9 Sweetpotato IPPM FFS curriculum and ideas for learning activities

Contents

9.1 Example of a season long sweetpotato IPPM FFS curriculum developed by facilitators in North Eastern Uganda and Western Kenya

An example of a season long sweetpotato IPPM FFS curriculum developed by facilitators in North Eastern Uganda and Western Kenya is given below. It has been included to simply share and stimulate ideas, it is not intended to be prescriptive and is followed by a blank form (section 9.2) so that you can design a tailor made curriculum for the FFS you are involved in.

Objective:
To increase the returns from sweetpotato enterprise through improved production and post harvest management by smallholders.

Preseason/ preparatory activities

Session	WAP	Topic	Objectives/ expected output	Activities/tools	Materials required
1	-	**Village meeting** • Awareness creation on FFS formation and approach	• Community sensitised on FFS approach • Farmers understand process of FFS formation		
2	-	**FFS formation** • Registration • Membership • Leadership structure • Election of Group officials	• FFS group formed • Leadership structure established • Group officials elected	Participatory discussions and brainstorming	Flip chart, marker pens, masking tape crayons, note books,
3	-	**FFS process and methodology** • Background to the FFS approach - Why FFS - What FFS is (basic concepts and characteristics of an FFS) - Objective of FFS Programme • Process - Key programme activities - FFS schedules	• Farmers to understand the FFS Methodology and process	Participatory discussions.	Flip chart, marker pens, masking tape crayons, note books,

WAP = Weeks after planting

Season activities

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
4	-	**Introduction to SP production** • Role of sweetpotato within the livelihood system - Food security - Income generation (vines & roots) - Nutritional value (energy source, Amino acids, Vitamin A etc) • Sweetpotato seasonal calendar • Constraints and coping mechanisms	• Farmers to understand the importance of the crop in terms of food security and income	PRA tools like • Crop ranking matrix • Problem and solution tree	Flip chart, markers, pens, masking tape crayons, note books,
5	-	**Sweetpotato integrated pest and production management (IPPM)** • Concept of IPPM • Principles of IPPM • Why sweetpotato IPPM	• Farmers to understand IPPM and its relevance	• Participatory brain storming and discussion	Flip chart, markers, pens, masking tape crayons, note books,
6	-	**Site selection, soil characterisation and land preparation.** • Site selection • Characteristics of a healthy soil • How to maintain a soil healthy • Enhancing soil fertility • Field clearing & ploughing		• Transect walks • Demonstration on compost making	
7	-	**Field experimental design, treatments and field preparation** (making of mounds/ridges etc)	• To identify the data parameters		

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
8	-	**Seed selection and preparation** • Variety selection - Criteria of selection • Time & Methods of planting • Plant density • Planting material - Concept of a healthy planting material - Selection of healthy planting material - Sources of planting material (advantages, constraints of the different sources etc) - Dry season preservation of planting material - Harvest of cuttings - Seed storage	• To appreciate variation in compatibility or performance of different varieties in different environment • Optimum plant population/unit area • Minimise pest and disease transfers to the new fields • To ensure continuous supply of clean planting material	• Discuss with farmers the criteria they use in selecting their planting material • Rapid multiplication of planting material (Practical)	
9	-	**Seed selection and preparation** continued			
10	-	**Planting**			
11	1	**Agro-ecosystem and agro-ecosystem analysis (AESA)** • Concept of the ecosystem • Concept of an agro-ecosystem • Introduction to the concept of AESA • Process of AESA - Field observation - Processing of field data - Presentations - Harmonisation of presentations	• To understand the crop and its surrounding • To appreciate AESA as a key decision making tool • To empower farmers to conduct AESA	• Discuss the sampling techniques • Conduct the process	Polythene bags, vials, alcohol, hand lenses,

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
12	2	**SP growth stages and management** • Crop physiology, • Plant nutrition - Soil nutrients (macro and micro) - Sources - Nutrient needs of the sweetpotato - Symptoms of nutrient deficiencies	• To understand the SP growth stages and associated nutrient requirement • To understand functions of different plant parts.	• Discuss the SP crop phenology • Exercise on fertiliser analogy	
13	3	**Weed management** • Common SP weeds • Effects of weeds on SP	• Relate weed effects to formation of pencil root	• Open mound for the participants	
14	4	**Root profile and root differentiation**	• Farmers to appreciate the different rooting systems	• Open a mound to observe the root differentiation	
15	5	**Pest and natural enemy interaction** • Life cycles, food chains and food web	• To understand the interaction of pests and natural enemies	• Description & biology, damage, distribution and importance, control • Insect zoos	
16	6	**Identification of pests and natural enemies**	• Be able to identify and differentiate pests and natural enemies	• Sample collection • Demonstrate making of insect boxes	Glue, pins, manila paper, soft boards, masking tape, scissors
17	7	**Common sweetpotato pests** • Foliage pests • Sweetpotato vine pests • Storage root pests	• To acquaint farmers with the common SP pests	• Insect collections • Identifying of the pests • Mounting of the pest samples • Preservation of the samples	Polythene bags, sweep nets, vials, alcohol, hand lenses
18	8	**Common natural enemies** • Predators • Parasites • Pathogens	• To acquaint farmers with the common SP natural enemies	• Insect collections • Identifying of the common natural enemies • Mounting of the natural enemy samples • Preservation of the samples	Polythene bags, sweep nets, vials, alcohol, hand lenses

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
19	9	**Sweetpotato disease management** • Viruses • Fungi • Bacteria	• To understand the Symptoms, Distribution and Control of common SP diseases	• Collection of diseased samples • Collection of any vectors present in the field • Demonstrating and making of herbarium	Exercise books, tape, SP Diagnostic key
20	10	**Farming as a business (FAAB)**	• Improve the farmers capacity to select viable enterprises, time their production, appreciate their own price setting		
21	11	**FAAB (continuation)**	- do -		
22	12	**FAAB (continuation)**	- do -		
23	13	**Field day** • at peak vegetative stage	• Exposing the community to the SP Integrated Production and Pest Management practices	• Poster presentations by farmers • Conducting community around the FFS plots • Display of SP products • Demonstrate AESA	Video camera, still camera, processed products
24	14	**FAAB (continuation)**	- do -		
25	15	**Sweetpotato marketing** • The 4 Ps (Product, Place, Price & Promotion) • Quality • Storage • Processing • Market information • Farmer Market Linkage	• To obtain optimum returns	• Brain storming on the different market channels and associated constraints • How to conduct market surveys	
26	16	**Sweetpotato marketing (continued)**	- do -		
27	17	**Exchange visit**			

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
28	18	**Harvesting** • Maturity indicators • Harvesting techniques • Yield assessment & grading	• Timely harvesting to reduce on losses due to pests • To meet the market standards	• Observing the shedding of leaves, cracking, • Calculate maturity period • Checking on root size	Weighing scales, packaging material
29	19	**Post harvest management** • Why store roots • Fresh sweetpotato root storage • Good storage techniques for fresh roots (Clamp and Pit storage techniques - Practical) & fresh storage problems • Processing and storage of dried sweetpotato, driers	• Ensure continuous supply of fresh roots • To preserve quality	• Constructing of clump and pit storage structures • Slicing and drying • Construction of solar drier	Dry grass, poles, strings, garden tools, potatoes, polythene bags, slicers, polythene sheets (black and transparent)
30	20	**Post harvest management (continued)**			
31	21	**Pest and disease management of dried sweetpotato**	• To get high quality products • To minimise losses	• Trapping rodents • Regular checking of stored products	Traps, polythene bags, sealing machine
32	22	**Sweetpotato utilisation** • Product development • Nutritional aspects • Livestock feeding	• To explore new markets • Promote Vit. A consumption • Diversify income sources • To encourage supplementary livestock feeding	• Demonstration on slicing, crisps, cakes, etc	Recipes, charcoal, cooking oil, frying pan, salt, sugar, SP flour, wheat, maize, baking powder, soya etc
33	23	**Overall evaluation** • Gross margin analysis • Data processing and reporting	• To assess the performance of the different treatments • To assess success or failure of the various activities	• Review the objectives of different treatments • Compile and analyse all the data collected	
34	24	**Overall evaluation continued**	-do-		
35	25	**Follow up activities**	• To plan follow up activities		
36	26	**Field day & graduation**	• To recognise participants having become experts in SP production and utilisation		

Note: Some crop management practices like weeding, hilling-up, pest management interventions will always be determined by the AESA results

9.2 Blank season long sweetpotato IPPM FFS curriculum form

Use the blank form below, to design a tailor made curriculum for the FFS you are involved in.

Objective:

Preseason/ preparatory activities

Session	WAP	Topic	Objectives/ expected output	Activities/tools	Materials required
1	-				
2	-				
3	-				

WAP = Weeks after planting

Season activities

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
14					
15					
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23					
24					

Session	WAP	Topic	Objectives/ expected output	Activities/ tools	Materials required
25					
26					
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36					

9.3 Ideas for learning activities

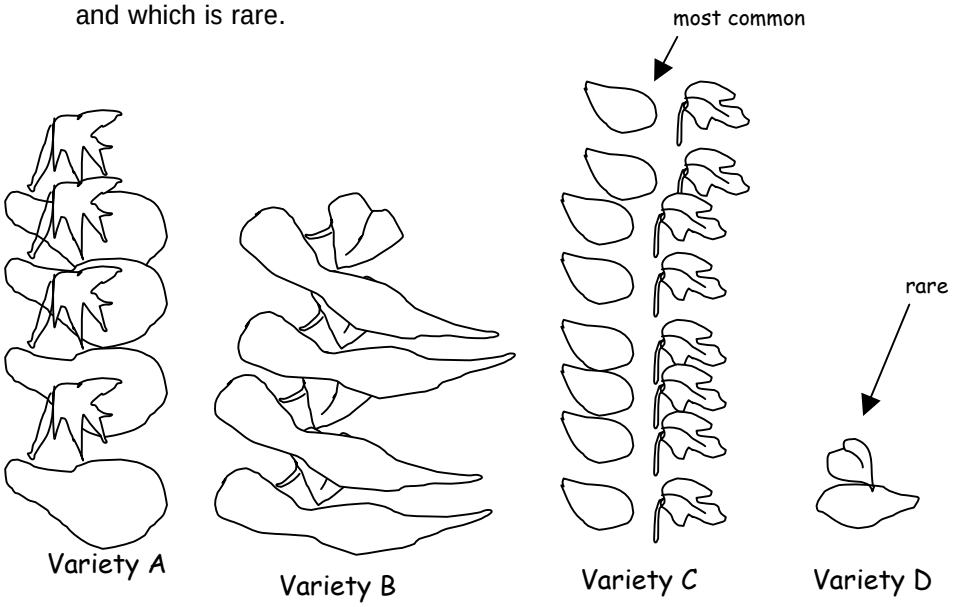
9.3.1 Variety selection

Objectives: To help participants better understand the factors to consider when selecting a variety

Materials: At the previous FFS session encourage participants to bring in named samples (foliage and roots of each variety) of every variety of sweetpotato that they grow, flipcharts, marker pens

Activity steps:

1. Using the named foliage and root samples of each variety grown by the participants, ask them to arrange the samples in columns on the ground to produce a physical histogram (see diagram below) so they can see which variety is the most common and which is rare.



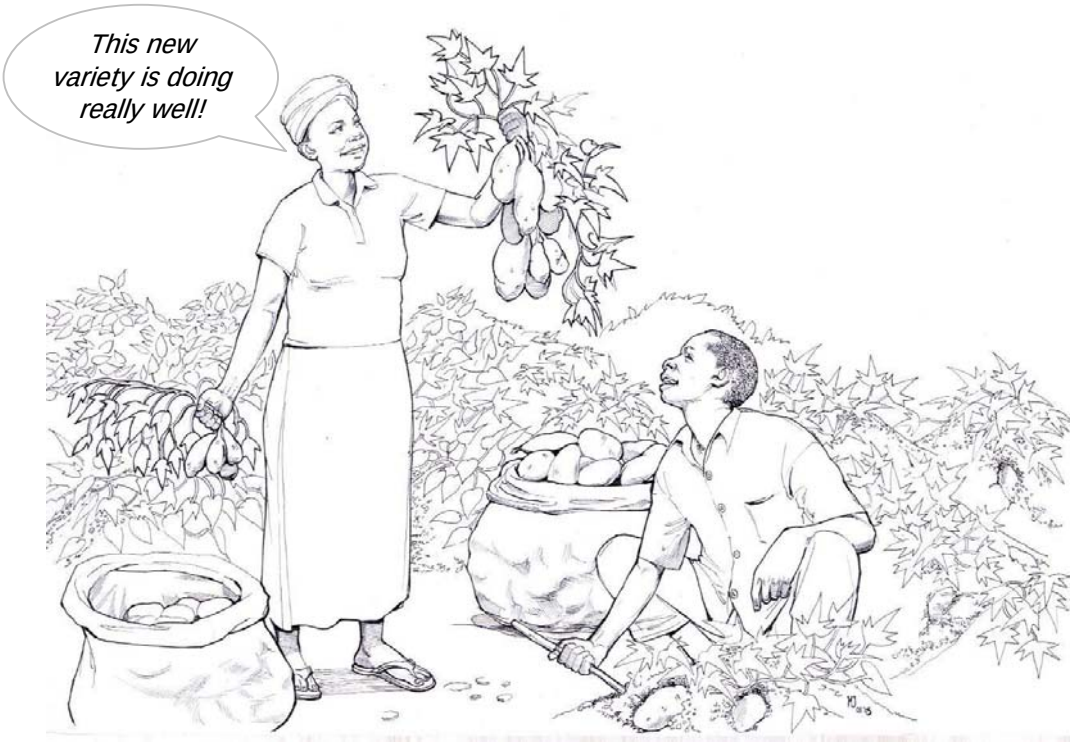
2. Make a table with three columns:

Name of the variety	Strengths	Weaknesses
	• •	• •
	• •	• •
	• •	• •

3. Let the participants fill in the strengths and weaknesses columns for each variety. This way, they can get a picture of the benefits of each variety, so farmers not growing that variety can get an idea of the possible benefits of changing to a new variety.
4. The participants could then list what they use sweetpotato for and discuss whether the varieties they grow meet their uses, or whether there are any obvious gaps?
5. The participants could then be probed to think about how they could get access to new varieties with potentially better characteristics, e.g. through exchange of clean planting materials with farmers from other areas, or with research stations. If they obtained planting materials of different varieties how would they test/ compare them against their existing materials to see if they were suitable for their conditions?
6. Ask the participants to decide which of the varieties they have brought along to the field school, they would like to plant in a FFS variety trial so that they can compare

the different varieties along with any other varieties they want to obtain or those that are recommended by extension or research etc.

9.3.2 Experimentation



Objective: To enhance participants understanding of the different stages of an experiment, and the basic principles of systematic experimental design. To provide participants with the skills to design, implement, and evaluate a simple experiment.

Materials: Flipchart, marker pens

Strengths and weaknesses of farmers' experiments, and an introduction to some principles of experimental design

Activity steps:

1. Ask the participants whether they have ever experimented with their sweetpotato crop? If so, ask the participants who have to describe the experiments they have done. The group should analyse and discuss the strengths and weaknesses of those experiments, and draw conclusions about how experiments should be designed.
2. Present the basic principles of systematic experimentation, drawing wherever possible on ideas that emerged from previous discussions, making sure that each of the points below are covered.
   - Prioritising and determining research topics (varying only one factor at a time in each experiment)
   - Setting a clear objective
   - Determining treatments
   - Designing the experiment (replications, randomisation, lay-out, variables to measure)
   - Planning the implementation (locations, inputs, labour)
   - Implementing the experiment (planting, monitoring, measuring variables, harvesting)

- Evaluating the experiment (simple data processing, analysis of results, drawing of conclusions)

Planning the FFS experiments

Activity steps:

1. Divide the participants into four small groups. Ask each group to discuss what they feel are the important topics that they want to investigate in the FFS field. Ask them to write these topics on a piece of paper and reach a common conclusion about the ranking of importance of these topics. Each group then presents their conclusions to the whole group and then the whole group reaches an agreement about which topic(s) they will choose for the field school experiment (depending on the size of the field they can plan for one or more experiments).
2. The whole group then defines the research objective and the treatments for each experiment.

   For each problem, generate the causes and possible solutions.
   Example:

Problem	Cause	Possible solutions
Low yield	*poor seed*	*high yielding varieties, clean planting materials*
	pests & diseases	*resistant varieties, clean planting materials*
	poor soils	*improved soil fertility, more manure, fetiliser*
	poor agronomic practices	*spacing, planting method, vine length*

*Design **experiment(s)** to address one of the problems or causes identified.*

*a) Develop research **objectives** to be addressed by the experiment.*
Examples of objectives:
- *To determine whether use of organic manure increases sweetpotato yield.*
- *To compare the yield and growth characteristics of improved sweetpotato varieties.*
- *To determine the effect of variety and planting method on growth and yield of sweetpotato.*

*b) Identify **treatments** for the experiment.*
- *alternative actions to do to get what you want*
- *the technologies or things you want to compare in the experiment*

Too many treatments or too few will not give useful information.

e.g.for treatment of malaria, one could try different drugs/treatments:
- *chloroquine, fansidar, quinine*

for soil fertility:
- *organic manure, inorganic fertilisers, compost, crop rotation*
- *dose (50, 100, 150) kg Urea/ha*
- *frequency of fertiliser application*

for planting method:
- *ridging, mounds, flat*
- *vine length 20, 30, 40 cm*

for varieties:
- *Mugande, Lunyululu, Kakamega, Zapalo, SPK004, Araka, Maraoko*

c) Control treatments
- *the common practice or level against which you want to judge the new/improved technology*
- *it may be the recommended or standard practice against which other variations may be tested*

Examples of controls:
- *no fertiliser*

- *the recommended fertiliser or pesticide dose*
- *the farmers' variety*
- *the common vine length*

d) Variables to measure/ record or observe

- *the response or characteristics of sweetpotato on the basis of which to judge performance of the treatments compared*
- *the actual property or character measured*
- *primarily based on objectives of the experiment*
- *with additional variables of interest*

Examples:

- *growth parameters*
- *pests and diseases*
- *yield components: number and weight of roots*
- *post-harvest qualities:*
- *socio-economic characteristics*

The title, objective and treatments for each experiment are recorded on a sheet of flipchart paper.

3. Experimental design or layout refers to how the treatments are assigned to experimental plots, it covers the arrangement of the treatments in the field and should include a field plan or map (more information is given in Chapter 8).
   a) Ask the participants to form four small groups, and then ask them if they had a piece of land on which they were testing three sweetpotato varieties, how would they layout the experiment in the field? Give them about 7 minutes to discuss and make a sketch of their plan. Then give each group 3 minutes to present their plans back the whole group.
   b) Ask the participants to discuss:
      a. What the differences between the four proposed designs are?
      b. What the key distinguishing characteristics are?
      c. What the importance of these differences and characteristics are in an experiment?
4. In small groups, ask the participants to design the experiments to address the problems, and possible solutions they identified earlier. Each group designs one experiment and one or more groups may be assigned to work on the same experiment. The design for each experiment includes:
   - title
   - objectives
   - treatments
   - number of replications
   - lay-out in the form of a plot map
   - materials needed
   - variables to measure, and
   - processing and evaluation procedures.
5. All groups present their design in a plenary session, compare and consolidate them, and come to a final collective design per experiment. The facilitator should watch whether the designs fulfil the criteria discussed previously.
6. Plan the implementation of the experiment together with the participants. When are the plots planted and treated? Who provides the materials? What data is going to be collected, and how? Who is in charge of monitoring and recording data throughout the season? Make sure everybody knows what is to be done when.

9.3.3 Sources of planting material

Objectives: To enhance participants' awareness of the different sources of sweetpotato planting materials and the associated advantages and disadvantages

Materials: A4 paper, pens or pencils, flipcharts, marker pens

Activity steps:

1. Ask the participants to individually list the different sources of planting material they use during the year and then to rank them in terms of which source they obtain most cuttings from.
2. The group can then share this information by listing on a flip chart each planting material source and the rank each participant gave it. This information can then be used to discuss, the different sources methods and their advantages/ disadvantages?
3. Are there other sources that they are not using? Could some planting material production methods work better if they were done communally as opposed to individually?

9.3.4 Healthy planting material and dry season preservation of planting material

Objectives: To enhance the participants' understanding about the important role of healthy planting material for crop health and pest management and to strengthen their planting material selection and preparation skills

Materials: flipchart; marker pens; analysis boards; sweetpotato FFS manual; nearby fields of sweetpotato that can be used for taking samples; sharp clean knife; plot for planting out experimental planting materials

Activity steps:

1. Divide the participants into small groups. Ask each small group to search in the neighbouring fields for examples of healthy and unhealthy sweetpotato cuttings. Unhealthy cuttings should show symptoms of virus infection, or other disease or insect infestation.
2. All the sample cuttings are then brought back to the FFS meeting place. In the small groups, the healthy cuttings are separated from the unhealthy ones and placed on the analysis board under the column headings "healthy" and "unhealthy" respectively.
3. The analysis boards of the different small groups are then compared. Cuttings with similar symptoms are put together and the cause of the symptoms is determined by the whole group. If necessary, the samples can be compared with the pictures in Chapter 4 of the manual showing symptoms of viruses and other diseases and pests.
4. The following questions can be used to lead a discussion:
    - What are the characteristics of unhealthy cuttings?
    - What are the characteristics of healthy cuttings?
    - How can we obtain healthy planting material?
    - How can we preserve planting material during the dry season?
    - What can we do to stop wandering livestock feeding on our planting material during the dry season?
    - How should we handle planting material (during storage and prior to planting) in order to maintain good crop health?
    - How do planting material health and handling methods affect root formation?
5. Following the 'variety selection learning activity' during which participants will have decided which varieties they want to include in their FFS variety trial, ask participants to calculate the amount of planting material needed and to agree on who will collect and bring it to the FFS field and when. The participants should look for healthy planting materials, meeting the requirements they determined as a whole group.

6. On the agreed FFS field planting day (which needs to be after the 'experimentation learning activity' where participants have discussed and decided on the experimental design and layout of their FFS variety trial), the participants evaluate the planting materials that have been collected and destroy any that show symptoms of disease or pest infestation.
7. The participants must agree on how they want to plant their cuttings (e.g. planting distance, direction of cutting in the soil, length of vine, lay-out of plot for experiments, etc.), before going out together and doing it. The field should be divided into several plots corresponding with the treatments of the experiments planned.

9.3.5 Rapid multiplication technique

Objectives: To provide participants with the knowledge and skills required for rapidly multiplying planting materials during periods of limited supply.

Materials: Flipchart, marker pens, sharp clean knife, compost or animal manure, shovel, healthy disease free vines, water, materials for use in shading the nursery bed.

Activity steps:

1. Explain that rapid multiplication is a technique used for overcoming the problem of low multiplication rates of vegetatively propagated crops such as sweetpotato and cassava in order to ensure there is adequate planting material available at the right time in the season (see Chapter 2 in the manual).
2. Demonstrate how to prepare the vines for rapid multiplication (see Chapter 2 in the manual)
3. The participants then plan and create a nursery bed and experiment with rapid multiplication techniques (see Chapter 2 in the manual). Unless you have already arranged for the necessary materials to be brought in, you will need to plan this activity one week and then conduct it the following week.
4. The development of the young plants is observed during the rest of the season and compared with the growth of plants from normal cuttings. The task of observing the growth development of these plants and nursery management practices such as watering could be assigned to a few participants who then report the results to the group.
5. The following questions can be used to lead a discussion at intervals during the season:
   - How does this method compare with farmers' experiences of planting material multiplication?
   - What are the problems FFS members face with rapid multiplication techniques, how might they overcome these problems?

9.3.6 Soil fertility and plant nutrition

Objectives: To enhance participant's knowledge about the composition, formation, fertility and maintenance of soils and how soils affect plant nutrition

Materials: Small plastic bags for transporting soil samples from the different sites to the FFS; hoe or spade to dig soil samples; collection of clear bottles to put soil samples in (e.g. used plastic water bottles); flip chart and marker pens; analysis boards; manure; compost; ash; different inorganic fertiliser available locally; healthy cuttings of one variety of sweetpotato; plot for soil fertility experiment

Preparation: Prior to this series of FFS learning activities the following preparations need to be made:

- Participants need to be asked to think about places where the soils differ and be given small plastic bags to collect samples from these different sites
- The location of an experimental plot for the fertiliser trial be agreed on

How do soils differ?

Materials: Small plastic bags for transporting soil samples from the different sites to the FFS; hoe or spade to dig soil samples; collection of clear bottles to put soil samples in (e.g. used plastic water bottles); flip chart and marker pens; analysis boards

Activity steps:

1. Arrange for farmers to bring in samples of soil from different places, e.g.
   - valley bottoms,
   - hillsides,
   - land that has been cropped intensively,
   - fields that have been newly opened up,

- fields on which the vegetation has been burnt,
- fields that often receive manure,
- fields that usually receive chemical fertilisers,
- wherever farmers think the soils might be interesting etc.

2. Compare the different colours, textures, humidity, smells of the soils. Let the farmers arrange them in order of fertility. Look for worms and other living organisms.
   - Which soils do they think are best for sweetpotato?
   - Why are the soils different?
   - What conclusions can they draw about cultivation and fertilisation practices and soil characteristics?
3. Use a set of empty clear bottles (e.g. plastic water bottles), put each soil sample into a different bottle, then fill the bottle up with water and shake vigorously until the soil becomes thoroughly dispersed. Then let the mixture in each bottle settle out in a shady place till the next day or the next meeting.
4. The soil will settle out in layers, the stones settling immediately, then the sand, clay particles and some organic matter may stay floating. Compare the different proportions of each layer in the different soils. High proportions of which layer are associated with fertile soils?
5. Farmers could also visit the nearby roadside edges to visualise the soil profile to enhance their understanding of the different soil components.

Plant nutrition and comparing different nutrient sources

Materials: flip chart and marker pens; FFS manual; manure; compost; ash; different inorganic fertilisers available locally; healthy cuttings of one variety of sweetpotato; plot for soil fertility management experiment

Activity steps:

1. Ask the participants to list all the types of fertiliser they know. Add to the list if there are no more answers from them: chicken dung, cow dung, compost, green manure, urea, TSP, KCL, DAP, CAN, NPK etc.
2. Discuss the concept of the different nutrients N, P and K with them. Comparisons can be made with a human diet needing maize porridge or rice or sweetpotato, vegetables and beans or meat or fish. Initiate a discussion about the composition of each fertiliser and list together or explain the N, P and K contents of each. Emphasise that organic fertilisers, such as manure and compost also contain other elements that are needed for plant development. Explain that all elements are also available in nature, i.e. in the air, water and soil, albeit in very small concentrations. A comparison could be made between the price of organic manure versus inorganic fertilisers, calculated on a basis per kg of nutrient content (see Chapter 3 in manual).
3. The following questions can be posed by the facilitator to stimulate the discussion:
   - Why should we use manure or TSP as basal applications?
   - What are the advantages of manure as compared to chemical fertilisers?
   - What are the advantages of chemical fertilisers as compared to manure?
   - What are the advantages and disadvantages of the different types of fertilisers?
   - What are the advantages and disadvantages of compost versus manure?
4. Design an experimental plot with participants to test some of the different sources of plant nutrients they listed above. Do not forget to include a 'nil' treatment and/or a 'typical farmers practice' treatment. Participants may also want to test different application rates of some of the fertilisers so that they learn about the appropriate application rates. Ensure the experimental design does not become too complicated, so that interpreting the results is not a problem.
5. They could then see what effect each of the different fertilisers when applied before planting has on:

- the foliage of the sweetpotato plants
- the roots of the sweetpotato plants

6. Try to work out which of the manures or fertilisers increases the yield of sweetpotato the most for the least cost.

Caution: Application of some fertilizers such as urea without following the right recommendations may lead to permanent soil damage. The soil condition may be very difficult to reverse, for example it may become acidic.

Nutrient deficiency symptoms

Materials: flip chart, marker pens; analysis board; FFS manual

Activity steps:

1. Ask the participants what a healthy crop looks like? List the characteristics they mention.
2. Ask the participants in small groups to visit a sweetpotato field and collect samples of sweetpotato leaves which do not look healthy. Bring the leaves back and in the same small groups ask participants to group those with a similar appearance together on the analysis board and then to position all the analysis boards together.
3. Initiate a discussion about why the leaves don't look healthy and what might be causing the problems, use the Manual (Chapter 3 section 3.3.2) to identify nutrient deficiency symptoms.
4. Discuss what could be done to correct the nutrient problems.

Nitrogen fixing plants

Materials: flip chart, marker pens; analysis boards; shovel or hoe, nearby fields with leguminous plants in that FFS participants can sample,

Activity steps:

1. Dig up some leguminous plants (peas, beans etc).
2. Look for the small nodules on the roots.
3. Discuss the fact the nodules are 'fixing' nitrogen from the air and turning it into fertiliser for the plant. Inside the nodules are large colonies of tiny nitrogen-fixing bacteria. The nodules are also full of nitrogen that the bacteria have pulled out of the air in the soil. Nitrogen fixing bacteria pull nitrogen from the air that is in the soil and change it into the form plants can use. In other words, the bacteria fertilise the plant. In return, the plant helps feed the bacteria. When the bean plant dies, the nitrogen is left in the soil for other plants to use, unless the farmers dig the whole plant up at harvest and take it home!
4. How many plants do the participants know that have these nodules? Does sweetpotato have them? (No, it doesn't). Are there any of these plants grown as intercrops with sweetpotato?
5. Discuss the fact that as sweetpotato does not have nodules, the growing of legumes with or before sweetpotato can feed the sweetpotato plant. Do any of the participants use any of these legumes to act as fertilisers for sweetpotato either as an intercrop or a previous green manure? Do they think it works?
6. This could be something that farmers want to include as a treatment in a trial in order to see the effects of legumes on sweetpotato.

9.3.7 Crop development

Objectives: To enhance participants understanding of how sweetpotato plants develop during the season, and how this development can differ between different varieties.

Materials: flip chart, marker pens; analysis boards; shovel or hoe, cuttings of different sweetpotato varieties, FFS field

Activity steps:

1. Ask the participants to identify which of the sweetpotato varieties they grow are early or late maturing varieties.
2. Plant several cuttings of an early and a late variety of sweetpotato in the learning plot.
3. Ask the participants to dig up one or two plants of each variety every month and draw the root system as well as the above ground part of the plant. How are the plants changing? What does this tell them about the right time to harvest?

9.3.8 Observing the crop and its environment, presenting and analysing the agro-ecosystem results

Objective: To enhance participants understanding about the merits and method of routine observation of the crop and its environment, and to increase their field observation skills.

Materials: Flip chart, marker pens, analysis board, FFS field

Activity steps:

1. Lead a discussion about the participants' habits of observing their crops by asking the following questions:
   - At what intervals do you normally observe the sweetpotato crop?
   - How do you observe the crop?
   - Why is it necessary to observe the crop?
2. Explain that field observation is one of several routine activities in the IPPM farmer field school. The objective of routinely observing the field is to increase farmers' skills in analysing crop and environment conditions, and in making informed crop management decision. During every FFS session, this activity includes:
   - Field observation in small groups
   - Discussion and analysis of results (agro-ecosystem analysis in the small groups)
   - Presentation of results and discussion in the large group
3. Explain that the observation activities in the FFS will gradually develop as follows:
   - During the FFS session X (insert the number as appropriate for the school you are facilitating): observation of the field conditions and the field environment
   - During the FFS session XX: observation of the field conditions, the field environment and crop health
   - During the FFS session XXX: observation of the field conditions, the field environment, crop health and occurrence of natural enemies.
   - From FFS session XXXX onwards: a complete observation, including the field conditions, the field environment, crop health, occurrence of natural enemies and pests and diseases.
4. Divide the participants into small groups and invite them to the FFS field. During each session when a new element is added to the observation practice, the facilitator explains the appropriate way to observe (see Chapter 8 for details on observing the crop and its environment).

- During the FFS session X: explain how to observe the field conditions (soil, water condition) and environment
- During FFS session XX: explain how to observe crop development and health
- During FFS session XXX and XXXX: explain how to observe pest, disease and natural enemy populations.

5. The participants observe the FFS field. Each small group should sample 10 observation points (see Chapter 8)
6. Provide small plastic bags for the participants to collect leaves, insects, soil samples, etc. Encourage them to collect both healthy and unhealthy elements that they can find in the sweetpotato agro-ecosystem.
7. Within each of the small groups of participants, the data collected at the 10 sample points are aggregated, discussed and analysed.
8. After an introduction to the agro-ecosystem has been made, each week the participants are encouraged to use the analysis boards for processing and presenting their observation data. All healthy ecosystem elements collected are pasted, pinned and/or written on the left hand side of the board, while the unhealthy elements on the right side.
9. The participants should draw a sweetpotato plant in the centre of a flipchart sheet representing the development stage they observed in the field, and attach the paper sheet in the middle of the analysis board. Encourage them to pay special attention to the development stages of the root system. The elements they could not collect in the field should be drawn or written on the flipchart. Ask each of the small groups to draw conclusions about:
   - The conditions of the field and the environment by weighing healthy and unhealthy elements
   - Crop management practices that need to be implemented during the upcoming week

<table>
<tr><td colspan="3">NAME OF FFS:__</td></tr>
<tr><td colspan="2">AESA No:
Group No:
Plot No:
Problem addressed:</td><td>Date:
Week No:</td></tr>
<tr><td colspan="2">GENERAL INFORMATION</td><td>PARAMETERS</td></tr>
<tr><td colspan="2">Variety:
Date planted:
Age of crop:
Spacing:
Fertiliser:
Weather:
Time of observation:
Plant population:</td><td>Vine Length;
No. of leaves:
No. of branches:
No. of dead leaves:
Root size:
No. of storage roots:
Root skin colour:</td></tr>
<tr><td>INSECT PESTS</td><td>PLANT DRAWING</td><td>NATURAL ENEMIES</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="2">OBSERVATIONS</td><td>RECOMMENDATIONS</td></tr>
<tr><td colspan="2">Soil moisture:
Diseases:
Insect pests:
Plant (vine) health:
Deficiency:
Weeds:
Predators:
Growth stage:</td><td>What management practices should be applied</td></tr>
</table>

10. The groups present the results of their agro-ecosystem analysis and discuss them. The role of the facilitator in these discussions is to always relate the findings of this week with those of the previous week in order to keep track of changing conditions with regard to the development of vines and roots (nutrient deficiencies, number and size of storage roots), and of pest, disease and natural enemy populations (types and numbers).
11. Draw a final conclusion about the condition of the field and the environment, and about crop management practices needed during the upcoming week.

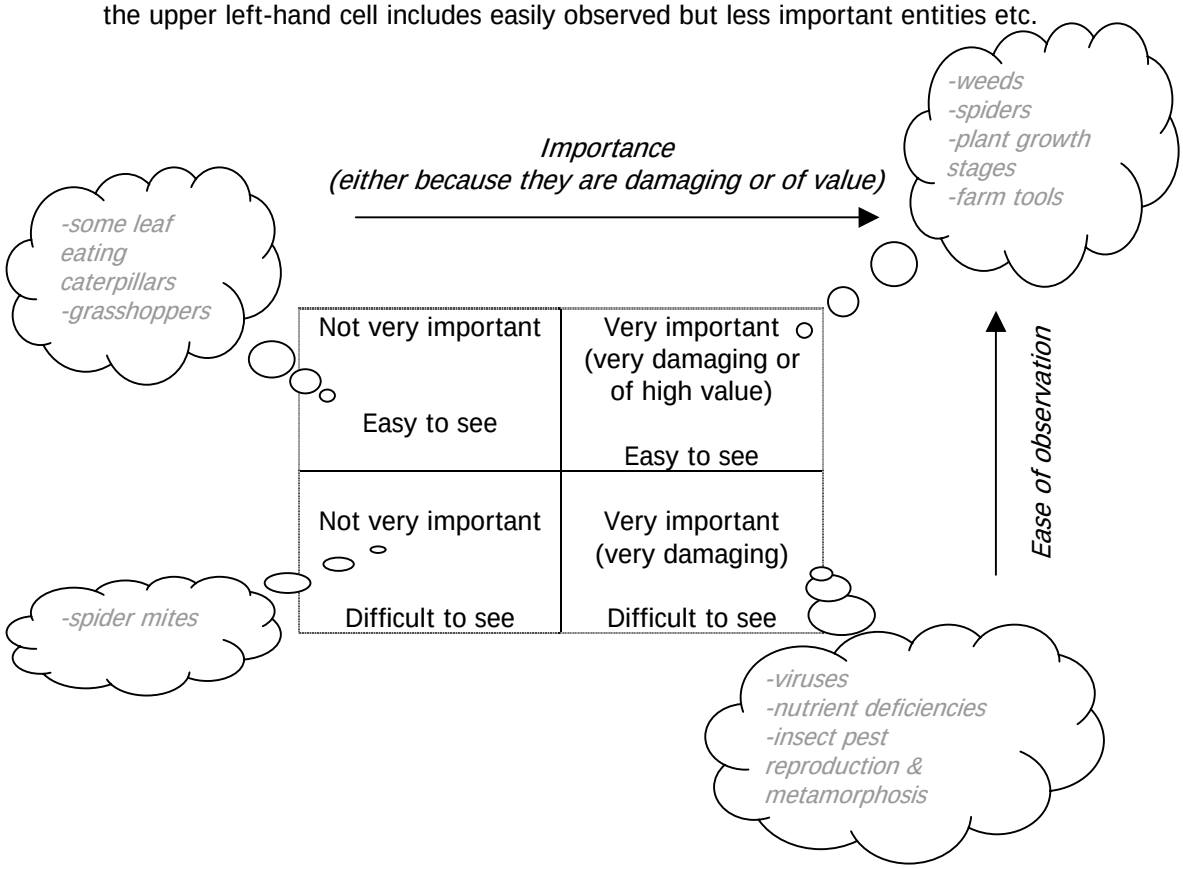
9.3.9 What is damaging my sweetpotato plant?

Objectives: To identify the major sweetpotato pests and diseases and understand their life cycles

Materials: flipcharts; marker pens; analysis boards; bottles/ jam jars or containers for keeping pests and diseased plant samples in; nearby sweetpotato field; weevil infested sweetpotato roots; maize grains for scoring with;

Activity steps:

1. Farmers have the advantage of spending lots of time throughout the year in the field where they can observe pests and diseases, and the disadvantage of lacking the advanced equipment that scientists have for identifying exactly what is causing damage. This means they can know an enormous amount about something that they can see easily and is important (either because it is of value or because it causes harm) but may know little about something that is hard to see, even if it is really important (e.g. some viruses). People normally classify and develop taxonomies for those organisms, things or ideas that are both conspicuous and important. The diagram below attempts to divide farmers' knowledge into four typical types of knowledge, e.g. the upper right-hand cell includes easily observed important entities, the upper left-hand cell includes easily observed but less important entities etc.



2. Collect as many samples of pests and diseases as possible. See how many have specific names. Explain the above diagram and concept to the participants and ask how they fit different pests and diseases into it.
3. Put each type of pest into a bottle with some sweetpotato foliage and see which ones eat it (to observe this accurately you will need a few days).
4. Ask the participants what methods they have for controlling different pests. Encourage them to realise that these methods are often better than any shop bought control methods that are available. Encourage them to exchange information about their different methods.
5. Ask each small group to collect a weevil infested root from the field. They should then cut the roots open, and look living organisms they can see inside the roots. Keep any larvae or pupae in ventilated jam jars in a cool safe place in order to see what the adults are like. Using these specimens involve the participants in a discussion about the lifecycle of the sweetpotato weevil. Discuss the concept of metamorphosis with the farmers. Draw the lifecycles of the sweetpotato weevil (egg, larva, pupa and adult), and other common pests. Is this new knowledge to the farmers? Discuss where each stage lives, and the effects they cause on root yield and quality, add the farmers comments about each stage onto the lifecycle drawings, including the approximate duration of each stage.
6. Put a few sweetpotato weevils into transparent containers with a sweetpotato root in them, cover the containers with a gauze lid so that air can pass in and out. Then ask for a few volunteers to keep the containers in a safe, cool and ant free place. They should inspect the container regularly every day over a period of a few months to see what the weevils are doing, and keep a record of the weevils' behaviour and numbers.
7. Ask the participants to mention all the methods they usually apply to control weevils. Then ask the participants what criteria they use for evaluating their weevil control methods. Make a grid on a flipchart and in the first column list the criteria they have mentioned, then add the different weevil methods in as column headings.

Control methods **Criteria**	**Method A**	**Method B**	**Method C**	**Method D**	**Method E**
Effective					
Easy					
Cheap					
TOTAL					

8. Put the flipchart sheet down on the ground and conduct a matrix ranking by letting the participants individually score the different control methods for each of the criteria (give each participant 7 maize grains to score with). When each criteria has been done, count the number of maize grains for each method and write the scores on the flipchart. Then move onto the next criteria and ask the participants to score the methods in terms of this criteria etc. When scoring has been done for each of the criteria add up the total score and draw conclusions.
9. Discussion:
   - What are the strengths and weaknesses of each method?

- Are there any other methods to control weevils that they have heard of but have hardly ever practiced? (Bring up important measures if they have not been mentioned such as sanitation).
- Has the earlier discussion about insect lifecycles, helped them to think of any new control measures?
- Why is field sanitation particularly important in weevil management? What is the most practical method?
- What natural enemies of the sweetpotato weevil can we normally find in the field?

9.3.10 Do insect pests have natural enemies? What are they?

Objectives: To enhance participants' awareness and knowledge about the existence and role of natural enemies in the sweetpotato agro-ecosystem.

Materials: Flip charts; marker pens; small plastic bags; plastic or glass containers, one per small group (the containers should be coated inside with paper, and the lids perforated with small holes or provided with a screen-covered window); sweetpotato roots with and without weevil infestation; a knife.

Activity steps:

1. Make a calculation together with participants of the total number of sweetpotato stemborers that would develop from one pair during six months with the following assumptions:
   - One pair of adults produce 100 surviving caterpillars within one month
   - The adults die after having produced the next generation
   - At the age of one month, the next generation also produces 100 caterpillars per pair, and dies afterwards.
   - This cycle is repeated during a total of six months
2. Use the following questions to help prompt a discussion:
   - Do we normally experience an insect population growth like this within one season in our field?
   - Why does a population growth like this never happen in nature?
   - Have you ever noticed animals (insects) in your field that eat or attack sweetpotato pests? If yes, what are these?
3. Divide the participants into small groups. Each group collects insects and other animals from fields around the FFS meeting place that they believe are natural enemies. The samples are kept in small plastic bags. They should try to observe what and how the natural enemies are eating, whether they prey or parasitise. Predation can usually be observed near ant nests. The ants walking in and out of the nest should be observed and can be fed with some small caterpillars.
4. After field observation, the groups take turns in presenting their results.
5. Lead a discussion about the three different categories of natural enemies: predators, parasitoids and pathogens. Probe from the participants existing knowledge and add explanations about how each category lives and functions in the ecosystem. Show samples of each category that were collected from the field.
6. Each small group receives a container with a perforated or screen window lid. They can use this container as a life cage to experiment with and observe the behaviour of natural enemies. Every FFS session, the group participants should collect a certain type of natural enemy and different kinds of food. During the week, one of the group members can take the container home and observe whether, what and how much the natural enemy eats. The group members take turns in observing natural enemies at home.

7. The results of interesting observations should be reported during the next FFS session, for instance included in their agro-ecosystem analysis presentation. The following questions could be used to let the participants discover the behaviour and function in the agro-ecosystem:
8. How did the natural enemy behave during the period of observation?
9. What is the function of the natural enemy in the field?
10. Is this natural enemy common in the sweetpotato field or not?
11. How can we utilise this natural enemy in crop management?
12. Although it would be better if the participants determine themselves what they want to observe, some suggestions for easily observable pest-natural enemy relationships are given below:

    - *Predation by a rove beetle*

    A few rove beetles (Staphilinids) are put in the container which was given a little bit of soil on the bottom. Weevil infested sweetpotato roots are cut into pieces and the weevil larvae are taken out and put in the containers with the rove beetles. Observe what happens with the beetles and with the weevil larvae. How many weevil larvae are eaten a day per beetle? Try other foods also.

    - *Weevils can turn mouldy*

    Some (pieces) of weevil infested sweetpotato roots are put in the container. Observe the roots for a few weeks. If the weevils begin to emerge, add some fresh, uninfested roots in the container. Observe the weevils every day, and look for the weevils with their skin covered with a whitish powder. The whitish powder is fungus. Observe the behaviour of the fungus infected weevils. After how many days do they die?

    - *The existence of parasitoids*

    Several different species of insect pests that are likely to be infested with parasitoids (leaf eating and stemborer caterpillars, aphids etc) are collected from the field and put in a container. Observe the development of the pest insects every day and see whether the pest passes through its own life cycle, or whether parasitoids emerge. The following categories of parasitoids can be observed:

    Egg parasitoids: collect sweetpotato leaves with eggs of insect pests from the field. Eggs can normally be found on the back side of the leaves. Eggs of hornworms are usually easy to find since they are quite big, round and green coloured. Leaves with eggs are put in a container that is coated with filter paper. Too many leaves in one container may cause high humidity, hence rotting of the eggs. Observe the eggs every day to see whether caterpillars (=pest) or small wasps (=parasitoids) hatch.

    Larval parasitoids: Collect various kinds of leafeating caterpliiars from the field and put them in the container with some fresh sweetpotato leaves. Provide fresh leaves to the caterpillars every day. Try to maintain a low humidity in the container. If the conditions are favourable, the caterpillars will become pupae, but some caterpillars may die before they reach the pupal stage. What is the cause of death? Did a parasitoid (a wasp or a fly) appear? Observe all species of parasitoids that emerge.

    Other parasitoids: Collect sweetpotato leaves with aphids, whiteflies, mealybugs, etc., and put them in a container for each species. The containers should be coated with filter paper. Observe the insects every day to see whether parasitoids (small wasps) emerge.

    Leafminer fly parasitoids: Collect sweetpotato leaves with leafminer tunnels, and put them in a container coated with filter paper. Larvae of leafminer flies are often infested with parasitoids. After a few days, the larvae will emerge and pupate on the leaf surface. Observe the pupae continuously to see whether flies (=pest) or small

wasp (=parasitoids) emerge. The wasps are smaller than the flies. We can calculate the percentage of parasitism as follows:

$$\% \text{ parasitism} = \frac{\text{number of parasites}}{\text{number of parasites + number of pests}} = 100\%$$

9.3.11 Defoliation

Objective: To help participants understand the reaction of the sweetpotato plant to insect damage on the leaves, and what this does to the development of the plant, and whether the plant can recover from or compensate for this damage.

Materials: 10 sticks, weighing scale (at harvest time), flipchart, marker pens

Leaf damage versus yield loss

Activity steps:

1. Ask the participants to mention pests and diseases that damage the sweetpotato leaves, and list them on a flipchart.
2. For each of the pests and diseases listed, the participants should come to an agreement on what percentage of leaf damage they would tolerate without expecting yield loss as a result of the damage.
3. Then ask the participants during what development stage the crop would be more or less susceptible to leaf damaging pests and diseases. Would the percentages mentioned before vary over the season?

Defoliation experiment

Activity steps:

Preparation:

1. Discuss the objective and design of the defoliation experiment (see suggested defoliation experimental design below)
2. Prepare plot labels using stakes (e.g. bamboo sticks) and marking them with the plot number and treatment. Place them in the plots.

Treatment

3. The participants implement the first defoliation one month after planting treatments. At that time, they also measure the area of each plot and count the number of plants that are alive. All data are recorded on the 'Results of Defoliation Experiment form' below.
4. The first defoliation is done on plots 2A, 2B, 4A and 4B by picking of the leaves and vine tips, 50% for plots 2A and 2B, and 100% for plots 4A and 4B.
5. The second defoliation is done on plots 3A, 3B, 5A and 5B when the crop is three months old (work out which FFS session this will be in)
6. During consecutive FFS sessions, the condition and crop development of each plot is monitored and any striking observations are recorded.

Evaluation

7. At harvest time, the participants count the number of plants alive in each plot. They weigh the root yield of each plot, separately. All data are recorded on the Defoliation Experiment form.
8. The average yield (in kg/ plant and t/ha) of the two replications per treatment is calculated.
9. The results of the small groups are compiled, presented on a sheet of newsprint paper, and analysed by the group.

Discussion:

10. What percentage of leaf damage is still acceptable since it does not cause yield loss?
11. When is the effect of leaf damage on the root yield greater, when the crop is attacked at 1 or 3 months after planting? Why is this the case?
12. What can we learn from this experiment in relation to the management of leaf eating pests?

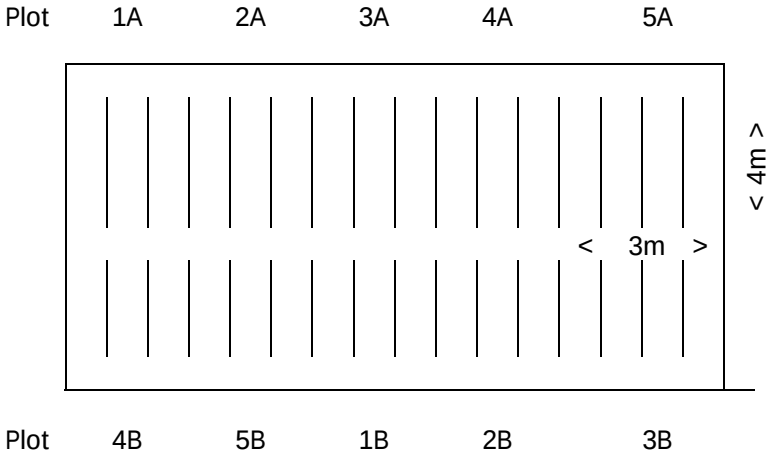
Defoliation experimental design

This experiment is carried out in the small groups; each group is responsible for one treatment. It requires a field of 120m^2. This field is divided into 10 plots, each of 12 m^3 (3 by 4m; for instanced three ridges of 4 metres long). The experimental field should be prepared and planted during the FFS session 2.

The experiment described here consists of five treatments with two replications (A and B), but can be adjusted as desired. The treatments compare different variations between percentage of leaves cut with age of the crop when defoliation is done, as follows:

Plot no.	Replication	% Defoliation	Crop age (months after planting)
1	A and B	0%	-
2	A and B	50%	1 month
3	A and B	50%	3 months
4	A and B	100%	1 month
5	A and B	100%	3 months

The field could be laid out as follows:



Leaf cutting is done by picking the leaves and vine tips according to the percentage for each treatment. The stem is left in the field.

Results of Defoliation Experiment Form

Group name:	
Village:	
Season:	
Variety:	

Plot	Treatment	Plot area (m2)	No. of cuttings planted	No. of cuttings harvested	Yield		
					kg/plot	kg/plant	Ton/ha
1A	0%						
2A	50% - 1 month						
3A	50% - 3 months						
4A	100% - 1 month						
5A	100% - 3 months						
1B	0%						
2B	50% - 1 month						
3B	50% - 3 months						
4B	100% - 1 month						
5B	100% - 3 months						

Average yield from two replications per treatment:

Treatment	Yield	
	kg/ plant	ton/ ha
0%		
50% - 1 month		
50% - 3 months		
100% - 1 month		
100% - 3 months		

9.3.12 Sweetpotato diseases and how farmers manage them

Objective: To enhance participants awareness and knowledge about the existence and importance of various sweetpotato diseases.

Materials: Flipcharts, marker pens

Activity steps:

1. Have a discussion with the participants to explore their ideas of different diseases. When do different diseases appear, are they associated with different times of year/ seasons/ growth stages (explore with the cropping calendar). Where do the diseases come from? List the information on a flipchart.
2. Divide the participants into small groups and ask them to go to nearby fields and look for and collect samples of disease symptoms on:

- Vines and leaves from older crops (they might find virus, *Alternaria* and leaf spot symptoms)
- Storage roots in just harvested crops (they might find root rot and nematode symptoms)

3. The samples are taken to the FFS meeting place and discussed one by one in the whole group. Determine together the local name and the cause of the disease symptoms. The facilitator could add samples with other diseases that have not been collected by the participants to cover all categories of diseases (fungi, bacteria, viruses and nematodes).
4. Ask the participants what management practice would be adequate to prevent and/or control each disease. Emphasise the importance of prevention of disease infection by sanitation and the use of clean planting materials.
5. If varietal resistance emerges as one of the possible ways to manage diseases. Are different sweetpotato varieties attacked with different severities or frequencies? A variety ranking activity could be suggested to determine together which of the commonly used varieties is most resistant against commonly occurring diseases. For each disease, the varieties listed are given a score for resistance.
6. Given the different knowledge that the facilitators can give the farmers e.g. from this manual can the farmers think of new ways to control these different diseases? How can the group test these possibilities?

9.3.13 Sources of disease infection

Objective: To enhance participants understanding about the sources of disease

Materials: Flipchart, marker pens, sweetpotato storage roots affected with symptoms of root rot, healthy sweetpotato storage roots, sack, several clean plastic bags.

Activity steps:

1. Ask the participants to list any source of disease infestation they can think of. With a simple experiment we will demonstrate that the major source of infection is a sick plant.
2. Put a storage root with root rot symptoms together with a healthy root in a clean sack. Close the sack and turn the sweetpotato roots around for about one minute. Then take the roots out and keep each of them separately in a plastic bag the infested roots bag should be labelled ‘sick’ and the healthy roots bag should be labelled ‘healthy 1’.
3. Put another healthy sweetpotato root in the same sack where the other two roots had been. Turn it around in the sack several times, take it out and put it in a clean plastic bag with a label ‘healthy 2’.
4. Wash the sack carefully with water until it is totally clean. Put another healthy sweetpotato root in the clean sack, turn it around several times, take it out and put it in a clean plastic bag with a label ‘healthy 3, clean sack’
5. Ask for a volunteer to take the plastic bags with the sweetpotato roots home and observe daily what happens with the roots. The volunteer should record when the different roots start to show root rot symptoms and how the disease develops on the roots.
6. During the next FFS sessions, the observation results are presented and discussed by the whole group. The following questions could be used to lead the discussion:
7. What is the difference in development of root rot among the four sweetpotato roots? What is the best way to prevent infection of root rot diseases?
8. If the root which was put in the clean, washed sack still showed black symptoms, what would be a better way than washing with water to prevent the transmission of the disease through tools and materials? (for example sun drying, washing with soap)

9. If the participants are interested in testing these other methods, a new experiment could be conducted.

9.3.14 Could disease incidence be linked to where I plant my sweetpotato?

Materials: flip chart, marker pens; (if they want to do a field experiment will also need two plots one near an old sweetpotato crop the other far away from any sweetpotato crops; jembe; planting materials)

Activity steps:

1. Ask the participants to draw a village map showing where old and new sweetpotato crops are planted.
2. Use a cropping calendar to work out when most sweetpotato crops are planted. Are they planted over a short period or spread out over several months? How many major planting seasons each year and how long do the crops remain in the field before they are completely harvested?
3. Discuss what the pressures are that force farmers to re-use land repeatedly for sweetpotato or to plant near old fields?
4. Can farmers work together to plan their crops so new crops are planted separate from old crops?
5. Another experiment the participants might want to set up, is one where they establish one new sweetpotato crop right next to an old sweetpotato crop and another new sweetpotato crop far away from any old sweetpotato crops (they might decide to have two FFS study plots set up this way). During their regular AESAs of the two plots they will make observations and written records about the incidence of different pests and diseases in the two young crops. At intervals through the season they should compare the records they have for the two plots and as a group discuss what the different results signify for pest and disease control.

9.3.15 Sweetpotato virus disease

Objectives: To enhance participants understanding and recognition of virus diseases, and to facilitate their testing of different virus management strategies.

Materials: Flipchart, marker pens

Activity steps:

1. Ask farmers what they think contributes to causing sweetpotato virus disease. List their responses on a flipchart.
2. Conduct an experiment in which farmers take cuttings from sweetpotato virus diseased plants, to show that any plant that grows from it is still diseased.
3. Establish several plots. In some of the plots remove any SPVD affected plants that can be seen, start removing the virus infected plants a few weeks after planting when the symptoms start to become noticeable. In the other plots do not remove the SPVD affected plants. Map the spread of disease in these different plots, under these different disease management practices (e.g. removal of affected plants vs no removal of affected plants). Discuss the results at different stages during the growing season.
4. Encourage farmers to question whether the small yield they get from a diseased plant is worth the risk of spreading the disease to the other plants in the field, or whether it would not be better to remove and destroy the diseased plants early on so that the disease does not spread.
5. Discuss whether farmers identify high yielding, good quality varieties that are disease resistant? Can the facilitator obtain high yielding good quality varieties that are

disease-resistant from outside sources e.g. from institutes, research stations, NGOs? Could the farmers test these varieties to see whether they yield well and are resistant to disease when grown in their local environment as well as at the research station?

9.3.16 Weeds

Objectives: To enhance participants understanding about the disadvantages and advantages of weeds in the sweetpotato crop and to strengthen their knowledge of weed management options

Materials: Flip chart; marker pens; analysis board; nearby sweetpotato fields

Activity steps:

1. Divide the participants into small groups and invite them to collect samples of as many different types of weeds as possible from the fields.
2. In small groups ask the participants to group the weeds on the analysis boards distinguishing between the weeds that significantly affect crop development and those that are considered not harmful. Ask the participants to write the local names of the weeds next to the samples, and if any of the weeds are used by the participants they can include details of the uses.
3. The groups can then present and discuss their results.
4. All the weed species found by the various groups are written on a flipchart in the first column of a ranking table. Two other columns are drawn with the headings:

   Causes yield loss

   Is difficult to control
5. The various weeds listed are ranked by the group for each of these columns, separately, by giving a score of 10 to the weeds causing the highest yield loss or the ones which are most difficult to control, after which the other weeds are scored proportionally. The total score for the weeds is calculated by adding the scores of the two columns.
6. Use the following questions to help prompt a discussion:
   - How can weeds affect the development of a crop?
   - Do all weed species affect the crop negatively?
   - How can weeds in the field be useful?
   - What is the most appropriate way to manage (and utilise whenever possible) weeds?

9.3.17 When is a good time to harvest?

Objectives: Participants will gain knowledge about determining the right harvest time

Materials: Flip chart, marker pens, scales

Activity steps:

1. Involve the participants in a discussion about what factors they consider when determining the time to harvest their sweetpotato crop. List the factors they mention on a flip chart. Discuss to what extent each factor provides flexibility to postpone or move forward the time of harvest in order to optimise the outputs, the group may want to add suggestions to their initial list.
2. Calculate together with the participants the income from a sweetpotato crop by comparing a crop of 4 and 6 months. Probe for details considering prevailing conditions with regard to:
   - Root yield of a popular sweetpotato variety with flexible growth duration, when harvested at 4 versus 6 months (kg per unit area)

- Estimated market price per kg of roots when harvested during the peak season or two months later

Calculate the income by multiplying the yield times the price at 4 months and at 6 months.

3. Discuss:
   - Which harvest provides the highest gross income?
   - If calculated on a per month basis and considering the opportunity value of the land, does the conclusion change?
   - What are the risks involved when postponing or moving forward the harvest time?
   - What about piecemeal harvesting practices?

9.3.18 Bartering and yield?

Objectives: Participants will change their attitude about their role in the bargaining process with traders, and will enhance their knowledge and skills in estimating the yield of their crop

Bartering

Materials: Flip chart, marker pens

Activity steps:

1. Initiate a discussion about the problems that farmers normally face when negotiating about the price of their produce with traders.
   - Do they think they always get a fair deal?
   - Have any of them ever been cheated?
   - What role do they have in the negotiation process?
   - Are they satisfied, if not, what are the problems?
   - How can farmers improve their bargaining power?
2. If appropriate, suggest the following ways for farmers to strengthen their position:
   - Gain skills in yield assessment, particularly where the produce is sold as a standing crop
   - Reinforce group cohesiveness and establish a network through which farmers inform each other about prevailing prices and current market conditions

Yield assessment contest

Materials: Flip chart, marker pens, FFS field at harvest time, scales

Activity steps:

1. Invite the participants to take part in a yield assessment contest. Explain the objective of the activity, i.e. to enhance the participants' skills in estimating the sweetpotato root yield of a crop that is still in the field, in order for them to gain bargaining power in the negotiation process with middle men buying the standing crop.
2. One plant is randomly selected in the FFS field. The soil is partly removed to expose the storage roots. All participants estimate the weight of the storage roots. Write all of their estimates on a Yield Assessment Contest form (as shown below).
3. When all participants have taken their turn in estimating the root weight, harvest the roots and weigh them. Then write the actual root weight in the appropriate column of the Yield Assessment Contest form. The participants are given ranks according to how close their estimates were to the actual yield, using a rank of 1 for the person who was closest.
4. Select a second plant in the field and repeat the process.
5. Repeat the exercise as many times as the group wants to, it is recommended to estimate the weight of at least ten plants to provide sufficient opportunity for the participants to improve their skills.

6. When finished, add the total of ranks per participants and determine who has won the contest (the one with the lowest total score). Discuss whether the participants feel that their skills increased throughout the contest, meaning that they got closer every time.
7. The harvested roots for the contest should be returned to the field for later determination of the total yield of the FFS field.

Yield Assessment Contest form

	Root weight estimate for each plant										Ranking for each plant									
Name	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1.																				
2.																				
3.																				
4.																				
5.																				
6.																				
7.																				
8.																				
9.																				
etc																				
Actual yield																				

Assessing the total root weight yield and value of the field before harvesting

Materials: Flip chart, marker pens, FFS field at harvest time

Activity steps:

1. After the participants have taken part in the yield assessment contest, and learnt to assess the average weight of roots per plant, farmers can use this skill to calculate the approximate weight of the whole crop in the field and its monetary value.
2. Ask the participants what they consider the easiest and most practical way to determine the total number of plants in a field, and reach a group decision. Let them determine the number of plants in the FFS field.
3. Calculate the expected harvest of the field by multiplying the total number of the plants in the field by the average root weight per plant as assessed in the contest.
4. Then, calculate the value of the field by multiplying the expected harvest by the prevailing market price per kg of roots.
5. The expected harvest and the expected value are noted down for later comparison with the actual harvest and price obtained from the field.

Harvesting the FFS field

Materials: Flip chart, marker pens, FFS field at harvest time, jembe, scales, tape measure, notebooks or sheets of paper, sacks

Activity steps:

1. The participants will harvest the FFS field. Explain the procedure to them:
   - Determine which of the participants will take accurate notes of all the data. A form similar to that used in the defoliation experiment learning activity should be drawn up on a flip chart.
   - Cut the vines and count the number of plants separately per plot of the various experiments. Make notes of any stem damage by insects of diseases. If the group is planning to sell the vines, they may want to record the weight and number of vines from each plot separately.
   - Measure and record the area of each plot, if this had not been done at planting time.
   - Harvest the roots and weigh them for each plot separately and keep a record of their weight.
   - Calculate the average harvest of the replications per treatments, and convert this into yield (tons/ha)
2. When everyone is clear about the procedure, look at the map of the FFS field and divide up the tasks for harvesting the various plots and recording data.

3. The group should agree on how to deal with certain pest and disease problems, particularly sweetpotato weevil and root rot, if these are important in the area. Do they need to be considered in the harvest? They might decide to weigh the marketable and unmarketable roots per plot separately.
4. When the task distribution is clear, everyone is invited to harvest the field.
5. After harvesting is finished, the facilitator collects the data sheets for further processing and analysis by the group.
6. Ask the participants whether field sanitation is needed or not, i.e. are there weevil infested roots still in the field? If there is a need, agree on the method and implement it together.
7. Later the group meet to analyse the data collected (see Chapter 8 for suggestions), the participants should present the results of the experiments conducted. The discuss:
   - Which treatments resulted in the best yields?
   - What are the advantages and disadvantages of the treatments tested, compared to farmer practice?
   - What experiments are still needed to further test and adapt some of the sweetpotato IPPM technologies?

9.3.19 Why store sweetpotato roots?

Objectives: Participants will have identified the advantages and disadvantages of sweetpotato storage

Materials: Flip chart, Marker pens

Activity steps:

1. Explain that the purpose of this activity is to identify the advantages and disadvantages of sweetpotato storage under local conditions.
2. Divide the participants into small groups and ask them to discuss their experiences regards storing sweetpotato roots. Each group should analyse and make a list of advantages and disadvantages of the different storage techniques ever practiced by the group members. The result of the discussion is written on a sheet of newsprint paper.
3. Each group then presents back to the plenary and together they draw the overall conclusions.
4. The group should then decide whether or not they have an interest in testing a storage technique. If they do the following activity could be scheduled for another session, since it requires preparation of materials which will need to be agreed on by the group.

9.3.20 A simple fresh storage technique

Objectives: Participants will have gained knowledge on fresh storage techniques and potential problems

Materials: Clean undamaged sweetpotato storage roots, dry grass, shovel, thatching grass and poles for making a small thatched roof for pit or clamp store, twine

Activity steps:

1. Make sure the materials and location for setting up the store(s) are prepared in advance.
2. Depending on whether the participants want to compare the two different fresh storage techniques e.g. clamp and pit store, or whether they want to compare what happens when a random selection of roots are stored as compared to carefully selected undamaged roots, several areas of 1-2m^2 might be needed.

3. Arrange in advance for the participants to meet at the place where the store will be set up. The objective and design of the experiment is explained, and tasks are divided among the group members. The stores should be constructed following the details and photos in the manual (Chapter 5).
4. One participant should be assigned to keep records of the store, including:
   - date of store preparation
   - weight of roots stored in each treatment at date of store preparation
   - market price of sweetpotato at date of store preparation
   - any observations during period of storage (e.g. occurrence of rats)
   - date of taking the roots out of the store (approx 2 - 5 months later)
   - weight of roots stored in each treatment at the end of the storage period, distinguishing between healthy roots, sweetpotato weevil infested roots and roots infected by rot
   - market price of sweetpotato at 1, 3, 5, 7, etc. weeks of storage and at the end of the storage period
   - any other remarkable observations
5. This data should then be presented to the group, analysed and discussed. An economic analysis could be done of the different storage methods.
6. Questions could be asked such as:
   - What are the advantages and disadvantages of the different storage methods, which method is the most profitable?
   - Would the participants apply this method in the future? If yes, why? If no, why not?

9.3.21 Stop eating my sweetpotato chips!

Objective: Participants will have discussed, analysed and gained knowledge and skills on the different ways they can protect their dried sweetpotato products under local conditions.

Materials: Flip chart, marker pens, pan, firewood, sweetpotato roots, knife, drying platform, salt, mat, sheet of plastic, a range of different containers for storing dried sweetpotato chips, ash,

Activity steps:

1. Ask the participants whether they have stored sweetpotato in a dried form before. If they have discuss why they decided to store dried sweetpotato and then make a list of the ways they prepared the sweetpotato chips. Did they experience any problems during storage, if so what did they do about them? How long did they keep the sweetpotato chips for?
2. After reviewing the list of the farmers methods, discuss the different practices for helping to reduce insect damage to dry sweetpotato chips during storage (see Chapter 5).
3. The farmers might want to set up an experiment to compare a few of the different practices in their own homes. They could chip the sweetpotato roots together as a group and decide whether they want to parboil or salt some of them, or how they want to sun-dry them etc. The different methods of preparing the sweetpotato chips can be used as different experimental treatments, along with different types of storage containers, different protectants such as plant materials or ashes.
4. Ask the farmers to keep a record of the different treatments they decide to use, and to then check the stored product (every week or so) to see whether there are any differences between the treatments.
5. After two months of storage ask the farmers to bring samples of the stored chips from the different treatments to the meeting so the group can compare them. It

might be interesting for the participants to use the pictures of the different stored product insect pests given in Chapter 5 of the manual to identify any insects damaging their product, do these insects have local names?

6. Discuss the outcomes of the experiment with the group, and see if any of the participants have thought of new storage practices they might use in the future.

9.3.22 Adding value to the sweetpotato crop

Objective: Participants will have analysed the opportunities for sweetpotato utilisation under local conditions and gained knowledge and skills related to simple sweetpotato processing techniques.

Materials: Flip chart, marker pens

Activity steps:

1. Explain that the purpose of this activity is to learn about participants' experiences with and analyse opportunities of sweetpotato utilisation under the prevailing conditions.
2. Divide the participants into small groups and ask them to discuss their experiences of utilisation of sweetpotato roots and vines. Each group should list the various types of utilisation its member have practised. The groups should give a multiplication rate representing the additional value of (or increased income from) the sweetpotato crop as a result of utilisation as compared to direct selling of the produce. This should be done for each type of utilisation. The results of the discussion are written on a sheet of newsprint paper.
3. Each small group can then take it in turn to present their results back to the plenary and overall conclusions can then be drawn by the whole group through discussion.
4. After discussion the groups could decide whether or not they have an interest in learning more about one or more utilisation technique, e.g. preparation of flour, dried chips, juice, or one of the recipes given in the sweetpotato FFS manual (Chapter 6) from sweetpotato storage roots; preparation of animal feed from sweetpotato vines; or a cross-visit to a processing enterprise or industry. The activities should then be scheduled for other FFS sessions, since they require prior arrangements and preparation of materials. Arrange which dates these sessions will happen. The facilitator should prepare the session using the information in Chapter 6 of the manual or involve someone experienced in the technique(s) to be practiced.

9.3.23 Economic analysis of the sweetpotato enterprise

Objective: To enhance participants' skills in making an economic analysis of the sweetpotato enterprise, as a tool for crop cultivation decision making.

Materials: Flipchart; marker pens.

Activity steps:

1. Explain that the purpose of this activity is to understand the factors determining the profit of the sweetpotato enterprise, and to present a method for economic record keeping and analysis.
2. Initiate a discussion by probing the participants about how much they think their net income per acre from sweetpotato will be. What are the reasons for different profits obtained by different farmers?
3. Ask the participants to mention all activities throughout a sweetpotato growing season, from soil preparation to marketing. List them on the flipchart. For each activity a cost should be determined by the group, including both inputs and labour. Household labour should also be converted to realistic wages. Gross and net income can then be calculated. The net income is the gross income minus the total expenditures.

4. Building on the economic picture created together, a discussion can be held, focusing around the following type of questions:
   - What is the most important factor that determines the net income from sweetpotato?
   - Which expenditure can be reduced and how?
   - In order to obtain a reasonable income, what should the price of sweetpotato per kg be?
   - What is the farmers' daily wage, based on the analysis made? How much should it be for sweetpotato cultivation to become an attractive enterprise?
   - Do participants think they might have forgotten to include any costs or activities? If so, how could they make sure they include everything? This can link to the activity below about record keeping.
5. A discussion about the economics of processing sweetpotato or selling planting materials could then be stimulated, the cost benefit analyses found in Chapter 7 of the manual could be used as examples.

9.3.24 Sweetpotato cultivation record keeping

Objective: To provide participants' with a method for recording the information they need to study the economics of their sweetpotato enterprise, to help them with crop cultivation or utilisation decision making.

Materials: Photocopies of the sweetpotato seasonal cultivation record form (to be found at the end of Chapter 8) make enough copies for each participant to have one plus one extra for recording the management data of the FFS field; flipchart; marker pens.

Activity steps:

1. Distribute one photocopy of the sweetpotato seasonal cultivation record form to each participant.
2. Ask for one volunteer to keep a seasonal record of the FFS field in addition to their own field.
3. Explain what each of the columns and rows on the form mean, and how the records should be kept.
4. It is recommended that during each FFS session several minutes are spent on jointly determining what has to be filled in on the record for the FFS field by the volunteer participant, and to check whether the participants are having any problems keeping their own records of their own field.
5. During the evaluation session at the end of the season, the economic analysis of the FFS field is made by the group and profit determining factors are discussed. It would be an interesting exercise to compare the economic analysis of the FFS field with that of one of the participants who has already harvested.
6. Participants might like to develop a record form for their sweetpotato processing or planting material sale activities, these could be based on the examples given in Chapter 7.
