Ministry of Agriculture
The Republic of Sierra Leone

Sustainable Rice Production Project in the Republic of Sierra Leone

Project Completion Report

Annex 3: Extension Materials

July 2022

JAPAN INTERNATIONAL COOPERATION AGENCY

RECS International Inc.

Sustainable Rice Production Project
Project Completion Report
Annex 3: Extension Materials

Contents

Extension Material on Technical Package on Rice Production

Sustainable Rice Production Project in Sierra Leone (JICA-MOA) ***July 2022***

Session1-1 Introduction

Important messages:

1) The farmer field school (FFS) provides the farmers with an opportunity to learn how to obtain higher yields and profit with the use of improved farming techniques.
2) This FFS is organized so that farmers can learn the Technical Package on Rice Production (TP-R) developed by JICA. The FFS consists of 11 sessions which will be conducted throughout this cropping season. In each session, the farmers are the main players while MAF and extension workers are the facilitators.

How to facilitate the session

1) General introduction to the FFS on the TP-R
   - Tell the farmers about the objectives of the FFS, which provides an opportunity for the farmers to discuss issues on their agricultural activities among them to find out the solution to overcome the issues through field observation, consultation, and trials.
   - Explain to the farmers that the farmers will learn the Technical Package on Rice Production (TP-R) developed by JICA. It has been proven that the package can attain a yield of 3.0 ton/ha (48 bushels/acre) if recommended techniques including application of fertilizer are properly applied. Also, explain briefly about three yield components.
   - Emphasize that FFS is a practical learning process thus farmers' participation in all sessions is very important.

2) Schedule of FFS
   - Show the farmers the overall schedule of an FFS and the subject in each session as follows:

     1. Introduction, setting of the demonstration plot, and land preparation
     2. Yield components, the life cycle of the rice plant, and various variety
     3. Formulation of a farming plan and cropping calendar, and seed selection
     4. Nursery preparation
     5. Construction of bunds, puddling, and leveling
     6. Fertilizer application and transplanting
     7. Weed management
     8. Topdressing and water management
     9. Prevention of pest and diseases, and damage from rodents and birds
     10. Harvesting and post-harvest handling
     11. Evaluation of TP-R

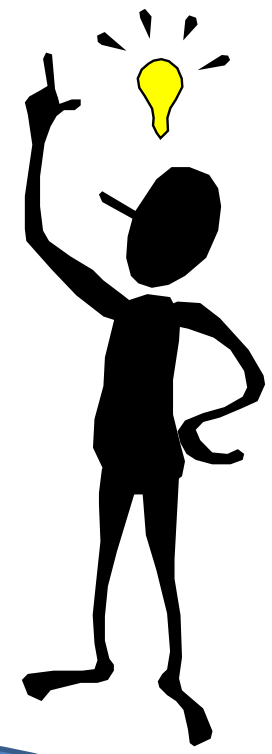
   - Also explain that the FFS sessions will be held on the days of their group work.

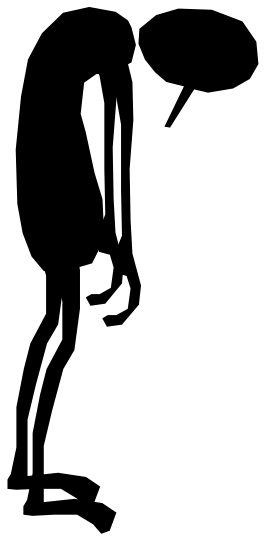
FFS Demonstration Plot

New Techniques

Improved techniques

Without fertilizer | **With fertilizer**





Compare rice performance

Conventional techniques

Session 1-2 FFS Demonstration Plot

Important message:

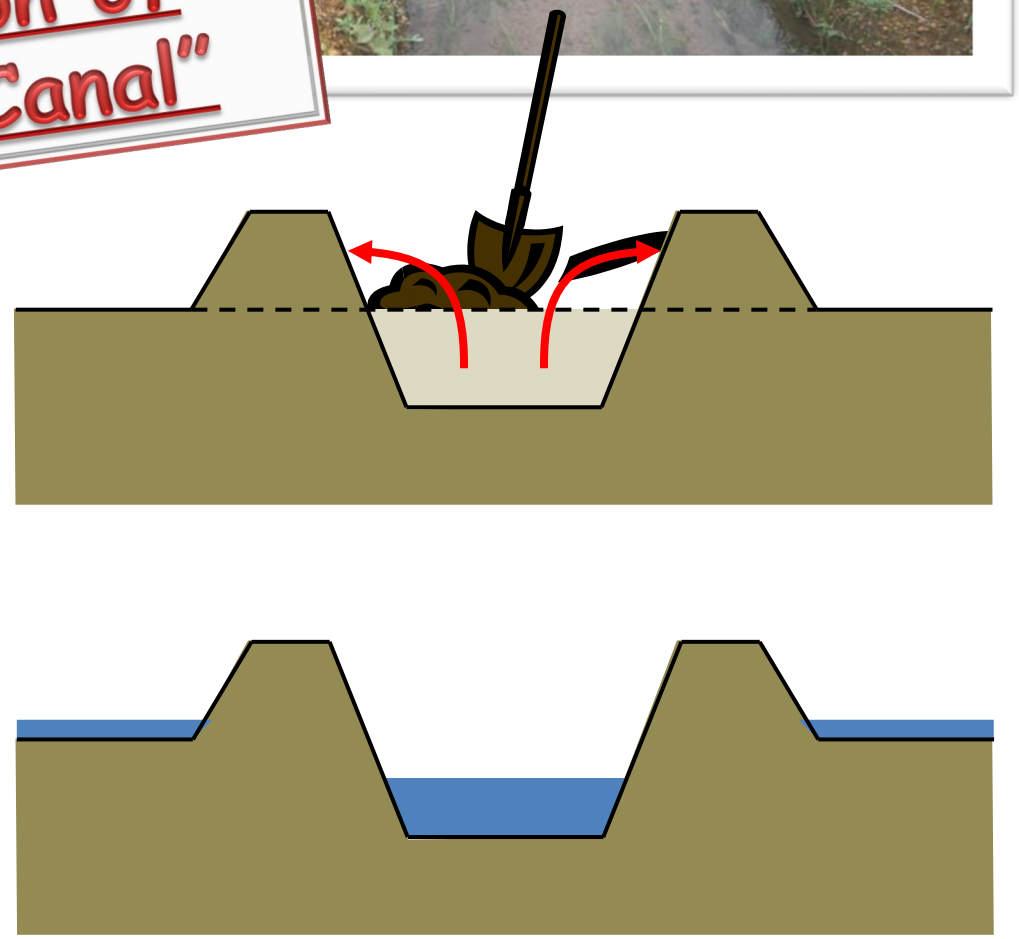
1) The FFS demonstration plot provides the farmers with opportunities to verify the value of new technologies on rice production.
2) New technologies should be adopted when their effectiveness or values are proven in the plot.
3) In establishing the FFS demonstration plot, homogenous land in terms of topography, soil, and water conditions should be selected.
4) The FFS demonstration plot consists of 2 sub-plots: the TP-R with fertilizer and the TP-R without fertilizer. A conventional plot where farmers' traditional rice farming is practiced is also selected for comparison.

How to facilitate the session:

1) Introduction of the FFS demonstration plot
   - Tell the farmers that extension workers are going to introduce a set of new farming techniques based on the TP-R, which will contribute to a higher rice yield.
   - However, the farmers may hesitate to adopt all the new techniques without seeing their effectiveness because they may have ideas on other farming practices or techniques that they want to try.
   - Therefore it is proposed to the farmers in this FFS to prepare a plot (FFS demonstration plot) to try those new farming practices or techniques to see their effectiveness.
   - Explain to the farmers that they will implement new techniques learned from FFS at this demonstration plot.
2) Selection of appropriate site for FFS demonstration plot
   - Select the site suitable for the FFS demonstration plot (demo plot) with the farmers. The FFS demonstration plot should be within or nearby the FBO group farm for all the member farmers to be able to observe the plots.
   - FFS demonstration plots should be as homogeneous as possible in topography, soil, water condition.
3) Establishment of FFS demonstration plot
   - FFS demo plot has two sub-plots: one for the TP-R with fertilizer, another for the TP-R without fertilizer. Another area adjacent to the demo plot with conventional practices is to be delineated for comparison.
   - The standard size of the FFS demonstration plot is 1,000 m^2, which is divided into 2 sub-plots of 500 m^2 (20 m by 25 m) each, but the size and shape may be adjusted depending on site conditions. (Respect the existing bunds in case of developed swamps, while assuring that the two sub-plots should clearly be divided by a strong bund in-between. It is also essential to set the demo plot with fertilizer in the downstream and the plot without fertilizer in the upstream in order to ensure that the fertilizer applied in the sub-plot with fertilizer should not affect the plot without fertilizer, even in case of flooding.)
   - Visit the site for the FFS demonstration plot and confirm that its condition is suitable for the purpose. If the site condition is acceptable, set up the plot using measuring tapes and sticks.

Tools and materials to be prepared: *poles, measuring tapes (2), pegs (many)*

Construction of "Drainage Canal"



Session 1-3 Construction / Rehabilitation of Bunds

Important messages:

1) Water control is a key to promote rice growth. Without water control, iron toxicity cannot be avoided, or fertilizer utilization by rice plants cannot be enhanced.
2) Paddy fields should be divided into plots by bunds so that water can be settled.

How to facilitate the session

1) Introduction
   - Ask the farmers about the present water condition of their lowland rice fields: for example, surface water (running or stagnant), water depth (high and low), shortage of water, presence of water seepage, etc.
   - Ask the farmers if they have iron toxicity in their fields. If they do, ask them to describe its symptoms (where they are observed and how they look).
   - Tell the farmers that they can reduce their iron toxicity problems by making drainage ditches in the plot and by making raised beds on which rice is planted.
   - Tell the farmers that water control is an important farming practice for the healthy growth of rice plants.

2) Importance of bunds
   - To make water conditions uniform and stable, bund construction is recommended. The plot surrounded by bund and leveled in soil surface is preferable.

3) Methods of constructing bunds

- Explain to the farmers the following points;
  - A bund is a small earth dike constructed around a rice field or in the field to divide it into plots. They keep water in the field (or the plots) for a while to prevent nutrients of fertilizer from escaping with water from the field.
  - The standard size of the bunds is about 20cm in height and 50 cm in width, although it can be adjusted depending on the site conditions.
  - Earth of the bunds should be compacted to be strong enough to sustain the structure even if people walk on the bunds and to prevent the water in the field from escaping through horizontal seepage.
  - Division of the plots by bunds should be made so that each of the plots is leveled to keep water level uniform assuring the uniform growth of rice plants.
  - A simple inlet and outlet should be established to draw in or drain out water.

Brushing, Clearing & Digging

Session 1-4 Land Preparation (Brushing, Cleaning and Digging)

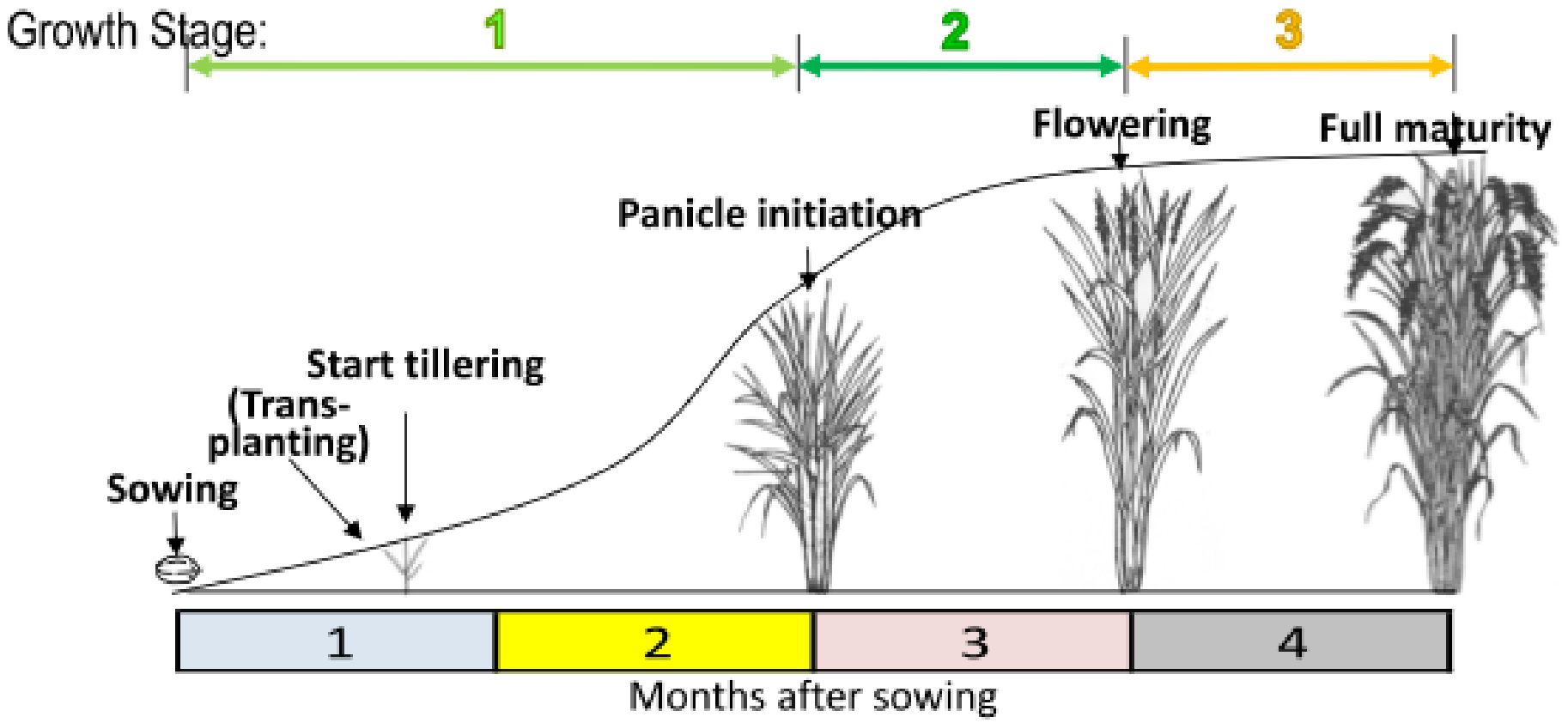
Important messages:

1) Brushing, clearing, and digging are to eliminate obstacles (weeds including roots) against rice seedlings when they are transplanted.
2) Brushed materials should be collected and brought out of the field or dried and burned in the field.
3) First digging (correspond to plowing) aims also at turning over and breaking soils and cutting roots of weeds.
4) Brushing, clearing, and digging should be finished before nursery preparation.
5) Digging should be done as deeply as possible.

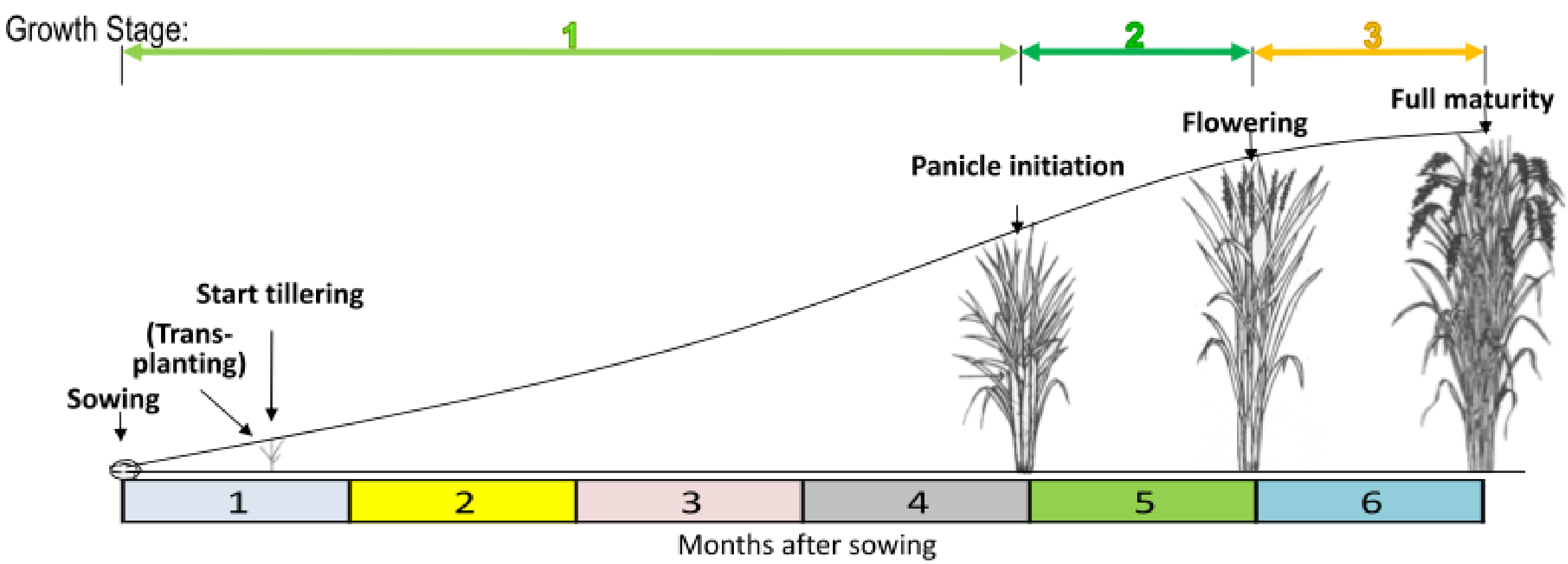
How to facilitate the session:

1) Introduction
   - Ask the farmers about their land preparation procedure including brushing, clearing, and digging.
   - Ask the farmers when they prepare their fields, before or after sowing in the nursery.

2) Brushing, Clearing, and Digging
   - Explain the following points to farmers;
     - Weeds should be brushed just above the ground to remove as much organic matter from the field as possible.
     - Deeper digging (at least 10cm) is recommended to turn over the soil to control weeds by cutting and drying their roots; however, the subsoil should not be exposed.
     - Brushing, clearing, and digging should be finished before sowing in the nursery, not to delay transplanting. Because the nursery period is short (2-3weeks only) and also there would be other works to be done such as puddling, leveling, and maintenance of bunds and drainage channels, first digging should be finished at the earliest time.
   - Emphasize the following points to farmers while working in the FFS demonstration plot;
     - Leave brushed weeds on the ground to dry for a while until they are lighter and easier to work with
     - Collect dried weeds and take them out of the field or burn them on the ground
     - If the soil of the plot is marshy, do not leave the organic matter in the field as it exacerbates iron toxicity
     - For digging, the use of work oxen may save time and cost



Life cycle of Rice plant



Session 2-1 Life Cycle of Rice Plant

Important message:

1) The entire life of rice plants is broadly divided into three growth stages.
2) The first stage (vegetative growth stage) is from sowing to panicle initiation, the second stage (reproductive stage) is from panicle initiation to flowering, and the third stage (ripening stage) is from flowering to maturity.
3) The duration of both the second stage and the third stage is almost the same with about 30 days irrespective of the varieties.

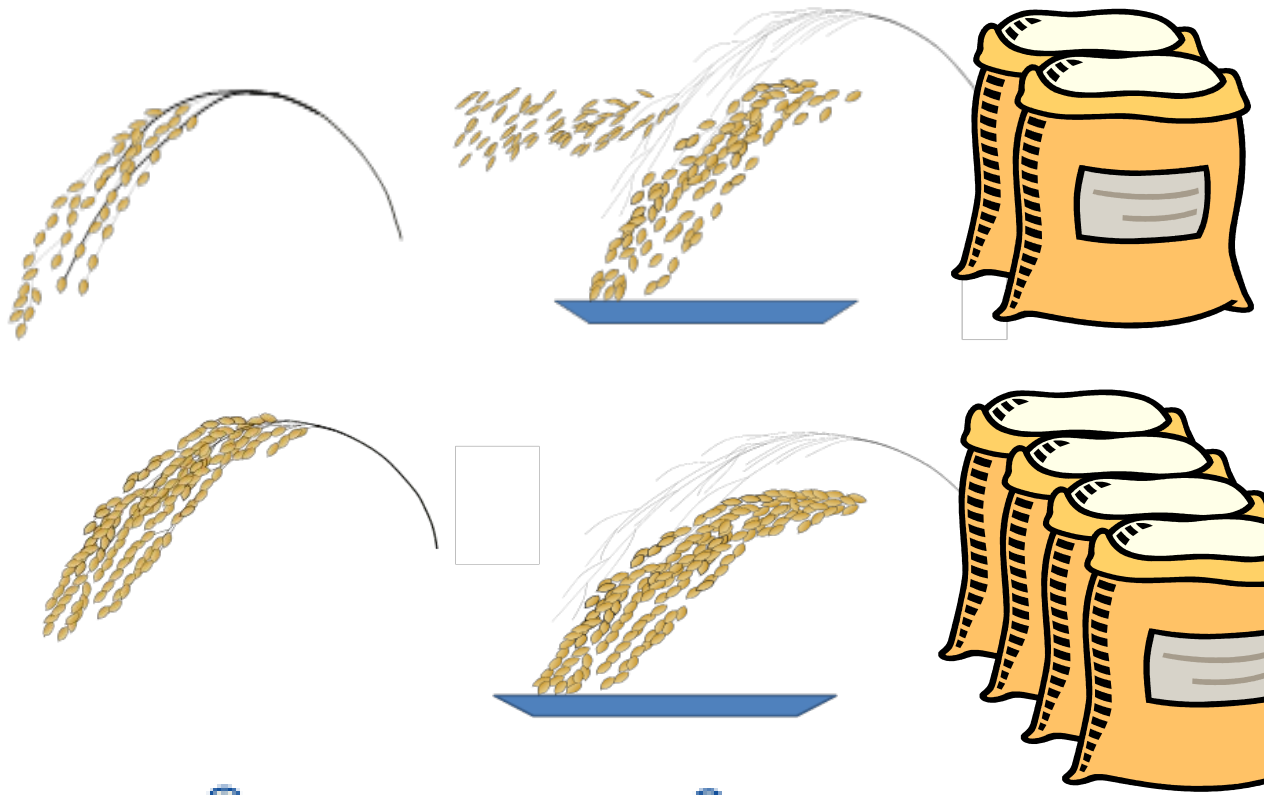
How to facilitate the session:

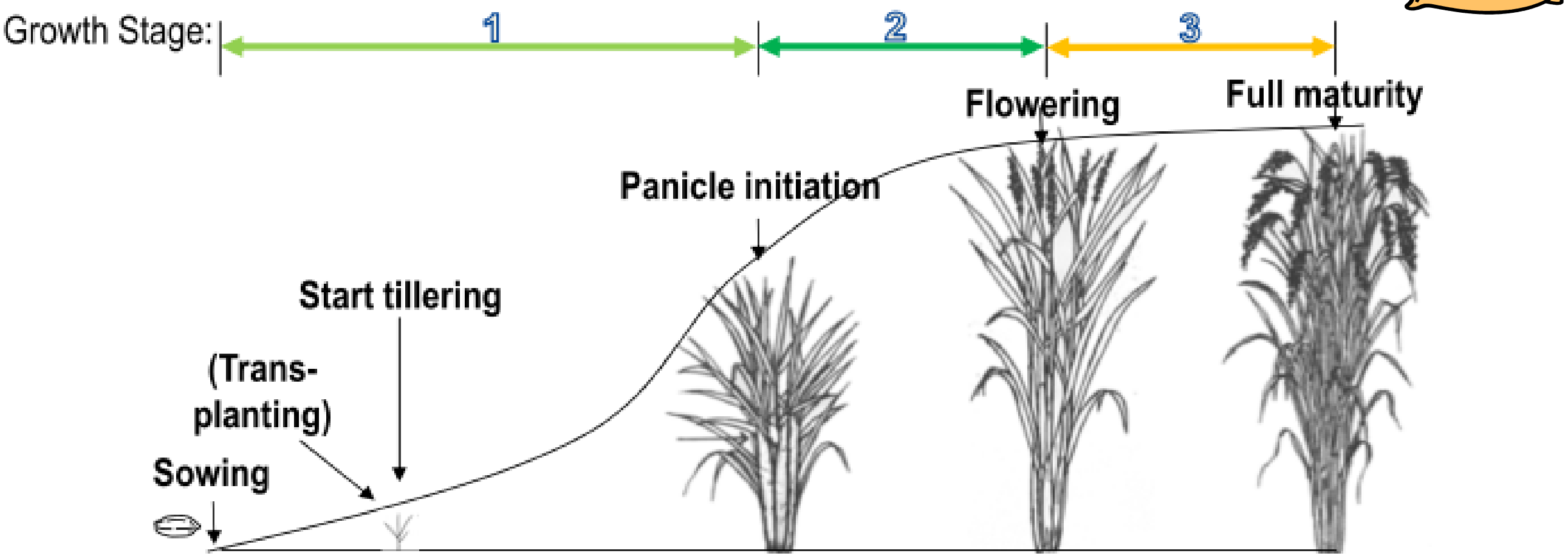
1) The life cycle of rice plant
   - Tell the farmers the following:
     - Tillering normally starts about two to three weeks after sowing (transplanting time) when the rice plant starts to develop the fifth leaf. During the period between the start of tillering and panicle initiation (vegetative growth stage), the number of panicles per unit area is determined.
     - Panicle initiation normally starts about one month before flowering. During the period between the start of panicle initiation and flowering (reproductive stage), the number of grains per panicle is determined.
     - After flowering, it will take about another one month for rice plants to mature for harvest. During the period between the flowering and full maturity (ripening stage), the ratio of grain filling is determined.

2) Three growth stages
   - Tell the farmers that the entire life cycle of rice is divided into the following three growth stages:

Growth stages	Vegetative growth	Reproductive	Ripening
Period (from A to B)	Sowing to panicle initiation	Panicle initiation to flowering	Flowering to maturity
Duration	Variable	Constant (About 30 days)	Constant (About 30 days)
Yield Component	Number of panicles	Number of grains	Rate of grain-filling

Yield components





Session 2-2 Yield Components

Important messages:

1) The three main components that affect rice yield are the following:
   - The number of panicles per unit area (more the panicles, higher the yield),
   - The number of grains per panicle (more the grains, higher the yield), and
   - The rate of grain-filling (more the grain-filling, higher the yield).
2) The value of each component is determined in a particular rice growth stage.
3) The farmers can improve these components and obtain higher yield through better farming practices.

How to facilitate the session

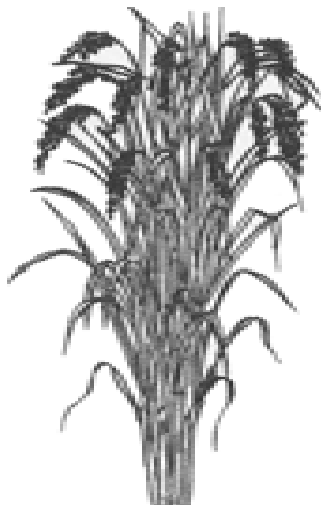
1) Three components that determine rice yield
   - Explain to farmers the three components that determine rice yield which are:
     - The number of panicles per unit area,
     - The number of grains per panicle, and
     - The rate of grain-filling.
2) The period that determines each component
   - Show the farmers the life cycle of the rice plant.
   - Explain to farmers that each component that contributes to the grain yield is determined in a particular growth stage.
     - The number of panicles per unit area: Vegetative Growth Stage
     - The number of grains per panicle: Reproductive Stage
     - The rate of grain-filling: Ripening Stage
3) To obtain a higher yield
   - Tell the farmers that a higher yield can be obtained by improving the value of yield components through better farming practices.
     - More panicles per unit area
     - More grains per panicle
     - More filled grains

Various varieties

- Long duration (6 months)

1 2 3 4 5 6

- Tall (130 cm)



- Photosensitive

- Medium duration (5 months)

1 2 3 4 5

- Medium (115 cm)

- Tolerant to Fe toxicity

- Medium duration (4 months)

1 2 3 4

- Medium

- Short duration (3-3.5 months)

1 2 3

- Short

Session 2-3 Various Varieties

Important messages:

1) The difference between long-duration and short-duration varieties is its difference in the duration of the vegetative growth stage. Long-duration varieties have a long vegetative growth stage, while the short duration varieties have a short vegetative growth stage.
2) Each variety has its own characteristic in terms of plant height, grain color, resistance to disease, suitability for agroecology, etc.

How to facilitate the session:

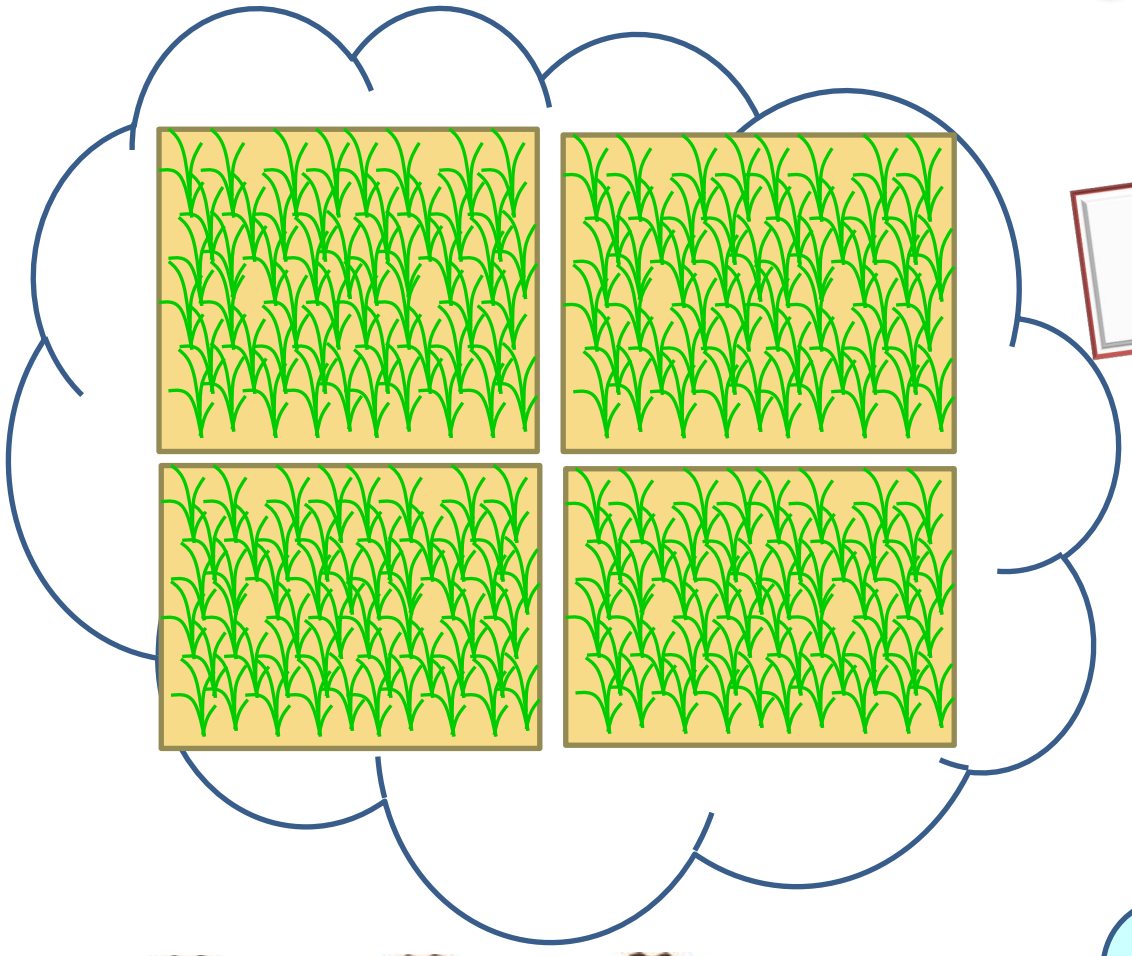
1) Growth duration of various varieties
   - Take one variety (long or short duration) as an example. Ask the framers to answer the growth duration (from sowing till full maturity) of that variety. The table below provides some information on the growth duration of several varieties commonly cultivated in the target areas of SRPP.

Variety	Growth duration	Remarks
NERICA L19	4 months (120 days/17 weeks)	
Pa Kiamp	4.5 months (135days/19 weeks)	Grow in both lowland and upland
ROK 5	4.5 months (135days/19 weeks)	For IVS and mangrove swamp
ROK 10	6 month (180 days/29 weeks)	Adapted to IVS, boliland, and mangrove swamp
ROK 24	5 months (145 days/20 weeks)	Tolerant to iron toxicity
Butter Cup	3-3.5 months (95-105 days/13-14 weeks)	

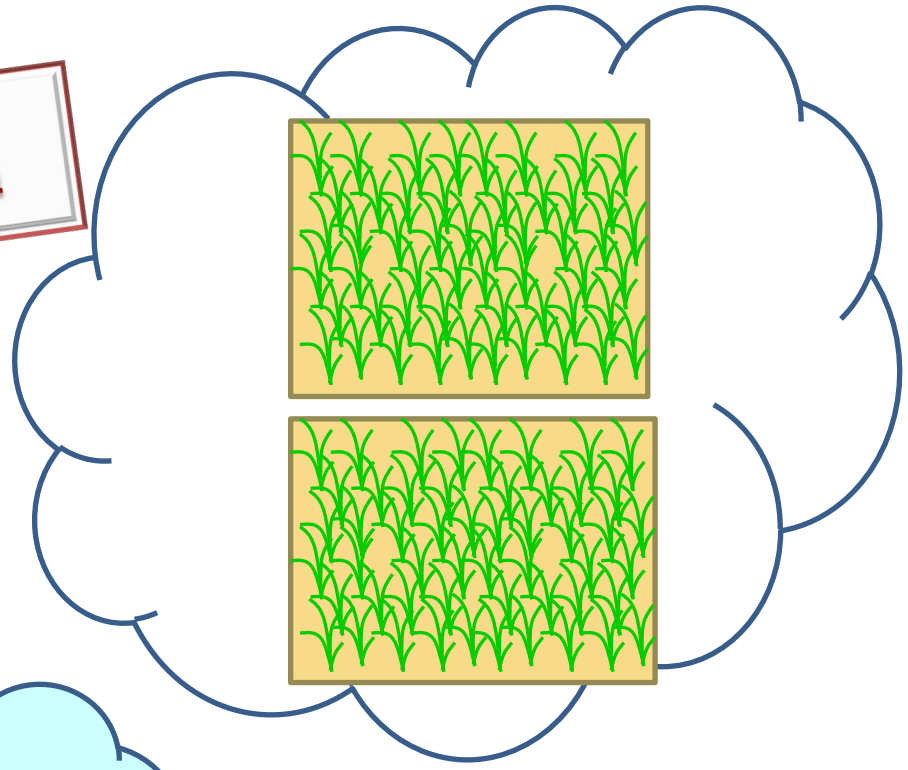
   - Explain that the different growth duration among varieties is attributed to the differences in the duration of their vegetative growth stage.

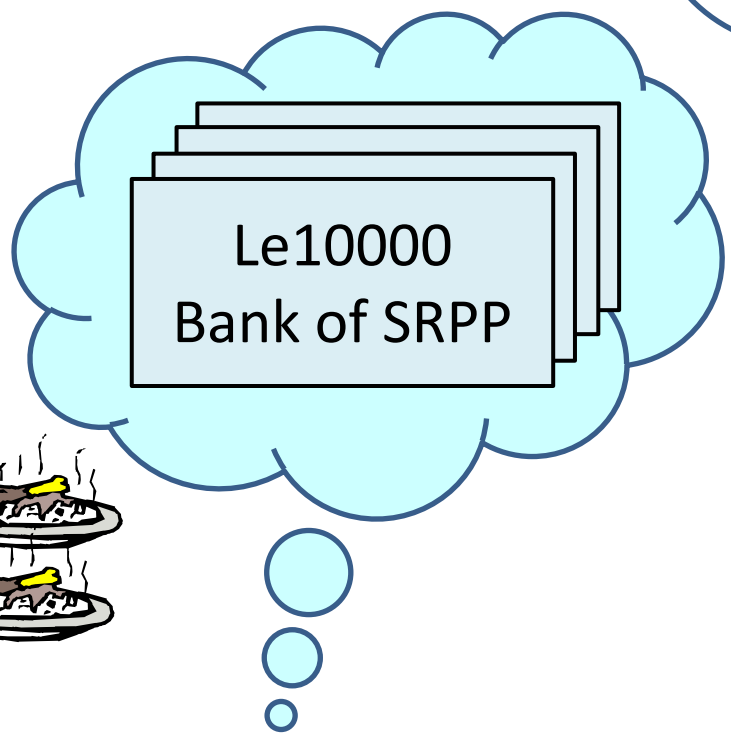
2) Different characteristics of various varieties
   - Tell the farmers that each variety has its own characteristics such as;
     - Growth duration: short, medium, or long duration
     - Tillering habit: high or low
     - Plant height: tall or short
     - Suitability for agroecology
     - Grain color: white, yellow, red, etc.
     - Tolerance to diseases

Technical Package on Rice Production - SRPP



Farming Plan





Session 3-1 Formulation of Farming Plan

Important messages:

1) Farmers should prepare a farming plan before starting a cropping season. According to the plan, they should prepare required resources for farming in the season.
2) Farmers should secure farm inputs (land, seed, laborers, etc.) according to the scale of farming and expected production.

How to facilitate the session:

1) Introduction
   - Ask the farmers to list up necessary inputs to be used for rice farming and write them down on flipcharts (e.g., seed rice, fertilizer, laborers, small hoes, large hoes, shovels, head pans, buckets, rice bags, tarpaulin sheets, winnower, etc.)
   - Ask the farmers if they have clear idea on the balance of payment of their rice farming (whether the expenditure is covered by the value of the rice produced)

2) Farming plan
   - A farming plan is worked out in the following manner:
     (1) Determine the location and area of the farm
     (2) Decide the rice variety to cultivate
     (3) Make sure that viable seed of the variety to be used is available
     (4) Calculate the required amount and quantities of inputs
     (5) Secure laborers and fund
     (6) Make sure the necessary tools and materials are available
     (7) Make sure that seed rice is viable
     (8) Procure fertilizer, seeds, and other necessary inputs
     (9) Prepare the cropping calendar

   - Tell the farmers to make a feasible plan based on the availability of labor and fund, which may often become constraints to the farming scale.
   - Tell the farmers to prepare fertilizer and seed rice well before a farming season starts because they are also sometimes hard to find

Technical Package on Rice Production - SRPP

Cropping Calendar

May (5)	June (6)	July (7)	Aug (8)	Sept (9)	Oct (10)	Nov (11)	Dec (12)

1	2	3	4	5

Session 3-2 Formulation of a Cropping Calendar

Important messages:

1) Farmers should prepare a cropping calendar that is appropriate for the rice variety to be cultivated. According to the plan, they should schedule the timing of land preparation, nursery preparation, sowing, transplanting, fertilizer application, weeding, and harvesting.

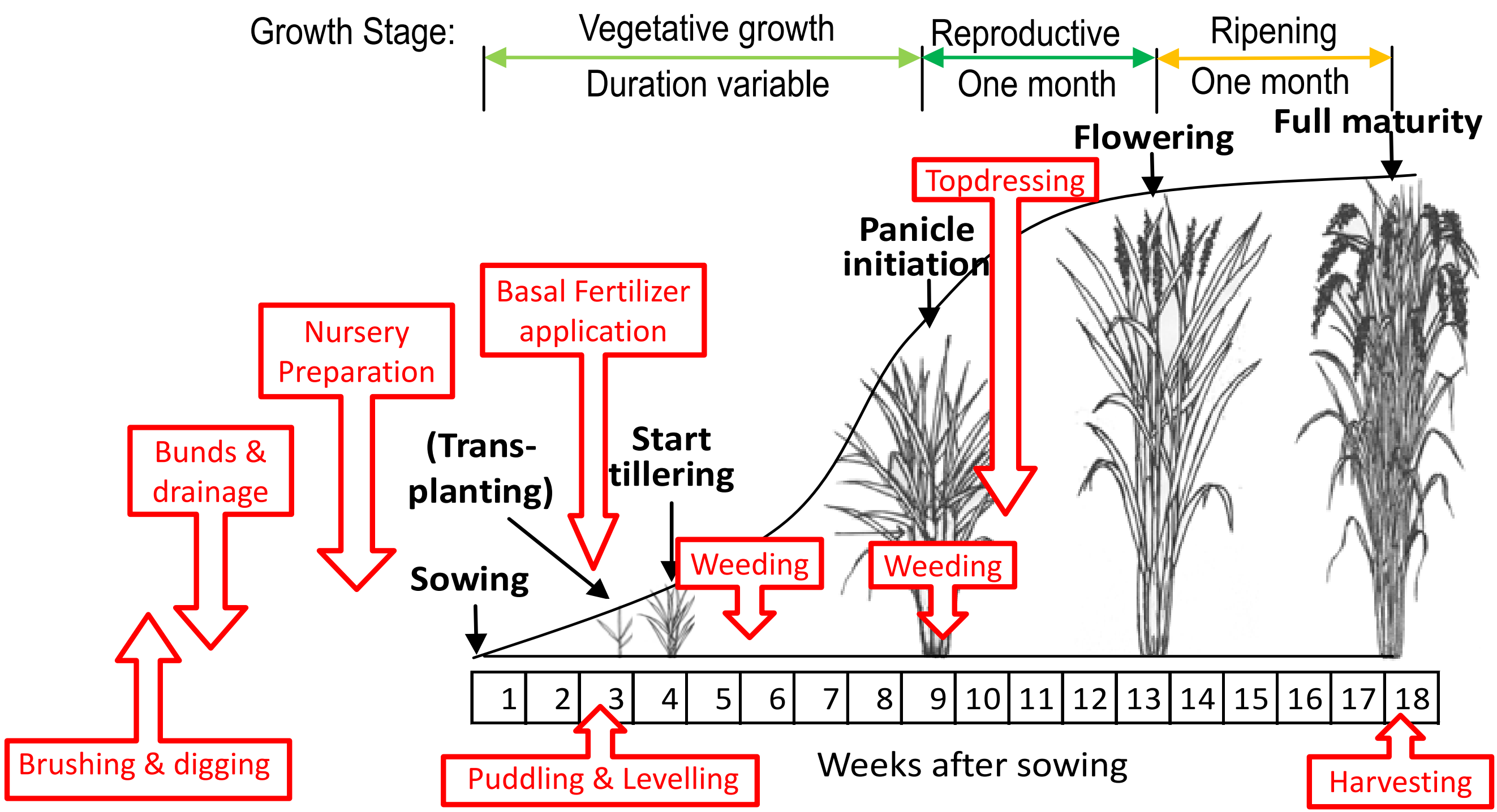
How to facilitate the session:

1) Introduction
   - Ask the farmers to describe their farming practices according to a variety to be used throughout the rice growth period in the order and write them on flipcharts (e.g., brushing, digging, bund making, drainage construction, nursery preparation, sowing, puddling, leveling, uprooting, transplanting, fertilizer application, weeding, water management, bird-scaring, harvesting, transporting, threshing, bagging, etc.)

2) Discussions
   - Ask the farmers to tell the appropriate timing of each activity in their normal undertakings. Emphasize the importance of making concrete plans with identification of specific time for each activity, as the timing of some activities causes positive or negative influence the growth of rice plant, thereby the yield. Farmers should know when to do what in order to grow their rice well and thus to obtain a good harvest at the end.

Tools and materials to be prepared: *Markers and Flipcharts*

CROPPING CALENDAR (Example of NERICA L19)



<u>Session 3-3 Formulation of a Cropping Calendar - Exercise</u>

Important messages:

1) Farmers should prepare a cropping calendar for the Group Farm, especially for the demonstration plots of this FFS.

How to facilitate the session:

- Explain to the farmers how to prepare a cropping calendar using the timeline indicated.
- Together with the farmers, prepare the cropping calendar with the identification of a specific date for every activity.

- Steps to formulate the cropping calendar
  (1) Set the expected time of harvest so that the ripening stage coincides with a period of sunny days
  (2) Avoid transplanting and topdressing during the peak rainy season
  (3) Decide when to sow the seeds, taking into account the growth duration of the rice variety to be used
  (4) Decide when to start brushing so that the first digging can be finished before sowing
  (5) Transplanting should be scheduled about 3 weeks after sowing seeds
  (6) Set the time of first weeding at 2-3 weeks after transplanting
  (7) Set the time of topdressing at about 2 months before the harvest time

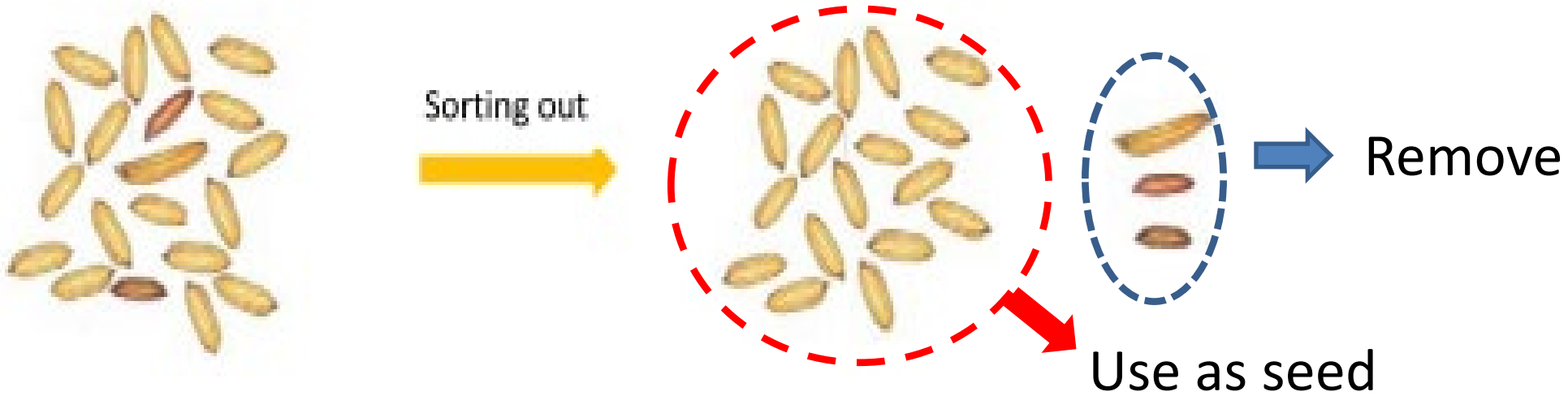
Tools and materials to be prepared: *Markers and Flipcharts*

Technical Package on Rice Production - SRPP

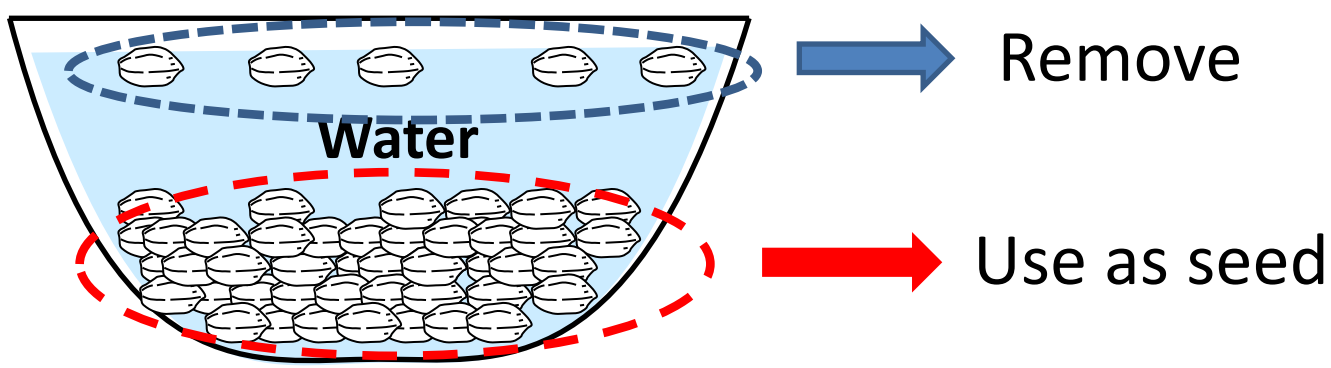
Sorting

↓

Purity



Selection with water



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Viability

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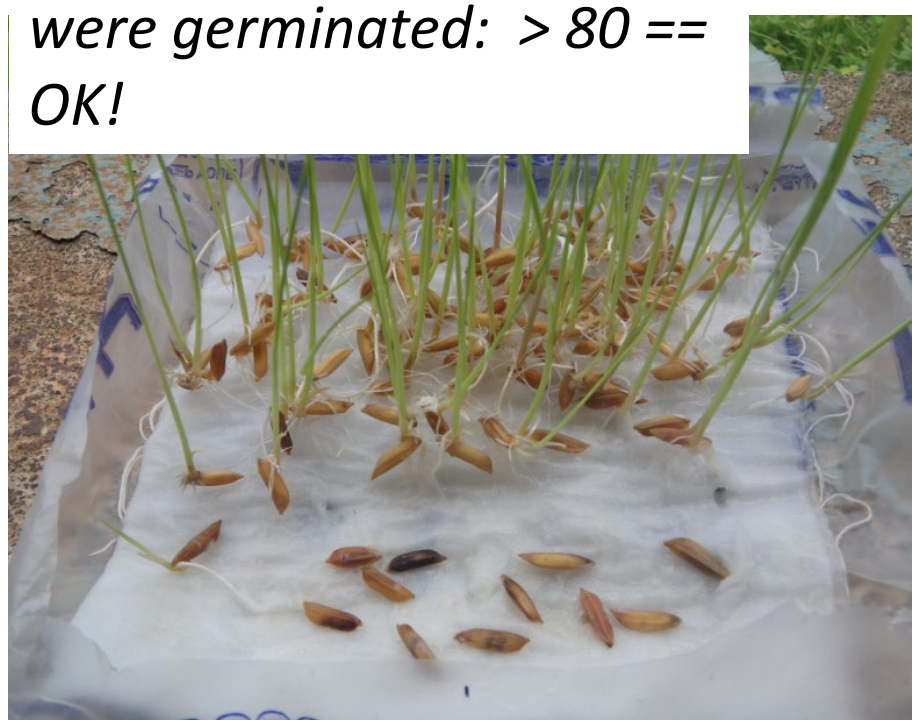
Germination Test

Count the number of germinated seeds after 4 days incubation

Out of 100 seeds, 88 seeds were germinated: > 80 == OK!



Session 3-4 Seed Selection

Important messages:

1) It is important to use pure (not mixed) and viable seeds to get a higher yield.
2) Cleaning of seeds should be done through sorting out.
3) The selection of healthy seeds is done by soaking in water.
4) A germination test should be conducted to confirm the viability of the seeds.

How to facilitate the session:

1) Sorting seeds
   - For seed purification, tell the farmers to find grains with different shapes and colors, weed seeds, and other foreign matter by carefully observing seeds and that those should be removed. It is important to remove the seeds of wild rice which may not easily be detected like weeds before heading, and by that time they will compete with rice plants for nutrition, sunlight, water, etc., thereby bringing negative effects on rice growth.
   - Explain to the farmers that if varieties with different growth periods are mixed, application of topdressing will not be effective due to the different timing of panicle initiation.
   - If time allows, let the farmers exercise sorting with a small amount of seed rice.
2) Selection of viable (high germination ability) seeds
   - Explain (and demonstrate) to the farmers the method of selecting healthy seeds by soaking them in water: To eliminate infertile and unfilled seeds, soak all seeds in water and remove those that float.
3) Germination test
   - Explain (and demonstrate) the method of germination test as follows:
     - Select 100 grains at random
     - Put them on absorbent material (e.g., paper, cloths, etc.) and keep them saturated for 4-5 days to 1 week at the maximum.
     - Count the number of germinated grains
     - If more than 80 grains out of 100 have germinated, the grains can be used for seed rice; If 70 to 80 have germinated, augment the amount of seeds by 10%, and If less than 70 have germinated, find another source of seed rice.

Tools and materials to be prepared:

Bucket, water, seed rice, newspaper (for soaking)

Plate, absorbent, water, seed rice (for germination test)

Nursery preparation (Site selection)

Nursery needs sunlight, fertile soil and sufficient moisture

Session 4-1 Nursery Preparation (Site Selection)

Important messages:

1) A nursery site should be in an open area full of sunlight to grow healthy seedlings.
2) The land for a nursery should be dry in the rainy season free from flood and inundation while it should be wet in the dry season with sufficient water supply.
3) Soils of the nursery bed should be fertile enough for seedlings to grow healthily during nursery period.
4) Nursery soils should not be of heavy clay, nor full of gravel.

How to facilitate the session:

1) Introduction
   - Ask the farmers how they usually select a nursery site for the rainy season cropping; if they do double cropping, also ask them how they select a nursery site for the dry season cropping.

2) Selection of nursery site
   - Explain to the farmers that, in general, a dry nursery is recommended for the rainy season to avoid high humidity and inundation.
   - Tell the farmers the desirable nursery conditions as follows.

   a) Where the sun shines:
      - Seedlings grown in open place become thick and strong with green color, while ones in shaded place are thin, tall and soft with yellowish color.

   b) Soils of not heavy clay and without too much gravel:
      - Heavy clay is difficult to plow and inhibits the growth of the root. It also makes uprooting difficult. On the other hand, soil with too much gravel makes it difficult to keep the moisture in the soil.

   c) Fertile soil (not sandy soil; preferably cultivated soils after vegetable production with fertilizer) to assure nutrient supply.

   d) Accessible to water sources: To ease watering.

   e) Free from inundation: To avoid risk of fungus diseases due to high humidity.

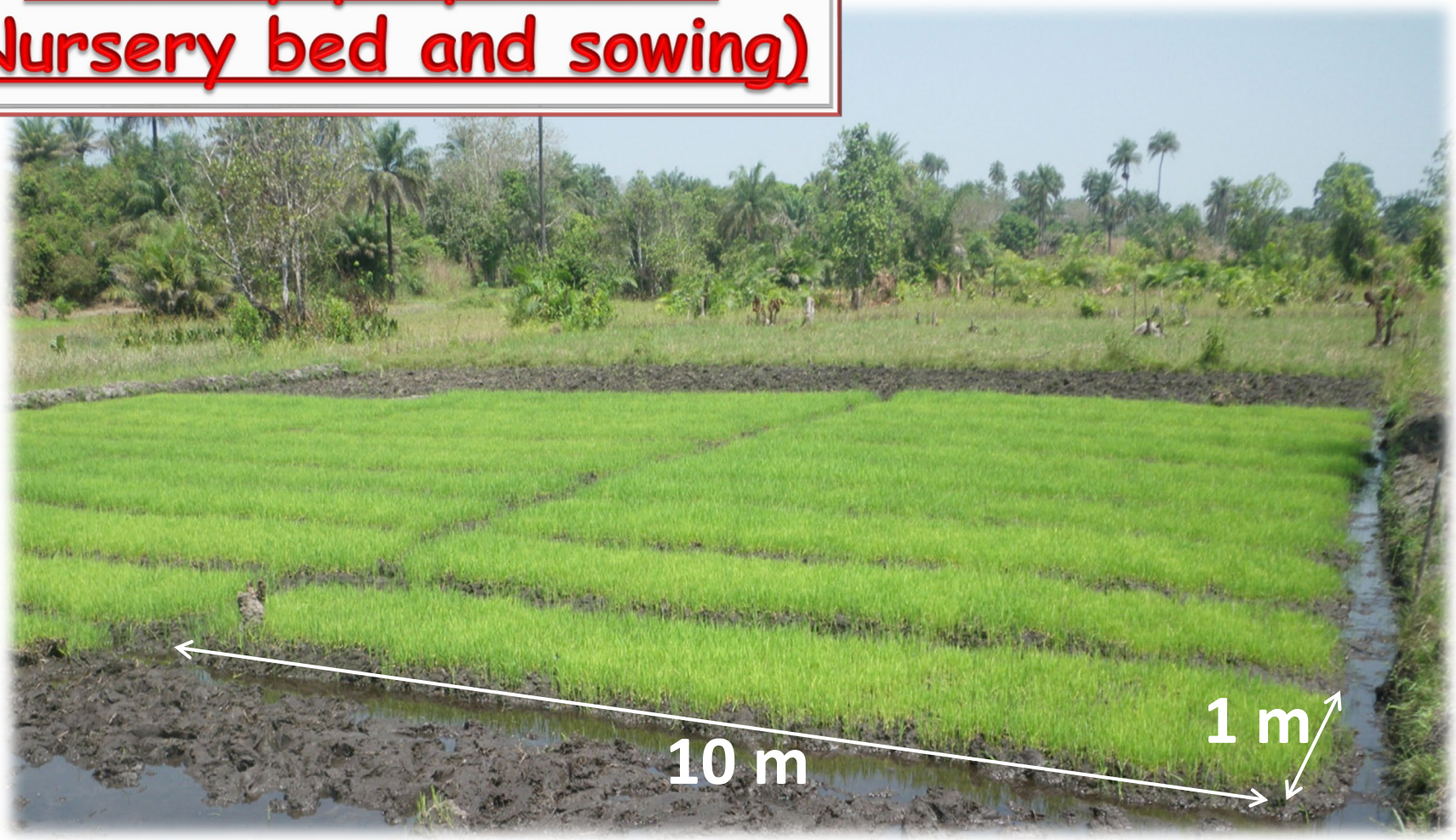
   f) Free from flood: To avoid for seedlings being swept away.

   g) Easily accessible: To ensure proper supervision and care of seedlings.

   h) Not too far from the main field: To ease transporting seedlings when transplanting.

   i) Not on a steep slope: To enhance the uniform growth of the root and avoid seedlings being swept away by run-off water.

Nursery preparation (Nursery bed and sowing)

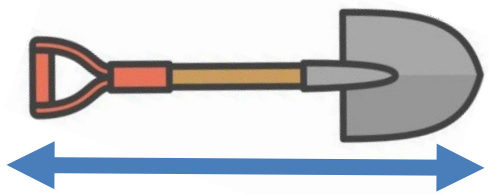


"Liter Cup"

Seed Rice:

1 kg

= 2 liter



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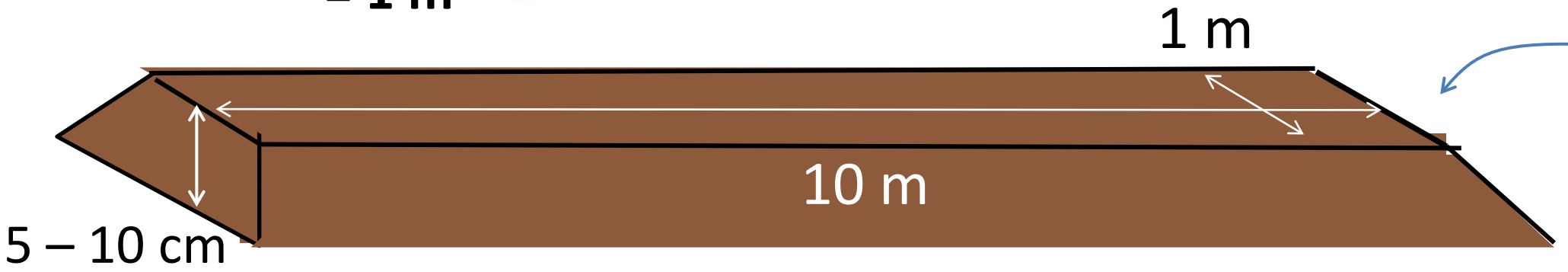
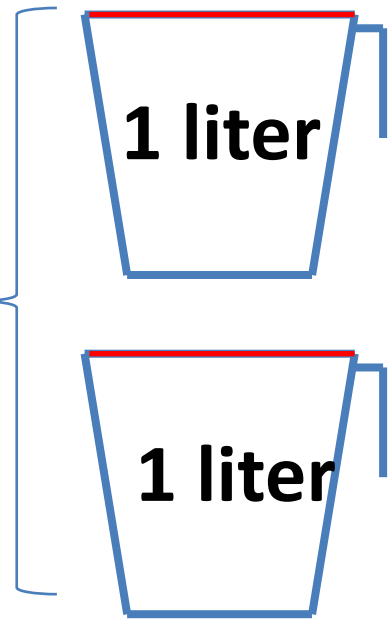




Session 4-2 Nursery preparation (Amount of Seed and Nursery Bed)

Important messages:

1) Nursery area is about 1/30 of main field area, and sowing density is about 1 kg per 10 m^2.
2) Nursery bed is slightly raised and divided into small beds by a footpath/water course to make the work easy and to control water. Soils should be well tilled before sowing, possibly with application of well matured compost, if available.
3) The amount of seed required in the main field is about 30 kg per ha which is much smaller compared to the conventional technique.

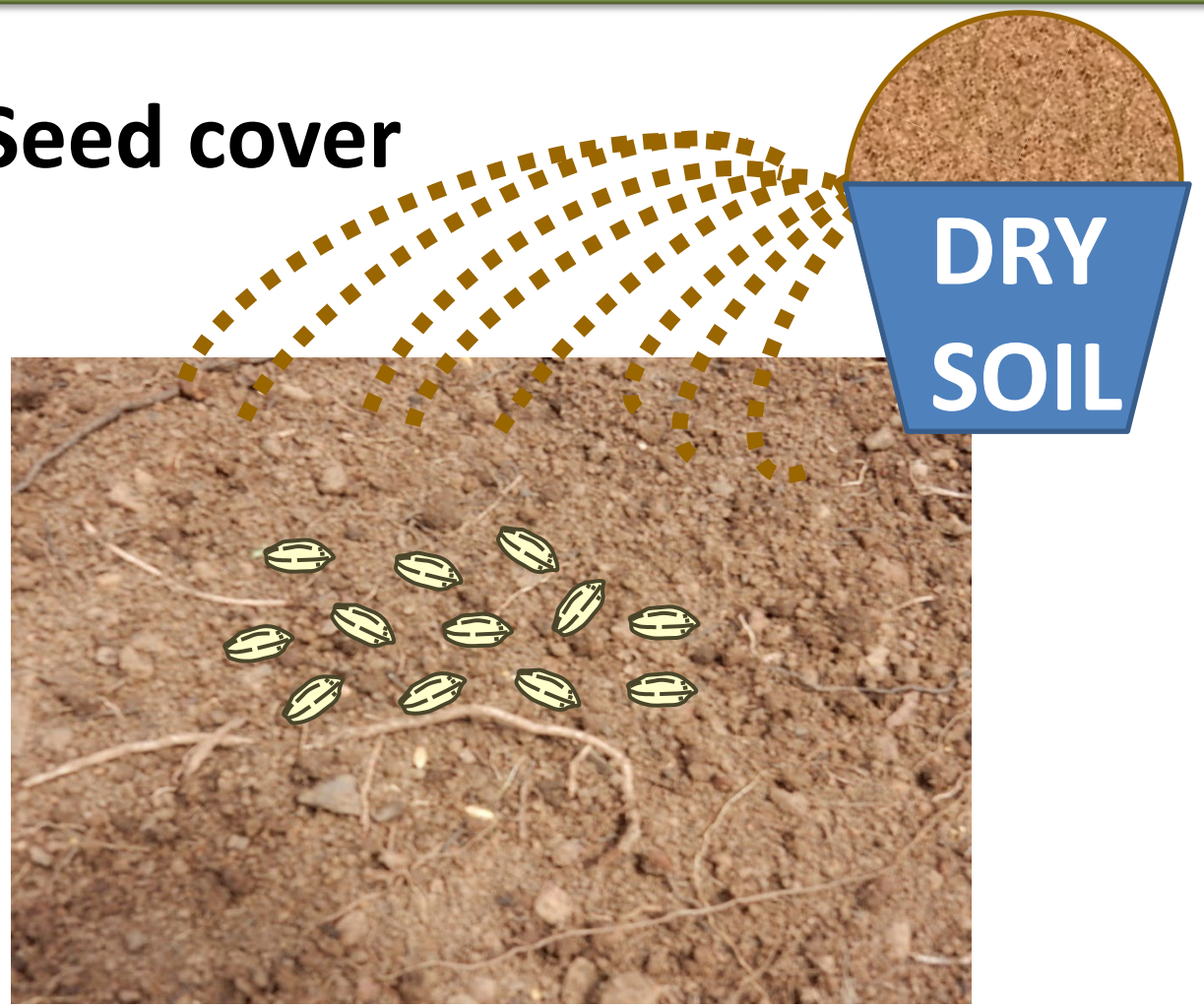
How to facilitate the session:

1) Amount of seed
   - The amount of required seed is much smaller with the improved techniques of the TP-R than in the conventional practices.
   - The standard seed rate for the main field is about 30 kg per ha (30 kg/10,000 m^2) or 12 kg per acre (12 kg/4,000 m^2) if the farmers follow the recommended transplanting and crop management.
   - This rate is much lower than the conventional rate, which is 1 local bushel (standard bushel is 25 kg) per acre (4,000 m^2); they can drastically reduce the amount and cost of seed.
2) Nursery bed
   - Recommended nursery area is about 1/30 of the main field: if the area of the main field is 1 acre (4,000 m^2), the area of the nursery is about 130 m^2.
   - For easy nursery management, a nursery bed size of 10 m by 1 m is recommended. To make the nursery of 130 m^2, 13 nursery beds of 10 m^2 are required. Tell the farmers that the standard length of shovel is about 1m.
   - The standard seedling rate is 1 kg of seeds per 10 m^2 nursery bed. As 1 liter-cup of seed is equivalent to about 0.5 kg, 2 liter-cups of seed are enough for sowing a 10 m^2 nursery bed.
   - The total amount of the seed required for the demo plot (1,000 m^2 in total) for this FFS is 3.0 kg. Three beds of 10 m by 1 m will be established and 1.0 kg of seeds are to be sown in each of the beds. Seedlings of one and half beds are to be transplanted in each of the two sub-plots.
   - High sowing density may weaken seedlings, and a large nursery is laborious.
   - Nursery bed is slightly raised at 5 to 10 cm from the ground level and divided by a footpath/water course to make the work easy and to control water. Soils should be well tilled before sowing. It is recommended that the well matured compost is applied, if available, to the soil at the time of tilling.

Tools and materials to be prepared: *Hoe, measuring tape, sticks, strings or ropes*

Sowing density

Seed cover



Session 4-3 Nursery Management

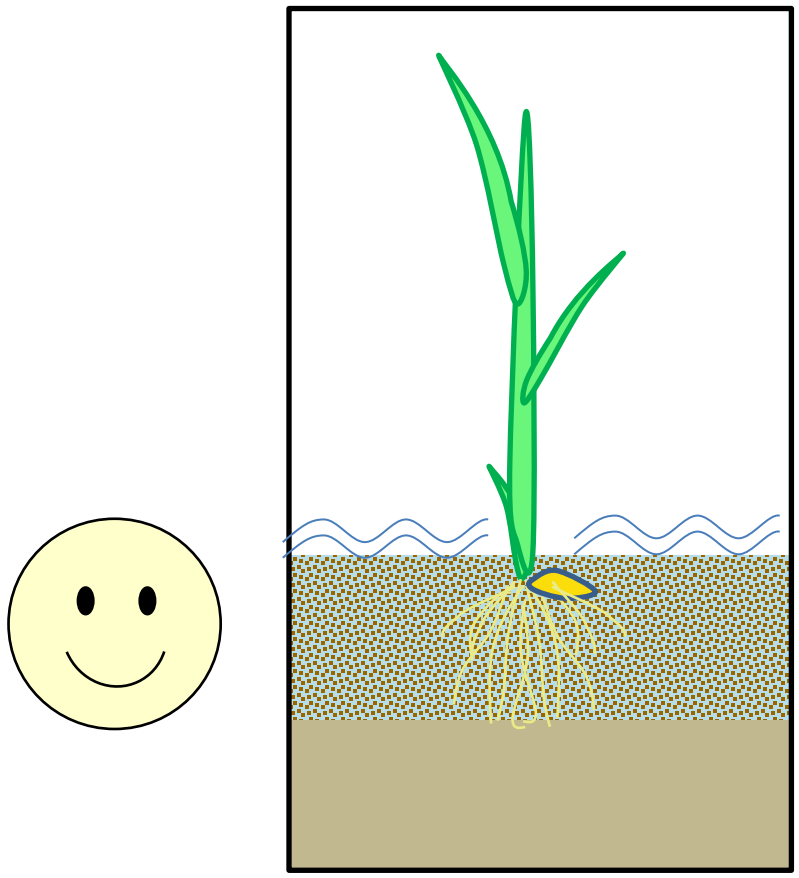
Important messages:

1) The seeds should be sown on nursery bed uniformly in each nursery bed
2) The seeds should be thinly covered with dry soil after sowing.
3) Nursery beds should be covered with palm leaves until germination so as to protect the sown seeds from being washed out by rain or attacked by birds.

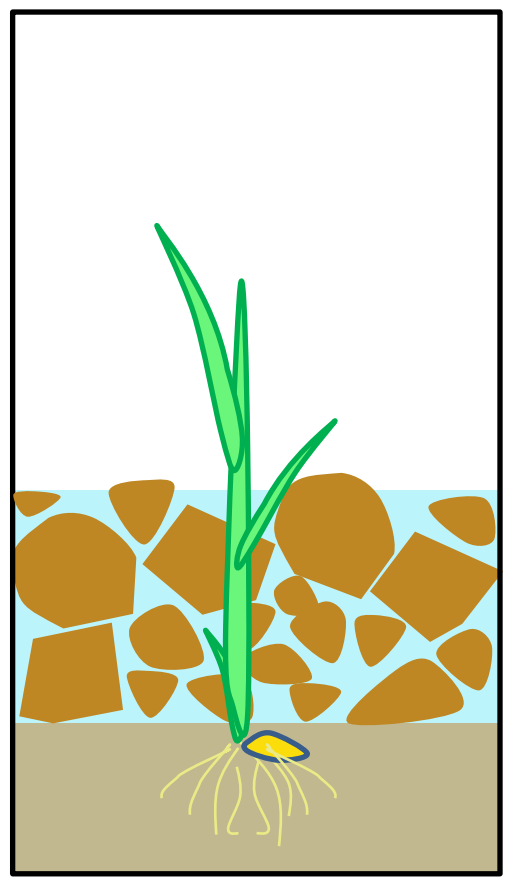
How to facilitate the session:

1) Introduction:
   - Ask the farmers how they normally sow the seeds in the nursery beds. Discuss with farmers what are the cautions to be made in sowing the seeds and management after sowing until the transplanting.

2) Cautions to be made in sowing and nursery management:
   - Tell the farmers to equally divide the seeds corresponding to the number of the nursery beds before sowing.
   - Explain to the farmers that the seeds should be sown sparsely but uniformly in each nursery bed. If congested, the growth of seedlings will not be uniform.
   - After sowing, the seeds should sufficiently be covered with dry soil.
   - It is advisable that the nursery beds are covered with palm leaves until germination to protect the sown seeds from being washed away by heavy rain or attacked by birds.
   - It is also necessary to check the soil of the nursery beds to make sure that it contains enough moisture, depending on the weather condition. If the rain falls less, the nursery beds should be watered from time to time.



Puddling



Session 5-1 Importance of puddling

Important messages:

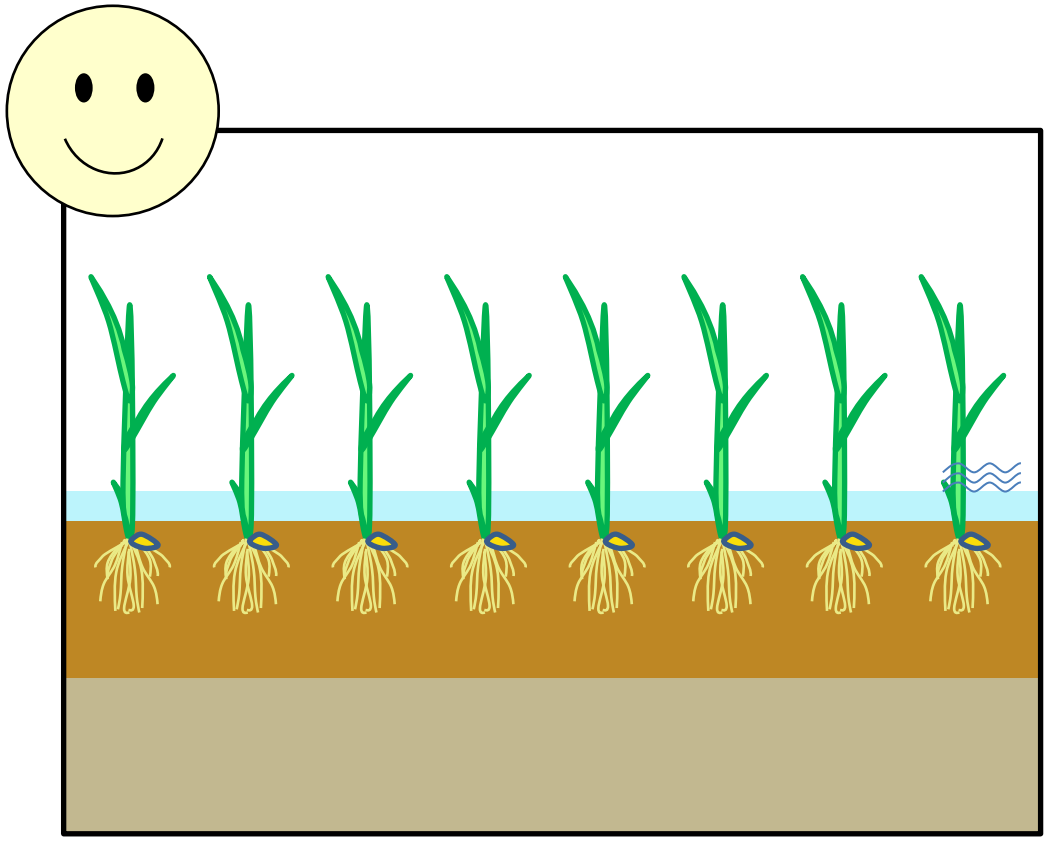
1) Puddling is conducted to mix soils well with water so that roots of the seedlings can freely grow and easily absorb water with nutrients right after transplanting.

How to facilitate the session

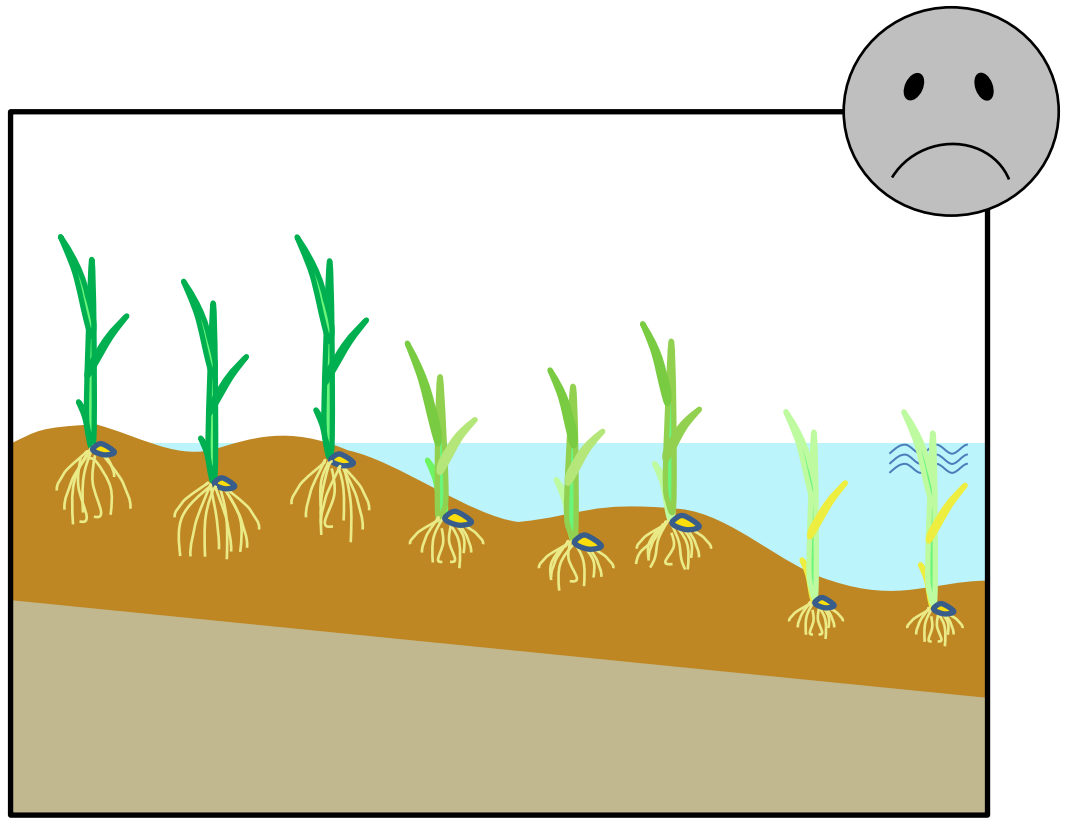
1) Introduction
   - Ask the farmers about the way they usually puddle (when, how often, how deep, by what kind of tools or method, etc.).
   - Tell the farmers that seedlings need soft soils to grow healthily.

2) Puddling
   - Describe puddling to the farmers as follows:
     - Puddling is the process of mixing water into the soil to make a muddy condition. Proper puddling is necessary for the uniform growth of seedlings, especially under shallow planting conditions.
     - The well-puddled field provides a favorable environment for root development. (Picture and photo on the left)
     - If puddling is not conducted, root development might become poor and the root cannot easily absorb water. (Picture and photo on the right)
   - Describe the proper method of manual puddling to the farmers as follows (If possible, practice it on the field together with farmers):
     - After breaking the large clods into small ones by hoe, stamp on the clods to further break them down into the mud.
       ✧ *Give the farmers a hint: Puddling provides comfortable room for transplanted seedlings to grow. It is like a bed for a newly born baby to sleep in.*

Tools and materials to be prepared: *Hoes and shovels*



Leveling



Session 5-2 Importance of leveling

Important message:

1) Leveling is conducted to provide rice plants with a uniform environment for growth in terms of water and nutrients.

How to facilitate the session:

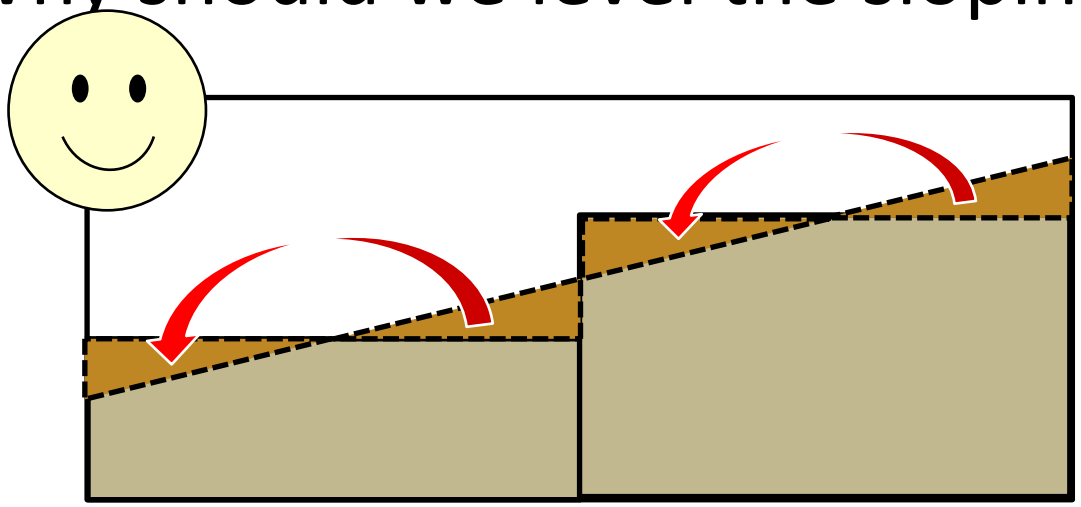
1) Importance of leveling
   - Tell the farmers the advantage of leveling as follows:
     - Leveled soil surface provides the uniform depth of water for rice plants in the plot, thus contributes to the uniform growth of the plants. (Picture and photo on the left)
     - In a field on the inclined or undulated ground, the water condition varies across the field and the growth of rice plants becomes uneven. (Picture and photo on the right)

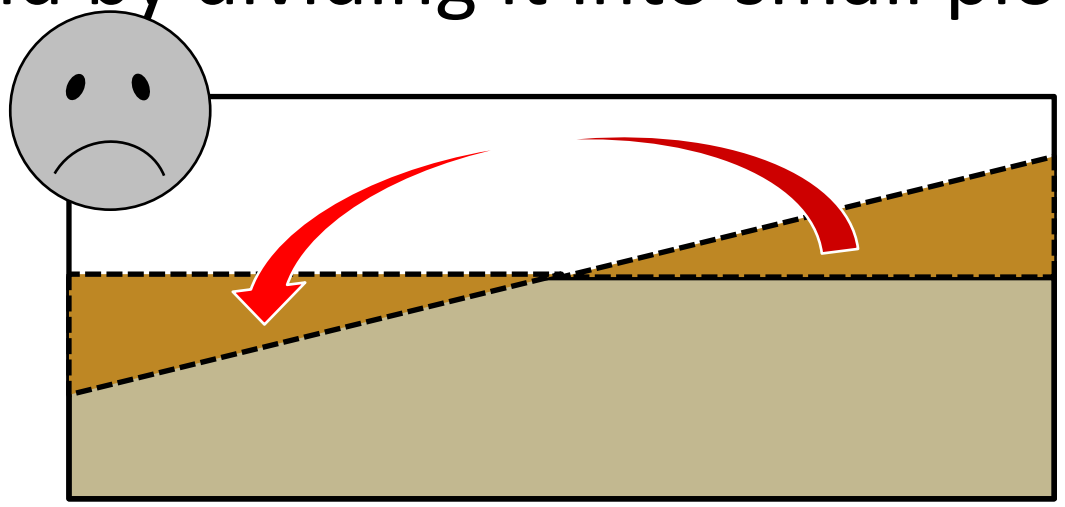
2) How to conduct leveling
   - Describe the proper method of manual leveling to the farmers as follows (Practice it in the field with farmers after explanation):
     - Leveling should be done when the water in the plot is shallow and the ground level can easily be checked. Move some amount of soil from the higher corner to the lower corner of the plot by hoes, shovels, head pans, or other tools.
     - A simple tool (rake) is useful for micro land leveling. (Photo in the center)

Tools and materials to be prepared: *Hoe, shovels, ground rakes*

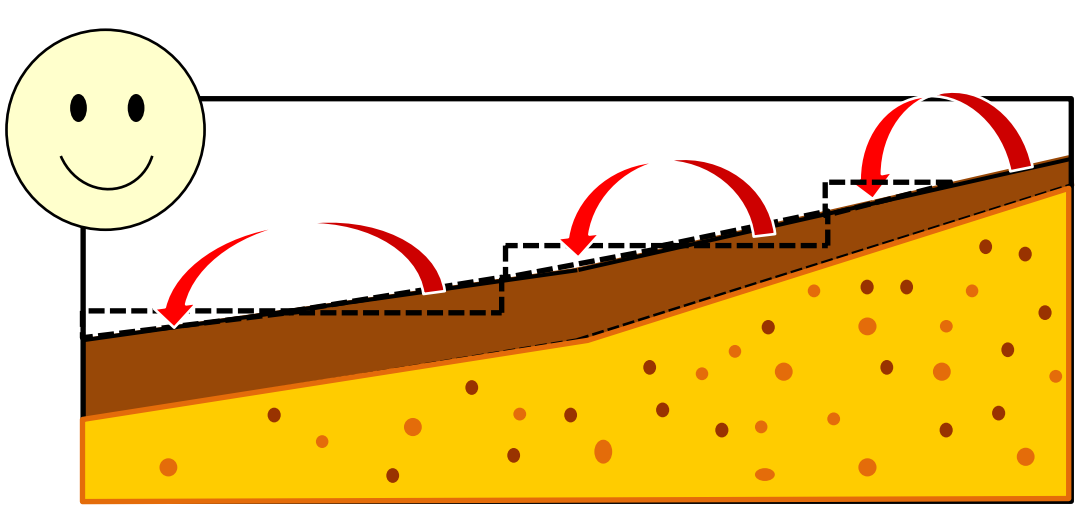
Terracing

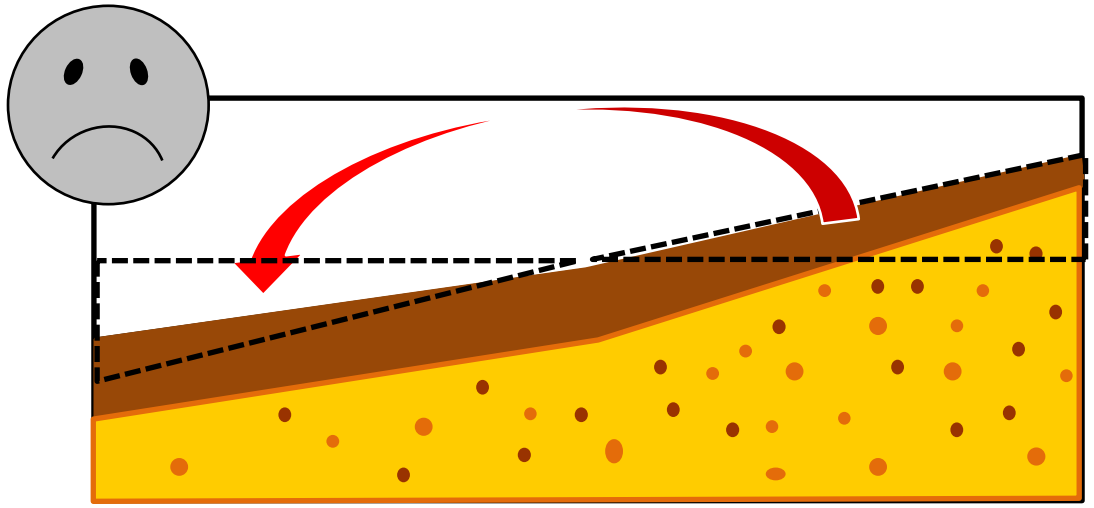
Why should we level the sloping field by dividing it into small plots?





Answer 1: To save the laborious earth work





Answer 2: Not to disturb subsoil

Session 5-3 Terracing

Important message:

1) Terracing may ease the leveling of the plots in the inclined locations. Dividing one big plot into smaller sub-plots can save the required labour for leveling and prevent the subsoil from being disturbed.

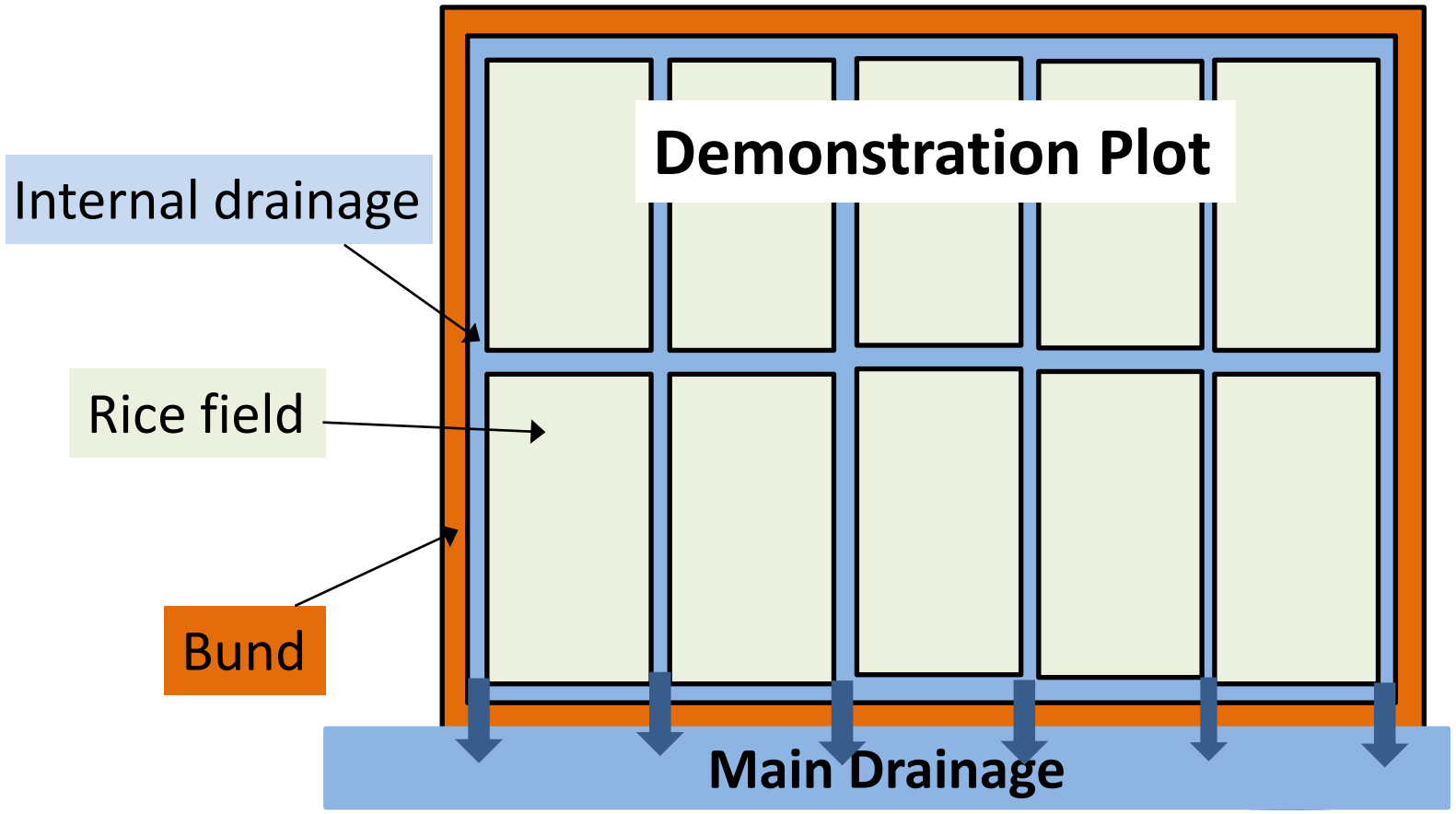
How to facilitate the session:

1) Terracing
   - Ask the farmers if they are familiar with the terraces in the rice fields.
     - The ground level can be different from plot to plot (higher in the edge of a swamp and lower in the center of a swamp), but the surface of the rice field should be as flat as possible.
     - If a plot is on a steep incline, it is desirable to divide the plot into smaller sub-plots as leveling is easier for small plots than a large and sloped plot.

2) The benefits of dividing the plot into smaller sub-plots
   - Ask the farmers why the inclined plot should be divided into smaller plots:
     - Explain to the farmers that the amount of the soil to be moved would be less in the smaller plots than the bigger one by comparing the two upper pictures. Movement of the soils between the divided smaller plots would require less labour.
     - When moving the soil from the higher corner, it is important NOT to completely remove the surface soil from one part of the plot. By showing the lower two pictures, explain to the farmers that dividing the plot into smaller sub-plots can also assure that the subsoil should not be disturbed.

Tools and materials to be prepared: *Hoe, shovels, ground rakes*

Construction of Internal Drainage



Session 5-4 Construction of Internal Drainage

Important message:

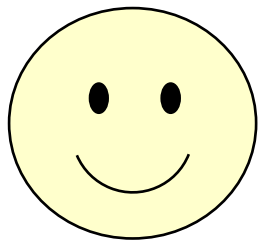
1) Internal drainage ditches should be constructed to establish a drainage system in the demo plots where the area is marshy and where water seepage from underground is found.
2) Internal drainage ditches should connect each other to drain excess water out of the plots.

How to facilitate the session:

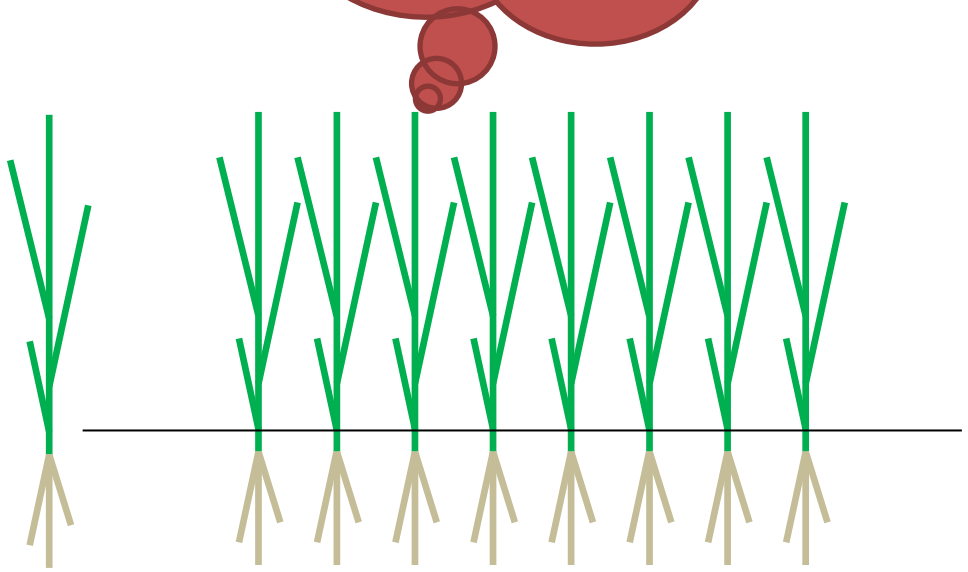
1) Necessity of drainage
   - Ask the farmers if the demonstration plots are marshy and if water seepage is found in the demo plots.
     - Explain to the farmers that rice growth will become poor if the water stagnates or if the water is excessive in the plots. In such a condition, water should be drained from the plot to lower the water level so that the rice growth would be improved.

2) How to establish a drainage system in the demo plots to effectively manage the water in the plot.
   - Explain to the farmers how to establish the drainage system:
     - Dig drainage ditches in the demo plot along the bunds as well as inside the plot as shown in the picture when puddling. Ditches should be at least 30 cm in both depth and width.
     - Soils dug from ditches should be put on the rice field to raise the height of the fields then leveled.
     - To control the water of the demo plot, bamboo pipes should be set at the outlets of the drainage ditch. The position of bamboo pipes should be lower than the soil surface of the demo plot.
     - Maintain the water in the ditch not to submerge the soil surface of the rice field by opening the bamboo pipes. Do not open the bamboo pipes when the water level in the main drainage is higher than that in the demo plots.

Nursery Period
Use young seedlings

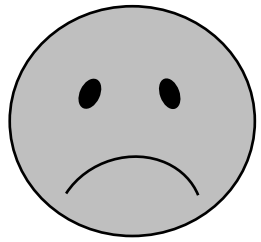


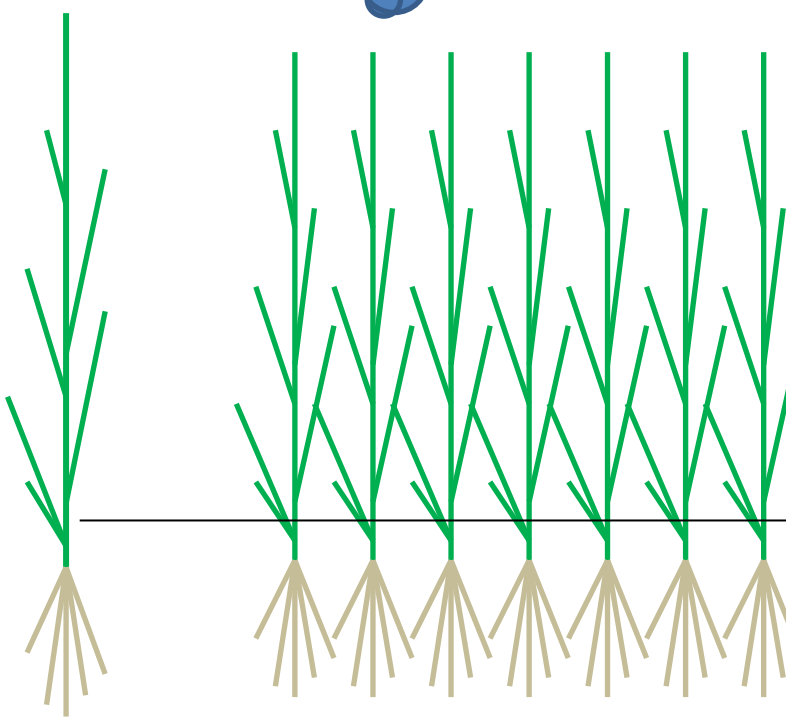
Healthy,
Vital
4 leaves



3 weeks

Too long,
Deterioration,
5 - 6 leaves,
Tillering started





more than 1 month

Session 6-1 Nursery Period

Important messages:

1) The seedlings in the nursery should be uprooted for transplanting when they develop the fourth leaf 2-3 weeks after sowing.

How to facilitate the session:

1) Introduction
   - Ask the farmers how long the nursery period is in their conventional rice farming in IVS.
   - Ask the farmers how a healthy seedling should look like. Tall or short, green or yellowish, thin or thick, and with or without tillers.

2) The appropriate time for uprooting seedlings
   - Tell the farmers that the appropriate seedling age for transplanting is about 2-3 weeks depending on temperature.
     - Seedlings start developing tillers at about the fourth leaf stage. It is the right time for transplanting, as the seedlings need more space to grow larger with tillers and absorb more nutrients.
     - As a new leaf develops every 4 days under the normal temperature, a seedling reaches the four leaves stage about 2-3 weeks after sowing. This is when seedlings should be transplanted.
     - If uprooting and transplanting are delayed: (1) seedlings become unhealthy with etiolation and chlorosis as a result of competition between seedlings for sunlight and nutrition, which should be avoided; (2) it takes longer time for seedlings to recover from planting shock; and (3) duration of tiller development becomes shorter after transplanting, which results in the smaller number of tillers.

Uprooting of seedlings

- ✓ Uproot seedlings carefully.
- ✓ Keep root wet.
- ✓ Transplant soon after uprooting.

Session 6-2 Uprooting of Seedlings

Important messages:

1) The seedlings should be uprooted little by little. The soil attached to the roots should be gently removed to minimize damage to them.
2) The roots of the uprooted seedlings should be kept wet until the seedlings are transplanted in the main field.

How to facilitate the session:

1) Introduction
   - Ask the farmers how they usually uproot and handle seedlings.
   - Tell them that seedlings should be carefully uprooted and transplanted. They need tender care just like babies who need their mothers' love and care.

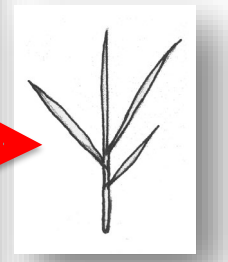
2) Handling of seedlings
   - Tell the farmers the following key points of uprooting and storage before transplanting.
     - Uproot young seedlings carefully to minimize damage to their roots and leaves. Do not pull too many seedlings out at once.
     - Gently remove soil attached to the roots of seedlings. Do not strike seedlings against other seedlings or the ground or kick them.
     - Uprooted seedlings should be transported to the main field as soon as possible.
     - Store uprooted seedlings properly. The root of the seedlings should always be wet. (Left picture)
     - Do not leave their roots without water under the sun. Seedlings become weak under dry conditions and eventually die before planting. (Right picture)

Tools and materials to be prepared: *Bowl, water, palm leaves, etc.*

Fertilizer Application

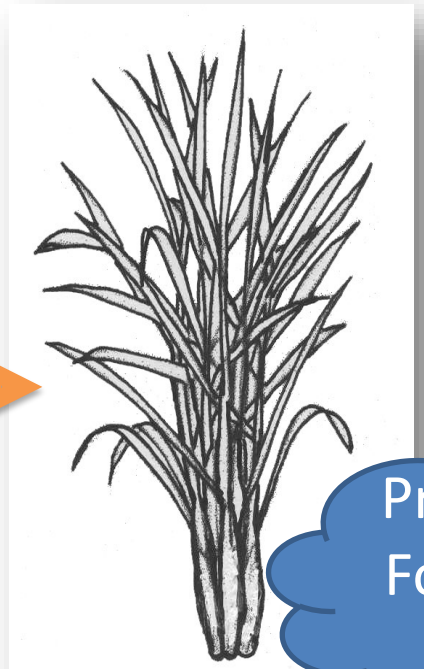
1. Fertilizer application

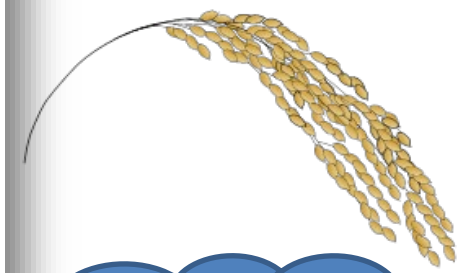
[1st] Basal Fertilizer Transplanting Stage



Promotion of Tillering

[2nd] Topdressing Panicle Initiation Stage





Promotion of Formation of Spikelets

Session 6-3 Fertilizer Application

Important messages:

1) Chemical fertilizer is supplemental nutrition contributing to the better growth of plants. It is dissolved into water and absorbed by plants. Nitrogen, Phosphorous, and Potassium are the major elements of fertilizer.
2) Fertilizer should timely be applied when rice plants require more nutrients. Fertilizer is basically applied two times: (i) when tillers are produced (at the time of transplanting) and (ii) when panicles are formed (about two months before harvesting).
3) For lowland rice in IVS, the recommended fertilizer dose is 270 kg of compound fertilizer NPK 15-15-15 per 1 ha.

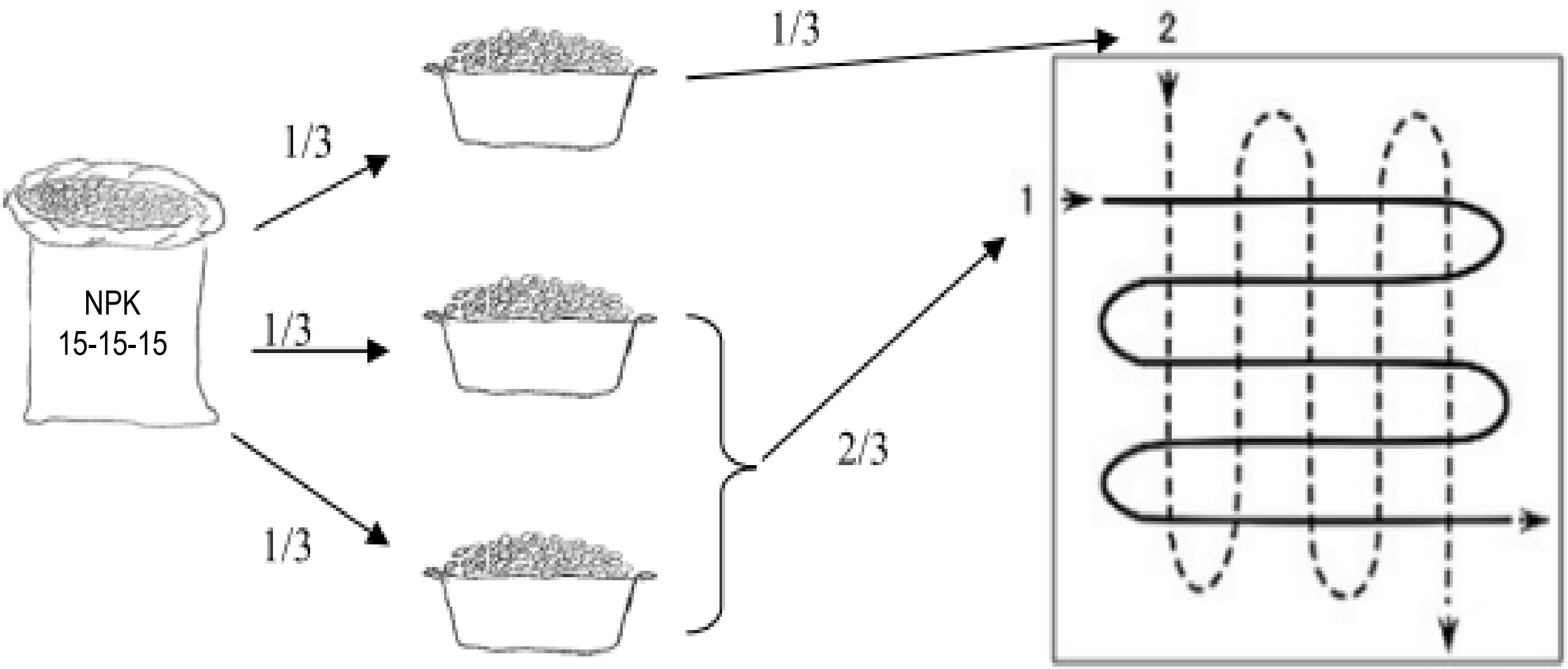
How to facilitate the session:

1) Characteristics of fertilizer
   - Ask the farmers what fertilizer is. Give them general information about fertilizer.
     - Fertilizer is like supplements to crops. Humans take various nutrients from foodstuff such as rice, cassava, fish, meat, eggs, vegetables, oil, etc., to grow or maintain their bodies. Crops also need minerals including nitrogen (N), phosphorus (P), and potassium (K) for their growth, and minerals are contained in soils and absorbed by crops through roots. Since the amount of minerals in the soil is normally insufficient for healthy crop growth, fertilizer is used to supplement the minerals.
     - Compound fertilizer of NPK 15-15-15 contains the three main essential elements with a balanced proportion of 15% each.

2) Time for fertilizer application
   - Tell the farmers that fertilizer should be applied at two separate times when rice plants require more nutrients as follows;
     a) The first time (Basal application) at transplanting (2-3 weeks after sowing)
        - It is when a seedling develops its fourth leaf or starts to develop tillers. Basal application is effective in increasing the number of tillers as well as in growing rice plants larger.
     b) The second time (topdressing) at about 60 days before full maturity
        - This timing corresponds to the panicle initiation stage. Topdressing contributes to an increase in the number of grains per panicle and grain-filling.

3) Fertilizer application rate
   - The recommended fertilizer dose for different size of the land is as follows
     - 1 acre (4,000 m^2): NPK 110 kg (2.2 bags of fertilizer) in total, for basal application, 75 kg (1.5 bags)
     - 1,000 m^2: NPK 27 kg (24 liter-cups of fertilizer) in total, for basal application, 18 kg (16 liter-cups)
     - 500 m^2: NPK 13 kg (12 liter-cups of fertilizer) in total, for basal application, 9 kg (8 liter-cups)

Proper way of fertilizer application for even distribution 1



<u>Session 6-4 How to Apply Fertilizer 1</u>

Important messages:

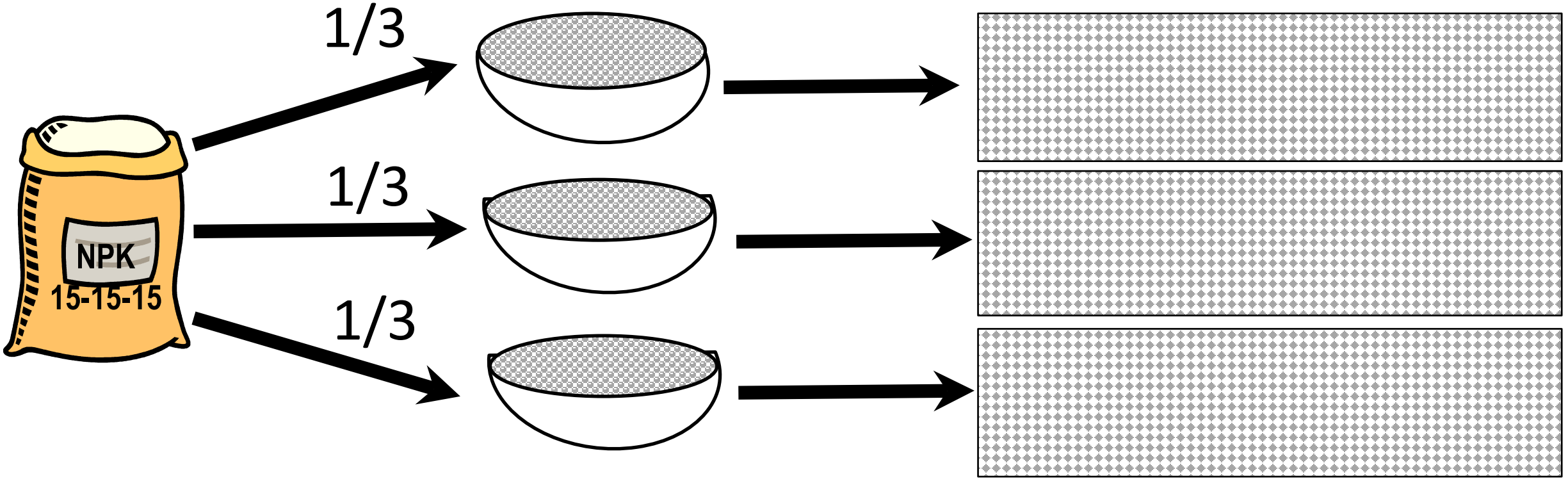
1) Fertilizer should equally be spread across the plot.

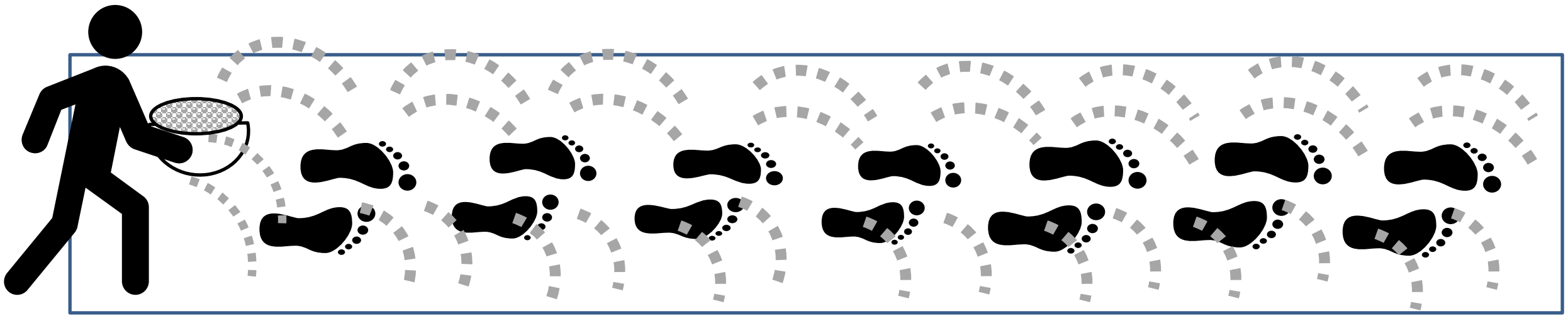
How to facilitate the session:

1) Timing of fertilizer application
   - Tell the farmers how to apply basal fertilizer at transplanting.
     - Fertilizer applied to the soil surface just before transplanting will be mixed into the soil as the farmers walk through the plot to plant seedlings. The effects of fertilizer last longer if its nutrition elements are held by soil particles.
2) Method of fertilizer application
   - Fertilizers should be applied equally across a field to promote the uniform growth of rice plants. Explain to the farmers how to apply fertilizer evenly in a plot as follows: (Picture on the left)
     - Divide the fertilizer into three portions and broadcast them separately at an orthogonal angle as shown in the figure.

Tools and materials to be prepared: *Fertilizer, bucket, bowls*

Proper way of fertilizer application for even distribution 2





<u>Session 6-5 How to Apply Fertilizer 2</u>

Important messages:

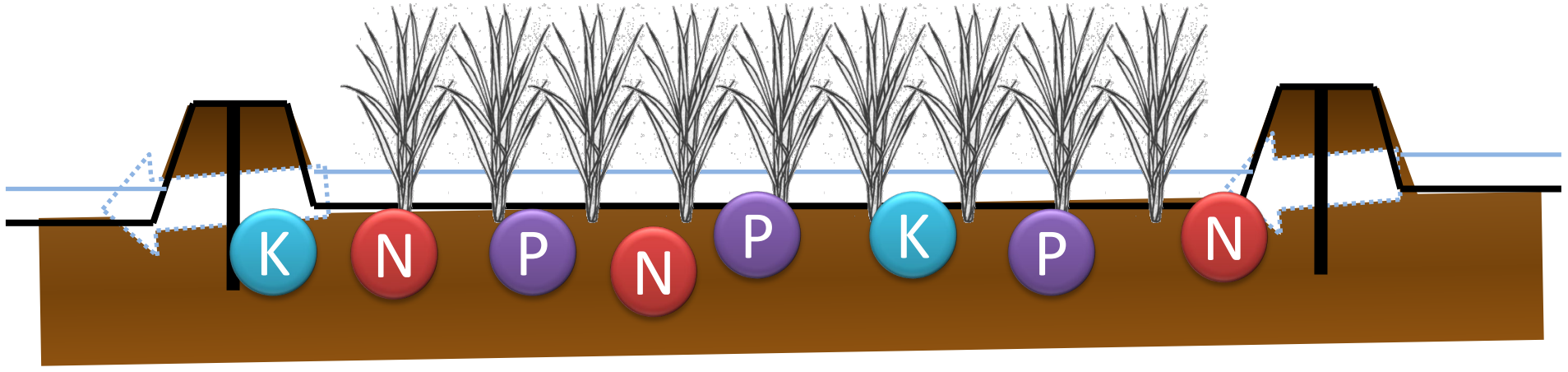
1) There is another method to ensure the uniform application of fertilizer across the plot.

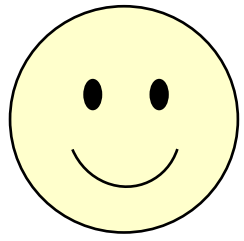
How to facilitate the session:

- Explain to the farmers that there is another method of fertilizer application as follows;
  - Divide the fertilizer into three (3) portions.
  - Divide the plot into three (3) areas in line.
  - Apply one-third of fertilizer to the first line area by casting the fertilizer to the left and right while walking straight. Make sure that all of the fertilizer was evenly broadcasted by the time to reach the end of the line area. If some fertilizer is left at the end, go back to the same line area to add the remaining fertilizer to the places where the farmer has cast less amount.
  - Repeat the same procedure in the other two areas in line.

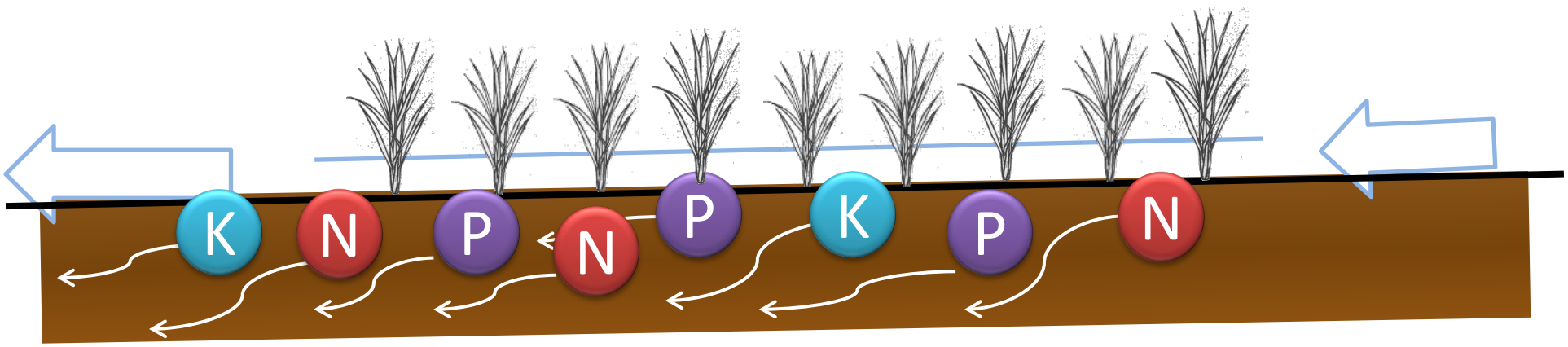
Tools and materials to be prepared: *Fertilizer, bucket, bowls*

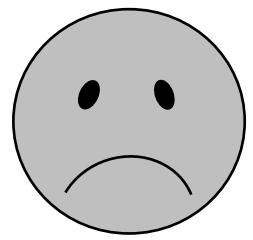
Water control can enhance fertilizer use efficiency.





With bunds, nutrients contained in fertilizer will stay in the field and absorbed by rice plants





Nutrients contained in fertilizer will be washed away with running water unless water control measures are properly taken.

Session 6-6 Water Management and Fertilizer

Important message:

1) Chemical fertilizer is supplemental nutrition contributing to the better growth of the plant. It is dissolved into water and absorbed by the plant. Nitrogen, Phosphorous, and Potassium are major elements of fertilizer.
2) Fertilizer is only effective under water-controlled conditions. If drainage and bund are not constructed or not functioned, nutrients added by fertilizer may easily be washed away from the plot.
3) Stable and lower (as low as possible) water level in a plot is a preferable condition for fertilizer application.

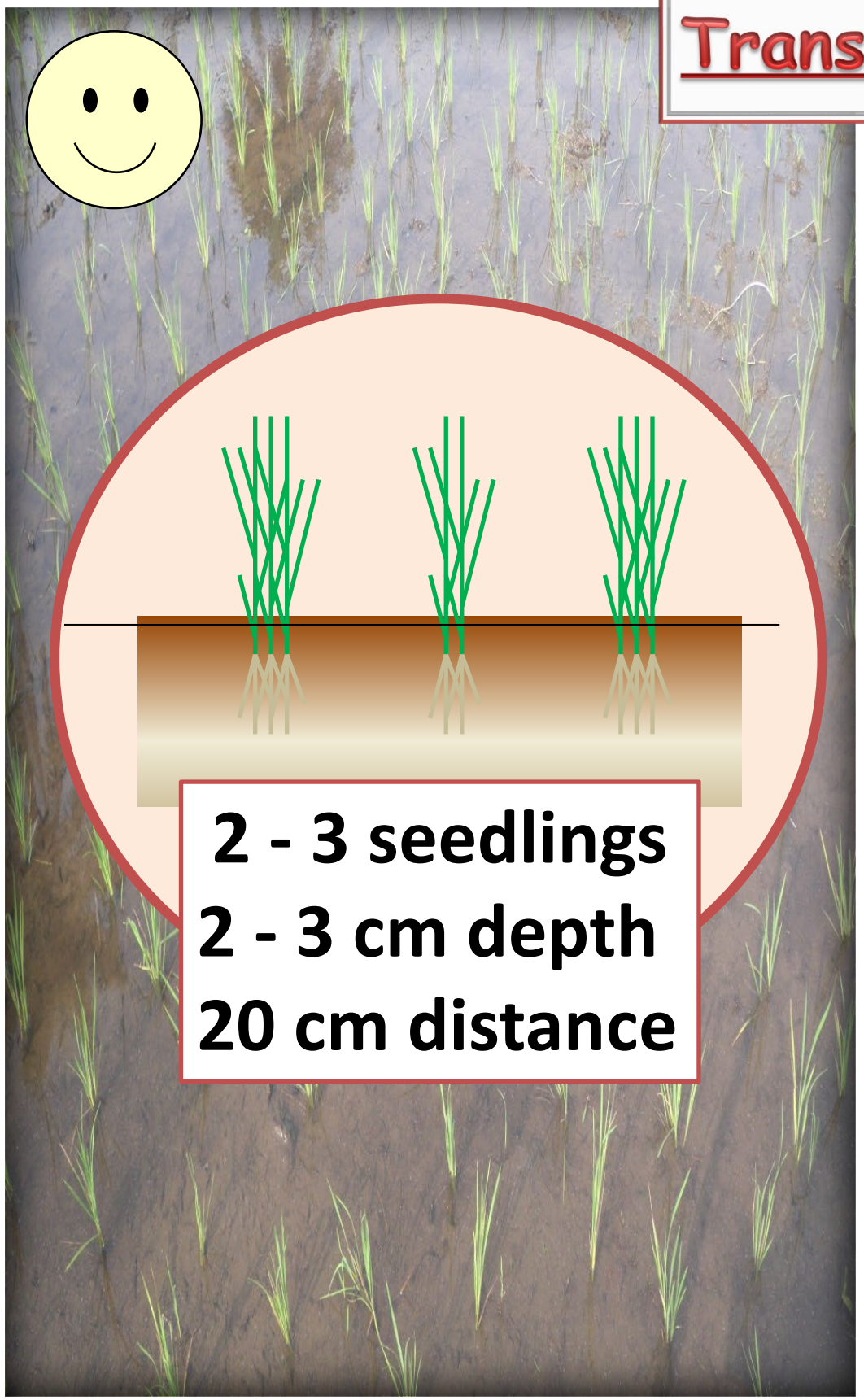
How to facilitate the session:

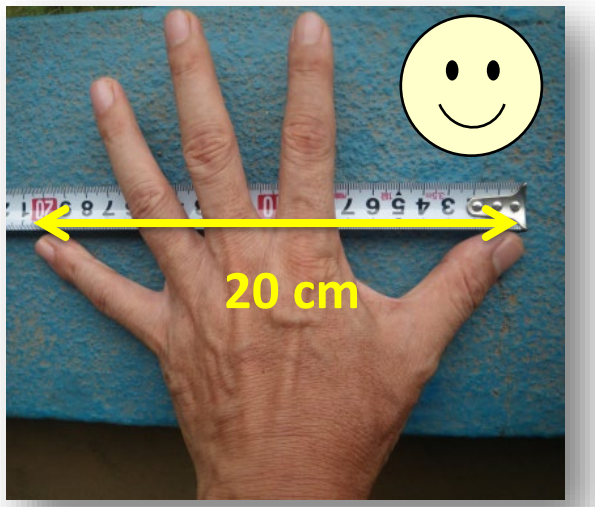
1) The necessity of water management
   - Remind farmers that bunds are important in settling water and nutrients in the field because without them water does not stay in the field flowing away with nutrients.

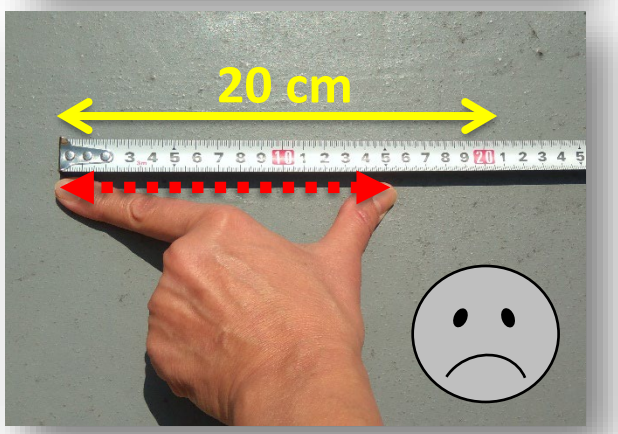
2) Method of water management
   - Tell the farmers the general principles of water management in a rice field.
     - The water level in the field surrounded by bunds can be controlled by opening and closing the inlet and outlet installed on the bunds in the higher and lower part of the field, respectively.
   - Tell the farmers that water should be settled in the field at the time of fertilizer application and that low water levels are preferable for efficient uptake of nutrients by plants, and explain as follows:
     - Running water may wash nutrients supplied by fertilizer away from a plot. Thus, water should be kept in the plot by bunds until nutrients are taken up by rice plants.
     - For a given amount of fertilizer, the concentration of its nutrients is higher in a lower volume of water than in a higher volume of water. Thus, the water level in a plot should be low for rice plants to take up nutrients more efficiently.

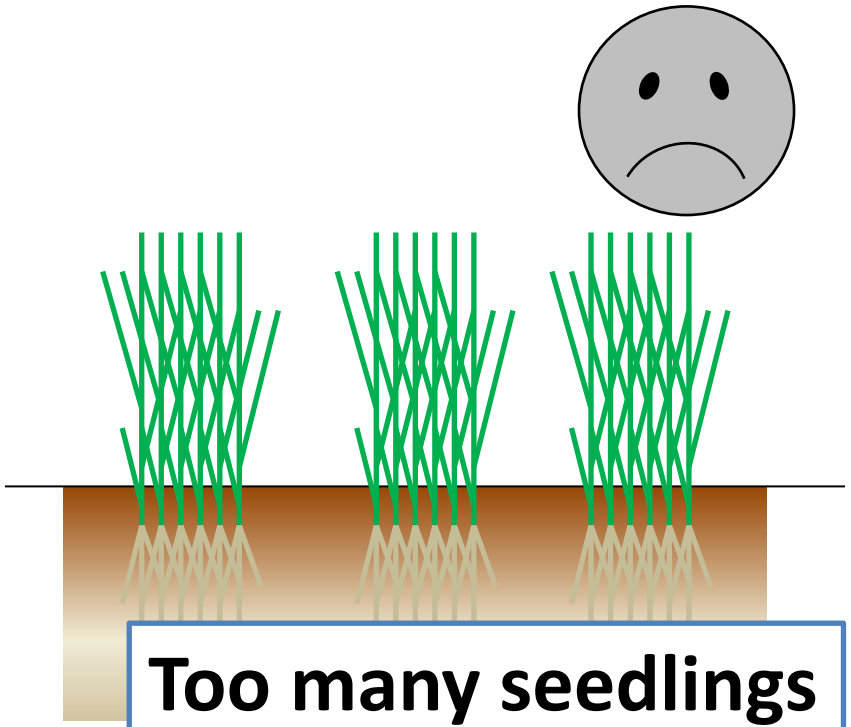
       ☆*Give the farmers a hint: One teaspoonful of sugar dissolved in a large water basin is not sweet and hard to drink all. The same amount of sugar dissolved in a small glass of water is sweet and easy to drink all.*

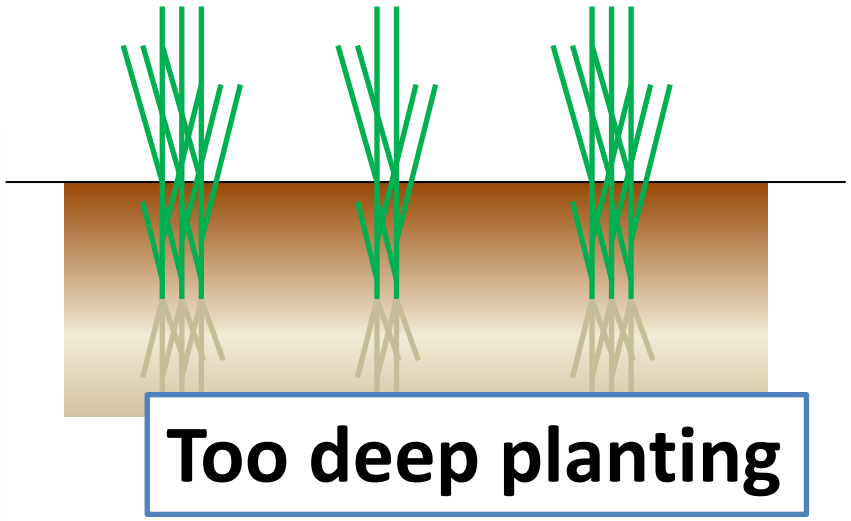
Transplanting Method

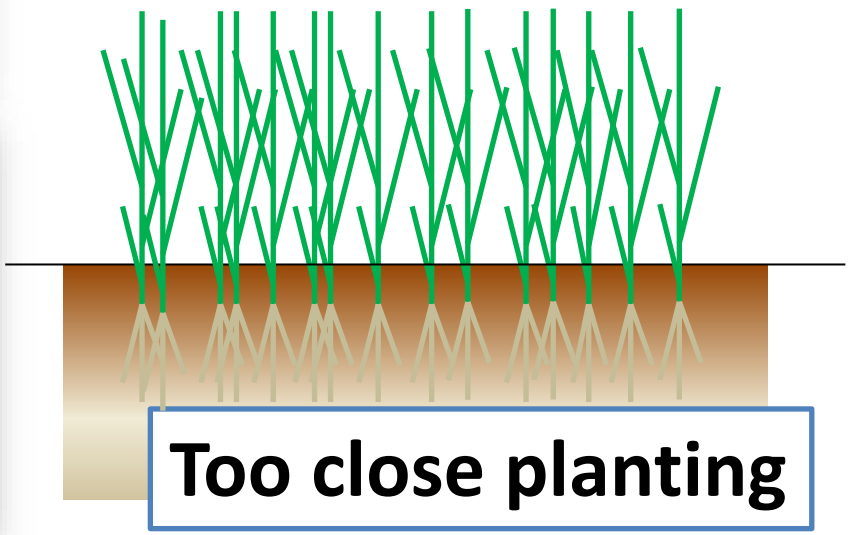












Session 6-7 Transplanting Method

Important messages:

1) Transplanting should be done with 2 to 3 seedlings per hill at 20 cm apart between hills.
2) The depth of the planting should be 2 to 3 cm.

How to facilitate the session:

1) Number of seedlings per hill
   - Tell the farmers that the recommended number of seedlings per hill is only two to three (2-3) because of the following reasons:
     - A single rice plant has the potential to develop many tillers. A few seedlings could develop enough tillers to attain a higher yield.
     - Using fewer seedlings per hill can save seed rice.
     - When too many seedlings are planted on a hill, they do not grow healthily due to competition with other seedlings.

2) Density of transplanting
   - Tell the farmers that the appropriate distance between hills is about 20 cm because of the following reason.
     - Closer planting or higher hill density inhibits active tillering and weakens rice plants.
   - Tell the farmers that 20 cm can be measured by the distance between a thumb and little finger when the palm is widely open.

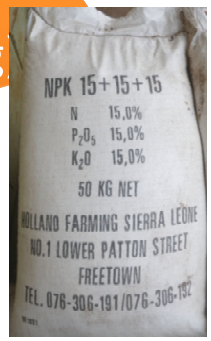
3) Planting depth
   - Tell the farmers that the suitable transplanting depth is only 2-3 cm from the soil surface because of the following reasons:
     - A sufficient number of tillers can be secured by shallow planting.
     - Deep planting (e.g., 10 cm or more) leads to delays in the start of tillering. The vegetative growth period is limited especially for short-duration varieties. Thus, deep planting significantly reduces the number of tillers and panicles per hill, resulting in a yield decrease.
   - Tell the farmers that 2-3 cm can be measured by the distance between the tip of the forefinger and its first joint.

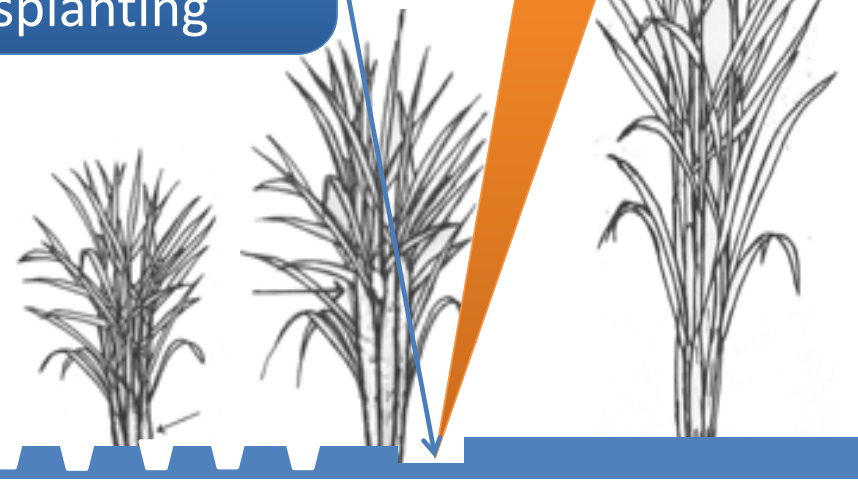
Control water by growing stage

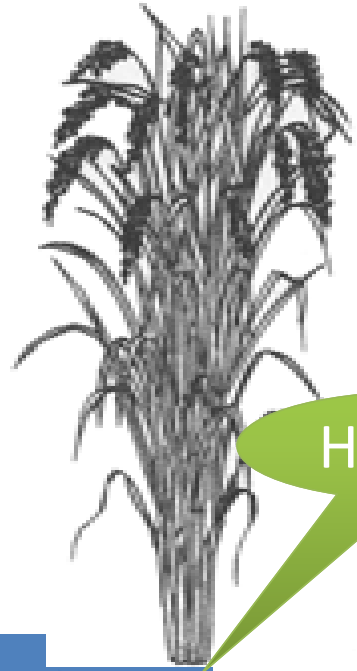
2nd Fertilizer
(Panicle Initiation)

Low water at fertilizer application and after transplanting

1st Fertilizer
(Transplanting)







Harvest

Intermittent irrigation

High water after panicle initiation

Drain water before harvesting

Session 6-8 Water Management at Transplanting and after

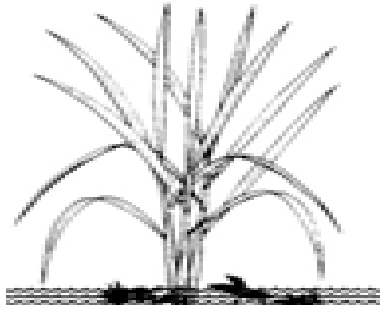
Important messages:

1) At transplanting, the soil of the main field should be saturated with water, well puddled, and leveled.
2) After transplanting, the water level should be kept low for several days to promote the seedlings' root development.
3) During the vegetative growth stage, intermittent irrigation should be practiced with about one-week intervals to mitigate iron toxicity and avoid case worm damage.

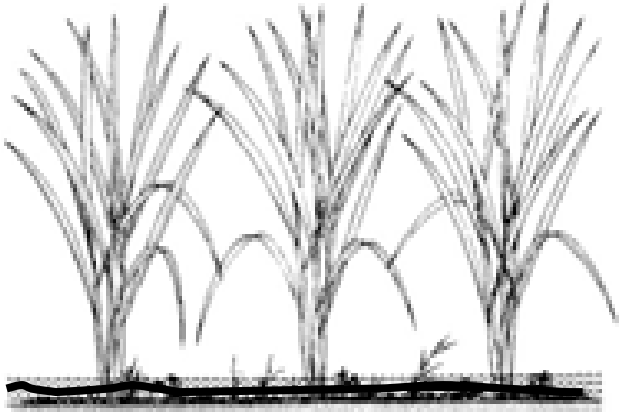
How to facilitate the session:

1) Transplanting and water management
   - Tell the farmers the following points to be kept in mind regarding the water management at transplanting
     - The soil of the main field should be saturated with water, well puddled, and leveled.
     - Floodwater may wash out young rice plants that have just been planted in the field. Farmers should note that the seedlings should be transplanted in a static water condition, like in a plot surrounded by bunds, to protect them from the risk of being washed out by floodwater.
     - The water level in the main field should be kept low for several days after transplanting to promote the seedlings' root development, to prevent shallow-planted seedlings from floating away, and to keep the nutrients of the fertilizer in the soil.
2) Water management after transplanting during the vegetative growth stage
   - Tell the farmers the following points to be kept in mind regarding the water management after transplanting
     - During the vegetative growth stage, intermittent irrigation should be practiced. It is a water management technique: draining out water from the field and drawing water into the field alternately at about one-week intervals.
     - This technique will allow the soil to dry periodically and exchange gas produced in the soil under the water with the air during the drainage period, which activates the roots of rice plant.
     - Through the adoption of the intermittent irrigation, it is expected that iron toxicity problem will be mitigated, and damage of case worm will be prevented.

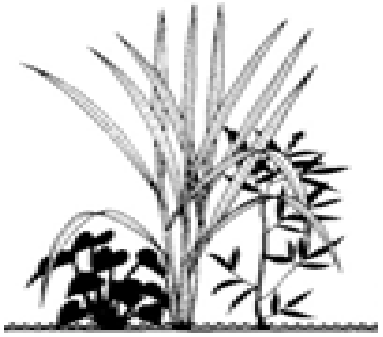
Weed control



Weeding done



Rice growth promoted



No weeding done

Stagnant growth of rice

Source: modified based on “A Farmer’s Primer on Growing Rice”; IRRI; 1992

Session 7-1 Weed Management

Important messages:

1) Weeds should be removed from rice fields because they compete with rice plants for nutrition, water, sunlight, space, etc.

How to facilitate the session

1) Introduction
   - Ask the farmers if they usually weed their fields (upland and lowland).
   - Ask the farmers why weeding is important.

2) Necessity of weeding
   - Give the farmers a general idea on weeding as follows:
     - Both lowland rice and upland rice need weeding.
     - Weeds compete with rice plants for nutrition, sunlight, water, etc., thereby hindering rice growth and leading to less grain yield.
     - A rice field should be kept clean by weeding especially when applying fertilizer as the weed can further elongate due to nutrients.

Session 7-2 Timing and Method of Weeding

Important message:

1) Weeding should be conducted at the timing of 2-3 weeks after transplanting when weeds are still small, for rice plants to grow faster without competitors.

How to facilitate the session:

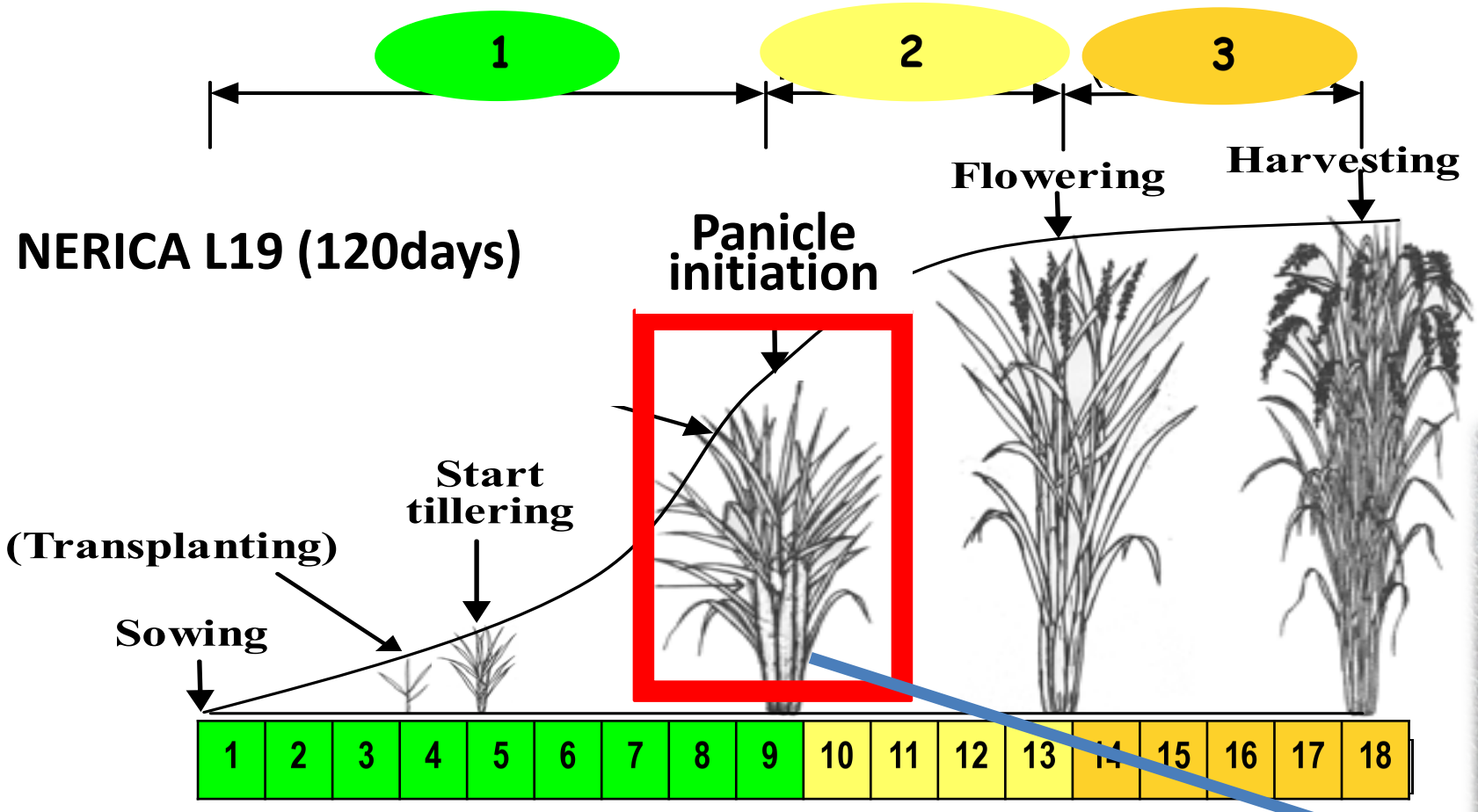
1) Timing of weeding
   - Tell the farmers that by timely and thorough weeding, rice plants grow faster by getting more nutrition, sunlight, water, etc.
     - The first weeding should be conducted at about 2-3 weeks after transplanting when rice plants develop the root system and weeds appear in the field. The timing of weeding can be adjusted depending on the field condition. Weeding in an early growth stage is important in lessening the competition for rice plants to grow and in reducing workload.
     - The second weeding should also be done before applying topdressing to ensure the effects of fertilizer.
     - Frequent removal of weeds is recommended to allow the rice plants to fully utilize the nutrients in the soil.

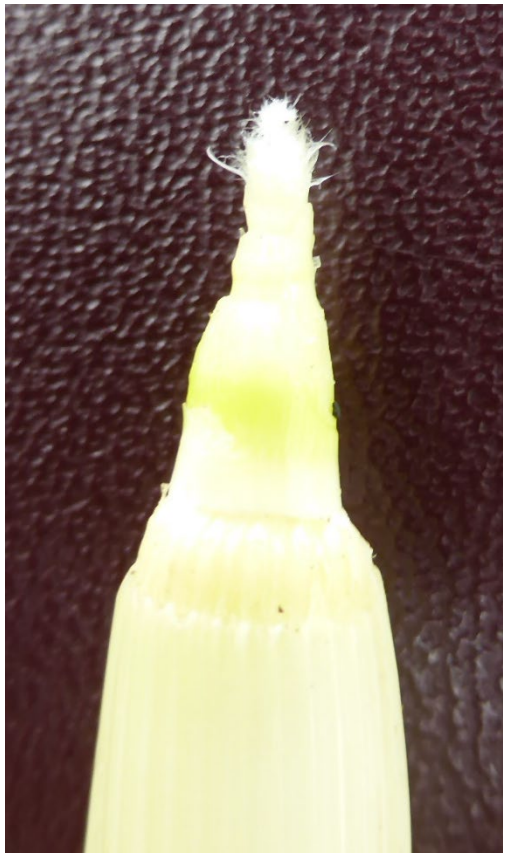
2) Method of weeding
   - Ask the farmers how to remove and reduce weeds; give them some advice including the following:
     - In Sierra Leone, hand weeding is common, which is laborious. To lessen the work, weeding should be done at earlier stage, when weeds are still small (about 2-3 weeks after transplanting for the first weeding).
     - Before weeding, the rice field should be irrigated until the water depth is up to about 5 cm. Under the submerged condition, scratching the soil will be effective and efficient weeding method to uproot the weeds from the soil. Uprooted weeds will be floated on the water, which should be collected and taken out from the field.
     - Before top dressing, sizeable weeds should be removed to avoid further competition with rice.

Right time for weeding

Panicle initiation

Growth stage:





Session 8-1 Identification of Panicle Initiation

Important message:

1) During the panicle initiation stage, the rice plant turns pale, grows taller, and becomes stiff at the stem base.

How to facilitate the session:

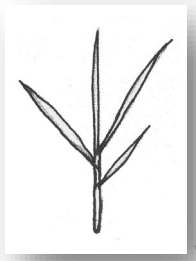
1) Identification of the panicle initiation stage
   - Tell the farmers how to identify the panicle initiation stage when topdressing should be applied.
     - Panicles start to form about 2 months before the full maturity, irrespective of the variety. For example, Nerica L19, a 4-month variety, reaches the panicle initiation stage about 2 months after sowing; while the one for Pa Kiamp, a 4.5-months variety, is about 2.5 months after sowing.
   - Ask the farmers to describe the changes they notice in the appearance of rice plants before heading. Then, describe to them several ways to identify the panicle initiation stage, including the following:

- Panicle initiation is not directly observable. A small panicle is formed inside the stem base where it starts to grow. About one week after panicle initiation, the panicle can be observed inside the stem base by stripping off the outer leaf sheaths with fingers or by splitting the bottom of the stem vertically in half with a sharp blade. When a small panicle is observed in several plants in the field, it is time to apply topdressing.
- There are also several changes in the appearance of rice plants during the panicle initiation stage. The color of the entire rice plant turns yellowish. The plants grow taller by elongating internodes, and their stem base becomes stiff. When these changes are observed, topdressing should be applied.

Fertilizer Application

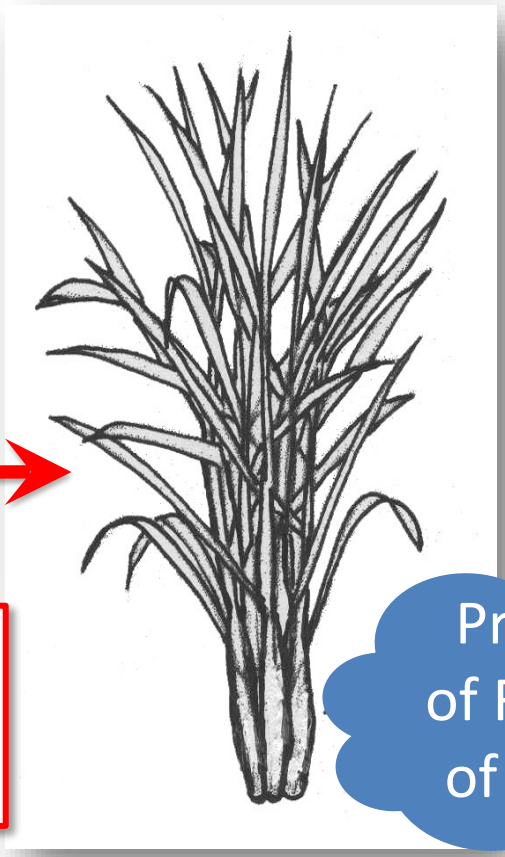
Fertilizer = Food for Rice

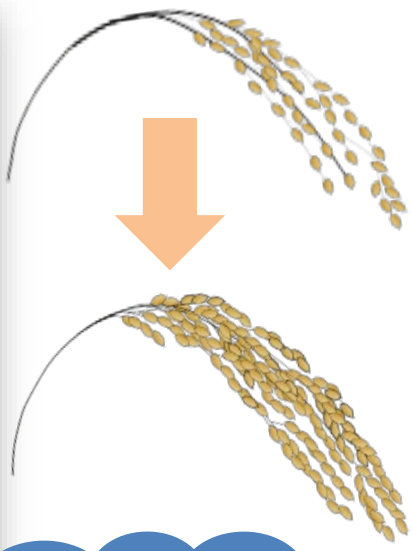
[1st] Basal Fertilizer
Transplanting Stage



Promotion of Tillering

[2nd] Topdressing
Panicle Initiation Stage





Promotion of Formation of Spikelets

Session 8-2 Topdressing

Important messages:

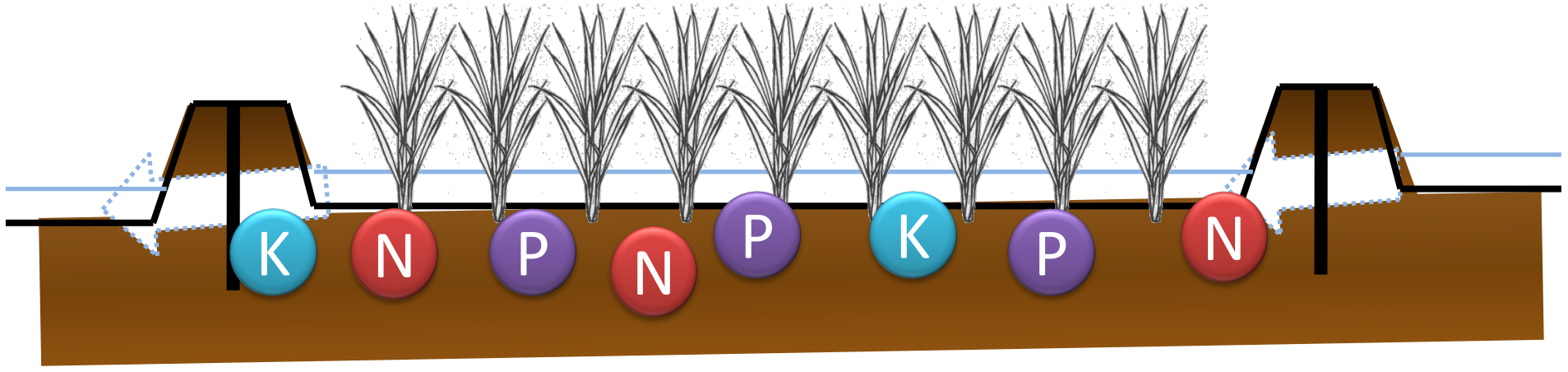
1) The purpose of topdressing is to increase the number of filled grains.
2) Topdressing should be applied at the panicle initiation stage when the rice plant starts forming panicles with spikelets; one-third of the total amount of fertilizer should be used for topdressing.

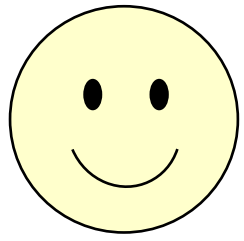
How to facilitate the session

1) Introduction
   - Ask the farmers why topdressing should be applied.
   - Ask them how to determine the appropriate time of topdressing.

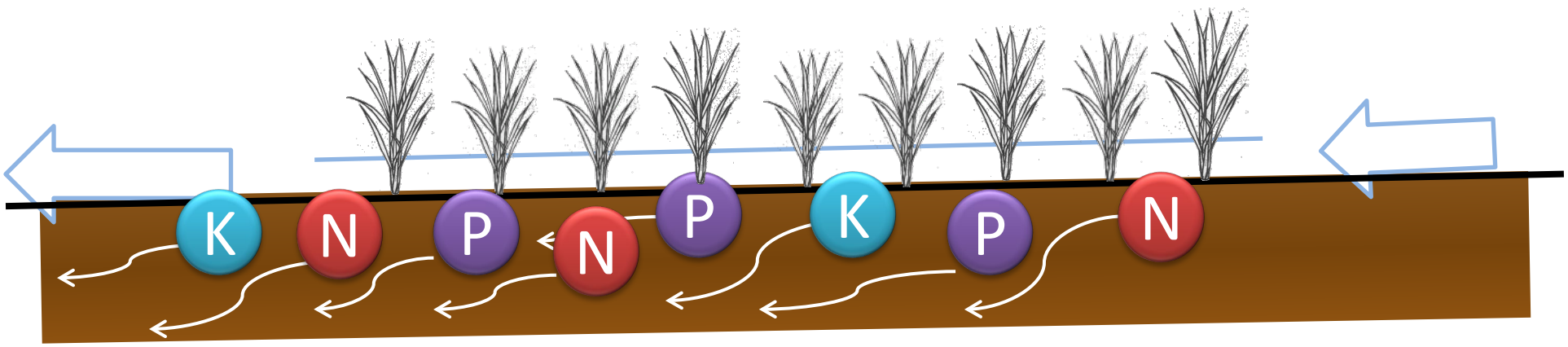
2) Necessity and method of topdressing
   - Explain to the farmers why topdressing is necessary:
     - At a certain point in its life cycle, the rice plant forms panicles where grains are produced. This is called the panicle initiation stage. In this stage, the plant needs more nutrients and energy to produce grains while maintaining its life. Topdressing helps the plants to produce more grains, which leads to a higher yield.
   - Explain to the farmers how to apply topdressing:
     - Topdressing should be applied at a rate of NPK=13-13-13 kg/ha, which is half of the basal application (one-third of the total).
   - Confirm that the second weeding has already been done before application of topdressing (second fertilizer application). If sizeable weeds are still observed in the plots, they should be removed before topdressing.

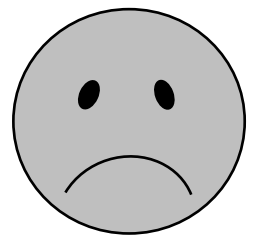
Water control can enhance fertilizer use efficiency.





With bunds, nutrients contained in fertilizer will stay in the field and absorbed by rice plants





Nutrients contained in fertilizer will be washed away with running water unless water control measures are properly taken.

Session 8-3 Water Management and Fertilizer （Review of Session 6-6）

Important message:

1) Chemical fertilizer is supplemental nutrition contributing to the better growth of plants. It is dissolved into water and absorbed by plants. Nitrogen, Phosphorous, and Potassium are major elements of fertilizer.
2) Fertilizer is only effective under water-controlled conditions. If drainage and bund are not constructed or not functioned, nutrients added by fertilizer may easily be washed away from the plot.
3) Stable and lower (as low as possible) water level in a plot is a preferable condition for fertilizer application.

How to facilitate the session:

1) The necessity of water management
   - Remind farmers that bunds are important in keeping water and nutrients in the field because without them water leaks out of the field taking nutrients away with it.

2) Method of water management
   - Tell the farmers the general principles of water management in a rice field.
     - The water level in the field surrounded by bunds can be controlled by opening and closing the inlet and outlet installed on the bunds in the higher and lower part of the field, respectively.
   - Tell the farmers that water should be settled in the field at the time of fertilizer application and that low water levels are preferable for efficient uptake of nutrients by plants, and explain as follows:
     - Running water may wash nutrients supplied by fertilizer away from a plot. Thus, water should be kept in the plot by bunds until nutrients are taken up by rice plants.
     - For a given amount of fertilizer, the concentration of its nutrients is higher in a lower volume of water than in a higher volume of water. Thus, the water level in a plot should be low for rice plants to take up nutrients more efficiently.

     ☆*Give the farmers a hint: One teaspoonful of sugar dissolved in a large water basin is not sweet and hard to drink all. The same amount of sugar dissolved in a small glass of water is sweet and easy to drink all.*

Technical Package on Rice Production - SRPP

Insect

African Gall midge

Caseworm

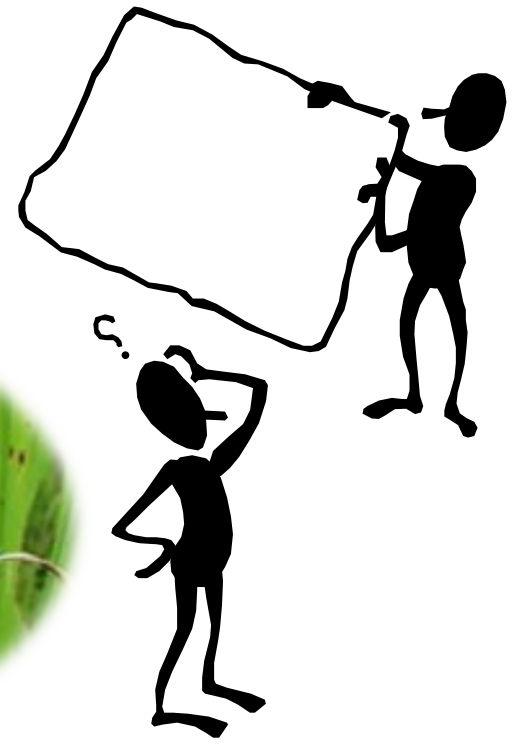
Leaf hopper

Rice bug

Disease

Brown Spot

Leaf-scald



Session 9-1 Control of Insect Pests and Diseases

Important messages:

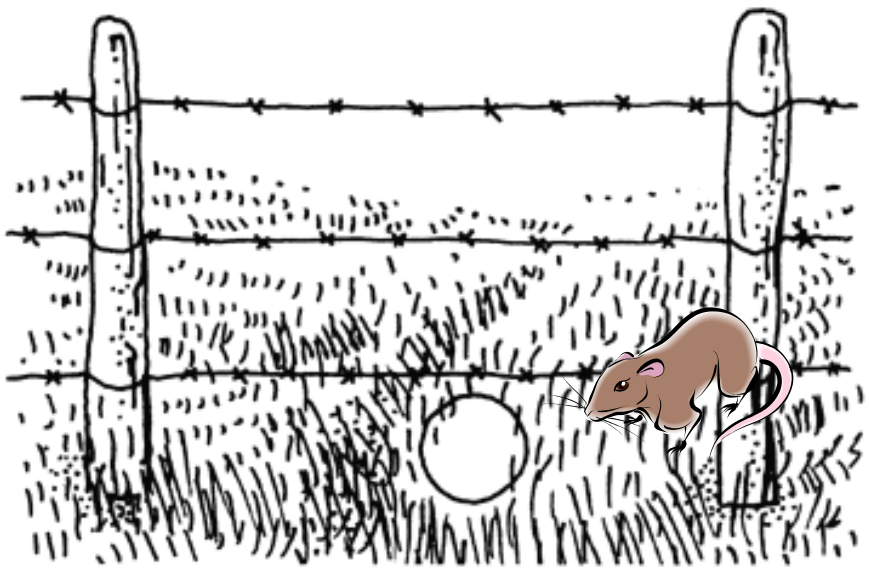
1) The early detection of insect pests and diseases is important in implementing effective countermeasures; therefore, frequent field inspection is necessary.
2) Farmers should consult the extension workers about the control measures against pests and diseases as soon as they observe such damage.

How to facilitate the session

1) Introduction
   - Ask the farmers what kind of insect pests and diseases they find in their rice fields.
2) Presentation on insect pests of rice and control measures
   - Present the following to the farmers:
     - Two common insect pests are African gall midge and caseworm, which are observed up to the active tillering stage of the rice plant. Other insect pests of rice include leafhopper and rice bug. Stem borer and stalked-eye fly may also be found but they are not quite common as the other insect pests.
     - To mitigate the damage by caseworm, draining of the field is effective since the insect cannot respirate in the air.
     - To prevent damage by Africa rice gall midge (ARGM), host plants like wild rice found surroundings of rice fields should be removed and burned in the off-season to disturb the life cycle of ARGM and decrease the population.
3) Presentation on rice diseases
   - Present the following to the farmers:
     - Brown spot and related fungal diseases are common and found across the rice-growing agroecology. Brown spot is a physiological disease, caused by the nutrient imbalance in the rice plant. It is rare to be found in rice plants grown in fertile soil.
     - Leaf-scald is a disease that could be caused by both fungal and physiological factors.
4) Observation of insect pests and disease if any in the demonstration plot
   - Visit the FFS demonstration plot with the farmers and have them carefully observe insect pests and diseases if any.
   - Ask the farmers to write down the results of their observation on a flipchart; discuss control measures against the pests and diseases with them.

Rodents

Rats



<u>Session 9-2 Prevention of Damage from Rodents</u>

Important message:

1) Rodents (cutting grasses and rats) should be kept away from the field by fencing, traps, cleaning bunds, and slashing the surrounding bushes.

How to facilitate the session:

1) Introduction
   - Ask the farmers what kind of animals cause damage to rice plants in their field during the grain-filling stage and how serious the damage was in the previous season.

2) Prevention of damage from rodents
   - Explain to the farmers how rodents (cutting grasses and other rats) damage the rice and tell them about measures to prevent possible damage.
     - Cutting grasses move in groups, trample over rice plants, chop them, and chew them into pieces from the booting through harvesting stages. Preventive measures include clearing weeds and bushes in and around the field, fencing with snares, hunting, and pitfalls. These measures should be taken as soon as a sign of damage is found in the field to minimize damage.
     - Rats eat grains in the field as well as in the storage. Measures against rats include setting the metal snap traps, clearing weeds and bushes in and around the field, and keeping water in the field until the time of harvest.

Technical Package on Rice Production - SRPP

Birds

Damaged by weaverbirds

Session 9-3 Prevention of Damage from Birds

Important message:

1) Birds (mainly weaverbirds) should be kept away from the field by scaring them immediately after flowering.
2) Bird scaring is essential to protect the rice at the final stage, without which all the efforts made and resources spent so far will be wasted.

How to facilitate the session

1) Introduction
   - Ask the farmers what kind of birds cause damage to rice plants in their field during the grain-filling stage and how serious the damage was in the previous season.
   - Ask the farmers how they usually scare birds. Discuss with them the effectiveness of different scaring methods.
2) Scaring of birds

- Explain to the farmers about the damages by birds and tell them about the recommended method as follows:
  - Birds (mainly weaverbirds) damage rice grains at the milky stage by chewing.
  - To reduce bird damage, take measures such as putting up scarecrows, hanging tin cans, beating cans or drums, shouting, throwing stones, searching and destroying bird nests, and removing roosting sites.
  - Working in groups in adjacent fields at the same time is also effective in keeping birds away.
- Tell the farmers not to rely on small children to do the bird-scaring as they do not understand the importance of the work.
- Emphasize that the bird-scaring is important to secure the harvest and that if the bird-scaring is not properly done, all the efforts made and resources spent so far will be wasted.
- Discuss with the farmers the effective ways to conduct regular bird-scaring for the FFS plots, such as setting an internal rule to organize small groups among members and assign the groups to take turns.

Over ripened

Immature

Harvest your rice at right time!

80-85 % matured

Session 10-1 Timing of Harvest

Important messages:

1) Harvesting at the right time is necessary to minimize the losses of the grains.
2) At the ripening period, careful observation of the field should be made to judge the timing of harvest.
3) Over-ripening of the grains increases losses by shattering.
4) Early harvest causes a low rate of filled grains.
5) The right harvest timing is when 80 - 85 % of the grains on the panicles are colored in yellow.

How to facilitate the session:

1) Introduction
   - Ask the farmers how they determine the time to harvest rice.
   - Ask the farmers what happens if they harvest rice plants too early or too late.

2) Determination of the timing of harvest
   - Tell the farmers the importance of timely harvest
     - Early harvest leads to a greater number of immature grains and delayed harvest to more shattering and a greater chance of rodent attack; both result in yield decrease.
     - In general, the appropriate timing of harvest is 4-5 weeks after flowering, but to determine the exact timing for harvest, it is necessary to visit the field frequently.
     - The followings are the indicators of the right harvest timing.
       a) The majority (about 80-85%) of the grains on the panicles have turned yellow or gold in color.
       b) The majority of grains are well dried, judged by biting.
       c) Most (80%) of the rachis-branches of panicles have become dry.

3) Comparison of rice production among FFS demo plots (TP-R with fertilizer, TP-R without fertilizer) and the conventional plots
   - Tell the farmers that the difference of rice plants in two FFS demo plots shows the effect of fertilizer and that the difference of those between in FFS demo plot without fertilizer and the conventional plot shows the effect of crop management including water control.
   - Ask the farmers to harvest the rice in the FFS demo plots and in the conventional plot separately and compare the amount of production among the three plots.

Threshing, winnowing, and drying

Session 10-2 Post-harvest Handling 1

Important message:

1) Harvested rice grains should be transported carefully to minimize loss.
2) Thresh rice grains in a clean condition to minimize contamination with foreign materials such as small stones.
3) Threshed rice grains should be dried well and uniformly under the sun before putting them in sacks.
4) Spreading on the earth is not recommended.

How to facilitate the session:

1) Introduction
   - Ask the farmers about their methods of post-harvest handling including binding, transporting, field drying, threshing, cleaning, drying, and storage.

2) Post-harvest handling
   - Tell the farmers the recommended methods of post-harvest handling as follows:

- Binding and transporting
  a) Use binding materials such as vine tree barks and woven grasses or palm leaves
  b) Use a large pan, basket, cloth, or tarpaulin to carry rice to reduce handling loss
- Threshing
  a) Thresh the rice plants by trampling, beating against a hard object, or beating with sticks
  b) Spread a tarpaulin sheet on the threshing ground; otherwise, thresh on cleaned flat ground
- Cleaning
  a) Clean threshed rough rice because it contains various foreign matters such as bits of straw, empty grains, and gravel
  b) Remove light foreign matters such as empty grains, chaff, weed seeds, and bits of straw by winnowing
  c) Remove stones and other hard and heavy foreign matters by hand and winnower
  d) Use a tarpaulin sheet in cleaning to avoid further contamination by foreign matters

Store well-dried and winnowed grains in proper ways

Session 10-3 Post-harvest Handling 2

Important message:

1) Rice should be well dried before putting them in sacks.
2) Rice bags should be kept in the proper place to avoid damages from rats, pests, and fungus.
3) Rice bags should not be piled too densely to secure ventilation.
4) It is recommended to put the bags on the pallet of woods, instead of putting them directly on the floor, to avoid unfavorable moisture absorption from the floor.

How to facilitate the session

1) Post-harvest handling
   - Tell the farmers the recommended methods of post-harvest handling as follows:
     - Drying
       a) After cleaning, dry the rice grains further under the sun on clean ground, tarpaulin, or drying floor near storage
       b) While drying, watch the grains carefully to avoid contamination by soil and gravel

     - Storing
       a) Put the dried rough rice into sacks (normally 50kg) and store them in a storage room or house
       b) Place the sacks on a wooden pallet or timbers laid side by side as a mat to keep them away from moisture seeping through the floor
       c) Do not pile the sacks too densely; space them out for ventilation
       d) Keep the storage room or house always clean so as not to attract rats and other pests

Conventional Techniques	TP-R without Fertilizer	TP-R with Fertilizer
Variety: (_____) Area: (_____m^2) Date of Sowing: (_____) Date of Transplanting: (_____) Date of Harvesting: (_____) Amount of Seed: (_____kg)=(_____TP) Amount of Fertilizer: (_____kg) Amount of Production: (_____kg)=(_____bushel) Yield: (_____ton/ha) = (_____bushel/acre)	Variety: (_____) Area: (_____m^2) Date of Sowing: (_____) Date of Transplanting: (_____) Date of Harvesting: (_____) Amount of Seed: (_____kg)=(_____TP) Amount of Fertilizer: (_0_kg) Amount of Production: (_____kg)=(_____bushel) Yield: (_____ton/ha) = (_____bushel/acre)	Variety: (_____) Area: (_____m^2) Date of Sowing: (_____) Date of Transplanting: (_____) Date of Harvesting: (_____) Amount of Seed: (_____kg)=(_____TP) Amount of Fertilizer: (_____kg) Amount of Production: (_____kg)=(_____bushel) Yield: (_____ton/ha) = (_____bushel/acre)

Session 11-1 Comparison of the Yield Performances

Important messages:

1) The yield performances of the conventional plot, the TP-R without fertilizer plot, and the TP-R with fertilizer plot are to be compared.

How to facilitate the session

1) Introduction
   - Ask the farmers if they are satisfied with their rice production in this season. Ask their general impression on the TP-R that was tried out in the demo plots.
   - Review with the farmers the issues and experiences during the cropping season.

2) Evaluation of rice yield with improved cultivation techniques
   - Using the table, compare the yield between the demonstration plots with the improved cultivation techniques and the conventional plot with the farmers' normal practices. Highlight the different timing of farming activities.
   - Tell the farmers that the difference in rice performance between the FFS demo plot without fertilizer and the conventional plot shows the true effect of TP-R.
   - Discuss with the farmers the results and possible reasons for the difference in yield.

What were the big differences between the TP-R and conventional practices?	• • •
What do you think were the good/beneficial aspects in the TP-R?	• • •
What do you think were the unfavorable aspects in the TP-R?	• • •
Do you want to apply the TP-R in your individual plot in the next season? If not, why?	• • •

Session 11-2 Evaluation of the TP-R

Important message:

1) Clarify the difference in the farming techniques between the TP-R and the conventional practices.

How to facilitate the session:

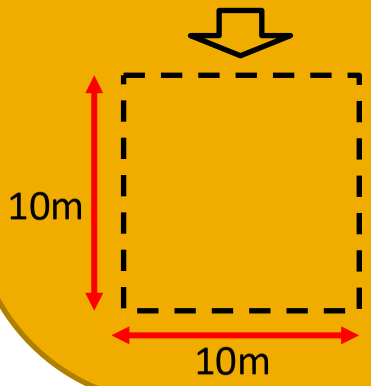
1) Review of the improved rice production techniques
   - Review all components of the TP-R by showing all the materials used so far.
   - Discuss with the farmers which techniques have successfully been implemented in this season and which ones have not, and the reasons why they were or were not implemented successfully.
   - Discuss with the farmers what are the positive and negative points of the TP-R compared with their conventional farming practices.

2) Discussion on the way forward
   - Ask the farmers if they would like to apply the improved techniques learned; ask them which techniques they will apply in the next season. Also, ask the reasons why some of them will not apply any techniques.
   - Discuss with the farmers what is to be done in the coming cropping season in the group farm (as well as in their individual farms).

The TP-R Demonstration Farm

The TP-R Demonstration Farm

Seed Multiplication Plot



1. The TP-R Demonstration Farm

Important message:

- The Graduate FBOs are expected to demonstrate the TP-R in a larger scale to disseminate the recommended techniques and showcase the effectiveness of the techniques.
- The Graduate FBOs are thus supported by SRPP in this main cropping season 2021 with some inputs to cultivate rice in the TP-R Demonstration Farm (Demo Farm) to be set in their group farm. The input support, however, is provided only once in this season, and the FBOs should manage themselves to secure the inputs to continuously cultivate rice with the TP-R for coming seasons.
- The Graduate FBOs are also taught about seed multiplication, and they have to set up a small seed multiplication plot within the TP-R Demo Farm, so that they would be able to secure the quality seed to be used in coming season.

How to facilitate the session:

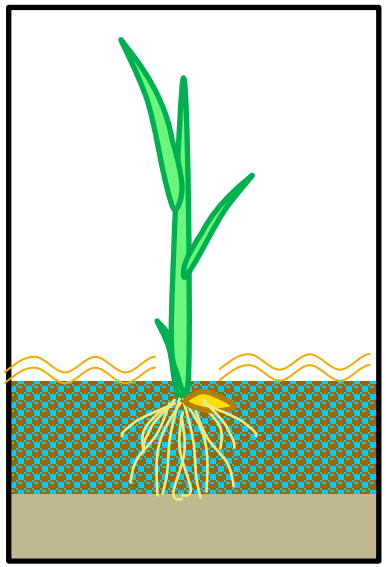
- Explain to the farmers the following about the TP-R Demo Farm:
  a) The maximum size of the Demo Farm to be supported in the main cropping season 2021 is one (1.0) acre.
  b) The amount of seed to be sown for the Demo Farm of one acre is 12 kg based on the TP-R recommendation.
  c) The total amount of fertilizer (NPK15-15-15) to be applied to the Demo Farm of one acre is 108 kg, i.e. 72 kg for the basal application, and 36 kg for topdressing.

- Explain to the farmers that a part of the Demo Farm with 100 m^2 of area (10 m x 10 m) is to be delineated by bunds as the seed multiplication plot.

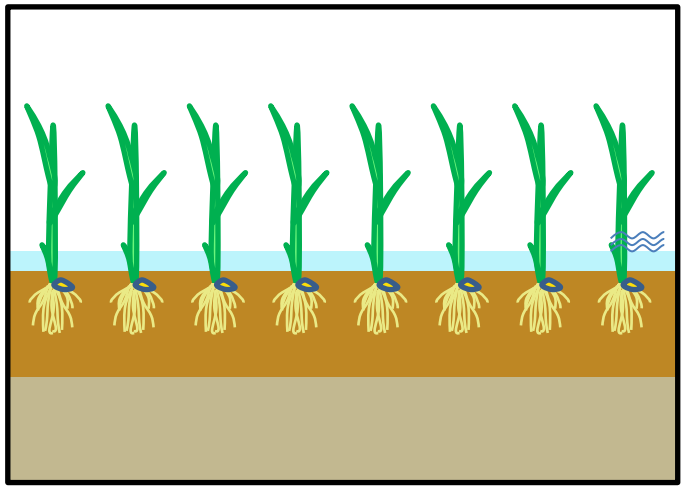
Key Components of the TP-R

Construction of Bunds & Drainage

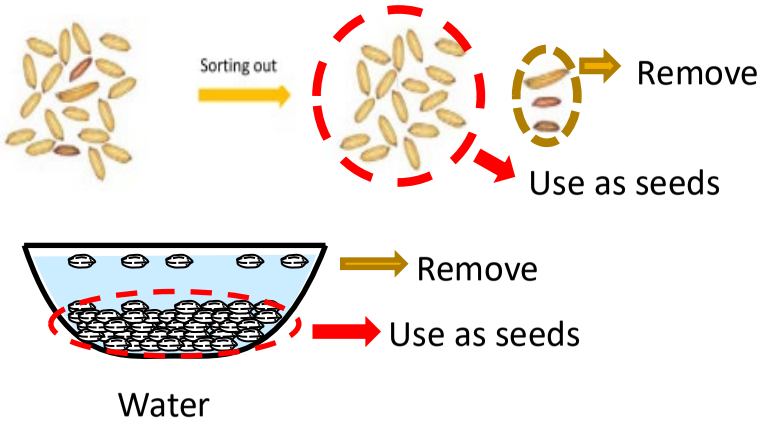
Puddling



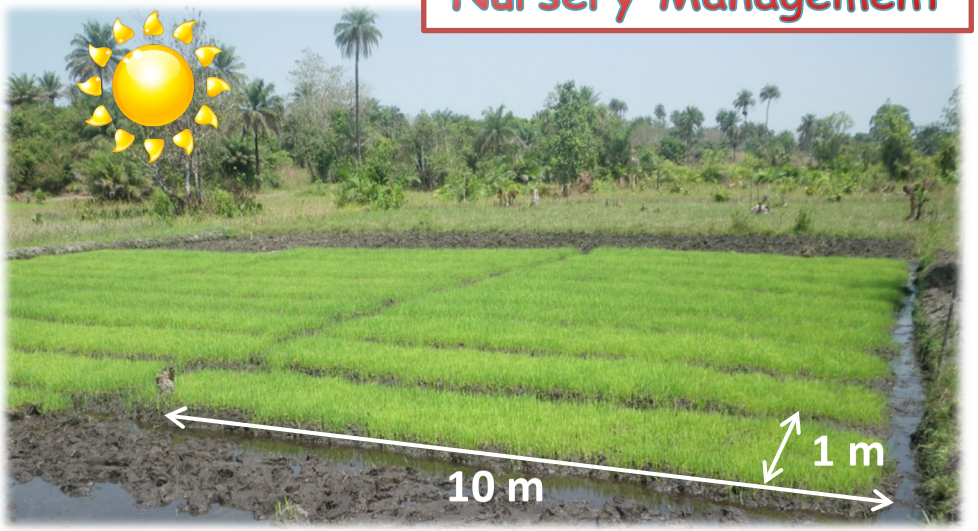
Leveling



Seed Selection



Nursery Management



2-1. Key components of the TP-R

Important message:

- The TP-R is composed of various improved techniques which are different from the conventional practices of the farmers
- The TP-R techniques cover entire farming activities from very initial land preparation to post-harvest handling.

How to facilitate the session:

1) Review of the TP-R

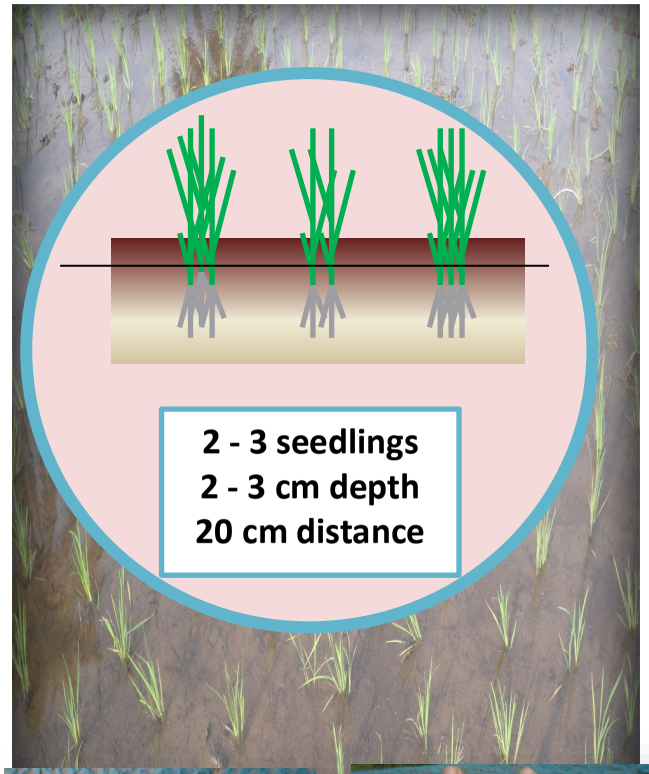
・Ask the farmers what are the TP-R recommendations and reasons why they are recommended at each stage of rice cultivation.

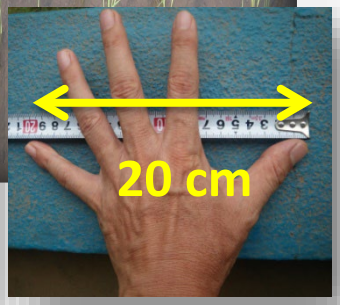
Farming activity	TP-R recommendations	Reasons why it is recommended
Land preparation	• Brushing, clearing, and digging should be done at early stage before sowing.	• Transplanting will not be delayed if land preparation was done ahead of time.
Bund and drainage construction / rehabilitation	• Bunds and drainage canals should be constructed / rehabilitated at the time of land preparation.	• Internal bunds and drainage can help improve water management. • Proper water intake and drainage will enhance the growth of rice plants and harvest. Proper drainage also prevents iron toxicity and some pests that may be transmitted with flow of water such as caseworm.
Puddling and leveling	・Puddling should thoroughly be done. ・Leveling should carefully be done.	・Root development can be facilitated in softer and well saturated soils. ・Growth of rice plants can be uniform as water and nutrient can evenly be provided to all plants.
Seed selection	・For seed purification, grains with different shapes and colors, weed seeds, and other foreign matters should be removed through careful observation and sorting. ・To select the viable seeds, floating method and germination test are to be conducted.	・Better germination and growth can be expected by using good seeds.
Nursery management	・Seeding rate is 12 kg per acre (smaller amount is enough). ・Nursery site should be open place with good sunlight exposure and soil should be fertile enough, not much clayey or with gravels. ・Seeds should be sown uniformly in nursery beds.	・With proper spacing at the time of transplanting, smaller number of seedling is sufficient considering their tillering capacity. ・Seedlings can grow healthier in such nursery sites. ・Uniform growth of seedlings can be ensured.

・Explain to the farmers that these TP-R techniques will be applied in a larger scale in their TP-R Demo Farm.

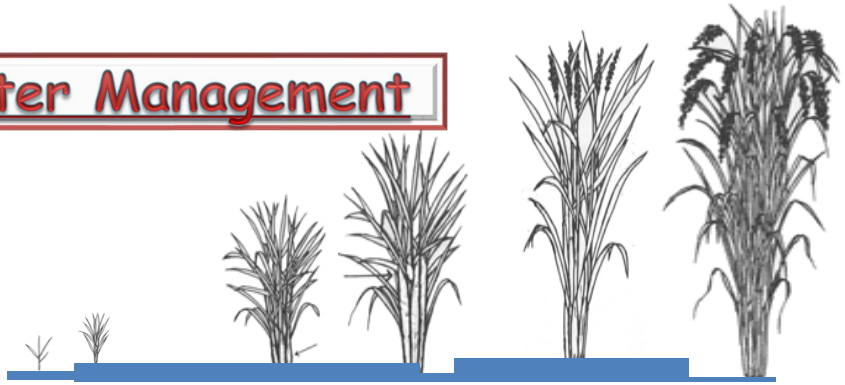
Key Components of the TP-R

Transplanting Method

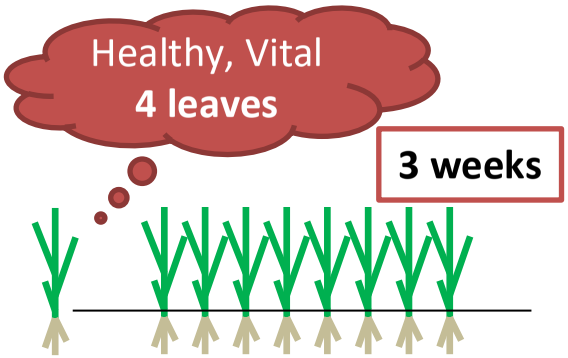




Water Management

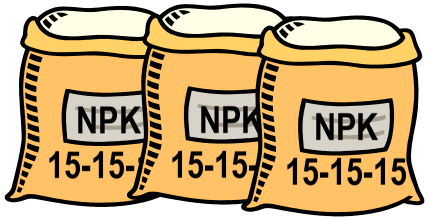


Young Seedlings



Weeding

Fertilizer Application



2-2. Key components of the TP-R (continued)

How to facilitate the session:

1) Continue the review of the TP-R

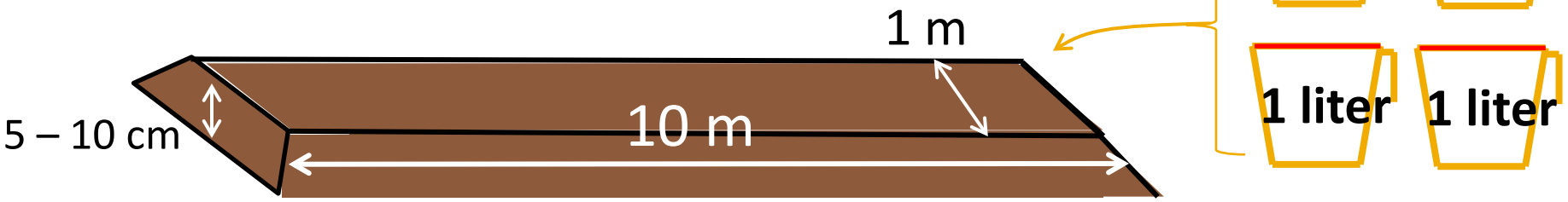
- Continue with the TP-R recommendations and reasons why they are recommended at each stage of rice cultivation. (This exercise may be done by using the following table on the flipchart)

Farming activity	TP-R recommendations	Reasons why it is recommended
Use of younger seedlings	• Younger seedlings are to be transplanted.	• Chances for the rice plant to develop more tillers will be increased.
Transplanting method	• Only 2-3 seedlings per hill are to be transplanted • Seedlings are to be transplanted with 20cm distance between hills • Planting depth should be 2-3cm.	• Smaller number of seedlings in wider spacing can obtain enough water, nutrients and sunlight with less competition. • Deep planting reduces the number of tillers, hence panicles per hill.
Weeding	• Weeding in paddy field should be done. • The first weeding should be done at 2-3 weeks after transplanting while weeds are still small. • Major weeds should be removed before application of topdressing.	• Rice plants will not be deprived of water, nutrients and sunlight by weeds. • Growth of rice plant will not be disturbed and it will be more difficult and laborious to do weeding once weeds grow bigger. • Weeding before topdressing will ensure that the nutrients will properly be absorbed by rice plants.
Fertilizer application	• Basal fertilizer is to be applied at the time of transplanting. • Topdressing should be done at the panicle initiation. • Two-thirds (2/3) of the recommended amount of fertilizer should be applied as basal, while the remaining one-third (1/3) is to be applied as topdressing.	• Basal fertilizer will help the rice plant to grow bigger and develop more tillers. • Topdressing will contribute to the increase in the number of grains per panicle.
Water management	• Water level in the demo farm should be controlled.	• The water level should be kept low for several days after transplanting to promote the root development, prevent shallow-planted seedlings from floating away and keep the nutrients of the fertilizer in the soil. • During the vegetative growth stage, the water level should be kept slightly high to reduce weed. • Before the harvesting, the water should be drained to ease the work in the plot.

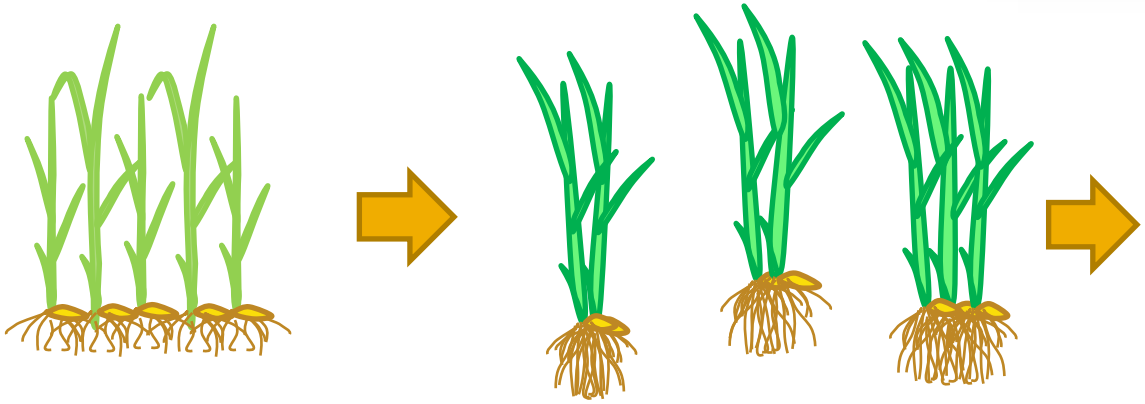
- Explain to the farmers that these TP-R techniques will be applied in a larger scale in their TP-R Demo Farm.
- Encourage the farmers to also apply these TP-R techniques to their individual farms.

Sowing Density in the Nursery for the Demo Farm (with application of fertilizer)

Seed Rice: 2 kg
= 4 liters for 10 m²



Demo Farm (Main Field)



3. Different Sowing Density for the TP-R Demo Farm

Important messages:

1) The sowing density in the nursery can be higher if the fertilizer is applied in the main field, which can reduce the workload in nursery preparation and management.

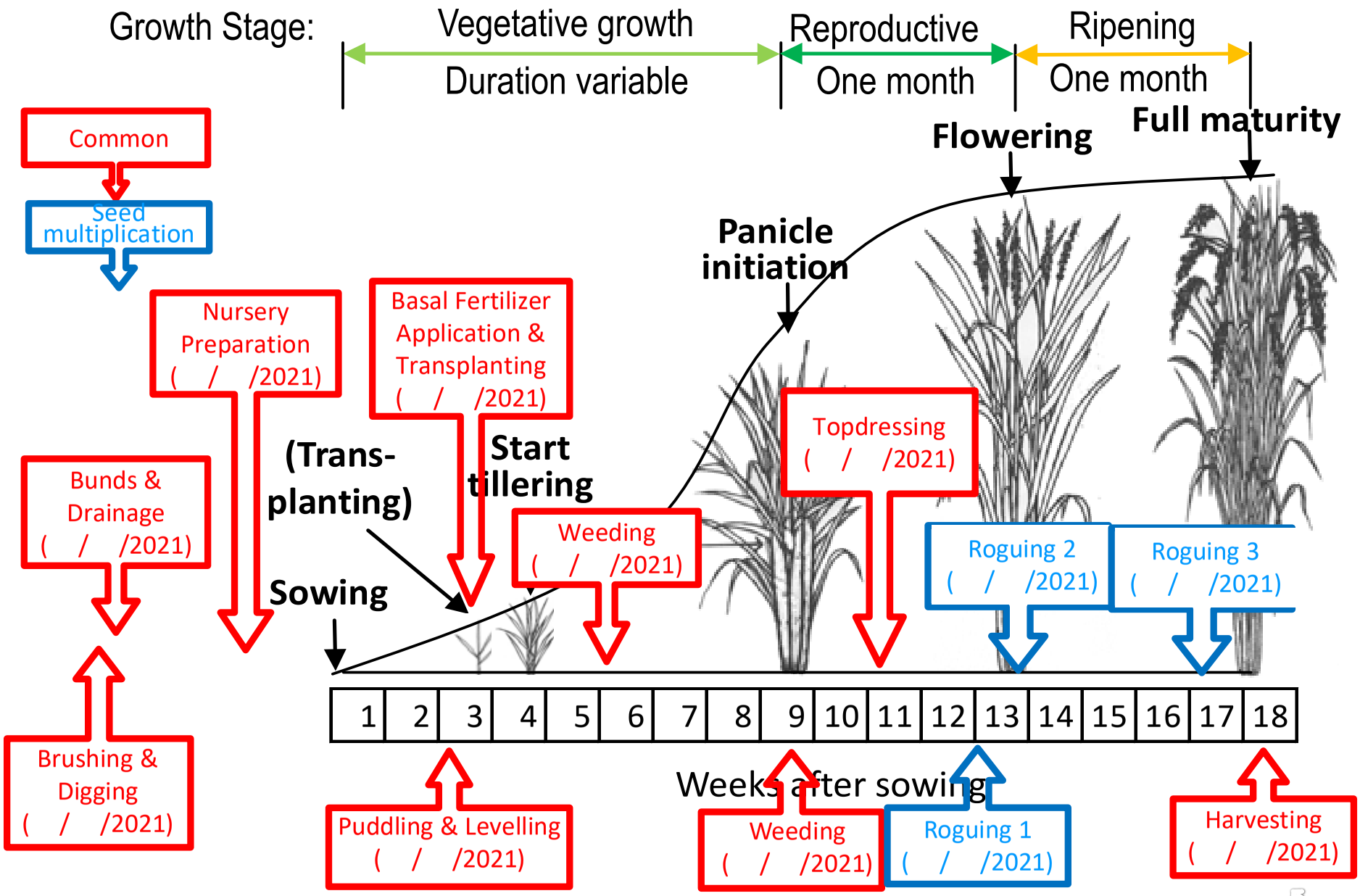
How to facilitate the session:

1) Review of the seed rate and sowing density recommended in the TP-R during the FFS
   Ask the farmers if they remember the seed rate and sowing density applied during the FFS and remind the farmers the following:
   - Recommended seed rate: 30 kg per 1 ha = approximately12 kg per acre
   - Sowing density: 1 kg (2 liter-cups) of seed to be sown in a nursery bed of 10 m^2 (1 m x 10 m).

2) Introduction of the result of the on-farm trial
   - Explain to the farmers that an on-farm trial was conducted in the rainy season 2019.
   - The result of the experiment indicated that the growth of seedlings from the nursery with higher density can be recovered after transplanted in the main field if fertilizer is applied in the main field.

3) New recommendation on the sowing density for the TP-R Demo Farm
   a) Explain to the farmers the following:
      - Since the TP-R Demo Farm will be applied with fertilizer, the sowing density can be twice as high as the original recommendation of the TP-R, i.e., 2 kg (4 liter-cups) of seed to be sown in a nursery bed of 10 m^2.
      - If the area of demo farm is 1 acre, the seed can be sown in six (6) nursery beds of 10 m^2 with this new recommendation, instead of twelve (12) beds, which reduces the time and labor for nursery preparation and management.
   b) Remind and emphasize that this higher sowing density is applied only if fertilizer can properly be applied in the main field. It is recommended to follow the original sowing density of 1 kg per 10 m^2 bed if fertilizer would not be applied, such as in cases of plots of individual members.

CROPPING CALENDAR (Example of NERICA L19)



4. Cropping Calendar

Important messages:

1) Farmers should prepare a cropping calendar which is appropriate for the rice variety to be cultivated. According to the plan, they should schedule the timing of land preparation, nursery preparation, sowing, transplanting, fertilizer application, weeding and harvesting.

How to facilitate the session:

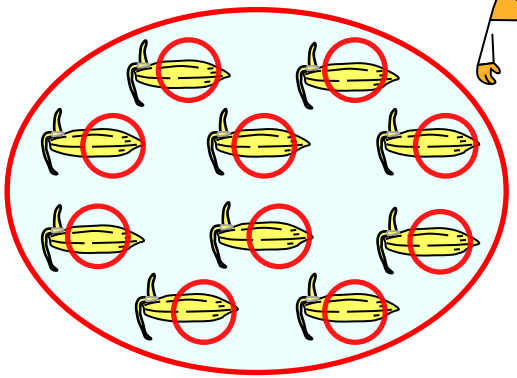
1) Introduction
   Ask the farmers to describe their farming practices according to a variety to be used throughout the rice growth period in the order and write them on flipcharts (e.g., brushing, digging, bund making, drainage construction, nursery preparation, sowing, puddling, leveling, uprooting, transplanting, fertilizer application, weeding, water management, bird-scaring, harvesting, transporting, threshing, bagging, etc.)

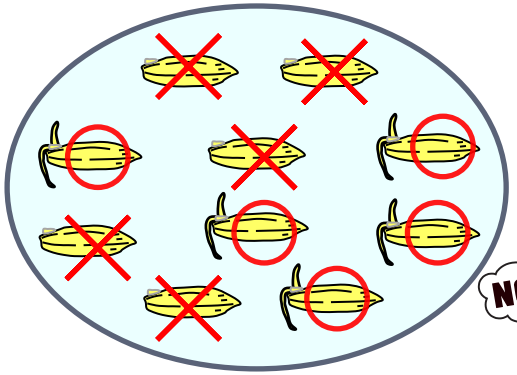
2) Discussions
   Ask the farmers to identify appropriate timing of each farming activity to be conducted in the TP-R Demo Farm. Emphasize that the timing of some activities causes positive or negative influence on the growth of rice plant, thereby on the yield. Farmers should know when to do what in order to grow their rice well and thus to obtain good harvest at the end of the season.

3) Formulation of the cropping calendar
   Explain the steps to formulate the cropping calendar and plan together with the farmers
   (1) Set the expected time of harvest so that the ripening stage coincides with a period of sunny days
   (2) Avoid transplanting and topdressing during the peak rainy season
   (3) Decide when to sow the seeds, taking into account the growth duration of the rice variety to be used
   (4) Decide when to start brushing so that the first digging can be finished before sowing
   (5) Transplanting should be scheduled about 3 weeks after sowing seeds
   (6) Set the time of first weeding at 2-3 weeks after transplanting
   (7) Set the time of topdressing at about 2 months before the harvest time

Seed Multiplication

[Quality seed]
- Ensure viability and purity





Different harvesting time

5-1 Seed Multiplication 1

Important message:

- Seeds are the life of farmers. Without the seeds, they cannot cultivate, eat or live.
- Quality seed should have high germination rate and high purity.
- The admixture of the seeds of different varieties causes the non-uniform growth and will result in the loss of the yield.
- Under the insecure condition of supplying valuable seeds in this country, seeds must be produced by the farmers themselves.

How to facilitate the session:

1) Discussion with the farmers:
   - Ask the farmers if they have ever had problems regarding the quality of the seed rice which they have been using.
   - Ask the farmers what kind of problems were encountered and how the problem may be solved.
   - Explain to the farmers that the quality seed may be produced by the farmers with specific techniques of seed multiplication

2) Purity and viability of seeds
   - Explain that high germination rate and high purity of a variety are very important for the seed multiplication.
     - High germination rate ensures to produce suitable number of seedlings.
     - High purity of a variety contributes to the uniform harvesting time in a field.

3) Negative effect of impure seeds
   - A mixture of the target variety and off-types with different growth duration leads to yield reduction because the grains of the off-types are likely to be immature or overripe at the time of harvest, which leads to the loss of the yield.

Method - Seed selection

Sorting

↓

Purity

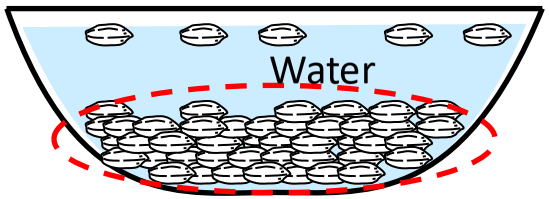
Selection with water

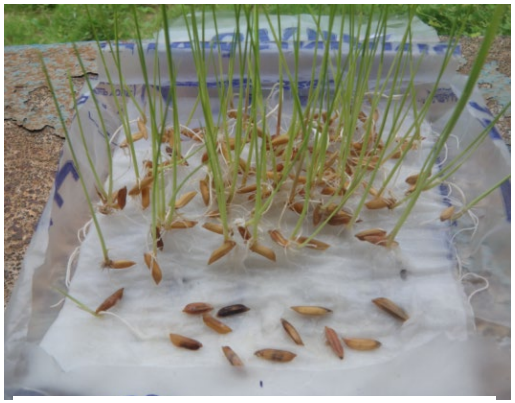
↓

Viability

↑

Germination test

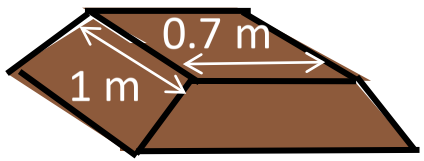




Out of 100 seeds,
88 seeds germinated.
88 > 80 === OK!

Nursery preparation

Take 70 grams (about 2,500 grains) of selected seeds, and sow on the separate nursery bed with an area of 0.7 m^2.



5-2 Seed Multiplication 2

Important message:

- To produce the quality seed rice, a seed multiplication plot should be established within the demo farm.
- Farmers need to select the seed carefully, especially for the seed to be multiplied.
- For the seed multiplication plots, a separate nursery bed should be set up, which is different from the nursery for the demo farm.

How to facilitate the session:

1) Method of seed selection

a) Sorting seeds

- For seed purification, tell the farmers to find grains with different shapes and colors, weed seeds, and other foreign matter by observing seeds carefully and to remove them. (If time allows, let the farmers exercise sorting with a small amount of seed rice.)

b) Selection of viable (high germination ability) seeds

- Explain (and demonstrate) to the farmers the method of selecting healthy seeds by soaking them in water: To eliminate infertile and unfilled seeds, soak all seeds in water and remove those that float.

c) Germination test

- Explain (and demonstrate) the method of germination test as follows:
  - Select 100 grains at random
  - Put them on absorbent material (e.g., paper, cloths, etc.) and keep them saturated for 4-5 days to 1 week at the maximum.
  - Count the number of germinated grains
  - If more than 80 grains out of 100 have germinated, the grains can be used for seed rice; If 70 to 80 have germinated, augment the amount of seeds by 15%, and if less than 70 have germinated, find another source of seed rice.

2) The seed multiplication plot:

- Inside the demo farm, a small plot for seed multiplication will be set up.
- The area of the seed multiplication plot is 100 m^2, (10 m x 10 m), which should be delineated with bunds.
- About 100 grams of seed is needed for the seed multiplication plot, which will first to be sorted, selected and tested. The selected seeds are to be sown in a nursery bed of 0.7 m^2 (1 m x 0.7 m) which should separately be set up from those nursery beds for the demo farm as a whole.

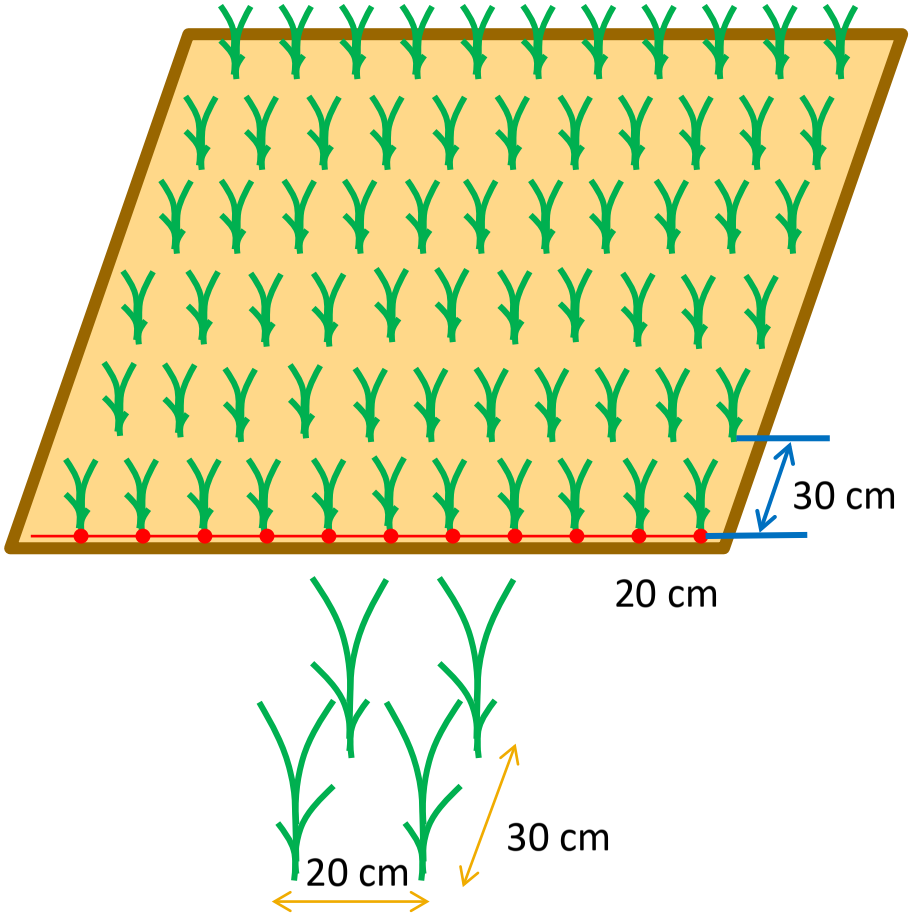
Transplanting method for Seed Multiplication Plot

Line planting

To remove rice plants in irregular places.

Single seedling per hill

To remove off-type plants completely.



5-3 Seed Multiplication 3

Important message:

- Single seedling is transplanted in a hill, in line, 30 cm apart and 20 cm between the hills.
- Line planting is recommended for seed multiplication.
- Seed multiplication plot should be located in an easily accessible area.

How to facilitate the session:

2) Method of seed multiplication

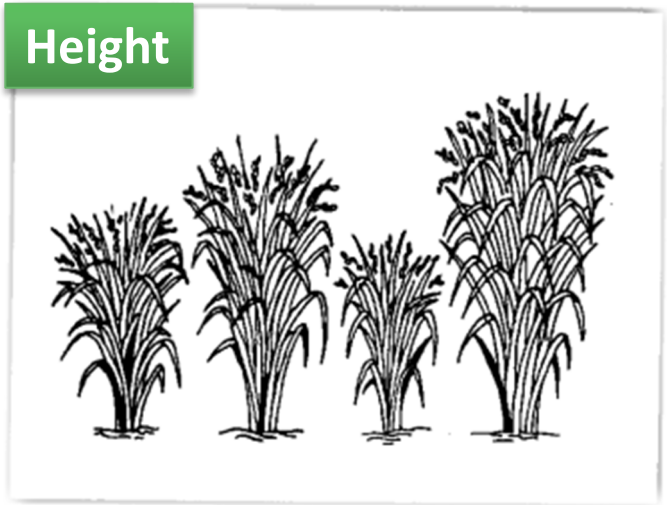
- Explain how seed multiplication is different from normal rice production. The main points of seed multiplication methods are as follows:
  - Line planting of seedlings with spacing, for example 30 cm x 20 cm to make it easy to weed and identify self-germinated plants.
  - Transplanting of only one seedling per hill. It is to distinguish characteristics of each rice plant. Although the plants may look very weak in a week, they will develop tillers vigorously as time goes on.

3) Selection of plots for seed multiplication

- Tell the farmers that the seed multiplication site should be in an accessible area where observation and management are easy.
- Explain to the farmers that, if the seed multiplication plot is properly managed, the amount of seed produced from the plot can be about 300 times of the amount of the sown seeds, for example, 150 kg of seed can be produced out of 500 g (1 liter cup) of the seed.
- Explain land area necessary for certain target multiplication; in general, 70 g of seed requires land about 100 m^2 (e.g. 10 m x 10 m) for the seed multiplication plot, assuming that germination rate of the seed is 80%.
- Discuss with the farmers and find a suitable site for the seed multiplication plot.
- Visit the site to evaluate its condition and determine if it is appropriate for the seed multiplication plot.

Purifying seed by roguing (Removal of off-type plants)

Height

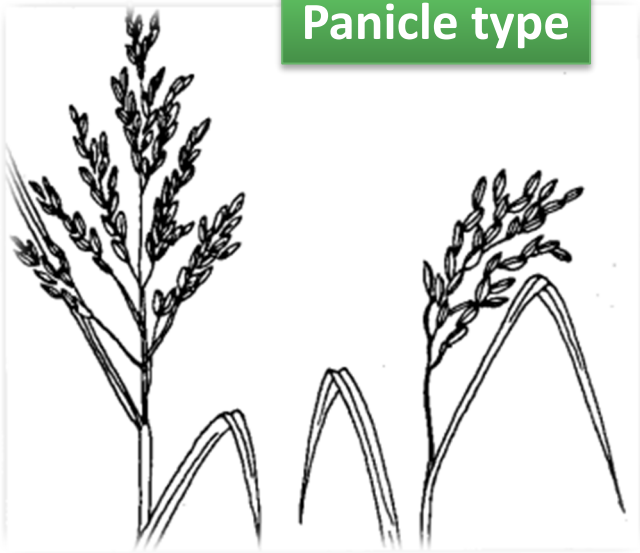


Leaf, culm, grain color

Gain shape

Panicle exsertion

Panicle type



Source: Purifying seed through roguing; IRRI; 1988

5-4 Seed Multiplication 4

Important message:

- Periodical removal of off-type plants is necessary for purifying the seed through careful observation at the seed multiplication plot.
- Off-types are identified by height, maturity time, grain color and shape, leaf color and angle, and other characteristics.
- Off-types should be removed from the field periodically before harvest, as it is difficult to separate grains after harvest and threshing.

How to facilitate the session:

1) Importance of rouging (removal of off-type plants) to purify the seed

・Explain to the farmers why it is necessary to remove off-type plants.

- A mixture of the target variety and off-types with different growth duration leads to yield reduction because the grains of the off-types are likely to be immature or overripe at the time of harvest.
- By removing the off-types from the seed multiplication plot, pure seeds can be obtained.

2) How to identify the off-type plants

・Off-types are distinguished by several characteristics such as:

- height of the plants,
- grain color,
- shape and size of grains,
- color of the leaves,
- panicle exertion, and,
- type of panicles.

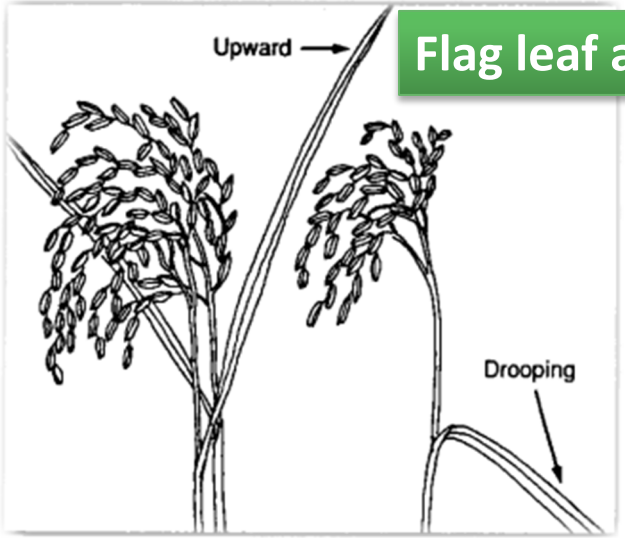
Purifying seed by roguing (Removal of off-type plants)

Heading time

Leaf angle

Awns

Flag leaf angle



Remove off-type plants

Source: Purifying seed through roguing; IRRI; 1988

5-4 Seed Multiplication 4 – Continued

2) How to identify the off-type plants - continued

The other characteristics to be observed to identify the off-types includes;

- leaf angle and width,
- maturity time,
- presence of awn, and,
- flag leaf angle.

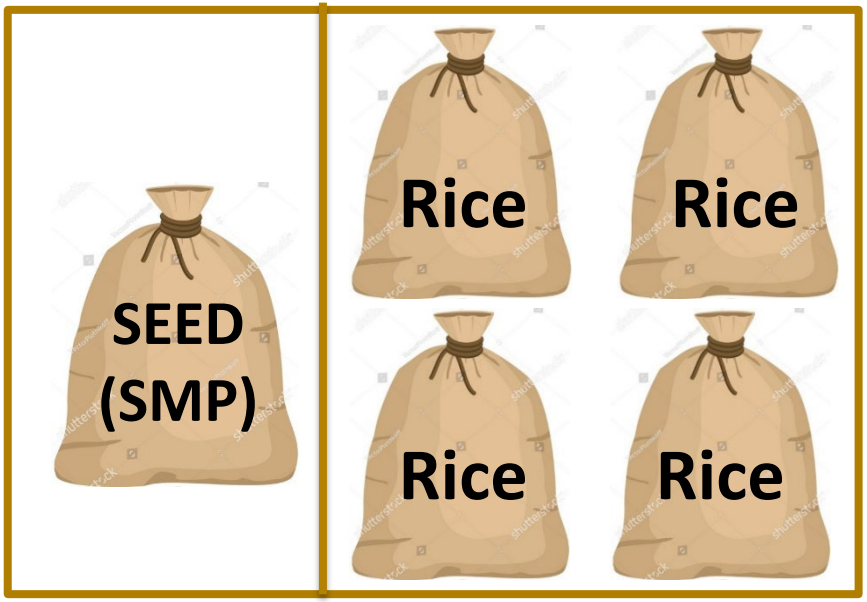
3) Timing of roguing

- Off-types should be removed from the field before harvest because it is difficult to separate the harvested grains after harvest and threshing.
- Removal of off-types is recommended at least three times: before flowering, at flowering and at ripening.

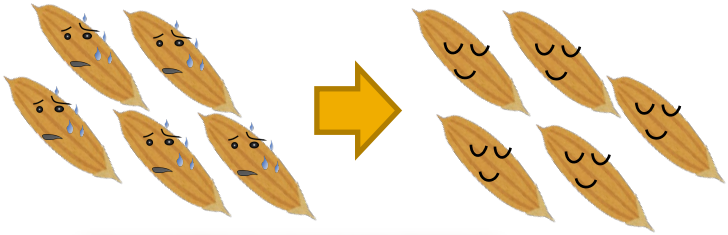
Maintaining the seed quality

Removal of Empty Grains and Foreign Matters

Separate Storage



Periodic Drying



https://www.naro.affrc.go.jp/org/nfri/yakudachi/gaichu/zukan/16.html

5-5 Seed Multiplication 5

Important message:

- Careful post-harvest treatment is required to maintain the quality of the seed multiplied at the SMP.
- Removal of empty grains and cleaning of the seeds by winnowing and with manual sorting should carefully be done at the harvest as well as after every drying.
- The seed obtained from SMP should be clearly marked on the bag and stored separately from other rice bags.
- To maintain viability, seed rice should be kept under cool and dry condition until next season.
- Seeds should be dried under the sun on a regular basis to prevent possible damage by weevils and keep the viability.

How to facilitate the session:

Explain to the farmers that more careful post-harvest treatment is requires for the seed to keep the viability.

1) Cleaning:
   - Empty grains and other foreign matters should carefully be removed by thorough winnowing.
   - Some large foreign matters should also manually be removed before bagging.
2) Storage:
   - The seed bags should clearly be marked and kept separately from other rice bags to avoid any risk of mixing up.
   - The seed should be stored in a dry and cool place with enough air ventilation to keep the viability.
   - The storage place should always be clean to avoid the risk of attack by rats.
3) Periodic drying
   - It is necessary to dry the seed periodically to prevent the weevils' attack and keep the viability. It is advisable to dry the seed at least once a month.
   - Spread the seed on a tarpaulin sheet or a clean cloth to dry them under the sun.
   - After drying, clean the seed by winnowing and with manual sorting before bagging.