System of Rice Intensification (SRI)

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System of Rice Intensification Basics

SRI involves the use of certain management practices which together provide better growing conditions for rice plants, particularly in the root zone, than those for plants grown under traditional practices.

SRI was developed in Madagascar in the early 1980s by Father Henri de Laulaníe, a Jesuit priest who spent over 30 years in that country working with farmers.

Best Conditions

No external inputs are necessary for a farmer to benefit from SRI. The methods should work with any seeds that are now being used. **However,** you do need to have an open mind about new methods and a willingness to experiment.

The potential within plants is drawn out by giving them the best possible conditions for their growth.

Moving From Traditional Cultivation

•At first, the practices of SRI seem somewhat counterintuitive. SRI challenges assumptions and practices that have been in place for hundreds, even thousands of years.
•Most rice farmers plant fairly mature seedlings (20-30 days old), in clumps, fairly close together, with standing water maintained on the field for as much of the season as possible.
•These practices seem to reduce the risk of crop failure. It seems logical that more mature plants should survive better; that planting in clumps will ensure that some plants will survive transplanting; that planting more seedlings should result in more yield; and that planting in standing water means the plants will never lack water and weeds will have little opportunity to grow.

ECHO Rice Cultivation:
differences between SRI and traditional cultivation

Traits of Cultivation	Traditional	System of Rice Intensification
Age of Seedlings at Transplant date	20-30 Days	10-14 Days
Number of Seedlings per hill	3-6	1
Spacing between seedlings	15.24 cm	25-30 cm
Water regimentation	Paddies flooded heavily	Cycle through periods of wet and dry every few days
Use of compost	Not stressed	Important
Labor Requirement	Low	Medium*
Yield in ton per hectare	1-2	4-8

* Traditional practices of having a thick layer of water on the top of the paddy keeps weeds from being able to grow. SRI requires more labor in weed control which should be practiced about every 10 days.

SRI Seedlings- Modified Mat System

1) Stack 3 layers of green banana leaves or other solid leaves in a small section of the seedling bed
2) Secure the edges roughly with segments of sticks
3) Mix together a 5 to 1 ratio of sifted compost to rice hulls
4) Lay this mixture on top of the banana leaves to create a layer at least 3 inches thick
5) Wet the soil
6) Sew soaked SRI seed on top
7) Sprinkle charred rice hulls or other charred material into fine powder overtop of the seeds.
8) Water gently.

Transplanting SRI Seedlings

1. **Seedlings are transplanted early.** When first two leaves emerge from the stalk (8-15 days). Transplant with care, making sure not to "J" the roots and maintain the seed sac if possible
2. **Seedlings are planted singly rather than in clumps.** This reduces competition for resources.
3. **Wide spacing.** At least 25cm X 25cm. Feel free to experiment with the spacing, because the optimum spacing (producing the highest number of fertile tillers per square meter) depends on soil structure, soil nutrients, temperature, moisture and other conditions.

Do not let the seedling dry out- plant within 15 minutes of removing it from the nursery.

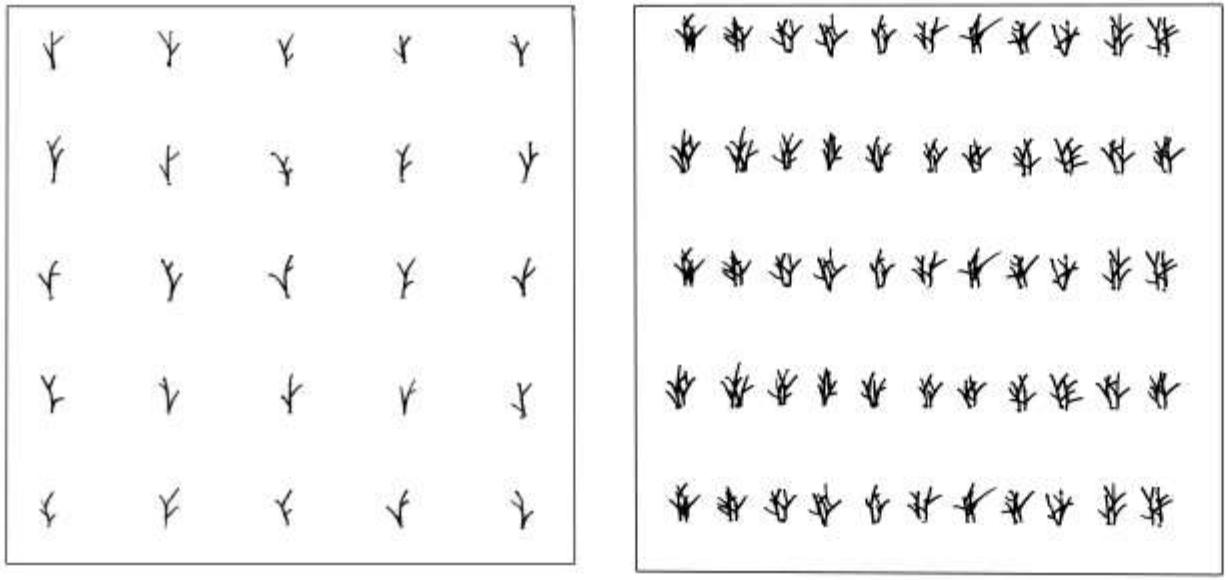


Figure 2. SRI seedlings (at left) are very widely spaced compared to seedlings planted with traditional methods (at right). These diagrams show seedlings at approximately one month of age, when seedlings are roughly the same size. However, SRI seedlings, having been transplanted several weeks earlier, by this time have already undergone transplant shock and may have begun to tiller. Sketches by Christi Sobel.

To space the plants carefully (which makes weeding easier), you can place sticks at appropriate intervals (e.g. every 25 cm) along the edge of the field, then stretch strings between them. The strings should be marked at the same intervals so that you can plant in a square pattern. Leaving wide spaces between each plant ensures that roots have adequate room to grow, and the plants will be exposed to more sunlight, air and nutrients. The result is more root growth (and thus better nutrient uptake) and more tillering.

When farmers are more experienced, they can save time by just marking cross-hatched lines on the field surface with rakes or other devices

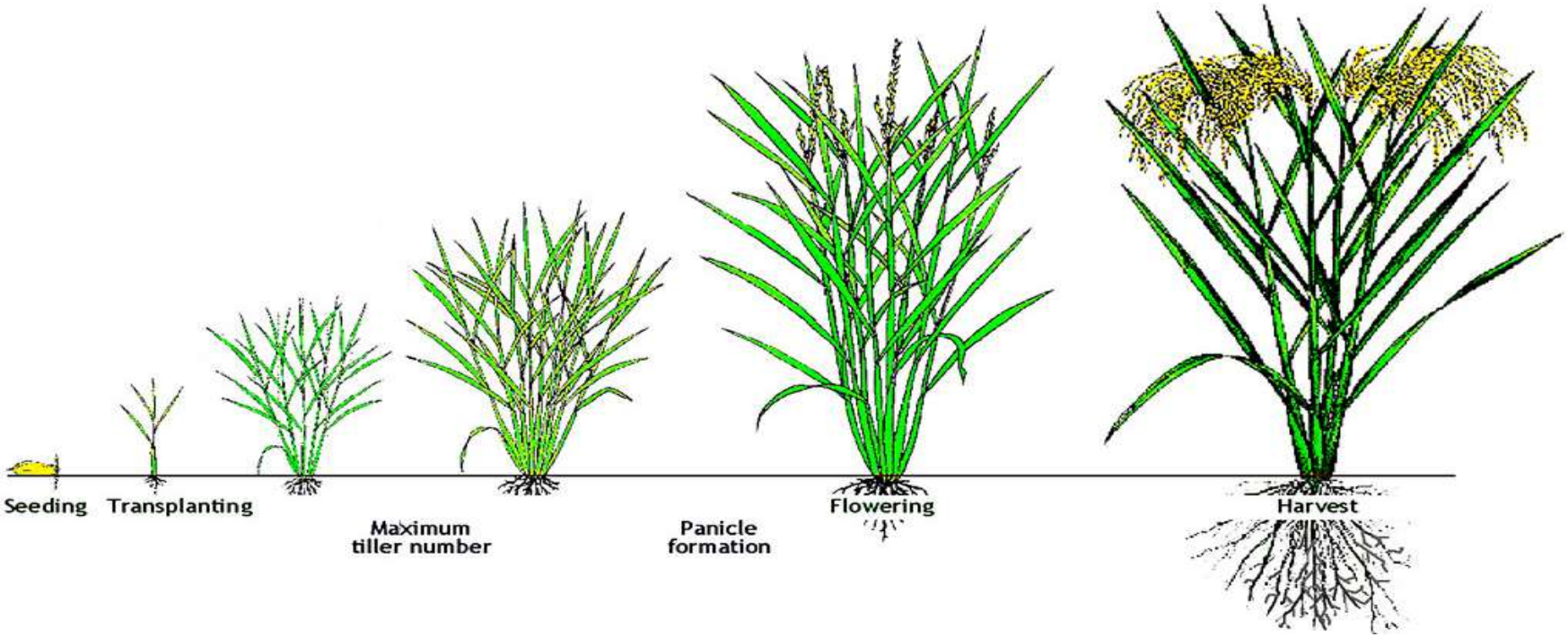
Notice that SRI uses a much lower seeding rate than do traditional methods; one evaluation of SRI revealed that the rate of seed application was only 7 kg/ha, compared to the traditional seeding rate of 107 kg/ha! Yet yields were doubled because each plant produced so much more grain.

4. **Moist but unflooded soil conditions.**

Rice roots have been shown to degenerate under flooded conditions, losing ¾ of their roots by the time the plants reach the flowering stage.

With SRI, farmers use less than half of the water they would use if they kept their paddies constantly flooded. Soil is kept moist but not saturated during the vegetative growth period, ensuring that more oxygen is available in the soil for the roots.

Occasionally (once a week) the soil should be allowed to dry to the point of cracking. This will allow oxygen to enter the soil and will also induce the roots to grow and “search” for water. When the soil is flooded, roots have no need to grow and spread, and they lack enough oxygen to grow vigorously.



5. **Weeding. This can be done by hand or with a simple** mechanical tool (see Figure 3).

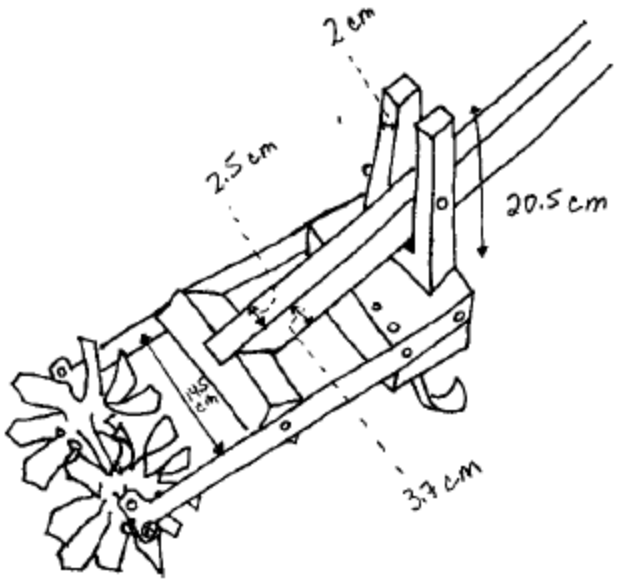


Figure 3. One example of a mechanical weeder with vertical rotating toothed wheels, often used with SRI. Plans are available at ECHO for this weeder and for a larger weeder with five wheels. Sketches of weeders by Paya deMarken, Peace Corps Volunteer in Madagascar.

First Weeding after 10-12 days, then weed as needed.
Recommend weeding at lest 2 more times before harvest.

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6. **Organic inputs.**

SRI was developed initially with chemical fertilizers to increase yield on the very poor soils of Madagascar. But when subsidies were removed in the later 1980s, recommendations switched to use of compost, and even better results were observed.

Compost can be made from any biomass (e.g. rice straw, plant trimmings and other plant material), with some animal manure added if available.

Banana leaves can add more potassium, cuttings from leguminous shrubs add more nitrogen, and other plants such as *Tithonia*, may be high in phosphorous.

Compost adds nutrients to the soil slowly and can also contribute to a better soil structure. With huge yields of rice being harvested, something needs to be returned to the soil!

Testing and Results

- It has since been tested in China, India, Madagascar, Indonesia, the Philippines, Sri Lanka and Bangladesh with positive results.
- In Madagascar, on some of the poorest soil to be found and where yields of 2 tons/hectare were the norm, farmers using SRI are now averaging over 8 tons/hectare, with some getting 10 to 15 tons/hectare. A few farmers have even gotten over 20 tons/hectare.
- In other parts of the country, over a five-year period, hundreds of farmers averaged 8 to 9 tons/hectare.

	Traditional Methods		SRI Methods	
	Ave.	Range	Ave.	Range
Clump/m²	56	42-65	16	10-25
Plants/clump	3	2-5	1	1
Tillers/clump	8.6	8-9	55	44-74
Panicles/clump	7.8	7-8	32	23-49
Grains/panicle	114	101-130	181	166-212
Grains/clump	824	707-992	5,858	3,956-10,388
Yields (t/ha)	2.0	1.0-3.0	7.6	6.5-8.8
Root strength (kg)	28	25-32	53	43-69

Table 1: Comparison of rice grown with traditional vs. SRI methods. Data for traditional methods were calculated from measurements on five adjacent fields. Data for SRI methods are averages and ranges from 22 test plots. Data are from a master's thesis by Joelibarison, 1998.

ECHO 2014 SRI vs. Traditional Results

Traditional Paddy							
	straw	grain (with hull)	grain (unhulled)	bran	chips	grain + chips	Total Mass
mass (kg)	4.626642	12.56451	5.216312	5.102914	0.793787	6.0100986	11.113013
ratio to total mass	0.416327	1.130612393	0.469387743	0.459184	0.071429	0.540816312	

Total Grain (unhulled) Yield Traditional Paddy = 5.216312 kg/25ft^2 = 22.4591273498 tons/hectare

SRI Paddy							
	straw	grain (with hull)	grain (unhulled)	bran	chips	grain + chips	Total mass
mass (kg)	5.533827	11.090333	3.515341	3.17515	0.680389	4.19573	7.37088
ratio to total mass	0.7507688	1.50461451	0.476922837	0.430769	0.092308	0.56923054	

Total Grain (unhulled) Yield Traditional Paddy ~ 4.678253 kg/25ft^2 = 20.1424837896 tons/hectare

*some grain given to AT for mill demonstration, had to estimate actual unhulled grain weight using Traditional ratio to total mass. (11.090333*1.130612393)* 0.476922837 = 4.678253 kg

NO STATISTICALLY SIGNIFICANT YIELD DIFFERENCE

Frequently Asked Questions

Why does SRI work?

When used together, SRI practices result in a rice plant structure that is different from what results when traditional practices are followed. Rice plants under SRI have many more tillers, greater root development, and more grains per panicle. In order to tiller, plants need to have enough root growth to support new growth above ground. But roots require certain conditions of soil, water, nutrient, temperature and space for growth. Roots also need energy from the photosynthesis that occurs in tillers and leaves above ground. Thus the roots and shoots depend on each other. In addition, when growing conditions are optimized, there is a positive relationship between the number of tillers per plant, the number of tillers that become fertile (panicles), and the number of grains per tiller.

Frequently Asked Questions

This sounds too good to be true. What is the catch?
SRI requires more labor than traditional cultivation.

Is SRI sustainable? How can you get such high yields?
Inputs are required
- Microbial activity can mitigate input requirement

Summary

In summary, the main elements of SRI are as follows: Transplant young seedlings to preserve their potential for tillering and root growth while they also benefit from other favorable growing conditions. Provide the plants with wide spacing, without competition either in hills or between hills. Keep the soil well aerated but sufficiently moist, so that the roots can “breathe”; for this, use both water management and weeding practices that aerate the soil. Finally, provide nutrients that feed the soil as well as the plant, so that a rich and healthy soil gives plants the nutrients and positive environment needed for best growth and performance.


Questions?

Resources

EDN # 70
Stacy Reader Rice Report 2014