A Training Guide to Trainers

MICRONESIA GROWS TECHNOLOGY

A Program to Facilitate Distance Learning for Agriculture and Extension Students at the College of Micronesia-FSM

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GLOSSARY

COMPOST
any product in solid or liquid form, of plant or animal origin, that has undergone substantial decomposition that can supply available nutrients to plants with a total N-P-K 2.5 to less than 5 percent.

KOREAN NATURAL FARMING
an approach to agriculture that specializes in producing farm input to improve plant growth. It was developed by Cho Han-Kyu in the 1960s.

ORGANIC CONCOCTIONS
are based on the principles of K.N.F which utilizes fermentation in the production of farm inputs.

ORGANIC EXTRACT
are ingredients that have been pulled from natural sources, such as plants, fruits, vegetables, grains, meat or seafood.

ORGANIC FERTILIZER
is a fertilizer that is derived from organic sources, including organic compost, cattle manures, poultry droppings and domestic sewage.

TABLE OF CONTENTS

GENERAL INSTRUCTION

01

INFORMATION AND INSTRUCTIONS TO THE TRAINER

This manual should be used purely as a facilitator's guide. The sessions under each module are presented with an outcome(s) to facilitate the assessment of participants' understanding and depth of knowledge at the end of each session. Following the outcomes are the topics to be covered and facilitating methodology. However, the facilitator should feel free to adapt the methodology suggested to the needs of participants. To enhance a participatory learning process, some methods of presentation and the steps to follow are therefore outlined. The manual also provides some background information on each session. The information is also meant to aid the facilitator in the preparation for the session. Like all participatory methods, the involvement of the participants in all stages of the learning process is vital. However, all users of this manual must study and research into the content of each module before the presentation. Start each sub-topic and group activity by explaining the objective and learning outcomes expected of them, and ensure they are met.

The session should be interactive, participatory, lively and interesting. Let the participants express themselves in local language, if deemed necessary, for them to understand the concepts. Encourage them to ask questions especially on concepts that they do not understand. Switch to either English or vernacular language when you find some farmers or all of them do not understand you in one of the languages.

Start the session with greetings, welcoming remarks, and introduce yourself. Ensure you have the necessary stationery, equipment, and materials for the trainees: projector, flip charts or whiteboard, whiteboard markers, marking pens, posters, and handouts. Be time conscious as you facilitate the session.

This manual is organized around aspects of Organic Agriculture, its fundamentals and principles, formulating organic concoctions and extracts, and producing organic fertilizers.

02

USERS OF THE MANUAL

The manual is intended to be used by facilitators in conducting training workshops across the College of Micronesia-FSM through the aid of C.R.E extension agents and agriculture major students.

03

PRESENTATION METHODOLOGY

The methods of presentation outlined in the manual are suggested as a guide to the facilitator. The facilitator is expected to use his or her judgement in selecting the appropriate method or combination of methods in presenting each session.

04

ASSESSMENT

At the end of each session, the facilitator is expected to assess/evaluate the participants' understanding and level of knowledge by using a simple question and answer session as appropriate. In some of the sessions, assessment questions are suggested as activities whilst in some, the facilitator is given a free hand in determining the kind of questions to be asked. However, all assessments must relate to the session.

PROJECT BRIEF

The Federated States of Micronesia are situated in the Pacific Island region and have a mix of traditional cultures impacted greatly by successive Spanish, German, Japanese, United Nations and United States colonizations and territorial agreements. The food systems here are in transition. Large pelagic and near shore aquatic resources are spread across thousands of kilometers and the potential for misuse is extreme. Local land-based agricultural practices are a mix of traditional and imported crop farming and husbandry. Both ocean- and land-based systems are subject to increasingly challenging results from climate change. In this context, one of the most important tools that local communities have is their knowledge. Showing how traditional knowledge integrates with modern, scientific agricultural research and practices is one of the benefits of a robust CRE program.

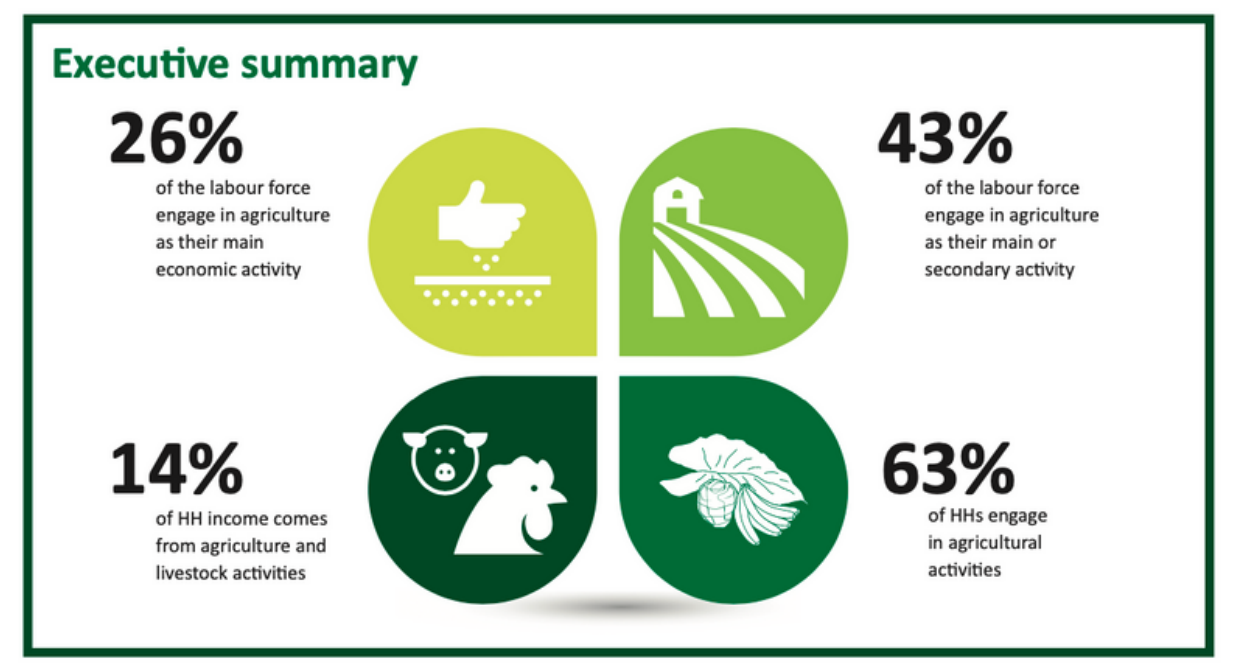
The College of Micronesia-FSM is a learner-centered institution of higher education that is committed to the success of the Federated States of Micronesia by providing academic and career & technical educational programs characterized by continuous improvement and best practices. The college is accredited by the Accrediting Commission for Community and Junior Colleges (ACCJC) of the Western Association of Schools and Colleges (WASC). Prior to the coronavirus pandemic, the college was not accredited to offer distance education programs to its students.

Distance education plays a major part in this process of integration now with the pandemic, as academic offerings of the college are exclusively online where feasible. As a result of the Micronesia Grows Technology program, well-trained agricultural workers will adopt best practices in the region, and will succeed in bringing integrated knowledge to local, state, and regional actors. Acting in concert with the college, which serves all four states of the Federated States of Micronesia (FSM), this progress will reach national communities and impact international practices as well-spoken contributions come from these former agricultural research and extension students. Affording them with personal laptop computers will make this possible in a way that faces forward and opens up access to the whole world of internet offerings in agricultural practices. Familiarity with computing helps make this happen.

The Cooperative Research and Extension (CRE) program provides training, knowledge and skill development in agriculture and aquaculture, nutrition, resource management, and youth and families through our research, extension, and resident instruction programs. The rental program providing laptops to agriculture students will add momentum to the overall goals of the college, and in particular will aid the CRE in its mission to provide unrestrained support in aiding the development of the Federated States of Micronesia.

In a Nutshell

FSM AGRICULTURE



Agriculture is extremely important for the livelihoods of households (HH) across the Federated States of Micronesia (FSM). 63% of HHs report conducting some form of agriculture and forestry. 43% of the labour force conduct agriculture as a primary or secondary activity, and agriculture contributes 14% to overall HH income.

However, most of these agricultural activities are for subsistence. Nearly 40% of HHs produce goods purely for their own consumption (subsistence). Only 24% of FSM HHs have sold any part of their agriculture production. Very few agriculturally active HHs hire labour or use inputs such as fertiliser and irrigation.

Agricultural production varies considerably across states. The most important food crops (in terms of total value sold, gifted and consumed) were: taro in Yap, breadfruit in Chuuk, yam in Pohnpei and banana in Kosrae.

Other crops also provide significant income in some states. Sakau (kava) had the highest value of production in total, and provides the highest income from sales, with more than USD2.5 million in sales in Pohnpei. Betel nut was a major income earner in Yap, and was sold, gifted and consumed across all states.

Livestock is also important for subsistence. 51% of HHs reported raising livestock but only 20% of these HHs sold their production. Pigs are the most important livestock, with 80% of livestock HHs reporting having pigs.

PRE-TEST

Direction. Read and analyze the questions thoroughly. Choose the letter of the correct answer.

1 **THE FOLLOWING ARE COMMON RAW MATERIALS FOR ORGANIC CONCOCTIONS AND EXTRACTS EXCEPT.**

a. Fruits *b. Vegetables* *c. Molasses, Muscovado, Brown sugar* *d. Salt*

2 **THE FOLLOWING ARE THE USES OF ORGANIC CONCOCTIONS AND EXTRACTS EXCEPT.**

a. Plant Defense *b. Growth enhancer* *c. Flower inducing* *d. Plant replicating*

3 **THESE ARE FARM INPUTS DERIVED FROM PLANTS, MICROORGANISMS AND ANIMAL MATERIALS PROCESSED TO HARNESS THEIR BENEFICIAL PROPERTIES.**

a. Wet fertilizer *b. Organic concoctions* *c. Soil conditioner* *d. Dry fertilizer*

4 **A FERTILIZER THAT IS FREE FROM CHEMICAL AND SYNTHETIC SUBSTANCE.**

a. Inorganic *b. Organic* *c. Complete* *d. Limestone*

5 **THE FOLLOWING ARE ALL ADVANTAGES OF ORGANIC FERTILIZER EXCEPT:**

a. OHN *b. FPJ* *c. FAA* *d. FFJ*

6 **THIS IS AN ORGANIC CONCOCTION THAT HELPS IMPROVE THE FLOWERING CYCLE AND FRUITING STAGES OF PLANTS.**

a. FPJ *b. FFJ* *c. FAA* *d. OHN*

7 **THIS IS AN ORGANIC CONCOCTION THAT USES COMMERCIAL RICE THAT AIDS IN INCREASING BENEFICIAL BACTERIA DURING FERMENTATION.**

a. Calcium Phosphate *b. LABS* *c. Indigenous Microorganism* *d. OHN*

8 **THIS ORGANIC EXTRACT CAN BE USED AS BIO-PESTICIDE FOR PLANTS**

a. FPJ *b. FFJ* *c. FAA* *d. OHN*

9 **THE FOLLOWING ARE FACTORS AFFECTING COMPOSTING EXCEPT:**

a. pH *b. Moisture content* *c. Aeration* *d. Acidity*

10 **THIS IS AN ORGANIC EXTRACT USED TO LURE AWAY FLYING INSECTS FROM CROPS.**

a. Probiotic *b. Natural Insect Attractant* *c. FAA* *d. OHN*

MODULE 2

FORMULATING ORGANIC CONCOCTIONS & EXTRACTS

This module covers the knowledge, skills, and attitudes you need to know about Organic Agriculture. It includes an overview of Organic Agriculture, and its underlying principles, models of organic agriculture, industry sectors, opportunities, and trends. It also introduces to the fundamentals of Organic Agriculture.

OBJECTIVES

AT THE END OF THE MODULE, YOU SHOULD BE ABLE TO:

- Enumerate uses and advantages for organic concoctions and extracts;
- Formulate and process the different Korean Natural Farming concoctions & extract;
- Explain what happens in the composting process;
- Discuss the factors affecting the composting process and its different methods

Topic 1 Organic Concoctions & Extracts

INTRODUCTION

Korean Natural Farming (K.N.F) is an approach to agriculture that specializes in producing farm input to improve plant growth. It was developed by Cho Han-Kyu in the 1960s. The fundamental principle is that strengthening the biological aspects of the plant would eliminate the need for chemical intervention. KNF can be applied to livestock management but its products mostly address plant growth and soil fertility.

Organic concoctions and extracts are farm inputs heavily based on the principles of Korean Natural Farming (K.N.F).

Organic concoctions and extracts are farm inputs derived from plants, microorganisms, and animal materials processed to harness their beneficial properties. These are usually in liquid form.

The most common use for organic concoctions, is fertilizer. They are applied by drenching (soil) or spraying (leaves, flowers, and fruits of plants).

USES OF ORGANIC CONCOCTIONS

- **Growth Enhancer**
- **Pesticide**
- **Flower Inducer**
- **Soil Conditioner**
- **Food Supplement for animals**
- **Natural antibiotic for animals**
- **Sanitizer for livestock and poultry houses**

Organic concoctions are based on the principles of K.N.F which utilizes fermentation in the production of farm inputs.

In fermentation, plant and animal materials are extracted fro their energy. That energy is then converted into organic acids which are beneficial to plants. Most organic concoctions and extracts are fermented.

RAW MATERIALS FOR ORGANIC CONCOCTIONS

COMMON TOOLS IN PREPARING CONCOCTIONS

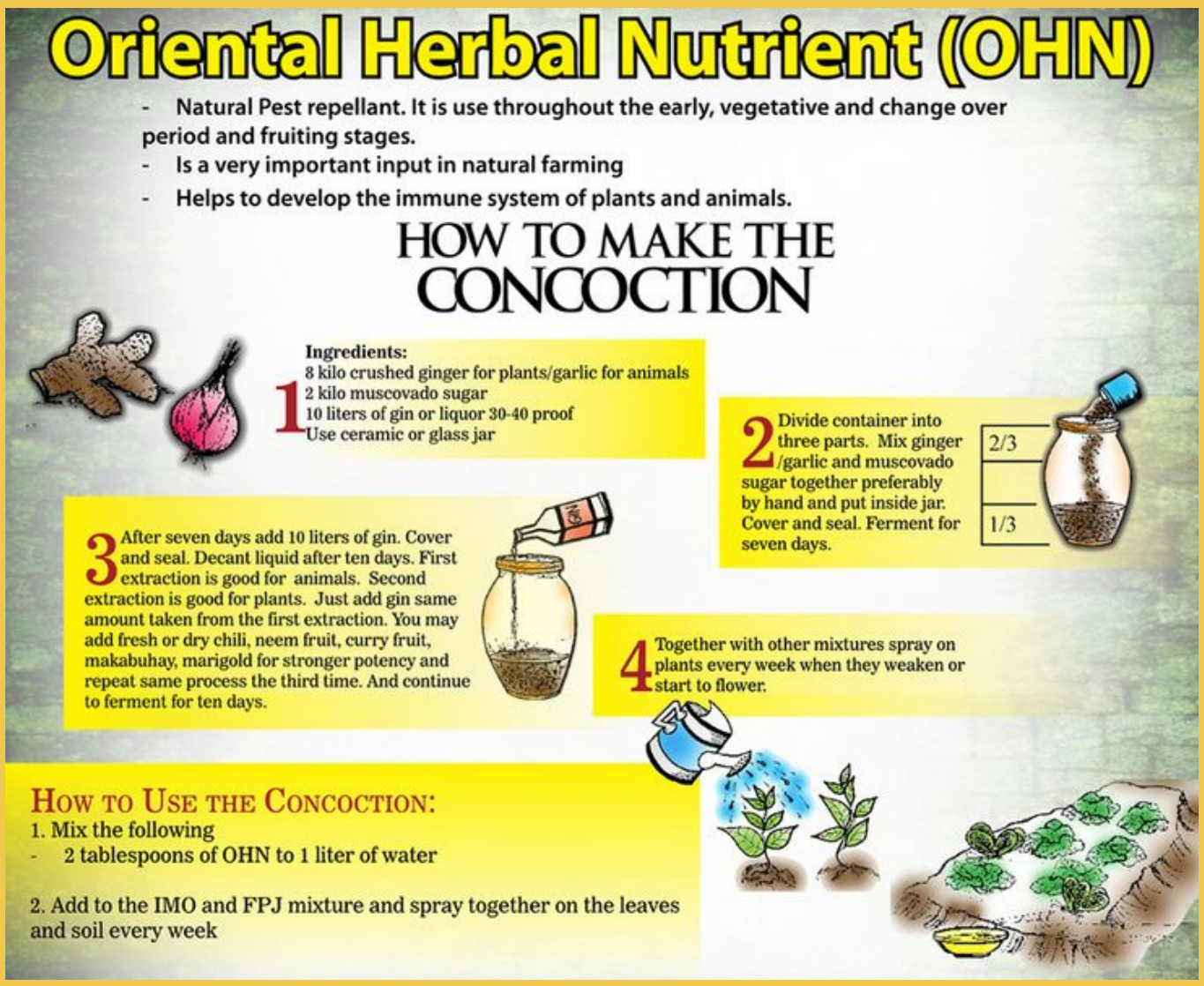
PROCESSING ORGANIC CONCOCTIONS

Ingredients:

- cooked rice
- muscovado sugar/molasses
- clean water (no chlorine or other chemicals)

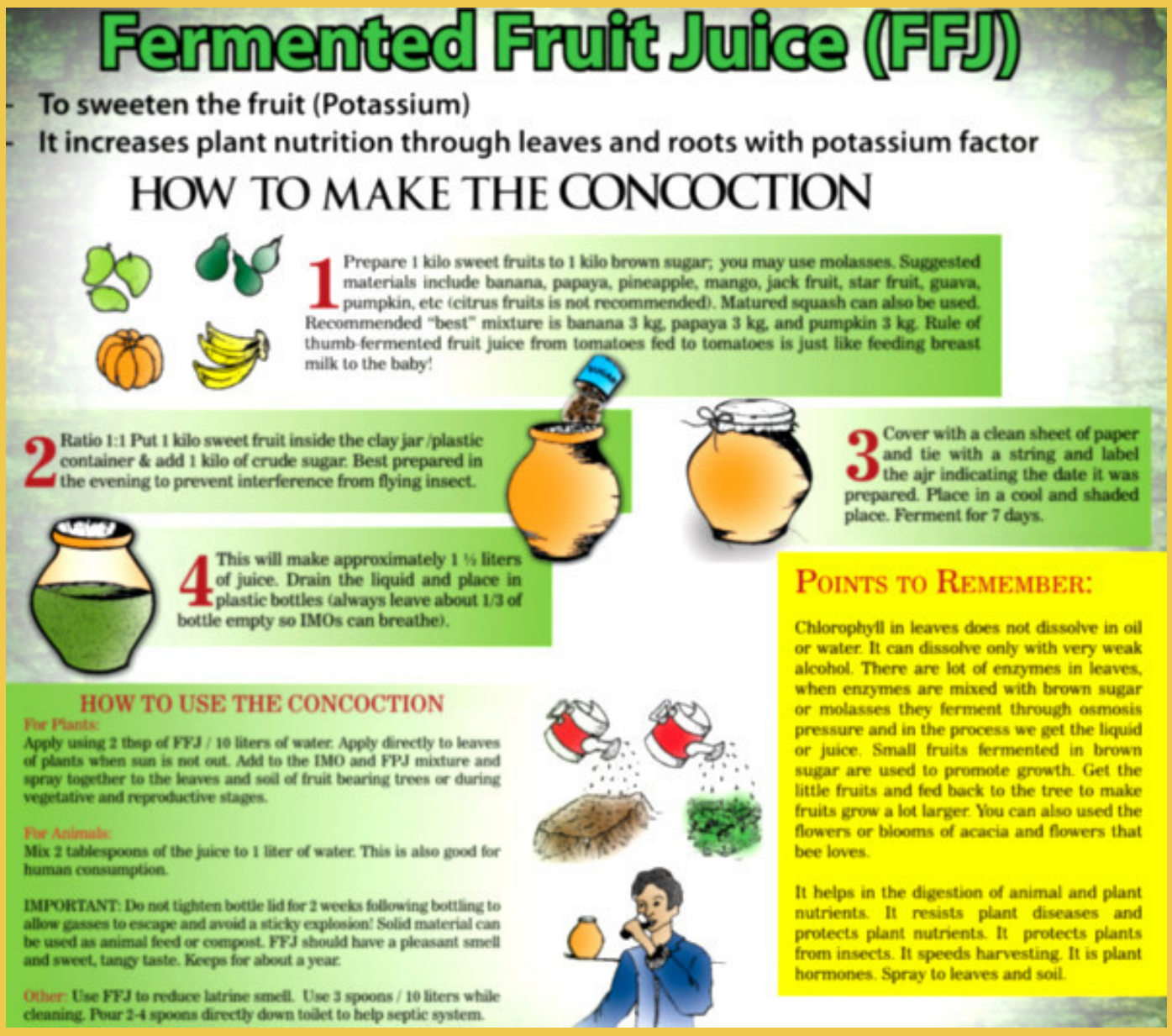
Materials:

- bamboo trough/clay pot
- Manila paper
- basin
- strainer
- funnel
- plastic
- marker



Materials:

- bamboo trough/clay pot
- Manila paper
- basin
- strainer
- funnel
- plastic
- marker

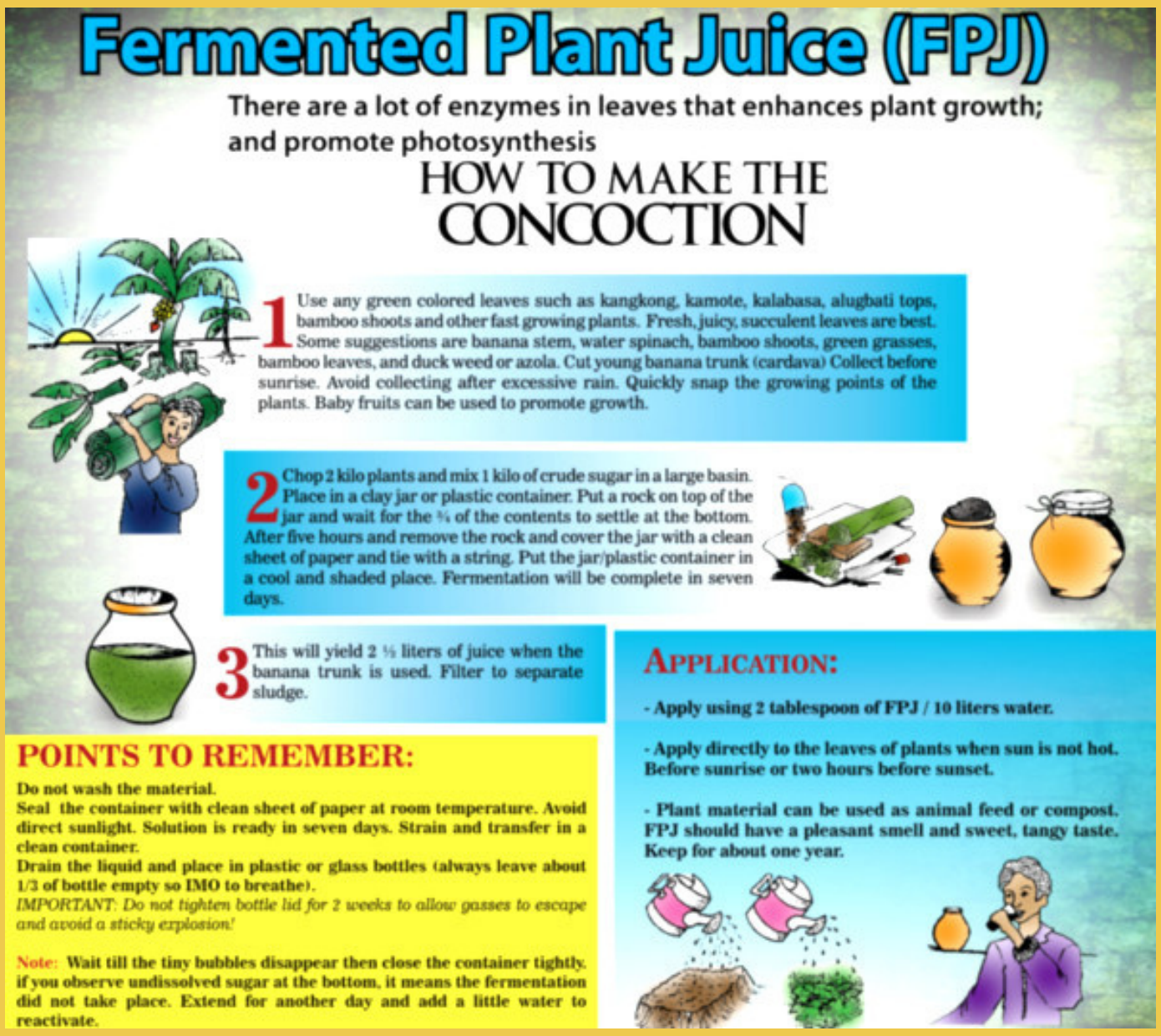


Ingredients:

- One or more fruits
  - designated assembly point
  - squash
  - papaya
  - banana
  - mango
  - jackfruit
  - watermelon
- muscovado sugar/molasses

Materials:

- pail/plastic container
- weighing scale
- Manila paper
- tape and marker
- cloth
- net
- rubber band or plastic straw
- stone (at least 50g)
- knife
- chopping board
- wooden ladle

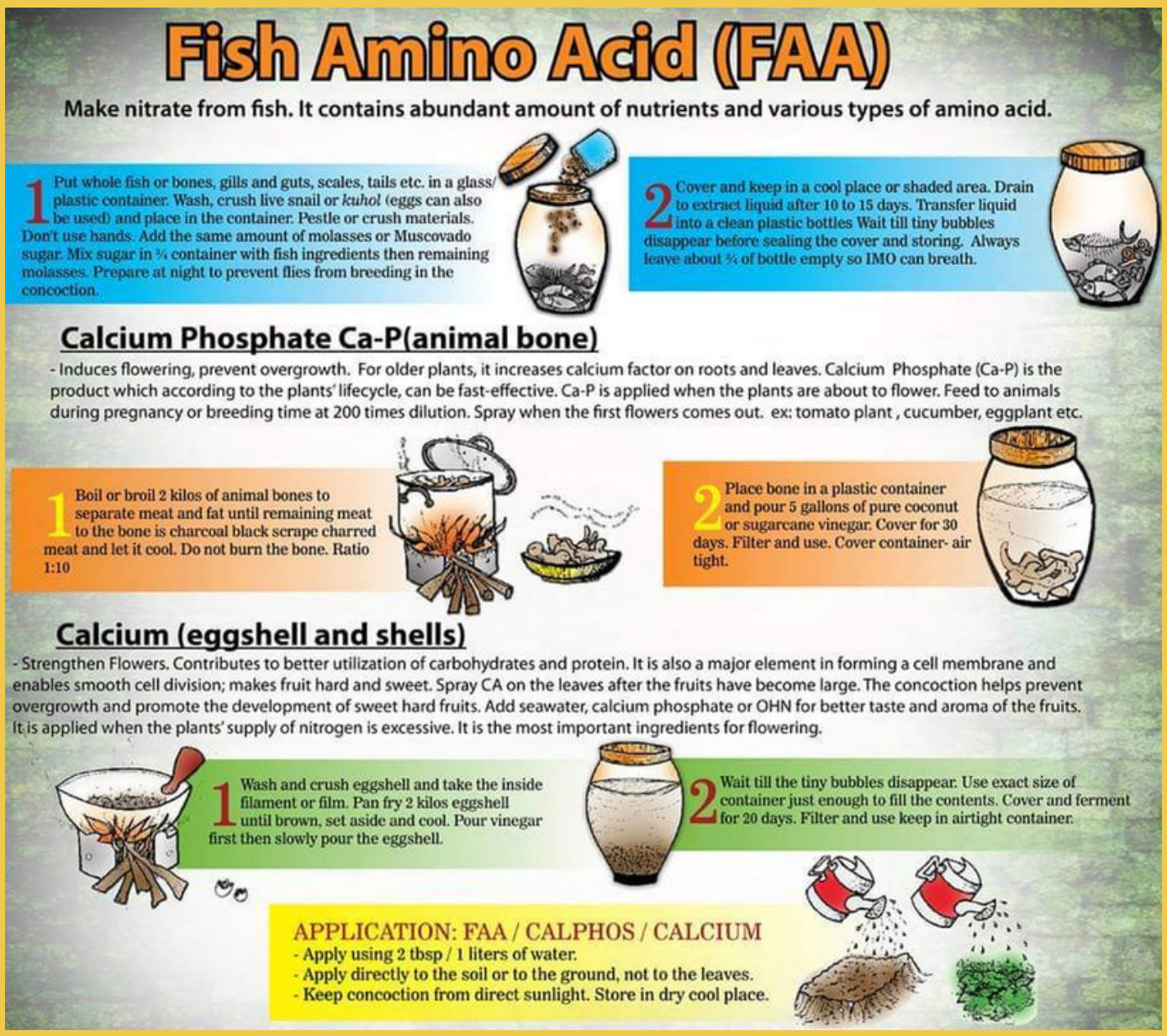


Ingredients:

- green, leafy plants
- water spinach or kangkong
- banana trunk
- sweet potato shoots
- bamboo shoots
- pumpkin leaves
- perennial peanut or
- malavar spinach
- molasses/muscovado sugar

Materials:

- pail/plastic container
- weighing scale
- Manila paper
- tape and marker
- cloth
- net
- rubber band or plastic straw
- stone (at least 50g)
- knife
- chopping board
- wooden ladle

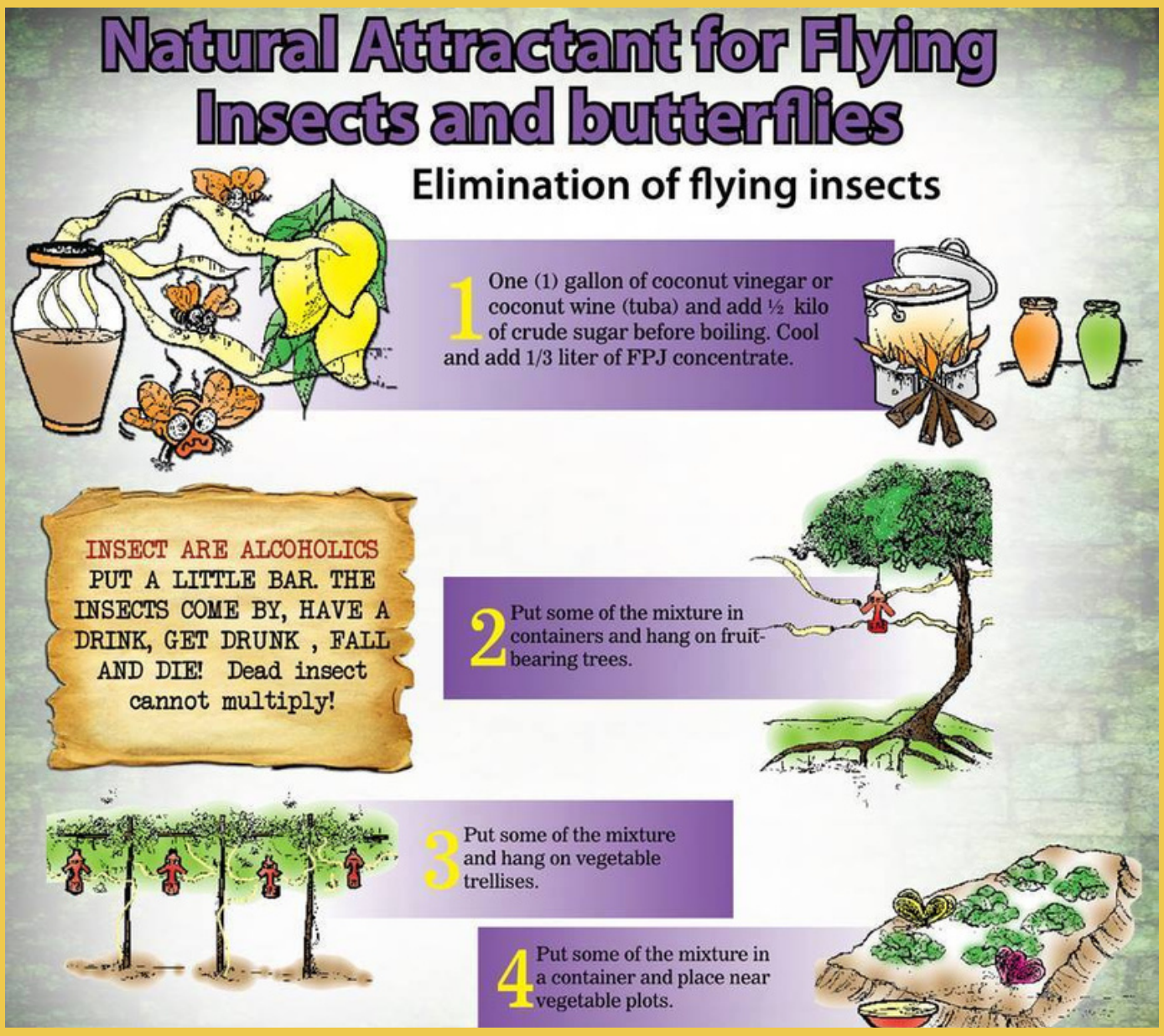


Ingredients:

- fish or fish trimmings such as scales, gills, entrails, head; OR
- molasses/muscovado sugar
- bones from pig, goat, cow or fish
- coconut vinegar
- eggshells

Materials:

- pail/plastic container
- weighing scale
- Manila paper
- tape and marker
- cloth, knife
- net, funnel
- rubber band or plastic straw
- stone (at least 50g)
- strainer
- chopping board
- wooden ladle



Ingredients:

- 1gal coconut vinegar
- 0.5L molasses
- 300mL fermented plant juice

Materials:

- stove and pot
- wooden ladle
- container

STORING ORGANIC CONCOCTIONS & EXTRACTS

Keep away from direct sunlight.

Exposure to direct sunlight accelerates spoilage so keeping it in a cool, dry place will preserve its potency for longer.

Practice the *"First In, First Out"* policy.

Do not seal the caps too tightly.

Pressure will continue to build up for 2 weeks after harvest and this may cause the products to gush out.

Keep storage area safe from pests.

Use pest-proof materials OR secure your concoctions and extracts and areas where pests can't reach.

If possible, store in refrigerators.

Concoctions and extracts stored in the refrigerator will last up to 6 months; except for *Natural Health Enhancer which can only last for 40 days and EMAS which is good for 1 month.*

Topic 2 Preparing for Organic Fertilizer Production

INTRODUCTION

The most widely used organic fertilizer is compost. It is a natural form of recycling that turns certain waste into organic material that can be used in a variety of ways. It is made from organic materials that have undergone complete decomposition; it contains essential plant nutrients and humus.

ADVANTAGES OF COMPOST

- **availability of raw materials**
- **minimal technology required for production**
- **utilizes farm wastes that would, otherwise, contribute to pollution**
- **preparation does not require technological equipment**
- **does not occupy a huge portion of farm space**

Composting does not mean to complete decomposition of all degradable organic materials, but to degrade only putrescible that could otherwise create odors and nuisance in the environment. Contrary to general belief, composting process also releases a few odorous gases even in most favorable conditions.

SOURCES OF COMPOST

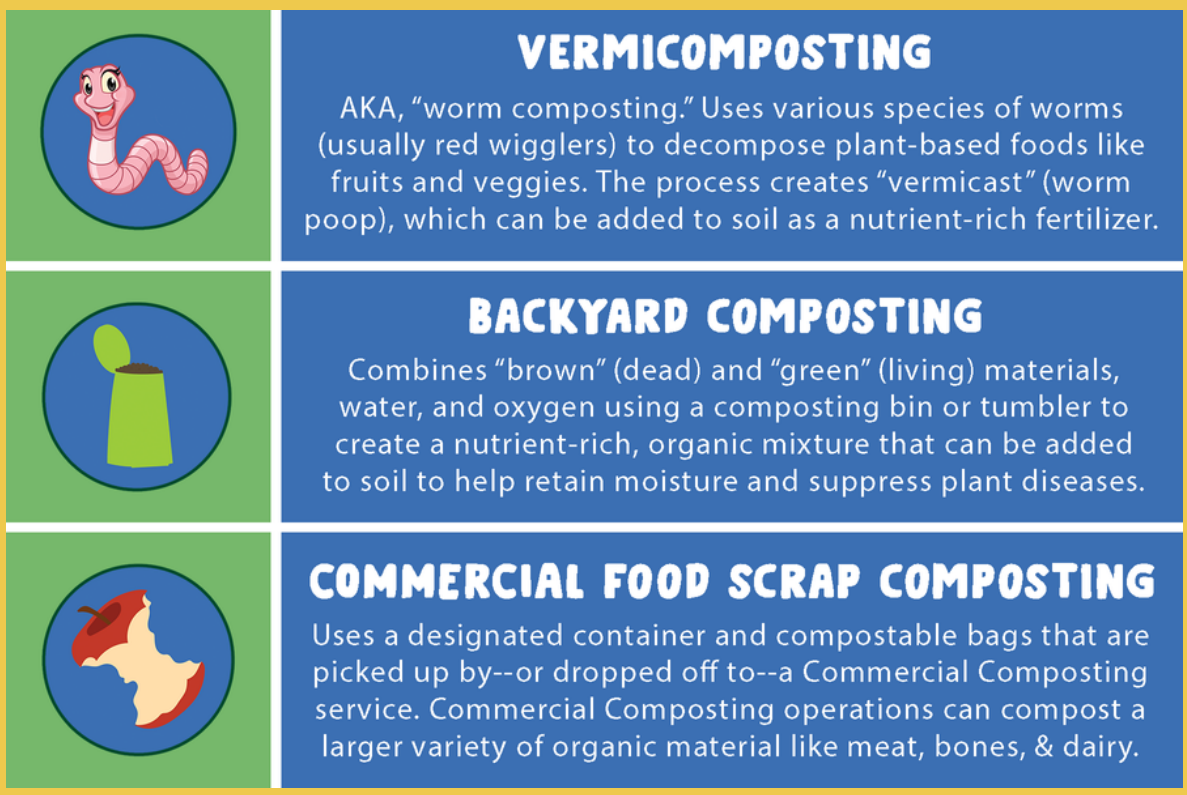
COMPOSTING FACTS

38 million tons of food waste was generated in 2014

5.1% of food waste was composted

20% of discarded waste is food waste

3 TYPES OF COMPOSTING



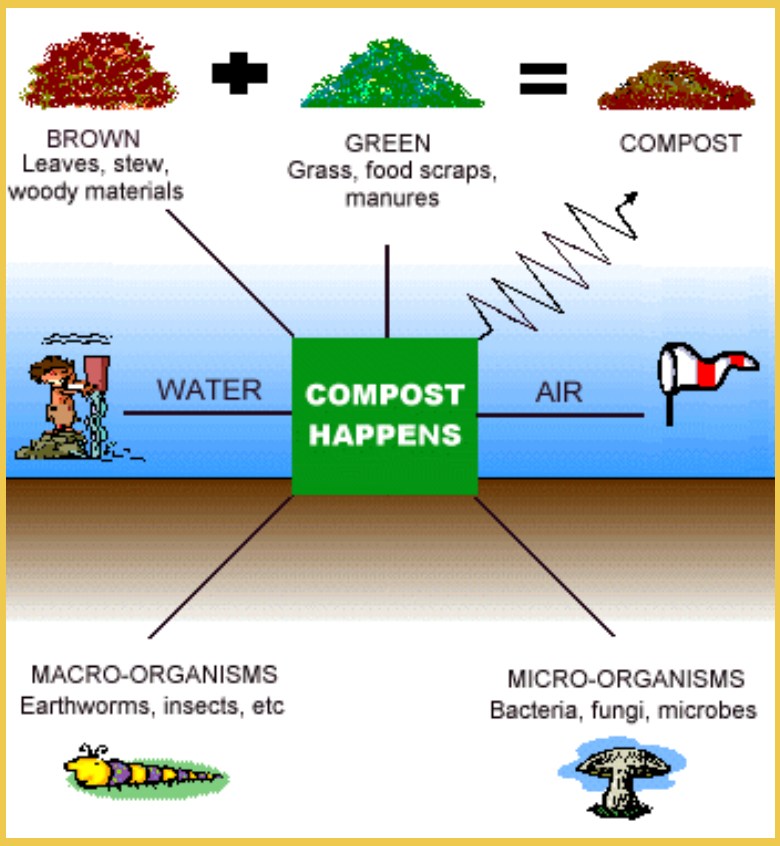


Figure 1. Process Flow Diagram of Composting Process

The easily degradable carbon is converted in to carbon dioxide and process does not stop at a particular point. Material continues to break down until the last remaining nutrients are consumed by the last remaining organisms and until nearly all of the carbon is converted to carbon dioxide.

However, the compost becomes relatively stable and useful long before this point. Compost is judged to be "done" by characteristics related to its use and handling such as carbon to nitrogen ratio, oxygen demand, temperature and odor. The carbon, chemical energy, protein and water in the finished compost are less that that of the raw materials. The volume of the finished compost is 50% or less of the volume of the raw material.

FACTORS AFFECTING THE COMPOSTING PROCESS

C:N Ratio	MOISTURE CONTENT	AERATION
Carbon and nitrogen are the two fundamental elements in composting, and their ratio (C/N) is significant. The bacteria and fungi in compost digest or "oxidize" carbon as an energy source and ingest nitrogen for protein synthesis. Carbon can be considered the "food" and nitrogen as the digestive enzymes.	Microorganisms can only use organic molecules if they are dissolved in water, so the compost pile should have a moisture content of 60-80% of water holding capacity. If the moisture content falls below 40% of water holding capacity the microbial activity will slow down or become dormant. If the moisture content exceeds 80% of water holding capacity, aeration is hindered, nutrients are leached out, decomposition slows, and the odor from anaerobic decomposition is emitted.	The decomposition occurring in the compost pile takes up all the available oxygen. Aeration is the replacement of oxygen to the center of the compost pile where it is lacking. Efficient decomposition can only occur if sufficient oxygen is present. This is called aerobic decomposition. It can happen naturally by wind, or when air warmed by the compost process rises through the pile and causes fresh air to be drawn in from the surroundings. Therefore composting systems or structures should incorporate adequate ventilation.

TEMPERATURE	AMOUNT OF SURFACE AREA	pH
Microorganisms generate heat as they decompose organic material. A compost pile with temperatures between 90 and 140 OF (32-60 OC) is composting efficiently. Temperatures higher than 140 OF (60 OC) inhibits the activity of many of the most important and active organisms in the pile. Given the high temperatures required for rapid composting, the process will inevitably slow during the winter months in cold climates.	Decomposition by microorganisms in the compost pile takes place when the particle surfaces are in contact with air. Increasing the surface area of the material to be composted can be done by chopping, shredding, mowing or breaking up the material. The increased surface area means that the microorganisms are able to digest more material, multiply more quickly, and generate more heat. It is not necessary to increase the surface area when composting, but doing so speeds up the process.	The level of pH in the waste depends upon the decomposition rate and characteristics of feed material. The release of organic acids may decrease the pH and production of ammonia from nitrogenous compounds may raise the pH. At higher pH levels, more ammonia gas is generated and may be lost to the atmosphere. A pH value between 6.5 and 8.5 is optimal for compost microorganisms. As bacteria and fungi digest organic matter, they release organic acids.

METHODS OF COMPOSTING

A. RAPID COMPOSTING

Chinese Rural Composting – High Temperature Method

Materials:

- animal manure and plant residues (1:4)
- water
- bamboo poles
- mud
- shovel

Procedures:

1. Collect animal manure and plant materials (ratio = 1:4).
2. Pile in alternate layers starting with chopped plant materials followed by animal waste.
3. Insert bamboo poles in the compost heap for aeration.
4. Add water to an optimal amount.
5. Add 3 cm of mud on top.
6. After 2 days, remove the bamboo poles, leaving holes for aeration.
7. After two weeks, turn the pile. Add more manure or water for moisture. Add another layer of mud.
8. In 2 months, the compost will be ready for harvest. The compost should have an earthy smell, not a foul odor. The raw materials should be unrecognizable and broken down to humus.

14-Day Method

Materials:

- plant materials and animal manure (1:1)
- 20kg plant materials
- 20kg animal manure
- shovel
- 1m x 1m plastic sheet
- banana/coconut leaves or jute sacks

Procedures:

1. Bring plant and animal materials to the compost site.
2. Reduce the size of the plant materials by using a shredder or by manual chopping.
3. Mix the crop materials with equal amount of fresh manure (ratio = 50:50).
4. Pile the mixture into a heap, measuring at least 1m x 1m x 1m (length, width, height).
5. Cover the heap with banana leaves, coconut leaves, or other suitable material such as damaged jute sacks.
6. After 3-4 days, check if the compost heap is generating heat. If not, add more manure.
7. On the same day, turn the pile inside out – from the center to the outer sides. This will also improve aeration.
8. Turn the heap after every 2 days to hasten decomposition.
9. In 14 – 18 days, the compost will be ready for harvest. The compost should have an earthy smell, not a foul odor. The raw materials should be unrecognizable and broken down to humus.

Institute of Biological Science (IBS) Rapid Composting

Materials:

- Trichoderma harzianum (CFA)
- substrates: rice straw, weeds, grasses, ipil-ipil leaves, legumes, chicken manure
- compost pen OR bamboo poles with holes
- plastic sheet/sack

Procedures:

1. Collect raw materials for the compost. Reduce the size of the plant materials by using a shredder or by manual chopping.
2. Mix carbonaceous and nitrogenous substrates at a ratio of 4:1. Some possible combinations are:
   - 4-parts rice straw to 1-part chicken manure
   - 4-parts grasses to 1-part legumes to 1-part manure
3. Pile the substrates loosely in a compost pen that is raised 30 cm from the ground. OR pile the substrates and insert perforated bamboo poles horizontally and vertically.
4. Scatter the CFA onto the substrates during piling. Use 1% or more of the total weight of the substrates for faster decomposition. Mix thoroughly. Cover with plastic sheet or plastic sack.
5. The compost heap will gain heat in 24-48 hours. Maintain the temperature at 500C or higher.
6. Turn the pile every 5 – 7 days for the first two weeks, and thereafter once every two weeks.
7. The compost will be ready for harvest in 21 – 45 days. The compost should have an earthy smell, not a foul odor. The raw materials should be unrecognizable and broken down to humus.
8. Harvest the compost and let it dry under the sun for 2 days.
9. Place in sacks and store in a shaded area.

B. CONVENTIONAL COMPOSTING

Materials:

- plant residues
- animal manure
- soi
- spade/shovel
- plastic sheet
- PVC pipe/bamboo sticks

Procedures:

1. Optional: If you want to prevent the nutrients from leaching, place a plastic sheet at the base of the compost pile. Add soil up to 10 – 20cm high around the plastic to create a "shallow tank."
2. Bring plant and animal materials to the compost site.
3. Reduce the size of the plant materials by using a shredder or by manual chopping.
4. You can add soil and/or ashes to the compost pile.
5. Build compost layers in the following sequence:
   1st layer (bottom): crop and other plant residues (15cm)
   2nd layer (middle): animal manure (8cm)
   3rd layer (topmost): soil (3cm)

6. Repeat the sequence until the pile is 1-meter high.

7. Insert a hollow tube (bamboo stick or PVC pipe) in the middle of the pile for air to enter and circulate. You can also put holes in the PVC pipe for added aeration.

8. Water the pile until it is sufficiently moist. Water regularly to maintain moisture content at 45 – 60%.

9. Begin turning the pile after 3 weeks. Afterwards, turn the pile every after 1 week.

10. The compost will be ready for harvest in 3-4 months. The compost should have an earthy smell, not a foul odor. The raw materials should be unrecognizable and broken down to humus.

POST-TEST

Direction. Read and analyze the questions thoroughly. Choose the letter of the correct answer.

1 **THE FOLLOWING ARE COMMON RAW MATERIALS FOR ORGANIC CONCOCTIONS AND EXTRACTS EXCEPT.**

a. Fruits *b. Vegetables* *c. Molasses, Muscovado, Brown sugar* *d. Salt*

2 **THE FOLLOWING ARE THE USES OF ORGANIC CONCOCTIONS AND EXTRACTS EXCEPT.**

a. Plant Defense *b. Growth enhancer* *c. Flower inducing* *d. Plant replicating*

3 **THESE ARE FARM INPUTS DERIVED FROM PLANTS, MICROORGANISMS AND ANIMAL MATERIALS PROCESSED TO HARNESS THEIR BENEFICIAL PROPERTIES.**

a. Wet fertilizer *b. Organic concoctions* *c. Soil conditioner* *d. Dry fertilizer*

4 **A FERTILIZER THAT IS FREE FROM CHEMICAL AND SYNTHETIC SUBSTANCE.**

a. Inorganic *b. Organic* *c. Complete* *d. Limestone*

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a. Calcium Phosphate *b. LABS* *c. Indigenous Microorganism* *d. OHN*

8 **THIS ORGANIC EXTRACT CAN BE USED AS BIO-PESTICIDE FOR PLANTS**

a. FPJ *b. FFJ* *c. FAA* *d. OHN*

9 **THE FOLLOWING ARE FACTORS AFFECTING COMPOSTING EXCEPT:**

a. pH *b. Moisture content* *c. Aeration* *d. Acidity*

10 **THIS IS AN ORGANIC EXTRACT USED TO LURE AWAY FLYING INSECTS FROM CROPS.**

a. Probiotic *b. Natural Insect Attractant* *c. FAA* *d. OHN*

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