Course Name- Field Crops-I
Course code- BSCAG-211

SYSTEM OF RICE INTENSIFICATION (SRI Method)

The system of rice intensification (SRI) is originated in Madagascar and has been first synthesized in 1983 by Father **Henri de Laulani'e,** a French Jesuit priest. He has been trained as an agronomist at the National Agronomic Institute in Paris, France. He is popularly known as **'Father of SRI'.** Father Henri de Laulanie has transplanted very young rice seedlings of just 14 days old seedlings; using a fairly wide spacing (25 x 25 cm) of single seedlings in a square pattern to facilitate mechanized weeding. The rice is grown in moist soil with intermittent irrigation. Laulane observed tremendous increases in tillering, rooting and subsequent number of grains. Seedlings should be transplanted only 1-2 cm deep in the mud, ensuring that the roots are laid in a horizontal position so that the root tips can easily resume their downward growth. Weeds need to be controlled regularly, starting about 10 days after transplanting. Mechanical rotary weeding, which ensures a churning action and thereby soil aeration, appears to be an important factor. Locally available sources of organic nutrients such as compost in particular are used instead of external inputs such as mineral fertilizers and other agricultural chemicals.

Key points in modified System of Rice Intensification:

- Perfect leveling with laser land levelers for good inputs management.
- Use of profuse tiller bearing rice varieties.
- Seed rate is 5 kg / ha. Seed treatment with Pseudomonas fluorescens @ 10 g / kg of seed.
- Nursery area requirement is 2.5 cents for mat nursery.
- Young seedlings 10 to 14 days and certainly less than 15 days with a soil clump (along with seed sac) attached to their roots.
- Seedlings per hill @ 1 seedling / hill or 1-2 seedlings per hill.
- Wider spacing and square planting at 25 x 25 cm or even wider.
- Weed suppression using a mechanical cono/rotary weeder or motorized rotary weeders 3-4 times after transplanting with 10-15 days interval in between the hills in perpendicular directions to aerate the soil and control the weeds.

Importance of system of rice intensification (SRI):

The system of rice intensification is a set of principles and ideas that translate into a combination of agro economic practices, which might differ depending on agro - ecological and cropping system conditions. SRI can reduce water requirements, increase land productivity, and promote less reliance on chemical fertilizers, pesticides, herbicides, and other agrochemicals.

The SRI is considered as Climate - Smart Agriculture. The SRI method is highly useful for sustaining rice productivity against climate change is attributable to two things viz.

(i) Improvements in crop root systems, with larger, better roots and less degeneration than under flooded, hypoxic conditions.

(ii) Soil biodiversity and biological activity.

The beneficial effects that soil microorganisms can have when residing within rice plants as symbiotic entophytes. The soil health is maintained with high use of organic source of manures in SRI method. The seed requirement is less. There is water saving up to 40% and improved input use efficiency. The grain yield is 10 to 20% high in SRI over conventional method of planting.

The water requirement is reduced and there is high crop water use efficiency. This benefits the ecosystems and people in competition with agriculture for scarce water supplies. There is less use of inorganic fertilizer and less reliance on agrochemicals for crop protection which enhances the quality of both soil and water. SRI is tolerant to abiotic stresses such as drought, storm damage and extreme temperatures. Methane emission from rice fields are determined

mainly by water regime and organic inputs. Flooded rice paddies are a major source of CH_4. The methane gas emission is reduced in SRI method. The flooding causes methane emission since organic inputs stimulate methane emissions as long as fields remain flooded. The mid-season drainage and intermittent irrigation can reduce methane emission by 40%. However, keeping soil nearly saturated conditions may promote N_2O release. About 15 to 20% of the benefit gained by decreasing methane emission is offset by the increase of N_2O emission. Soil organic carbon declines after a shift from flooded system to non flooded system. SRI enhances the growth and health of roots and of soil biota by keeping soil moist but not flooded. The soil is mostly aerobic, not continuously saturated and thereby aerating the soil frequently and enhancing the soil organic matter content due to addition of high organic manures.

Package of System of Rice Intensification Practices:

Soils- SRI methods worked best on the most fertile soils and not in saline or acidic soils.

Season- Dry season with assured irrigation is more suitable for SRI method than traditional practice of rice cultivation. It is difficult in areas with heavy downpour during crop establishment period.

Varieties: Hybrids and varieties with heavy tillering are suitable for SRI method of cultivation. Profuse tillering rice varieties may be used in SRI instead of shy tillering varieties.

Mat nursery management:

The seedlings can be produced using mat nursery technique. A mat nursery area of 2.5 cents or 100 m^2 is required for planting one hectare. The raised beds of 1 x 5 m^2 are made and a polythene sheet is spread over the shallow raised bed to prevent roots growing deep into soil. The wooden frames of 0.5 m long, 1 m wide and 4 cm deep divided into 4 equal segments are placed over the polythene sheet and filled to a height of 4 cm with a mixture of local soil (70–80%), decomposed farmyard manure (15-20%), rice husk (5-10%) and powdered di-ammonium phosphate 1.5 kg or 2 kg 17-17-17 NPK fertilizer per 100 m^2. Four m^3 of soil mix is needed for each 100 m of nursery, Azospirillum @ 2 kg, Pseudomonas fluorescens @ 750 g and mycorrhizal fungi @ 5 kg for 100 m can be applied in the nursery area. Seed rate is 5 kg / ha is needed for planting one hectare of land under SRI. Seeds are treated with Carbendazim @ 2 g / kg of seed. Soak the seeds for 24 h, drain and incubate the soaked seeds for 24 hours. Sprouted seeds and radical (seed root) grows to 2-3 mm long are spread uniformly on the soil. So the pre - germinated seeds weighing 90 to 100 g / m2 (100 g dry seed may weigh 130g after sprouting) uniformly. Cover them with dry soil to a thickness of 5 mm. Water is sprinkled immediately using rose to soak the bed and then later as and when needed (twice or thrice a day) to keep it moist all the time. Protect the nursery from heavy rains for the first 5 days after sowing (DAS) and continue watering until 14 DAS. If seedling growth is slow or leaves are yellow, spray 0.5% urea + 0.5% zinc sulfate solution at 8-10 DAS. Seedlings reach 18-20 cm height at 12-14 DAS depending on the local weather conditions, pest and diseases. Protect the nursery from heavy rains for the first 5 DAS. At 6 DAS, maintain thin film of water all around the seedling mats. Water should be drained 2 days before lifting the seedling - mats. Then remove the wooden frame. Seedling - mats that are approximately 12 to 14 days old should be lifted from the mat nursery and taken to main field for transplanting. Care should be taken to prevent any harm to seedlings while pulling them from nursery or at the time of transplanting. A metal sheet is inserted 4-5 inches below the seedbed and seedlings scooped along with soil without any disturbance to their roots. Lift the seedling mats and transport them to main field.

Advantages of mat nursery:

(i) Reduced nursery area and easy to manage: 100 m^2 to plant 1 ha.
(ii) Robust young seedlings (18-20 cm tall with 4 leaves) produced within 12-14 days after sowing.
(iii) Easy transportation of seedling - mats to main field and convenient for machine transplantation.
(iv) Easy separation of seedlings for transplanting with minimum root damage.

Main field preparation:

Puddled lowland prepared as described in transplanted section. Perfect leveling is the pre - requisite for proper water management and good crop stand.

Transplanting techniques:

Transplant 12 to 14 days old single rice seedling (3-4 leaf stage to preserve potential for tillering and rooting ability) within 30 minutes of pulling out of seedlings in square planting with spacing of 25 x 25 cm at a shallow depth of 2 to 3 cm. The tiller buds formed at the basal node are not suppressed in case of shallow plantings. Therefore, the seedlings should be transplanted at 2 to 3 cm depth. Shallow planting ensures quick establishment and more tillers. The deeper planting delays and inhibits tillering. The seedlings with 3-4 leaves stage have great potential for profuse tillering and root development. Fill up the gaps between 7th and 10th DAT. Young seedlings are unable to withstand heavy downpour and local flooding at transplanting of rice seedlings. When mature, however, rice plants under SRI management are considered to be more resilient to storms and cyclones, gap filling may be required to compensate for up to ten per cent of seedlings lost in the early stages of growth.

Weed management:

The manual operated cono weeder / rotary weeder or power operated two row rotary weeder is used with forward and backward motion on either direction of the rows and column three to four times during the growing period at 7 to 10 days interval from 10- 12 days after transplanting rice to bury the weeds, to churns up the soil with small toothed wheels and as well to aerate the soil. It saves labor for weeding, aerates the soil and root zone, prolongs the root activity, and improves the grain filling through efficient translocation and ultimately the grain yield. There is a substantial beneficial effect from using the rotary weeder and that this relates not to soil aeration but to pruning the lateral roots of the rice plants. Pruning the lateral roots encourages the rice plants to develop a deeper root system that can access water and some nutrients from lower soil layers. The manual weeding is also essential to remove the weeds closer to rice root zone. Normally, herbicide application is not recommended for SRI. Under special circumstances, the herbicides such as Butachlor @ 1.25 kg / ha or Anilophos @ 0.4 kg / ha as pre - emergence application or pre emergence application of herbicide mixture viz., Butachlor 0.6 kg + 2,4 DEE 0.75 kg / ha, or Anilophos + 2, 4 DEE 'ready–mix' at 0.4 kg / ha followed by one hand weeding on 30 to 35 DAT will have a broad spectrum of weed control. Any herbicide has to be mixed with 50 kg of dry sand on the day of application (3-4 DAT) and applied uniformly to the field with thin film water on the 3rd DAT. Water should not be drained for next 2 days from the field (or) fresh irrigation should not be given. If pre - emergence herbicide application is not done hand weeding has to be done on 15 DAT. 2,4 - D sodium salt (Fernoxone 80% WP) @ 1.25 kg / ha dissolved in 625 liters with a high volume sprayer, three weeks after transplanting of when the weeds are in 3 to 4 leaf stage can be sprayed to control emerged weeds.

Manures and fertilizer application:

The manures and fertilizer application for rice under SRI is done as per transplanted rice. The application of organic compost or animal manure is a highly desirable, conditioned by the availability of local resources. Green manure and farm yard manure application will promote positive microbial activity in the rhizosphere and increase the growth and yield of rice in this system approach. Under sodic soils, during rotary weeding, apply Azophosmet @ 2.2 kg / ha and Pink Pigmented Facultative Methylotrophs (PPFM) as foliar spray @ 500 ml / ha. Top dressing of nitrogenous fertilizers is done based on the color of the leaf using leaf color chart (LCC) in SRI method.

Water management:

Irrigation is given only to moist the soil in the early period of 10 days. The irrigation is given to a depth of 2.5 cm after development of hairline cracks in the soil until panicle initiation and to a depth to 5.0 cm after panicle initiation one day after disappearance of ponded water. The field is to be drained 15 days before harvest. The water requirement is 1100 mm in conventional method while 700 mm in SRI method through intermittent irrigation. There is 30% saving in irrigation water of 400 mm.

Cropping systems:

Dual cropping of rice - azolla reduces the weed infestation. Summer plowing and cultivation of irrigated dry crops during post - rainy periods reduces the weed infestation.

Plant protection measures:

Application of Pseudomonas fluorescens @ 5 kg / ha is effective in controlling rice blast disease. The incidence of sheath blight, leaf folder, brown plant hopper and the rat damage is less in SRI method.

Yield: The rice grain yield is 7 t / ha in the wet season and 5.6 t / ha in the dry season.

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