

Cultivating Wheat with SRI Principles: A Training Manual



Foreword

In 2008-09, Bihar Rural Livelihood Promotion Society (BRLPS, promoted by the World Bank and the Government of Bihar) along with the Agricultural Technology Management Agency (ATMA), took an initiative working with the NGO PRADAN, Nalanda branch, to promote *the use of SRI methods in wheat cultivation*.

Farmers of Gaya and Nalanda districts who had benefitted by using SRI methods in their paddy cultivation, adapted and extended the principles for wheat. This manual contains the experience of these farmers.

The manual is expected to be useful for farmers and village extension workers, to help small and marginal farmers with limited resources to produce more for themselves and to gain more food and financial security for their families.



What is cultivation of wheat with SRI methods?

The following core principles of SRI developed for rice that are being applied in SWI wheat cultivation are:

- **Low seed rate:** Use only 10 kg per acre
- **Priming of seeds** with seed selection/treatment
- **Wide and uniform spacing of single** plants set out in a square pattern in the field, 8 inches in between rows and also between plants (20cm X 20cm)
- **Aerating of the soil** 2 or 3 times by suppressing weeds mechanically rather than chemically or by hand

The other practices in crop husbandry are similar to those used with the usual methods of wheat cultivation.

The yields achieved by applying SRI principles are *at least double those achieved with conventional methods*.

Farmers from Gaya and Nalanda districts of Bihar have reported average yields of 3.5 tons per hectare, or more. When all the practices used well, the average yield is 6.5 to 8 tons, and up to 12.6 tons with best use. By 2011-12, farmers in about 300 villages had started applying the new methods in their cultivation of wheat. The total area under SWI management in Bihar was over 180,000 hectares



Seed varieties, seeding rates per acre and material requirements for priming of seeds

Seed selection

With SWI, there is no specific preference for any particular variety of seed, but it is better to use fresher seeds, while getting rid of older ones.

Seeding rate

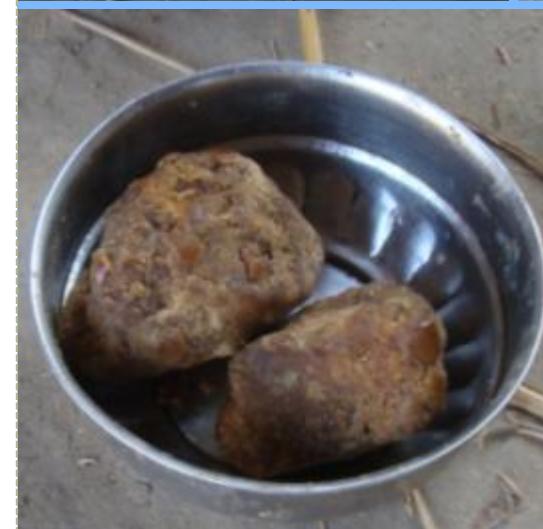
Only 10 kg per acre (25 kg per hectare)

Needed for priming of seeds :

The following materials are required for priming of seeds for 1 acre:

- 10 kg of seeds
- 20 liters of warm water
- 5 kg of vermicompost
- 4 kg of jaggery (coarse sugar)
- 4 liters of cow urine
- 20 gm of *Bavistin* broad spectrum systemic fungicide containing Carbendazim (50% WP)

Priming of seeds ensures protection for the crop from diseases.



Cow urine is a powerful natural manure for providing nutrients to the seed.

Priming of seeds and seed treatment

- Remove any pebbles and mud particles from the seeds
- Heat the water to about 60 degrees Celsius
- Put the seeds in to the warm water
- Remove all floating seeds and particles from the water
- Add vermicompost, jaggery and cow urine to the water and leave the mixture for 8 hours
- Recover the good seeds from the water and throw away the solution water
- Mix *Bavistin* with the seeds and put them inside a moist gunny bag for 12 hours for the seeds to sprout.

Such priming of seed helps in the good growth of the plant and provides strength .



Field preparation

- Field preparation is similar to the usual methods for wheat cultivation.
- 2 tons of farmyard manure (FYM) or 0.4 ton of vermicompost should be applied per acre. This is necessary as the stand-alone use of chemical fertilizers reduces the productivity of the soil over time.
- If the soil moisture is insufficient, provide some supplementary irrigation before tilling the land.
- Apply 27 kg of di-ammonium phosphate (DAP) and 13.5 kg of potash (MOP) in the soil before the last ploughing.
- Plough the field well, so that the soil is well pulverized for easy root growth.



Sowing with SRI methods

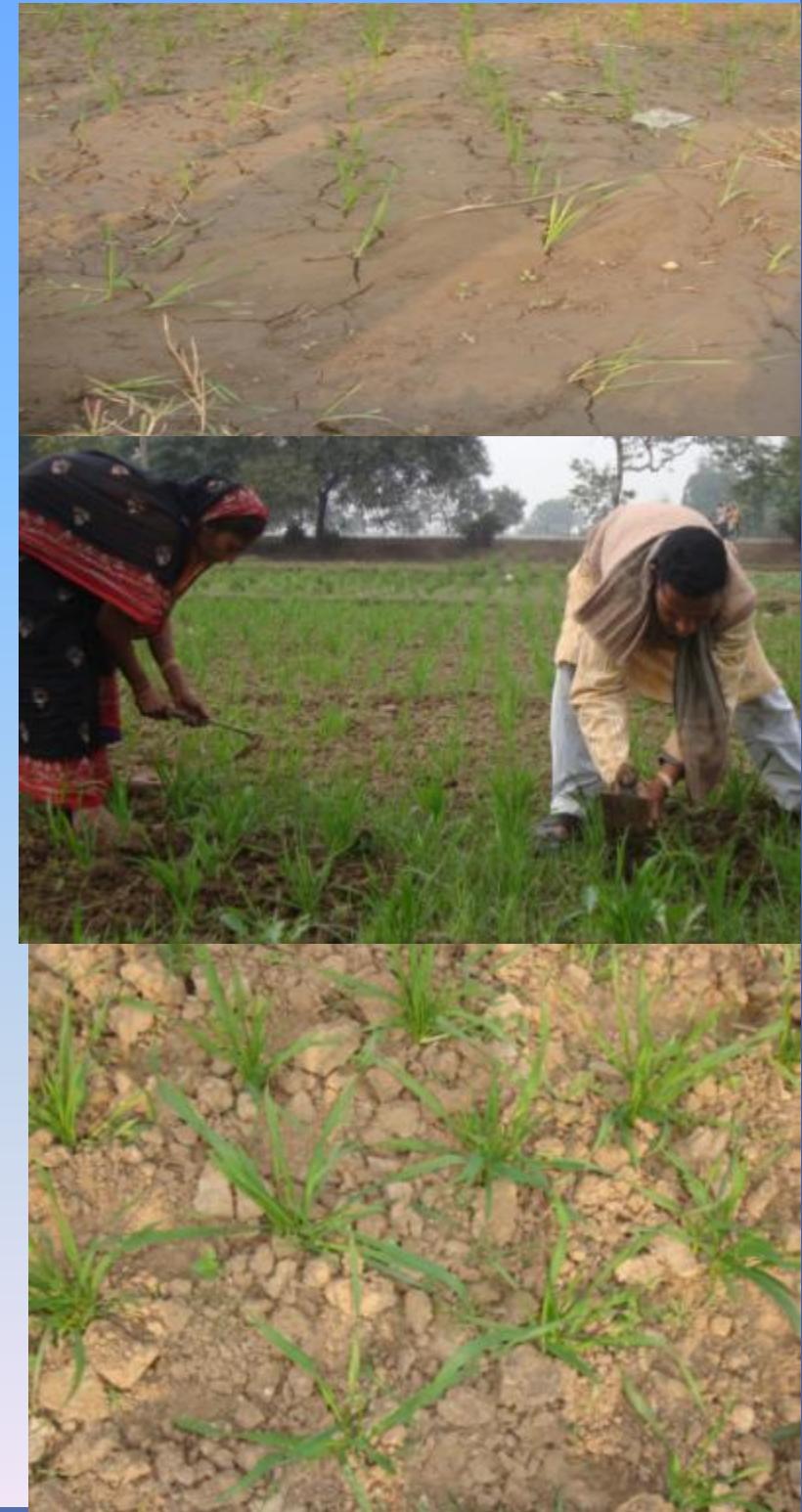
- Before sowing the seeds in the field, ensure there is moisture in the soil by irrigating it as necessary.
- Create shallow furrows of 1 -1.5 inches depth in a square grid with spacing of 8 inches between the rows in perpendicular directions.
- Place 2 sprouted seeds in the intersections where the marked furrows meet with 8 x 8 inches between them. After placing the seeds, cover them with some loose soil.
- After one week, fill any gaps in the field where germination has not occurred by putting a sprouted seed into the marked place.



Care of the field from the 15th day after sowing

- Give the field its first irrigation on the 15th day after sowing. This is needed as root development starts after this. If the soil is not moist, the plant will not develop its roots and becomes stunted.
- Apply a dose of urea (40 kg per acre) and vermicompost (400 kg per ha) on the 16th day, while there is still moisture in the field.
- On the 18th day, remove any weeds by hoeing or by using a weeder in between the rows. This will remove unwanted weeds which grow vigorously after irrigation and application of manure.

Mechanical weeding helps the plants by aerating the soil, helping the roots to grow and enhancing their uptake of moisture and nutrients from the soil.



Care of the field from the 25th day

Irrigate the field for a 2nd time on the 25th day, after which time the plant starts tillering profusely and hence there is a need for more moisture and nutrients.

After 2-3 days of 2nd irrigation, do a second round of weeding and hoeing. This controls the growth of weeds after irrigation.



Difference between 25 days old plant grown in SRI and normal method

Care of the field from 35th to 40th day

- Irrigate the field for a 3rd time between the 35th and 40th days, after which the plants grow still faster and tillering continues. Therefore, there is more plant need for moisture and nutrients.
- Apply a dose of urea (15 kg per acre) and 13 kg of potash (MOP) immediately after irrigation.
- 2-3 days after the third irrigation, remove any weeds by hoeing or with a weeder in between the rows. It will remove unwanted weeds, help in aeration of the soil and help the plants to grow faster.



40 days old
plant s: SRI
vs. normal
methods



For proper growth and grain filling irrigate the plot on 60th, 80th and 100th days after sowing.

Irrigation timing should be adjusted to soil and agro-climatic conditions.

If irrigation is not provided during flowering and grain filling, there will be drastic reduction in the yield of the crop.



Wheat grown with SRI methods

Wheat grown with normal methods



**Flowering and grain filling is very important stage for the crop.
There should not be any dearth of water during this phase.**



Comparison of SWI plant on left and regular wheat plant on right



Wheat yields achieved with SWI methods

Already during 2009-10, 15,808 women farmers in Gaya and Nalanda districts applied SRI principles in their cultivation of wheat.

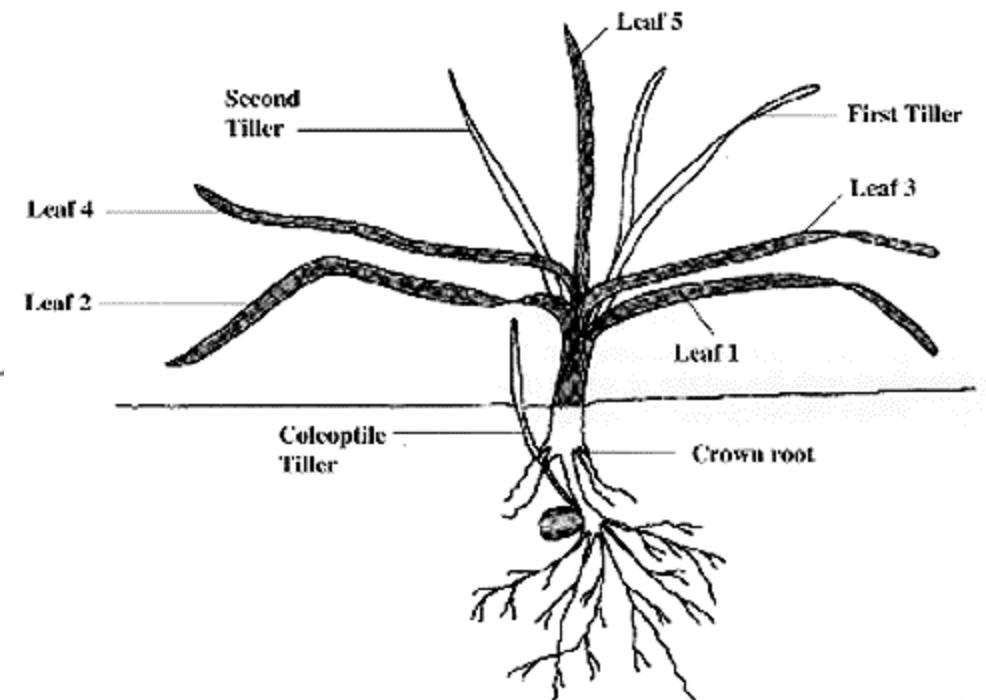
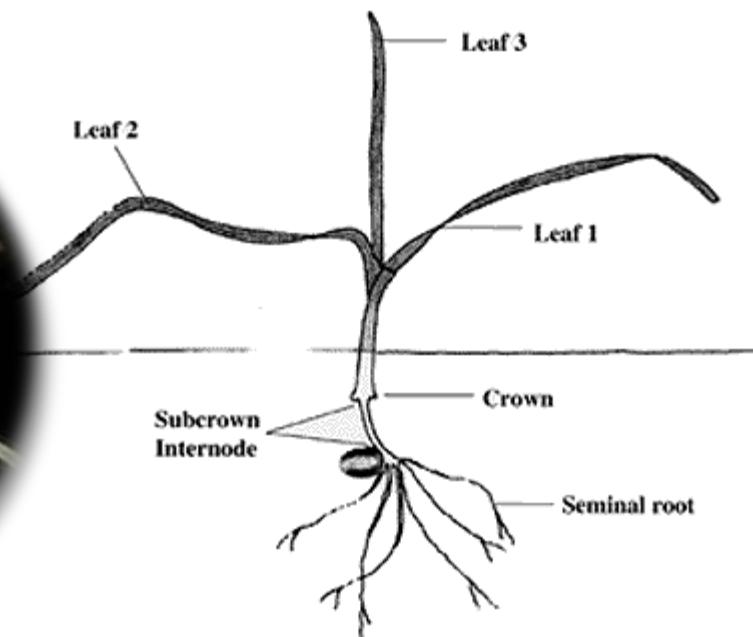
Farmers there using SWI methods averaged **1.82 tons per acre** compared to **0.8 ton** through usual methods (i.e., 4.6 vs. 2.0 tons per hectare).

Maximum wheat yield with SRI principles was **4.1 tons per acre** (10.25 tons per hectare), > 3x the maximum yield with traditional methods (1.1 tons per acre). In Bihar, organic SWI has reached 5.43 tons/acre (13.57 t/ha).



The yields achieved show that SRI methods are better than the usual methods.

Why are yields better with SRI methods?



To understand this, we need to understand the roots of the plant and their functions:

- Seminal roots are initiated after germination of the seeds and move downwards into the soil in search of nutrients and water. If the soil is not moist and becomes hard, then it becomes difficult for the roots to go very deeply into the soil.
- Crown roots which develop about 20 days after sowing spread out horizontally for nutrients and water. If the soil is hard, the young plants cannot spread out their root network for acquiring water and nutrients.

This stunting effect on plants induced due to hard soil is known as the Bonsai Effect.*

- Sometimes the roots are destroyed with the attack of a fungus named *Pythium*.

* http://www.soil.ncsu.edu/lockers/Gruver_J/PDF%20files/soil%20conditions%20and%20plant%20growth.pdf

* *Australian Journal of Plant Physiology* 14(6) 643 - 656 Full text doi:10.1071/PP9870643 © CSIRO 1987

Traditional methods



SRI methods



- Mechanical weeding applied with SRI methods loosens the soil and helps in aeration. This helps to control weeds, helps roots to grow, and enhances moisture and nutrient uptake from the soil.
- Priming of seeds ensures protection for the crop from diseases.
- Cow urine is a powerful natural manure for providing nutrients to the seed.
- Planting far apart means that each seedling has lots of light and plenty of space to obtain nutrients and water.



Cost estimates for cultivation of wheat (per acre in Indian rupees)

Material / Activity	Unit	Price per unit	Traditional methods		SRI methods	
			No. units	Total	No. units	Total
Seed	kg	15	50	750	10	150
Priming of seeds and seed treatment Materials (jaggery, cow urine, warm water, vermicompost)	lump sum	165	0	0	1	165
DAP	kg	12	27	324	27	324
MOP	kg	6	27	162	27	162
Urea	kg	6	55	330	55	330
Vermicompost	kg	4	0	0	400	1600
Sowing	man days	100	0.5	50	2	200
Irrigation	number	200	5	1000	5	1000
Weeding and soil work	man days + machine cost	170	0	0	2	340
TOTAL COSTS				2,616		4,271
GROSS REVENUE (grain sales)	ton	12000	0.8	9600	1.821	21852
NET PROFIT				6,984		17,581
PRODUCTION COST per kg				3.27		2.35

Some important points to apply SRI methods



- Only **10 kg seed** per acre are used
- **Priming** of seeds with seed (warm water, and *Bavistin*)
- **Wide and uniform spacing of single plants** in the field (8 inches in between rows in a square pattern)
- Use of **2 sprouted seeds** at each marked intersection of lines.
- **Aerate the soil** while suppressing the weeds mechanically, 2 or 3 times, rather than do chemical weed control or by hand.
- **Irrigate** the field during flowering and grain filling.

SRI methods are intended to help small and marginal farmers with limited resources to produce more for themselves and to gain more financially.





Removing SWI seedlings from nursery at 15 days



Transplanting 15-day SWI seedlings in field

A young boy with dark hair and a slight smile stands in a lush green field of tall grass. He is wearing a long-sleeved shirt with vertical blue and white stripes. In the foreground, a large, vibrant green plant with broad, curved leaves is visible. The background shows more of the field and a hint of a blue structure in the distance.

Thank you