into a fallow rice field to observe stubble, cracked land, dikes, irrigation canals, and seed beds.
- Closely observe the area using different methods:
 - Collect 4 or 5 stubble from fallow field; be careful to withdraw the stubble to get some roots. Put them into the netting. Put white paper under the netting and knock the netting so some small insects and spiders fall down to the white paper. Observe what kind of insects are there.
 - On the rice dike, measure 1-meter length; carefully observe the grass (open it up slowly) or other crops that grow on the dike.
 - On the seedbed, measure 1-meter square, search for all small insects and spiders.
 - Take water from the irrigation canals. Put it into the transparent plastic bag and hold it up to the sun or a light to observe it.
 - Carefully open the cracked land and look for insects and spiders inside the cracks. Look for spider webs.
- Return to the classroom. Draw a cross section of the fallow field including stubble, cracked land, seedbed, irrigation canal, and dike. Use a cross section. Now draw insects, spiders and other animals seen on the cross section, according to where, they were observed in the field. (example see below).

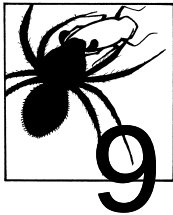


□ Discussion

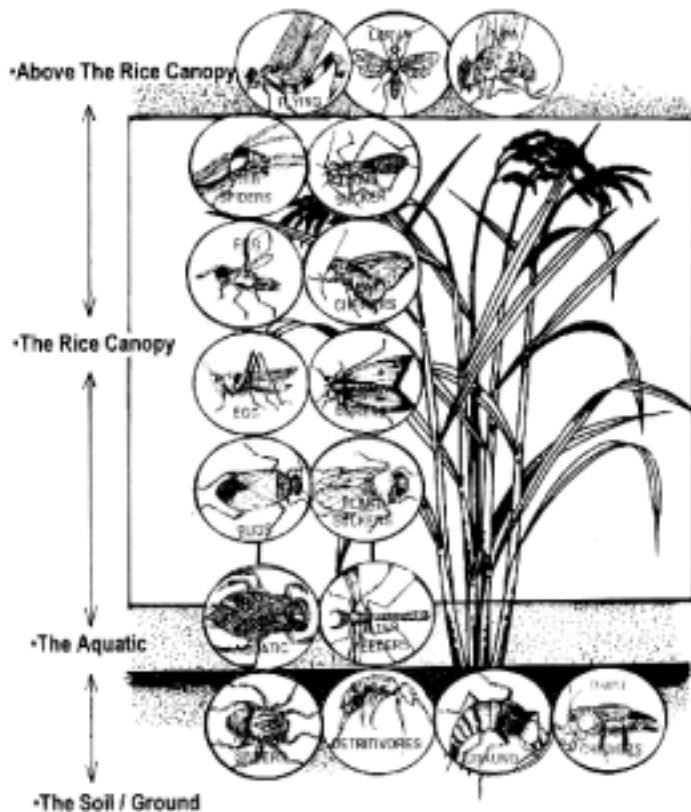
- Did we see small insect jumping when we knock the netting with stubble inside?
- Where were the most insects and spiders found in each area?
- Why is the habitat in fallow field important?
- What can we do to conserve habitat in the fallow field?

□ Follow up

- Make an aquarium to get more information about aquatic organisms. Set up a field study to see the impact of burning straw in the fallow field.



HABITAT STUDY IN RICE ECOSYSTEM



Background

In the rice field there are a number of “levels” or habitats in which insects live. One way to think of these is in terms of a vertical stratification. The top level is above the rice canopy. The second level is in the rice canopy itself. The third level is the aquatic, or water. The fourth level is the soil. Each of these habitats have different species of organisms.

Each insect has unique to it's habitat. The characteristics and function of insect are influenced by their habitat. Most insects that live in the water or soil function as natural enemies or decomposers.

All insects that live in the top level have are very dynamic and move among plot. Usually plant feeder live in the rice canopy.

Objective

We should be able to explain the different types of habitats found in a rice ecosystem and the types of organisms that live there.

Times: 120 minutes.

Materials: Flooded rice field, sweep net, plastic bags, large paper, pens, glue.

Procedures

□ Preparation

Use the following questions as discussion topics:

- How many habitats can be seen in the rice field?.
- What kind of insects can be found in each of these habitats?.
- What is the relationship between these habitats? Do they overlap and inter-relate?

□ Action

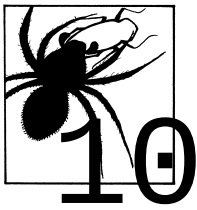
- Divide into four groups. One group should focus on one habitat.
- Have them first stand and observe their habitat. Then slowly begin to look closer.
- Collect organisms that they find in the habitat.
- Draw pictures of these organisms. Then have each group place them (the drawing) on a large piece of paper which has the rice ecosystem drawn on it with four habitats clearly defined.
- Discuss the relationship between these organisms.

□ Discussion

- What kinds of insects/spiders were found in each habitat?
- Are the organisms in one habitat related to another? Do insects change their habitat during their life cycles?
- How does the energy cycle relate to these habitats and organisms?

□ Follow up

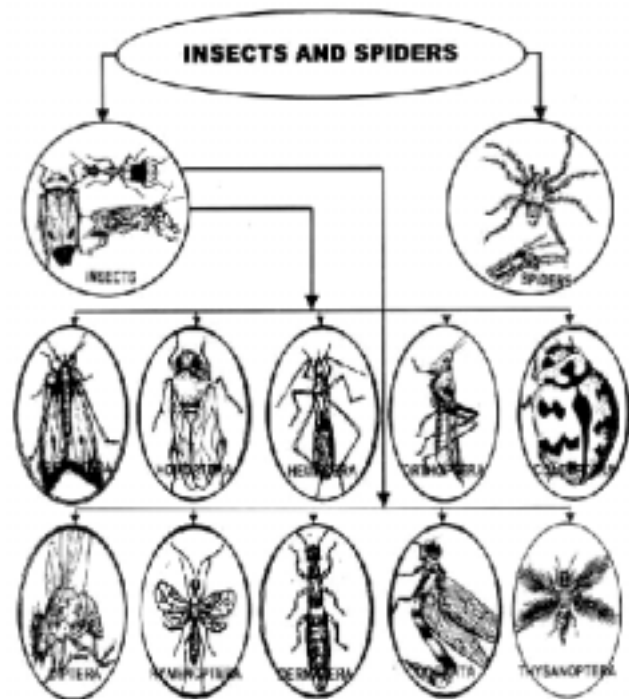
- Continue to observe the ecosystem, concentrating on each habitat. Identify the functions of the organisms that were found.



INSECT IDENTIFICATION AND DRAWING EXERCISE

Background

When we do an AESA, we draw all of the ecosystem components. The problem is that we need a long time to draw insects which reduces the time for analysis, the purpose of AESA. Drawing in an AESA is not for art but to help us analyze the ecosystem. Insects can be drawn more accurately and more quickly if you know the classification of the insect. A pattern can be used for each insect order to help draw it quickly and accurately.



Objective

We should be able identify an insect based on order classification and draw it quickly and accurately for easy analysis.

Times: 120 Minutes.

Materials: Insect collection, large paper, pen, ruler.

Procedures

□ Preparation

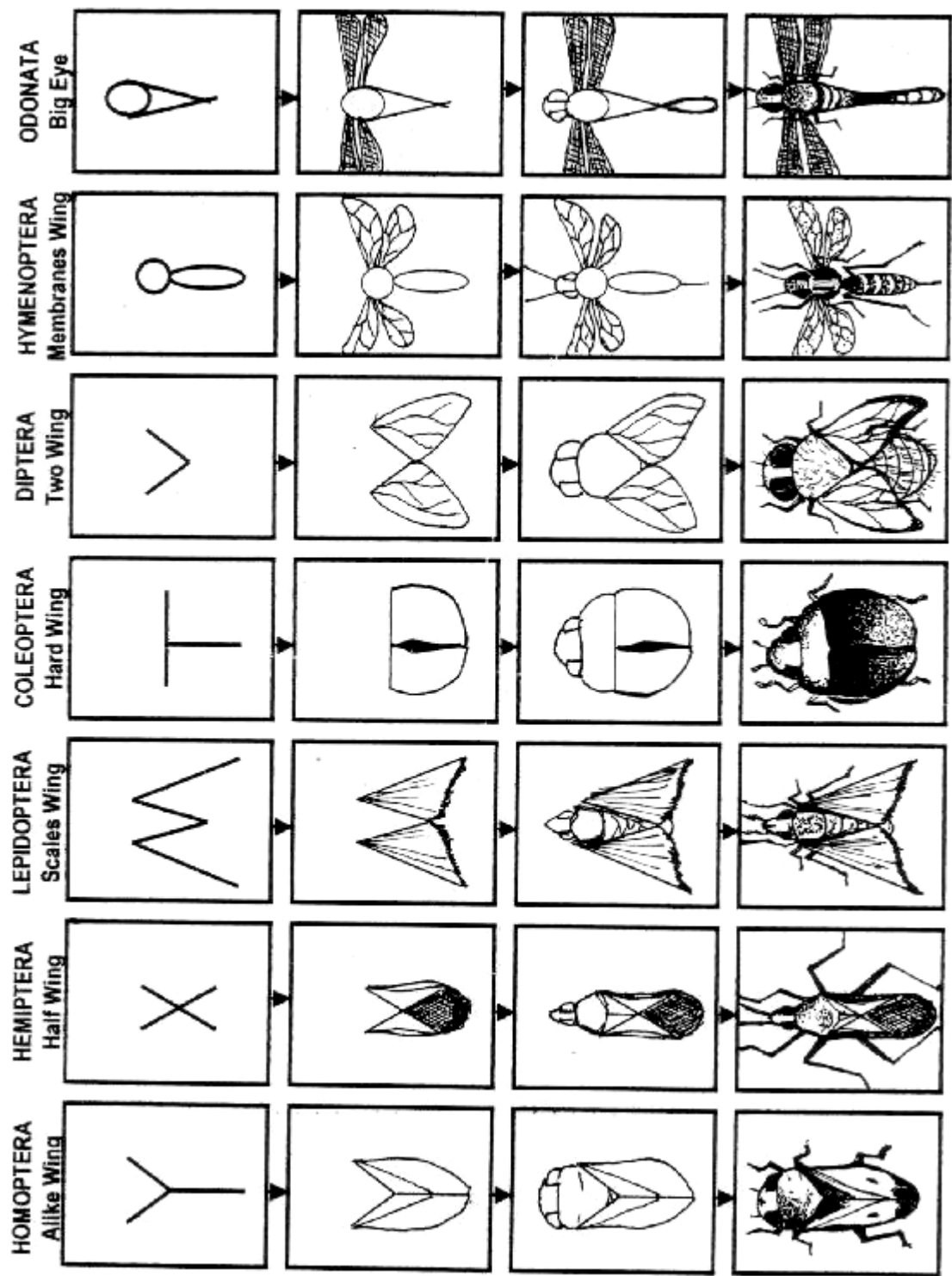
- Start the discussion by asking:
 - What the problems do we encounter when we draw insects in the AESA?
 - What are the distinguishing characteristics between insects and spiders?
 - How are the order names of insects related to wing types?
- Look at the insect samples and identify their order based on their wing types.
- Give examples of insects to draw based on wing type. Go through each one step by step. Use the examples of coleoptera, hemiptera and homoptera.

- Action
 - Try to draw the insect orders. Identify the insects based on their wing characteristics. Classify them by order. Look at their mouth parts. List a number of common insect types by their order.

Order	Examples	Life Cycle	Mouth Type

- Discussion
 - In which order are most plant feeders?
 - In which order are most predators?
 - In which order are most parasites?
 - Are there exceptions to these? Are function and order the same?
- Follow up
 - Closely observe the mouth types of various types of insects based on their function.
 - Use a microscope.

PROCEDURE OF DRAWING INSECTS



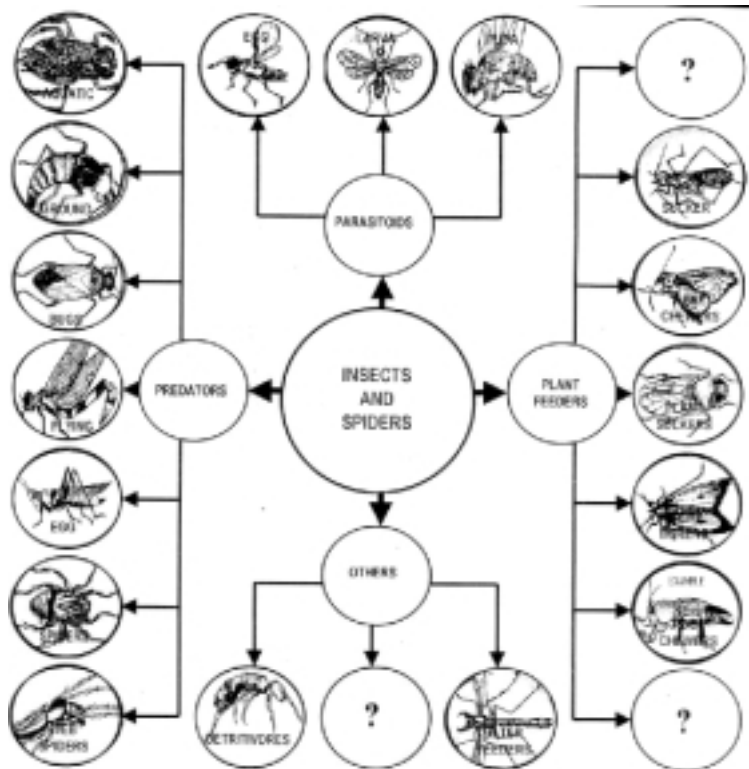


FUNCTIONAL GROUPS OF INSECTS AND SPIDERS IN THE RICE ECOSYSTEM

Background

During the planting season, we can find more than 500 species of insects in the field. It's very difficult to identify each species of insect. To make it easy to identify insects, however, we can classify insects by “functional group”. This means we can divide insects based on their function in the ecosystem.

This grouping into “functional groups” allows us to talk in greater detail about the system, and in a way that is clear and logical to farmers, without getting lost in all the details of working with hundreds species.



Objective

We should be able to identify the functional group of the specimens that we find in the rice field.

Times: 120 minutes.

Materials: Insects and spiders collected from the field, large papers, pen, ruler.

Procedures

□ Preparation

Start the discussion by asking:

- What are the problem in identifying the large number of species of insects and spiders in the rice ecosystem?.
- What is the meaning of a “functional group”, or “Guild”?
- Make a format of functional groups on the large paper (see sample above)

□ Action

- Put in the center of the piece of papers all of the insects and spiders that we have collected from the rice field.
- The specimens can be divided into 4 groups based on their function; (*Plant feeder, Predator, Parasite and neutral*)
 - The plant feeder group can be divided into several small groups, based on which a part of the plant is damaged by the insect.
 - The predator group can be divided into several small groups, based on where they live in the rice field, their specific prey, and in the part of the prey's life cycle, that they are feed upon by the predator.
 - The parasite group can be divided into small groups based on what part of the host's life cycle they attack (egg, larvae, pupae, adult).
 - The neutral group can be divided into 2 small groups based on food sources (organic matter and plankton/algae).
(See sample on the previous page)

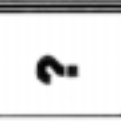
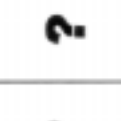
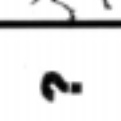
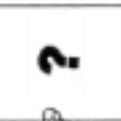
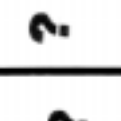
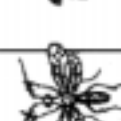
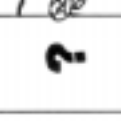
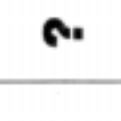
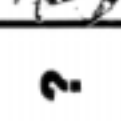
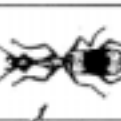
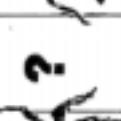
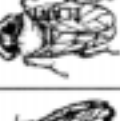
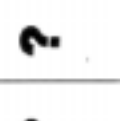
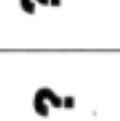
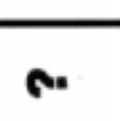
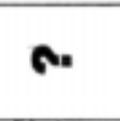
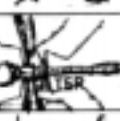
□ Discussion

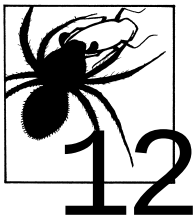
- How useful is this method of insect identification based on functional groups?
- Were some insects in more than one group? Could you find the functional group for every insect?
- How can you find the functional group for those you don't know? Do you have any suggestions for additional functional groups? What are they?
- What can we do to help farmers identify insects in their fields? Are neutral insects really neutral?

□ Follow up

- Continue to identify insects at each stage of the rice plant growth.
- While the IPM training going on, collect insects and spiders the were found in the rice field.
- Hang the insect collections on the format after we identified their function. (the format like as below)

INSECT POPULATION DYNAMIC
IN LONG SEASON RICE GROWTH

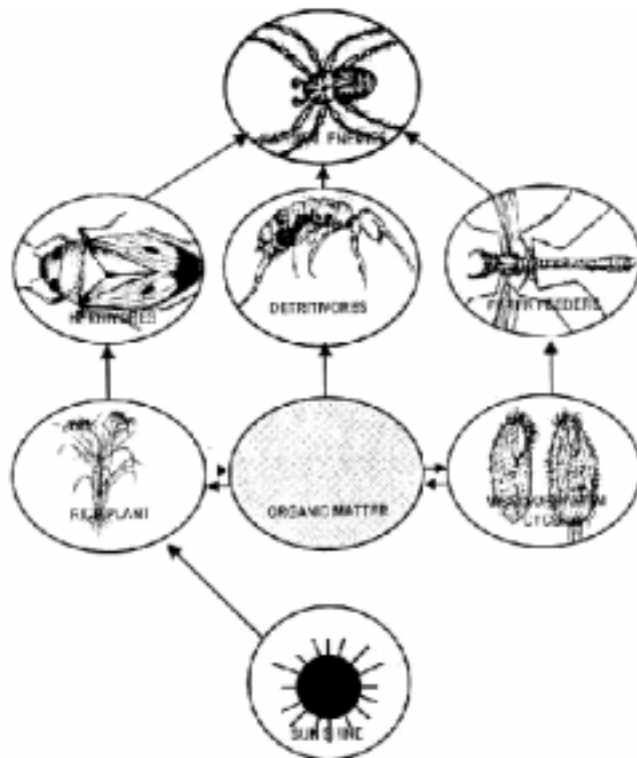
											
											
											
											
Fallow Field				Middle Season				Early Season			
				Last Season							
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ENERGY FLOW IN THE RICE ECOSYSTEM

Background

In the rice ecosystem everything has a function. Considering the energy flow in the rice ecosystem, there are different levels of functions. The source of energy is the sun. The rice plant becomes the producer of organic materials. Plants “feed” themselves in the sense that they can derive energy directly from sun (through photosynthesis) and use that energy to build “energy rich” molecules that then can be stored and transported throughout the plant.



Other levels in the ecosystem get energy from the rice plant. They are called herbivores and are the first consumer's level. The next level would be the predators that feed on the herbivores (consumers Level 2), and then we might have a parasite that attacks the predator (consumer's level 3). Finally, we have the group of organisms that feed on dead and decaying organic matter, the detritivores.

Objective

We should be able to demonstrate the energy flow in the rice field and three sources of natural enemy feeding.

Times: 180 minutes.

Materials: Insects and spiders collection, large paper, drawing pen.

Procedures

□ Preparation

Start with an open discussion by asking:

- What is energy flow, where does the energy come from?
- Why can the rice plant get energy from only the sun?

□ Action

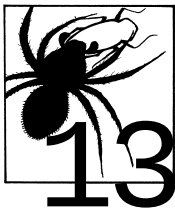
- Make a circle on the bottom part of a large paper and draw the sun in the circle,
- Draw another circle above and to the left of the first circle and draw a rice plant in it. Make an arrow from the sun to the plant that means the rice plant gets energy from the sun.
- Continue to make others circles containing the organisms we mentioned. Make arrows between the circles based on the direction that energy flow.

□ Discussion

- What is the food source of natural enemies?
- Why is organic matter in the soil important for natural enemies?
- What is the function of the detritivores in addition to decomposing organic matter?

□ Follow up

- Make an aquarium to get more information about water organisms. Set up a simple experiment about the effect of chemical and organic fertilizers on aquatic organisms.



BALANCED ECOSYSTEM COMPONENTS

Background

IPM is a pest management system that's based on interactions among the ecosystem. The goal of IPM is to maintain a balanced ecosystem (a healthy environment) which results in high economic, environmental, and social benefits. The objectives of ecosystem analysis are to make decisions about what to do to manage the rice field ecosystem to achieve the goals of IPM and the farmer.

Objective

We should be able to demonstrate the balance of the rice ecosystem components and to assess the probable impact of various management actions on the rice ecosystem.

Times: 120 minutes

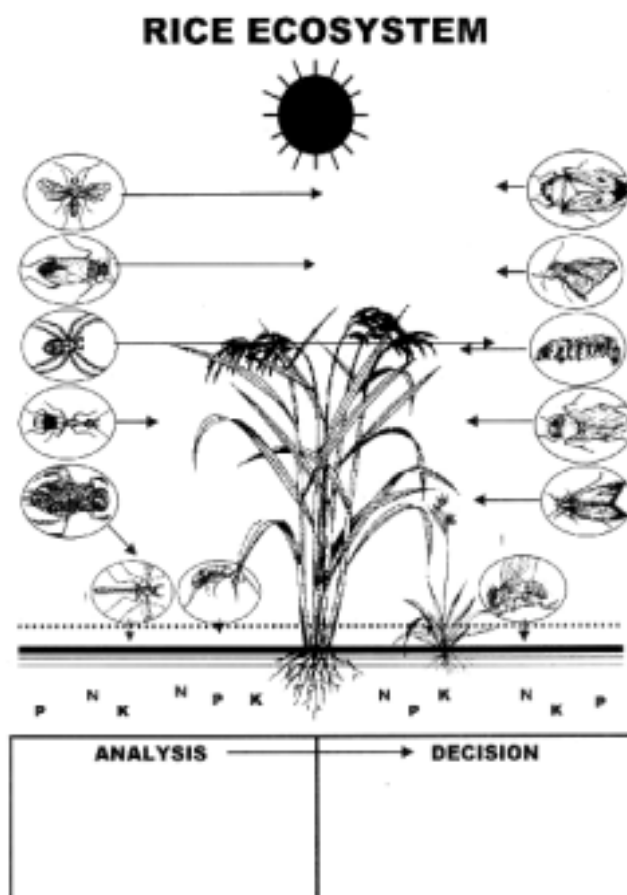
Materials: Small paper, large papers, pen, drawing crayon, glue, plastic bag

Procedures

□ Preparation

Open discussion by asking:

- What is an ecosystem? What is the meaning of “Eco” and what the meaning of “System”?
- What kind of components are in a rice ecosystem?
- What kind of inputs are put into the rice ecosystem?



□ Action

- Go to the rice field to observe and make notes on everything we find in the surrounding rice field. Try to catch some insects and spiders. Collect rice plants damaged by disease.
- Draw on small paper everything we have found, including the sun, rain, clouds and inputs that farmers provide to a rice field.
- Place the small pictures on a large paper and try to arrange the pictures into several related groups.
- Make a line between two components (groups) to explain interactions between the components.
- Discuss about some aspects within the each component (for example; in the soil there are three aspects i.e. soil structure, nutrients, and microorganism).

□ Discussion

- What is an ecosystem and what are the characteristics of ecosystems?
- What will happen if we give inputs into the rice ecosystem, such as:
 - chemical fertilizer?
 - organic manure when we prepare land?
 - more water over season?
 - Pesticides?
- What is a “balanced” ecosystem. Why is it important to grow a healthy crop, conserve natural enemies and observe the rice ecosystem weekly?

□ Follow up

- Continue to do AESA weekly.

Background

Energy from one level of the ecosystem moves to other levels along a chain of interactions within the foodweb. As an insect goes through its life cycle, it can play a different role within a food web.

We should be able to explain life cycle and food web chains for several insect pests.

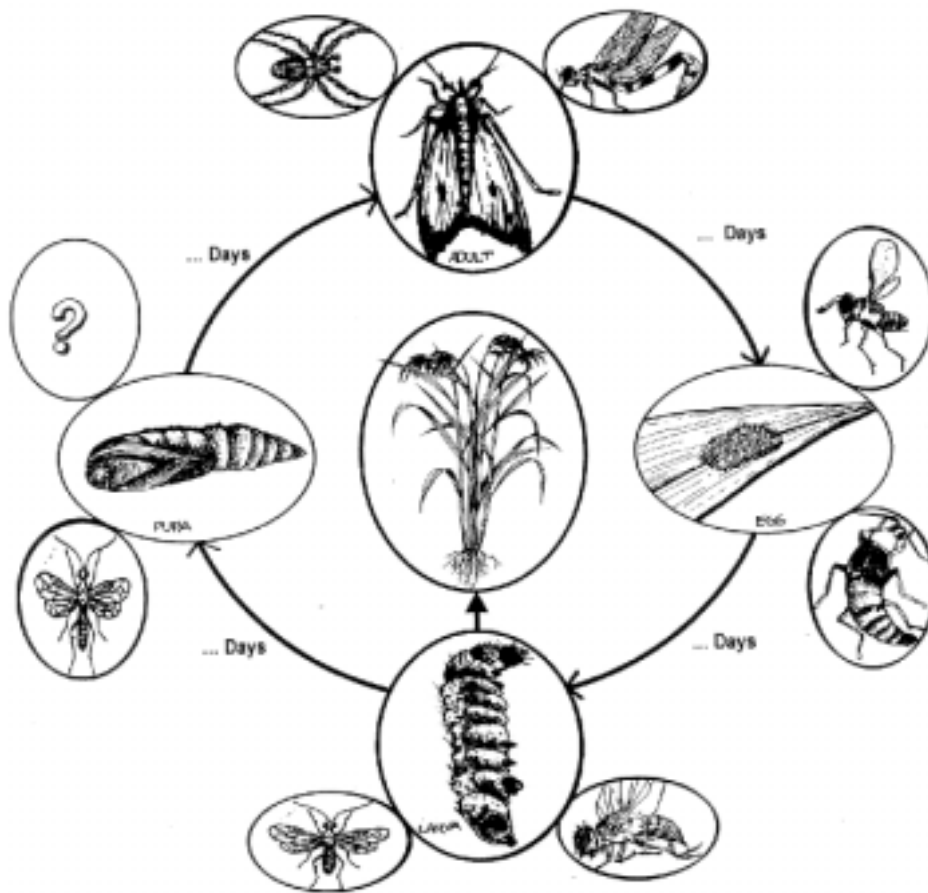
Materials: Large paper, drawing pen, and reference that have information about natural enemies of herbivores.

- ❑ Preparation

- What is the meaning of life cycle?
- How many kinds of life cycles do insects have?
- What is the meaning of food web in the ecosystem?
- How do life cycles and food webs relate to each other?

□ Action

- Each group should choose a guild to analyze (Brown plant hoppers, Stem borers, leaf folders, rice bugs, grass hoppers)
- Draw a large circle and draw in the general stages for the insect around the circle (see example below).
- On the drawing, draw the natural enemies that attack a particular stage of the insect.
- For the natural enemies, write the stages of the natural enemy life cycles.

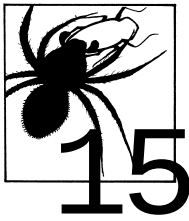


□ Discussion

- What would happen to natural enemies if there were no insect pests? Do we think insect pests can become beneficial at low populations? Why are they important?
- What will happen if we spray broad-spectrum pesticides?

□ Follow up

Analyze for other guilds.



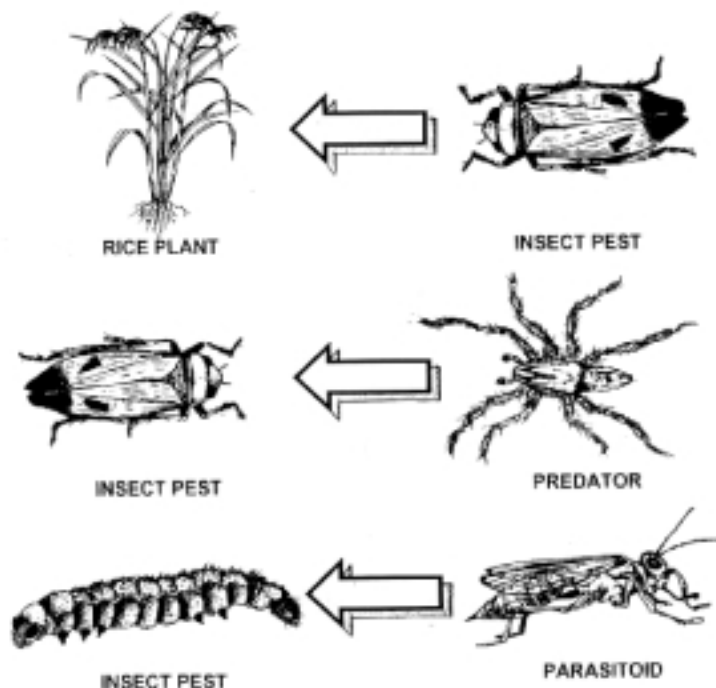
PREDATOR, PLANT FEEDER AND PARASITE BEHAVIOR

Background

All insects and spiders have different characteristics, activities and behaviors. One way to group them, however, is according to their food characteristics: plant feeders, predators and parasites.

All *predators* have some adaptations which help them to be better predators. Mouthpart, legs, eyes, and other parts of the body are well designed for the process

of hunting, killing and eating prey. The predator body structure is adapted to their ecological function. Adult wasp *parasites* are usually small, dark and winged. There are some flies, which are parasites also. Female parasites are very active in looking for hosts. After they find their host they put their eggs inside or near the host by using their ovipositor. *Plant feeders* have specially designed mouth parts to chew plant parts or to suck plant juices. Often they can migrate to areas in search of food.



Objective

We should be able to explain the different characteristics, activities and behaviors of plant feeders, predators, and parasites.

Times: 180 minutes

Materials: Plastic bag, large paper, drawing pen

Procedures

□ Preparation

Open discussion about the different characteristics of plant feeders, predators and parasites including their body structure and parts, activities and behaviors.

□ Action

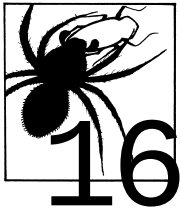
- Each small group should divide into 3 smaller groups. Each group is given a different task: (first group will observe plant feeders, second group will observe predators and the third group will observe parasites)
- Go to a near by rice field to observe the activities and behaviors of plant feeders, predators and parasites. Try to catch the insect with your hand or small sweep net.
- Kill the insects with alcohol (put into a glass for 15 minutes and then dry in an open place).
- Observe some parts of body with a microscope.
- Make notes that mention characteristics the body that is linked with their function.

□ Discussion

- What parts of predator body are important for their function as killer or hunter?
- What are the specific characteristics of parasites which allow them to find their host and lay eggs?
- What characteristics allow plant feeders to feed on specific parts of the plant?

□ Follow up

- Make an insect zoo to observe the characteristics of various insects, particularly parasites and predators. Rear some eggs or larva that are attacked by parasites.

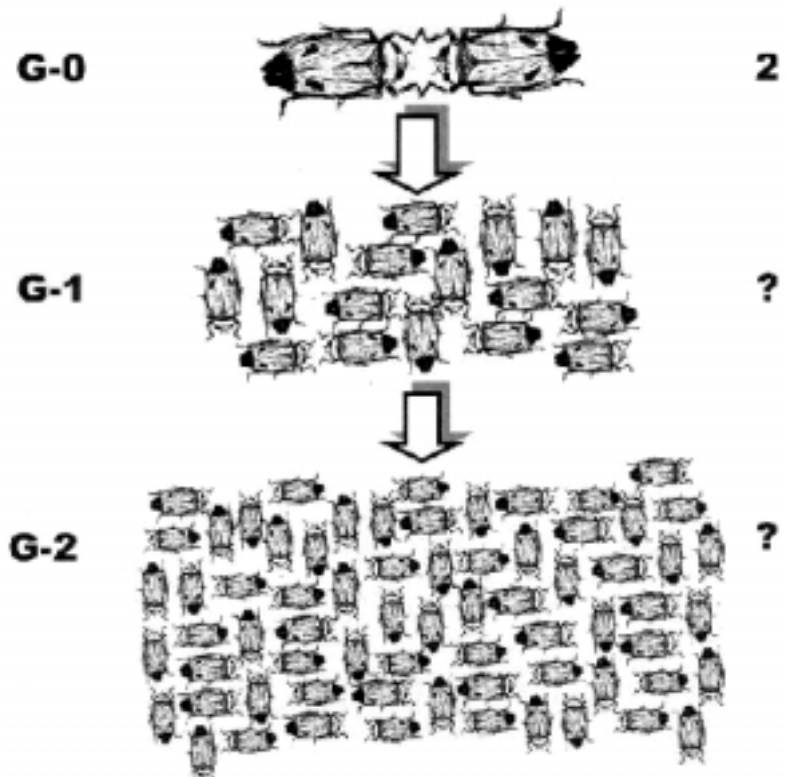


INSECT POPULATION GROWTH

Background

Insect population growth is affected by many factors. These could be genetic factors, food supply (quantity, quality, access), weather, natural enemies, and farming practices.

Normally, more than 98% of insects die before they reach maturity due to controlling factors in the ecosystem. This is important because insects have an extremely high capacity to reproduce and would consume a rice field within a short period of time without such natural controls.



Assuming there is sufficient food in the environment, what are the most basic biological factor that determine the growth of a population of any insect?. We will use a “Biological Model” to investigate this question of biotic potential. A model is a simple representation the employs a few simplifying assumptions.

Objective

We should be able to understand the relative level of controlling factors at work in the rice field to prevent large outbreaks of pest insects.

Times: 120 minutes.

Materials: Large seeds (like bean), large paper.

Procedures

□ Preparation

Start the discussion by asking:

- How many species of potential pest insects have we found in the rice field?
- How many eggs can be produced by one female during her lifespan?
- How long does it take from egg to adult for this species?
- Why do we not find populations of these insects in the field as high as these numbers seem to indicate?

□ Action

- Small groups should be given a potential pest insect to analyze
- Each group should write down the information about the lifecycle and reproduction characteristics of their insect
- Give each small group a supply of seeds
- Starting with the first generation “0” of two insects, have the groups calculate the number of insects in the next 4 generations based on their reproduction characteristics and the time it takes for this to happen. Let each seed represent one insect. Make a graph of the population increases. Calculate the weight of the population in the 4th generation if each insect weighed 0.1 grams. Compare this to the potential rice production.

□ Discussion

- Why can you not find the same level of insects that you have calculated using your seeds? What are all the factors responsible for preventing the population from reaching such high levels?.
- What happens if one factor is missing? What if more than one factor is missing? How do pest explosions happen? How can they be prevented?
- What management practices can have an impact on this?
- How does resurgence happen after spraying for pest insects?

□ Follow up

- Rear egg masses of stemborers in an insect zoo. Note what emerges.

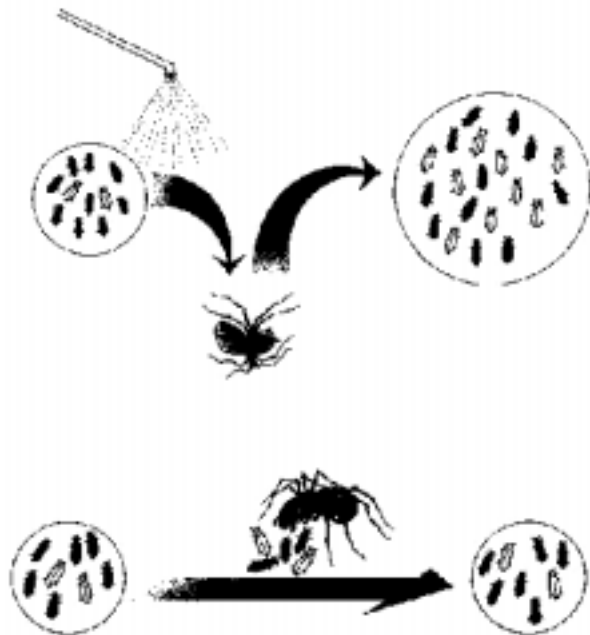


RESURGENCE AND RESISTANCE MECHANISM

Background

At any one time in the rice field, it is possible to find all life stages of a particular insect pest. Natural enemies keep these insect pests in control, often with different natural enemies attacking each different life stage of the pest. Although all the insects of one species in the field may appear the same, each one has a different genetic makeup. This makes some insects more or less affected by various environmental qualities / characteristics.

The phenomena of insecticide, induced pest resurgence by brown plant hopper (BPH) is based on the fact that early season sprays and granular application of insecticide kill off most of the hundreds of species of natural control agents. While not effecting BPH eggs that remain protected inside the plant. Then, some days later, the young BPH nymphs emerge into an environment that is virtually free of mortality factors.



Objectives

We should be able to understand the mechanisms by which both resurgence and resistance occurs and discuss ways to prevent it.

Times: 120 minutes

Materials: Round pieces of paper of various colors. Ruler, large paper, marker pens.

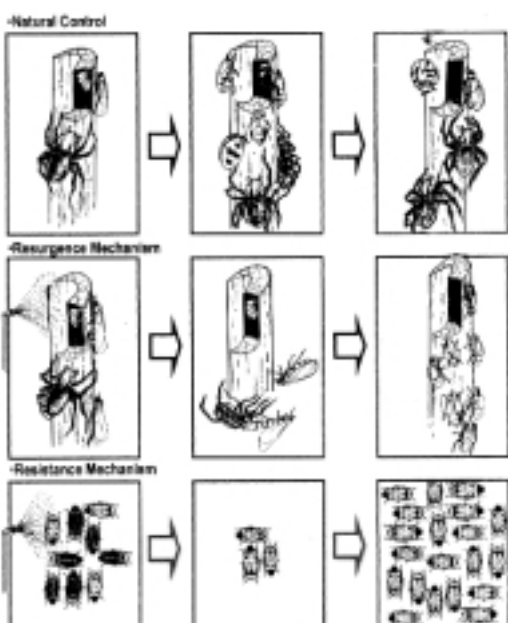
Procedures

□ Preparation

Start by opening the discussion with the following question:

- What do the difference between resurgence and resistance?
- How can the use of pesticides result in resurgence of insect pests?
- How do resistant varieties of rice lose their qualities of resistance?

□ Action



- Make a format with three columns and three rows on a large piece of paper. Put the round pieces of colored paper in the first column, first row. The red color represents BPH adult. Green color is the nymph. The yellow color is the eggmass. Black color paper represents spiders.

- Discuss what happens in the second column, first row after one week of interaction between the BPH and spiders. (Eggs become nymphs, nymphs become adults and spiders eat the adults) Continue to the third column after the second generation.

- In the Second row, first column, put the same organisms as column one row one. Use pesticides to control adult and nymph. Analyze what happens after one week, in the second column. Analyze after

the second generation in the third column.

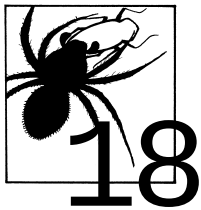
- In the last row, first column do the same as the first row but assume that red BPH are resistant to pesticide but the green color BPH are susceptible to pesticides. The yellow color BPH can easily feed on all varieties of rice. Use pesticide. Analyze what happens in column two and column three after one and two generations.

□ Discussion

- Explain how resurgence happens.
- Explain how resistance occurs.
- What is the impact of pesticides on secondary pest populations?
- Can you explain how a “pesticide cycle” is created?
- How you observed these occurrences in your area.

□ Follow up

Make another model to explain resurgence, resistance and secondary pests. Make a role play.

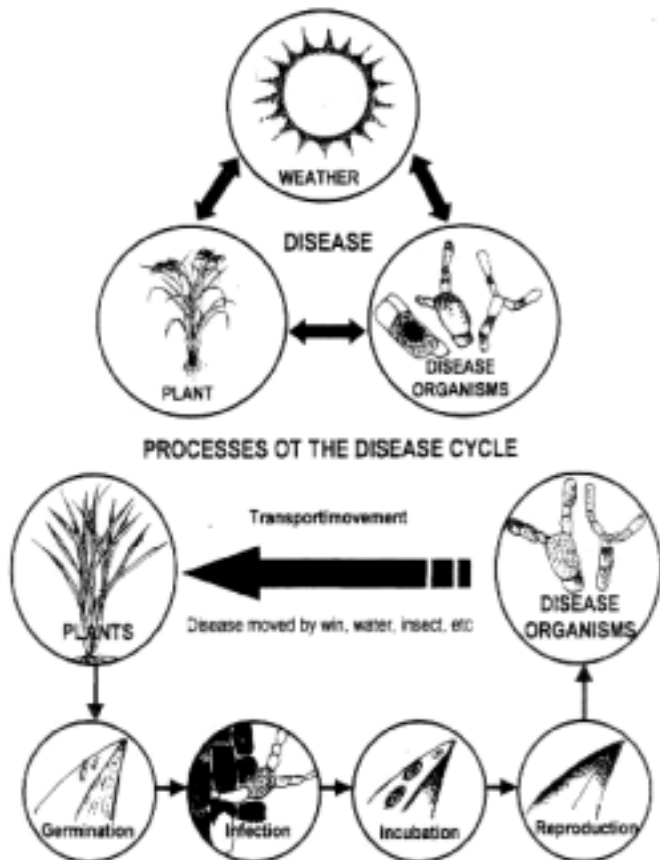


WEATHER, AGRONOMIC PRACTICE AND EFFECT ON DISEASE

Background

Disease organisms for plants include bacteria, fungi, virus and nematodes. Actually the meaning of disease is the interaction among plants, pathogens (disease organisms), and the environment. Weather and agronomic can effect the processes of the disease cycle in the following ways:

- Transport/movement: Disease organisms move to plant (host).
- Germination: Is mostly determined by the availability of an appropriate host.
- Infection: Success and failure of infection may depend on the growth rate of the disease organisms in relation to the defense rate of the host plant.
- Incubation: The time required for an infection to cause a symptom.
- Inoculum development/reproduction: Production of fruiting bodies on fungi can be a function of temperature, sunlight and relative humidity.



Objective

We should be able to explain the effects of weather and agronomic practice on disease.

Times: 120 minutes.

Materials: Paper, marker and book that contain rice disease.

Procedures

❑ Preparation

Open discussion by asking:

- What is the meaning of disease?
- How can disease organisms attack the plant?
- How is the plant damaged by disease?

❑ Action

- Choose a major disease (each small group choose a different disease)
- On large piece of paper, make three columns. On first column write disease process, the second column write effect of weather and the third column write effect of agronomic practice?
- Discuss in the small group to answer and complete the second and third columns. Find the answer in the book.
- Present our finding to the group.

❑ Discussion

- How can the plants be damaged by disease?
- What kind of ecosystem components have an impact on disease process

❑ Follow up

- Collecting disease symptom.



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