Mechanized System of Rice Intensification MSRI developed by FarmAll Technology – Pakistan www.farmalltechnology.com

Water is essential for plant's nutrient uptake. Soil nutrients dissolved in water enter plant roots and rise up to the shoot and leaves by a process of osmosis to nourish plant growth. Only a limited amount of water can pass through the tiny tubes, however. Excess water is wasted by evaporation into the air, and there can be detrimental effects: causing salinity and causing roots to degenerate.

Based on this understanding, an experiment using ideas and practices from the System of Rice Intensification (SRI) has been conducted, which was based on the motto of "More from Less".

These goals were set:

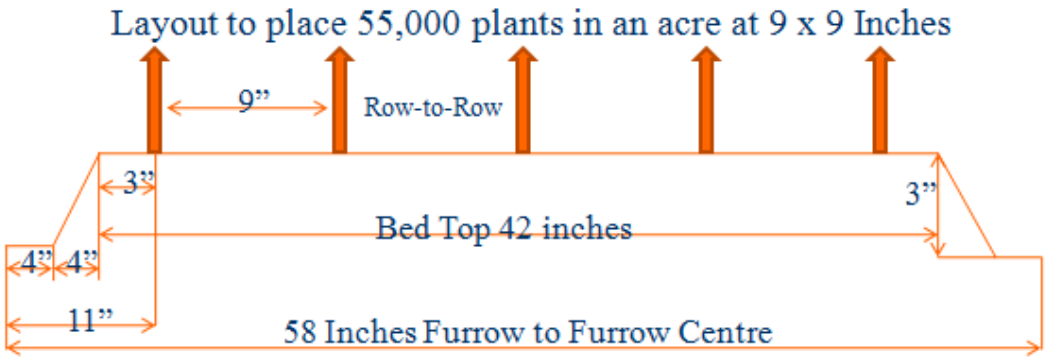
- Save at least 50% water per acre and even more on each tone of paddy produced
- Save at least 20% on cost of inputs per acre and even more on each tone of paddy produced
- Decrease labour intensity of production and thus the constraint that labour poses for large-scale production
- Increase per-acre yield of paddy to produce not just more but better quality Rice

To achieve these goals, the main innovations were:

1. Planting on raised beds to grow the rice crop in soil that is moist but not inundated and saturated
2. Precision placement of fertilizer & compost in a band so plant roots have easy access to it
3. Minimizing trauma to the young plants (10 days old) during their transplanting
4. Wider spacing to exploit the natural vigor of each plant to its maximum, minimizing competition with fellow rice plants and with weeds, both below and above ground.

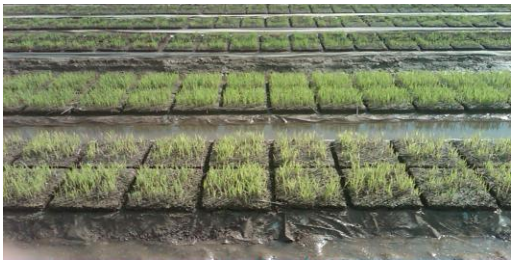
To put these principles in practice, a Crop Production Process (CPP) was developed, utilizing machines designed and produced for achieving their accurate in-field application.

The Process Steps



Nursery Raising: 55,000 seedlings were required for precision planting of an acre. Four pounds of seed were sufficient, in place of the 10-16 lbs used in conventional rice-growing practice. The nursery was raised on a mulched raised bed, growing seedlings that could be transplanted at just 10 days of age, without going through the usual transplanting trauma when seedlings are older. Plastic mulch under the nursery materials restricts seedling roots from growing deeper into the soil, and this reduces damage during the transplanting process (Fig 1).

Figure 1 Nursery on raised beds, with mats made of soil, compost and rice husks for easy handling



Raisedbed-Making with Fertilizer and Compost Banding: A machine was developed that could perform multiple functions in one pass: it makes open furrows and raised beds, at the same time placing fertilizer in a band 4 inches away from the hole where the seedlings are placed and 4 inches deep in soil, while a band of compost is placed where seedlings are going to be transplanted (Fig 2).

Figure 2 Mechanical raised-bed making with compost & fertilizer banding at the same time

Transplanting: Puddling of fields is a normal practice. This requires a large amount of water. Further, it is labour-intensive job, and regular plant-to-plant distance is never maintained. It was decided to transplant the seedlings in dry soil, a big innovation. For this, the major task was how to enable the seedlings to survive in extreme temperatures.

Figure 3 Transplanting 10-day-old seedlings in a dry soil

We developed Water Wheel transplanter that makes pits 2½" deep at a precise distance from each other (22.5 cm or 9 inches) and fills each with water into which a single young seedling is dropped by hand (Fig. 3). Soon after the transplanting, for the 1st irrigation, the field is flooded with water overtop the raised beds to enable the seedlings to get settled with sufficient fine dirt particles covering and protecting the root. Subsequent irrigations are only in the furrows for minimizing water needs.

Figure 4 Mechanical weeding with a precision weeder

Precision Weeding & Soil Aeration: Weedicides are currently used to eradicate weeds when rice is grown on a large scale. Their application requires standing water for at least 10 days. To save water and to reduce reliance on toxic chemicals which pollute both soil and water resources, a precision weeder was developed, to control weeds and at the same time break up the soil surface, to benefit the roots by aeration and promote more soil biological activity. This reduces water requirements breaking up capillary tubes in the soil which reduced evaporation from the soil (Fig. 4).

The resulting plants express their productive potential more fully as seen in the pictures below, which contrast the root growth of the mechanical SRI (MSRI) plant on the left and a rice plant grown conventionally on the right. The prolific tillering and impressive grain filling are seen in the adjoining picture. At 72 days, the average number of tillers per plant was 90.