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System of Rice Intensification: An Alternative for increasing Rice Yield

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Introduction

System of rice intensification or SRI is a climate smart agro ecological methodology for increasing the productivity of rice and other crops by changing the management of the plant, soil, water and nutrients. SRI emphasizes the use of early growth potential for seedlings, facilitates the competition of low light and nutrients, improves the efficiency of resources (seeds, water, fertilizers, pesticides) and reduces dependence on chemical fertilizers, promotes healthy root growth and increased activity of soil microbes and thus improved the biodiversity of soil organisms. It involves cultivation of young seedlings planted singly at wider spacing in a square pattern and intermittent irrigation that keeps the soil moist but not inundated, as well as periodic inter cultivation with a weeder that actively aerates the soil. It was developed in the year 1983 by the French Jesuit Father Henri de Laulanie in Madagascar and he observed SRI is an amalgamation of multiple beneficial practices. In 1998, SRI was introduced in China and Indonesia and in India first started in TNAU, Coimbatore.

Principles

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The methodology is based on the following principles:

- **Early transplanting**- In SRI method young seedlings of between 8-12 days old with 2-3 leaves are used for transplanting. Early transplanting ensures earlier and quicker establishment of plants to favour healthy and vigorous root and vegetative plant growth.
- **Careful transplantation**-Transplantation trauma should be kept to a minimum. Carefully remove the plant from the nursery, including the seed, soil, and roots, and place it in the field without diving too far into the soil.
- **Wider spacing-** Planting should be done in square planting rather than in rows by using a wider spacing of 25 cm x 25 cm. Low plant density is maintained to allow each individual plant to develop optimally and to prevent competition for nutrients, water, and sunlight among plants.
- **Weed management and aeration**- Use of Weed management tool such as cono weeder, rotary weeder to incorporate emerged weeds as well as aerate the soil. Reduced weed competition and soil aeration provide more oxygen and nitrogen to roots due to enhanced microbial activity.
- **Water management**- Water management is done by providing alternate wetting and drying method of irrigation instead of continuous flooding in the field,
- **Nutrient management-** In SRI method more organic nutrients are used along with reduced dose of inorganic fertilizers, because they are better at encouraging the abundance and diversity of microorganisms in the soil, beginning with beneficial bacteria and fungus. This will improve production by promoting optimal microbial activity.

Methods of cultivation

The System of rice intensification is not a brand-new approach or technology. It's simply changing management approaches to get a more productive phenotype from the same rice genotype. An artificial environment is built for rice plant growth and development in order to fully harness its genetic potential, as well as land and water resources. The following strategies can be used to accomplish this:

1. **Nursery-raising**

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a) **Site selection: -** The nursery bed must be prepared with particular caution in the SRI approach, as 8-12 day old seedlings and, in certain circumstances 14-15 day old seedlings (2-3 leaf stage) are transplanted for fast and successful transplantation.

b) **Bed Dimensions: -** The nursery bed for one acre transplantation can be raised in a 48 square yard (40 square meters) plot. Two beds, each size 24 square yards (20 square meters) can be raised per 1 kg seed depending on the conditions.

c) **Bed preparation: -** Farm yard manures (FYM) and soil are applied in four alternating layers to prepare the nursery bed. 1st layer: 1 inch (2.54 cm) thick well decomposed FYM, 2nd layer: 1.5 inch (3.75 cm) soil, 3 rd layer: 1 inch (2.54 cm) thick well decomposed FYM and 4th layer: 2.5 inch (6.3 cm) soil. All of these layers should be blended thoroughly to allow for easy root penetration.

d) **Seed rate: -** A seed rate of 2 kg (5kg/ha) is required to transplant in one acre of land. Seed should be thinly spread to prevent seedling crowding.

e) **Seed treatment: -** Healthy and pure seeds are used. Seeds are soaked for 12 hours in water and after draining out the water seed treatment is done with bavistin (2g/kg seed) or streptocycline (1g/kg of seed). After that, the treated seeds are placed in a gunny bag that has been soaked in water. After 24 hours sprouted seeds are used for sowing in nursery. The seeds should be broadcasted thinly over the bed in the evening time.

f) **Mulching: -** Cover the bed with paddy straw to keep it from getting too hot in the sun and to keep birds away. Apply water with rose cans twice daily, depending on the need. It is important to ensure that the seeds do not fall out during watering. Once the seeds have germinated, remove the straw.

2. Preparation of main field

The land used for SRI should be level and free of water logging. When the plot is watered, the water should be evenly distributed over the area. Similarly, there should be a way to drain extra rain water whenever it is needed. A day before planting, the main field is prepared and levelled with little standing water for grid marking. At a distance of 2 meters, 30 cm wide channels should be provided. For proper water management and optimal crop stand, perfect levelling is required.

3. Transplantation Method

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Before transplanting the field should be well puddled and levelled. After levelling the field, young rice seedlings 8 to 12 days old and in certain locations 14-15 days old seedlings (2-3 leaf stage) are used for transplantation. Seedlings should be handled with care when being removed from the nursery or when being transplanted. A metal sheet is inserted 4-5 inches below the seedbed, and seedlings are scooped with the soil without causing any root disruption. Tender seedlings must be transplanted with caution to avoid root stress. Young seedlings are planted horizontally and shallowly to help them establish fast. Seedlings are transplanted by carefully placing them at the intersection of markings with the index and thumb. The next day after transplanting, give the plants a light irrigation.

4. Nutrient management

In SRI farming, organic manures / vermi compost are recommended since they provide a better response and improve soil health. Before ploughing, apply FYM/compost (10-12 t/ha) and incorporate in situ cultivated 45-60 days old green manure crops. 50% of the recommended fertilizers (NPK), i.e. 50: 30: 20 kg NPK in kharif and 60: 30: 20 kg NPK in rabi are apply and incorporate depending on soil test values at the time of field preparation.

5. Water management

The SRI approach Irrigation is applied only to moist the soil in the early period of 10 days. Water is let in when surface soil develops hairline fissures and irrigation is administered to keep soil moisture near saturation. The irrigation intervals, on the other hand, vary according on soil texture. Because the soil is not inundated, the paddy plants' roots grow strong and deep in all directions.

6. Weed management

Weed density is more in SRI method, as there is no standing water. In SRI, alternate wetting and drying promotes excessive weed development, which, if left unchecked, can result in significant yield loss. Weeds are incorporated into soil by using a cono weeder between rows at the appropriate time, which also provides nutrients to the crop as green manures. First weeding is done after 10-12 days of planting. Depending on the requirement, weeding can be done at 10-15 day intervals till the crop reaches panicle stage. It is recommended to weeding with irrigation to ensure that the cono weeder runs smoothly and efficiently. To eradicate weeds growing along the hills rotary wedding is combined with one or two hand weddings. The principal benefit of the weeder is that it controls weeds while also

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adding organic matter to the soil. This provides the advantages of growing a green manure crop and aeration of the soil allows the roots to breathe. As a result, a varied range of soil microorganisms flourish, making nutrients available to the plant.

Benefits of SRI

- Savings of 30–40% irrigation water because the water requirement in SRI is lower.
- Seed savings of 85% because the seed requirement is less (5 kg/ha against 40-50 kg/ha in the conventional technique). This is especially important for hybrid rice cultivation because hybrid seed is more expensive. Growing hybrids under SRI is therefore more profitable.
- There is 30-50% increase in yield per ha in this method.
- Another benefit of SRI which is less frequently documented is that grain quality causes less breakage of grains during milling, resulting in about 10-15% more edible rice produced per bag of harvested paddy than conventional method.
- Organic manures and natural biocides are used instead of chemical fertilizers and pesticides which improves soil health by increasing soil microbial activity.
- Due to the lack of transplanting shock and faster seedling establishment, crop duration was lowered by 7-10 days.
- Seed multiplication (Breeder and Foundation) is best done with SRI since the initial seed demand is low and rouging is simple owing to single seedling planting and greater spacing.
- SRI technique is considered to be an eco friendly technique as there is less emission of methane gas as compared to conventional method of rice cultivation. Because the fields are not flooded in this system as flooding causes methane emission. Also the mid-season drainage and intermittent irrigation can reduce methane emission by 40%.
- More yield with lower cultivation costs, resulting in greater net returns and a higher benefit-cost ratio.

Conclusion

System of rice intensification is not a fixed package of technical specifications, but a system of production with four main components, viz., planting method, weed control, soil fertility management and water (irrigation) management. This is not a technology like that of

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the Green Revolution, where farmers were expected simply to adopt a 'package.' SRI in its core conception involves adaptation rather than adoption, and farmers are expected to become more innovative. Though farmers who involved are committed to continue SRI, immense steps have to be taken to disseminate not only the technology but also the scientific facts behind the technology as a means of promoting SRI. Though SRI is a promising and successful technology in increasing the yield, it has not yet become a major method of cultivation owing to existing institutional and behavioural factors. Some of the principal challenges viz., resistance to accept SRI, non-co-operation of planting labourer, lack of training and extension facilities, absence of precise water management and non-availability of essential tools. If we address these issues, SRI would be a successful technology to boost the rice yields and the income of farmer.