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How to Grow Rice with Bio-Plant and Pro-Plant

1. Compost and Soil Preparation

1.1 The Benefits of Compost

- See the file ***How to Make Rich Compost with Bio-Plant – Workshop Handouts***. Click here for how to make rich compost with Bio-Plant. Soil preparation with a lot of compost made with Bio-Plant will be invaluable in increasing growth. Add compost to the planting holes and spread it generously around each plant after planting. Add more compost around each plant monthly.
- If you do not make compost, refer to: ***How to Prepare the Soil With and Without Compost***. Click here.
- Use compost or manure to add nutrients to the field. Soil that is enriched with compost or manure will usually have better structure so that plant roots can grow more easily in the soil. Compost releases its nutrients more slowly than does chemical fertilizer so plants get more benefit from this source of nutrients.
- Making compost and working it into the soil of the field is usually a lot of work. But experience shows that this is a good investment for the farmer because the better quality soil supports better root growth and performance. Adding chemical fertilizer is not as good as adding organic material to the soil.

1.2 Plough the Rice Fields

- Plough the fields roughly after the harvest. Plough in the rice stubble. Leave the fields dry for 15-30 days. This helps to kill weeds.
- Then, soak the soil with water for 7-10 days so that the weeds and the remaining rice seeds germinate. After that, roughly plough the fields for the second time.
- Leave the fields saturated with water for 10-15 days. It takes 5-7 days for weed seeds to germinate after being soaked in still water. This is intended to let any further remaining weed seeds germinate again.
- Then, repeat the ploughing and level the land. Drain the water out until the level of water is shallow enough to see whether the land is even or not. If there are any parts that are not level to others, then these sections should be adjusted. This will also help control the amount of water required with more efficiency and ease.

1.3 Upland Rice

- In general, compost is quite sufficient as a source of nutrients. Chicken manure, for example, is very rich in nutrients. Consequently, apply at least 5 MT of compost mixed with Bio-Plant to each hectare before planting upland rice.
- Farmers have found that they get best results by working compost made from diverse sorts of biomass into the soil during the preceding cultivation season, when they are growing a crop between their rice crops, such as potatoes or beans or onions. The compost applied to the second crop between the rows of rice helps that rice crop to grow better, and the further decomposition of the compost provides adequate nutrients for the rice crop that follows.
- **Method 1:** To prevent weeds growing by smothering them, and to provide the soil with Nitrogen and nutrients, a cover crop should be planted after the rice harvest. The rice should be planted when the cover crop has died down. The space between the rows of rice should be mulched with the remains of the cover crop.

- **Method 2:** Often upland rice farmers plant a cover crop, such as beans, 2 months after planting their rice or maize crop. The crop should be well-established before the cover crop is planted. When the farmers prepare the soil to plant rice again, the bean cover crop has died down already, and it is cut to provide mulch between the rows.
- **Method 3:** A living mulch, such as clover, is planted between the rows of rice or maize. Clover, beans, legumes, and peanuts can be planted with rice and maize because they do not compete for light. Beans have deep roots while upland rice has shallow roots, so there is little competition for nutrients.
- The main crop may have a lower yield than if it is grown on its own with mulching and no cover crop, but the yield of the two crops together, such as beans and maize, will be higher than just one crop, e.g. maize, on its own,
- Before the introduction of chemical agriculture and mono-cropping, planting 2 crops together was normal. A diversity of crops increases plant health.

2. Seed Preparation

2.1 How to Prepare Rice Seeds

- **Sort the Seeds:** Separate good and bad seeds using the egg floatation technique, as follows:
  - **Step 1:** Fill a container with water, large enough for all your rice seeds.
  - **Step 2:** Place a fresh egg in the water. It will sink to the bottom.
  - **Step 3:** Mix salt with the water until the egg floats.

  - **Step 4:** Take out the egg and put in the rice seeds. Swirl the seeds around in the water for a few minutes. The good seeds will sink to the bottom and stay there. The poor seeds will rise to the surface. Scoop them out. Feed them to the chickens.

  - **Step 5:** Wash the salt off the good seeds by rinsing them in water 3 times, and then soak these seeds in another container of water for 24 hours.

2.2 Soak the Seeds for 24 Hours: Put the seeds in a plastic bag (with small holes punctured in it), or in a sock, a cloth, or sack and tie up the ends so that the seeds cannot escape. Water should be able to enter through holes. Soak them for 24 hours in water that contains 20 cc of Bio-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, reduce the water to just a few litres. *The amount of Bio-Plant can be increased to between 20 cc and 100 cc for a better effect.* Do not soak them for longer than 24 hours or they might rot. The container of water only needs to cover the seeds 3 inches. Place a cloth over the top to increase the warmth during the soaking.

- Put the sack (or whatever you soaked the seeds in) on the ground for 1-2 days. Keep it out of the sun and in a warm shaded place. Keep the seeds warm. They will germinate. When they have germinated, plant them either in a nursery for about 3 weeks before planting them in a field, or if you prefer, plant the germinated seeds directly in a field.

3. Growing Seedlings With the Modified Mat Nursery Method

- To increase the yield, you could use the modified mat nursery, in order to produce seedlings, as follows.

a. What is a Modified Mat Nursery

- A modified mat nursery establishes seedlings in a layer of soil mix on a firm surface. Seedlings are ready for planting within 15–20 days after seeding (DAS).

b. Why Use a Modified Mat Nursery?

- The modified mat nursery uses less land; it can be installed closer to the house than traditional field nurseries; and it uses less labour for both transporting seedling mats and replanting. As a result, root damage is minimal while separating seedlings.
- **Limitation:** The system is best suited for irrigated areas. If transplanting is delayed, the seedlings can be damaged when separated for planting.

c. How to Establish a Modified Mat Nursery?

Note: The numbers correspond to the photographs on the next page.

1. **Seed:** To plant 1 hectare (with 2 seedlings/hill at 25 x 25 cms. spacing), use 18–25 kgs good quality seeds. Well sorted seeds result in more uniform germination, vigorous seedlings, less replanting, fewer weeds, and 5%–20% increase in yields.
2. **Nursery Area:** Prepare 100 m^2 nursery for each 1 hectare to be planted. Select a level area near the house and/or a water source. If the area is not sufficiently compacted, then spread a plastic sheet or banana leaves on the marked area to prevent roots growing into soil.
3. **Soil Mixture:** Four (4) m^3 of soil mix is needed for each 100 m^2 of nursery. Mix 70–80% soil + 15–20% well-decomposed organic manure + 5–10% rice hull or rice hull ash.
4. **Pre-germinate the Seeds:** Soak the seeds for 24 hours (some varieties may need longer to bud). Drain and incubate (cover and keep moist) the soaked seeds for another 24 hours in a sack. In this time, the seeds will germinate and the first seed root grows to 2–3 mm long.
5. **Lay the Soil Mixture:** Place a wooden frame of 0.5 m long, 1 m wide and 4 cms. deep, divided into 4 equal segments on the plastic sheet or banana leaves. Fill the frame almost to the top with the soil mixture.
6. **Sow the Seeds:** Sow the pre-germinated seeds uniformly and cover them with a thin layer of dry soil. (Approximately 1 seed/cm^2 or about 200 grams for every 3 square meters.)
7. **Soak the Seedbed:** (a) Sprinkle water immediately to soak the bed. (b) Remove the wooden frame. Fill with the soil mix if the seeds become exposed.
8. **Water:** Water the nursery as needed to keep the soil moist. Protect the nursery from heavy rains for the first 5 days after seeding (DAS). If the nursery can be flooded then at 7 DAS, maintain a 1 cm water level around the mats. Drain the water two days before removing the seedling mats for transplanting.
9. **Fertilizer Application:** Spray Pro-Plant (20 cc in 20 litres of water) once or twice every 7-10 days while the seedlings are growing.
10. **Lift the Seedling Mats:** Transplanting should be done when the seedlings have just two leaves, and before they have more. This usually occurs between 8 and 15 days. Lift the seedling mats and transport them to the main field

The Modified Mat Nursery

The frame is shown being placed on a mat made of banana leaves.

The rice seedlings in the mat nursery are ready for transplanting.

4. Sowing the Seeds: Sowing by Throwing the Seeds

- We do not recommend this method of sowing seeds, especially as it makes weeding very difficult indeed. But if the farmers really want to sow the seeds by broadcasting the seeds, they should flood the field with water about 15 cms. deep first and then sow the seeds. Then they should let the water flow out once the seeds have settled into the mud. This stops the birds eating the seeds.

5. How to Get Plants to Produce More Tillers?

- The key to success with SRI is the early transplanting of seedlings, as explained below. This usually means transplanting seedlings before they are 15 days old, and as early as 8 or 10 days - when only the first small root and tiller, with two tiny leaves, have emerged from the rice seed. When you plant older seedlings, i.e. 3, 4, 5 or 6 weeks old, they have already lost much of their potential to produce a large number of tillers.

- When seedlings are planted with much delay after being removed from the nursery, they suffer a lot. Once removed from their seedbed, seedlings should be replanted in the field within half an hour, and preferably within 15 minutes.
- When seedlings are pushed into the ground, rather than gently laid into the soil, they also must expend a lot of energy to resume root growth. This disturbs their development.
- Transplanting rice seedlings early and carefully helps plants resume their growth in the field without reducing their potential for high yields by harvest time.

6. How Can We Get Rice Plants to Grow Stronger Roots?

- Plant single seedlings, one by one, rather than plant them together in bunches of 3 or 4 seedlings, or even more, as is usually done. When several seedlings are planted together, their roots must compete with each other. This is a similar problem for rice plants as when they grow close together with weeds and must compete with them for nutrients, water and sunlight.
- It is important, as discussed below, that the seedlings be spaced wide apart, usually at least 25 centimeters from each other, and preferably in a square pattern. This facilitates weeding at the same time it gives the rice more access to sunlight and air above ground.

- Spacing is a variable to be tested and evaluated. It is usually best to start with 25 x 25 cms. spacing, possibly increasing the distance between plants as farmers' gain skill and confidence, and as soil fertility is enhanced by compost.
- When the rice plants are set out far from each other, and if the soil conditions are good, their roots will have plenty of space to spread out into, especially when they are not competing with each other.
- With wider spacing and with single planting, there will be many fewer plants in a field. Indeed, there may be only 10 or 16 in a square meter instead of 50 or 100. The highest yield has been achieved with only 4 plants per square meter, spaced 50 cm by 50 cm so the plants grow like bushes. Wide spacing saves seed - as much as 100 kilograms per hectare - at the same time that it contributes much greater production at harvest time because the rice plants produce many more tillers and grains.
- Planting seedlings with precise spacing can be one of the more difficult aspects of SRI at the beginning, when farmers are not used to this.

- **Seedling Spacing Methods**
  Two different methods have been developed:

1. Farmers can stretch strings across their field, tied to sticks stuck into the bund at the edge of the field, spaced at 25, 30 or more centimeters, with the strings marked (knotted or painted) at whatever interval has been chosen (25, 30, or more centimeters), and then these sticks and strings (parallel to each other) are moved across the field; or…
2. A kind of "rake" that has teeth the desired distance apart (25, 30 or more centimeters) can be constructed simply from wood. It is pulled across the surface of the prepared muddy field, scratching lines onto the surface at desired intervals. Drawing the rake across the first set of lines perpendicularly (at a right-angle) to them creates the desired square pattern, on which seedlings are planted at the intersections of lines.

- The first method is more precise but the second is quicker and saves considerable labour time.

7. Mortality of Seedlings

- Farmers are often worried, when planting, about some seedlings dying. In fact, with SRI methods there is very little mortality, maybe 2%, so that it is not worth the effort to replace them, as surrounding plants grow a little larger to take advantage of the open area. Farmers who are concerned should plant some seedlings along the edge of the field that they can transplant into any vacant spaces at the time of the first weeding.

8. Planting Seedlings

- A very important influence on the size and health of the roots is how the tiny seedlings are placed into the soil when they are transplanted.
- When seedlings (or the clump of several seedlings) are thrust straight downward into the soil, the tips of their roots will be pointed up toward the surface. The shape of the transplanted seedling will be like a J, with its root bent upward.

- The rice plant root grows from its tip. If the tip is pointing upward, the root must change its position in the soil to get the tip pointed downward before it can resume growth. This requires a lot of energy and effort from the tiny root, at a time when it is still weak after transplanting, especially if it has been allowed to dry out by delay in getting it from the nursery and into the field.
- With SRI, one does not thrust seedlings downward into the soil. Rather, each seedling is slipped sideways into the soil, very gently and close to the surface, so that its root lies horizontally in the moist soil. This makes the shape of the transplanted seedling more like an L than like a J. With this shape, it is easier for the tip of the root to grow downward into the soil. When the plant is shaped more like an L than a J, less energy is necessary for the plant's root to start growing quickly downward and to begin putting out more roots at the same time that it is sending tillers upward.

9. Weeding

- A very simple mechanical weeder, called a rotating hoe, pushed by hand has been developed to enable farmers to eliminate weeds easily, quickly and early. It reduces the hard labour of pulling up individual weeds by hand once they emerge. The weeder, by churning up the soil, destroys weeds before they absorb many nutrients. By leaving them on the soil to decompose, it returns their nutrients to the soil.
- This weeder, which has rotating wheels mounted vertically in the metal plate that is pushed along the ground, is not expensive. It can cost as little as US$5, if locally made.
- It may take as much as 25 days of labour to weed a hectare of rice. However, each weeding can add one ton or even two tons of production to the yield, so that the payoff to the farmer from each additional weeding can be very great.

- The first weeding should be within about 10 days after transplanting, and at least one more weeding should follow within two weeks. This will dig up weeds at the same time that it puts more air into the soil for the roots to utilize.
- Doing one or two additional weedings (3 or 4 weedings in all), before the plants have completed their growth and begin flowering, will provide still more oxygen to the soil. This is more important than removing any remaining weeds. Extra weedings can greatly increase yields.

10. Spraying Pro-Plant

- *(See page 8.)*

11. Guidelines for 100% Organic Farming

Crop Variety	Soil and Seed Preparation with Bio-Plant (1 Hectare)	Application of Pro-Plant During Crop Growth
Rice	1. *See* **1.1 Compost and Soil Preparation** on page 1**.** Prepare the soil with a lot of organic waste matter (at least 5 MT per hectare). Basically, use as much organic matter as you can. The more there is, the more the micro-organisms can turn it into a "factory" producing more and more micro-organisms. 2. Add 500 cc of Pro-Plant per hectare, if the soil is short of minerals. 3. Leave the soil for 14 days before planting the crop so that the micro-organisms have longer to multiply and fertilize the soil. Water the soil every 7 days while it is under preparation. **Note:** In actual practice, rice farmers tend to prepare the soil by ploughing in the rice stems. Then they cover the soil with 3 MT of chicken dung and cow manure, the more the better. This should add up to 5 MT. 4. **Seeds:** Put the seeds in a cloth or bucket and soak them for 24 hours. Soak the seeds in water that contains 20 cc. of Bio-Plant and 20 cc. of Pro-Plant per 20 litres. This is enough for each 20 kgs of seeds. *The amount can be increased to 100 cc of Bio-Plant for a better effect.* Then leave them for 2 days in a sack to germinate and then sow them the same day. • When the farmers sow the seeds, they flood the field with water and then sow the seeds. Then they let the water flow out at once. This stops the birds eating the seeds. **Notes About Actual Practice in Vietnam** • When the farmers release water into the fields every 2 weeks they mix 500 cc of Bio-Plant with each 500 litres of water, which is enough for 1 hectare. In other words, they add additional Bio-Plant during the crop, which is a good idea.	1. Day 1: No need to spray when the farmers plant the seeds as the seeds have been soaked in the bio-fertilizers. Apply the water mixture to the soil after soaking. 2. Spray on Day 15 (Optional): Equals 500 cc in 500 litres of water per hectare. 3. Spray on Day 30: Equals 500 cc in 500 litres of water per hectare. 4. Spray on Day 34: Equals 500 cc in 500 litres of water per hectare. 5. Spray on Day 50: Equals 500 cc in 500 litres of water per hectare. 6. Spray on Day 60: Equals 500 cc in 500 litres of water per hectare. 7. Spray on Day 70: Equals 500 cc in 500 litres of water per hectare. **Note:** If the rice is the 110-day kind, then also spray on Days 80 and 90. **Very Important Note:** Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well and ideally before 9 a.m. when the leaf pores are open most.

Crop Variety	Soil and Seed Preparation with Bio-Plant (1 Acre)	Application of Pro-Plant During Crop Growth
Rice	1. *See* **1.1 <u>Compost and Soil Preparation</u>** on page 1**.** Prepare the soil with a lot of organic waste matter (at least 2.5 MT per acre). Basically, use as much organic matter as you can. The more there is, the more the micro-organisms can turn it into a "factory" producing more and more micro-organisms. 2. If the soil is weak in micro-organisms and nutrients, spray 500 cc of Bio-Plant mixed with about 500 litres of water over the organic matter once it has been laid over the ground. 3 Add 250 cc of Pro-Plant if the soil is short of minerals. 4. Leave the soil for 14 days before planting the crop so that the micro-organisms have longer to multiply and fertilize the soil. Water the soil every 7 days while it is under preparation. **Note:** In actual practice, rice farmers tend to prepare the soil by ploughing in the rice stems. Then they cover the soil with 3 MT of chicken dung and cow manure, the more the better. This should add up to 5 MT. 5. **Seeds:** Put the seeds in a cloth or bucket and soak them for 18-24 hours (no longer). Soak the seeds in water that contains 20 cc. of Bio-Plant and 20 cc. of Pro-Plant per 20 litres. This is enough for each 20 kgs of seeds. *The amount can be increased to 100 cc of Bio-Plant for a better effect.* Then leave them for 2 days in a sack to germinate and then sow them the same day. • When the farmers sow the seeds, they flood the field with water and then sow the seeds. Then they let the water flow out at once. This stops the birds eating the seeds. **Notes About Actual Practice in Vietnam** • When the farmers release water into the fields every 2 weeks they mix 500 cc of Bio-Plant with each 500 litres of water, which is enough for 1 hectare. In other words, they add additional Bio-Plant during the crop, which is a good idea.	Day 1: No need to spray when the farmers plant the seeds as the seeds have been soaked in the bio-fertilizers. Apply the water mixture to the soil after soaking. 1. Spray on Day 15 (Optional): Equals 250 cc in 250 litres of water per acre. 2. Spray on Day 30: Equals 250 cc in 250 litres of water per acre . 3. Spray on Day 34: Equals 250 cc in 250 litres of water per acre. 4. Spray on Day 50: Equals 250 cc in 250 litres of water per acre . 5. Spray on Day 60: Equals 250 cc in 250 litres of water per acre . 6. Spray on Day 70: Equals 250 cc in 250 litres of water per acre . **Note:** For a lower yield, but a higher cost, you can spray every 15 days instead, namely on Day 30, 45, 60, and 75. If the rice is the 110-day kind, then also spray on Days 80, and 90. **Very Important Note:** Please spray Pro-Plant using spraying equipment that gives a fine, misty spray, and that the spray is directed diagonally upwards so that it hits the pores of the leaves underneath as well as lands on the leaves. Spray the leaves well, and ideally before 9 a.m. when the leaf pores are open most.

12. Bio-chemical Farming

12.1 Soil Preparation

- *See **1.1 Compost and Soil Preparation** on page 1.*

12.2 Preparing the Seeds *(See 2. Seed Preparation on page 2.)*

- Put the seeds in a cloth or sack, tie up the ends. Water should be able to enter through holes. Soak the seeds for 18-24 hours (no longer) before planting in water that contains 20 cc of Bio-Plant and 20 cc of Pro-Plant per 20 litres. (The ratio is 10 cc per 10 litres of water.) If the amount of seeds is small, which will be the case here, reduce the water to just a few litres, but do not reduce the amount of the bio-fertilizers. *The amount of Bio-Plant can be increased to 100 cc for a better effect.*
- Put the sack on the ground for 1-2 days. Keep it out of the sun and in a warm shaded place. Cover the sack with a cloth to keep it and the seeds warm. They will germinate. When they have germinated, plant them either in a nursery for a month before planting in a field or before sowing the seeds in a field. It depends on the local preference.
- **Sowing Seeds:** When the farmers sow the seeds, they flood the field with water about 15 cms. deep and then sow the seeds. Then they let the water flow out once the seeds have settled into the mud. This stops the birds eating the seeds. Plant around 8-10 kgs per section.
- **Planting the Seeds or Seedlings:** Plant the seeds or seedlings in the field 25 cms. apart. The quality will be higher in this way.

12.3 Spraying the Leaves With Pro-Plant

- See the spraying guidelines on page 8. Be generous when you spray.

12.4 Spraying Pesticides

- When you spray Pro-Plant the leaves get coated with micro-organisms that protect the leaves from disease. The Bio-Plant strengthens the immune system so that the plants are less susceptible to disease. If there is a need to spray pesticides, please spray them at least 3 days apart from when you apply the bio-fertilizers as the chemicals kill the micro-organisms that are now multiplying in the soil and being sprayed onto the leaves.
- If disease is a problem in the area, add Bio-Plant (5 cc) to the Pro-Plant (20 cc) in 20 litres of water and spray this over the rice.