

The System of Rice Intensification and Its Use with Hybrid Rice Varieties in CHINA

Yan Qingquan, Hunan Agricultural University, Changsha, Hunan

There are significant differences between the System of Rice Intensification (SRI) and Chinese methods of traditional rice cultivation (TRC) as summarized in Table 1.

The Demands of Super-High-Yielding Hybrid Varieties for SRI

SRI supplies very favorable conditions for vigorous growing and fully brings out the latent yield potentials of rice. However, external causes must achieve their effects through internal processes. That is to say, super-high-yielding cultural conditions are needed to enable hybrid varieties to accomplish super-high-yields.

In 2001 we have made field comparison experiments with two-line medium-duration hybrid rice varieties using SRI methods in Yunshun County, Hunan Province. The results showed that the yield potentials of different hybrids are generally enhanced by SRI practices compared to TRC (Table 2).

According to these experimental results and the characteristics of SRI methods, it appears that hybrid

varieties, to have the highest yield potential when used with SRI methods, should have the following characteristics:

Strong tillering capacity

Under a transplanting density of 25x25 cm to 50x50 cm and with just 1 seedling/hill, the tillering potential of rice can be more fully achieved. If a variety's tillering capacity is weak, the subsequent number of effective panicles, which are the main factor influencing yield, will not be numerous enough to achieve the expected target yield, and the goal of increasing grain production by large margins cannot be reached.

Lodging resistance

Generally speaking, hybrid varieties with lodging resistance have the following characteristics. Their stems are strong and elastic; the leaf sheath firmly surrounds the stem; there is higher degree of silicon in the stem; the root system is flourishing and powerfully absorbs nutrients; there is quick growth of spikelets and high degree of grain filling.

Table 1. The main differences in cultural measures between SRI and TRC

Practice	SRI	TRC
Seedling age (days)	8 - 12	25 - 35
Seedlings/hill (no.)	1	5 - 6
Plant spacing (cm)	25 x 25 - 50 x 50	16.7 x 20 - 20 x 26.7
Weedings (no.)	4	3
Method of weeding	Rotating hoe, called "wolf's fang" hoe in Chinese	By hands or by feet
Types of fertilizer	Organic sources: compost and/or barnyard manure	Organic and chemical fertilizers
Irrigation pattern	Discontinuous irrigation combining damp soil with drier soil	Discontinuous irrigation and continuous irrigation

Table 2. Grain yield and its components with two-line hybrid, medium-duration rice varieties using SRI methods

Variety	Effective panicles (10 ⁴ /ha)	Spikelets/panicle	Grain setting (%)	1000-grain weight (g)	Theoretical yield (t/ha)	Actual yield (t/ha)	Yield compared to TRC (%)
Pei'ai 64S/171	261.0	205.2	81.9	26.4	11.58	11.97	+2.57
Pei'ai 64S/004	246.0	209.8	80.0	26.5	10.94	10.98	-5.91
38S/9311	256.5	194.9	84.6	26.2	11.08	11.48	-1.63
Zhun S/572	202.5	218.5	92.0	29.8	12.13	12.23	+4.80
Yaza 1	240.0	233.0	84.9	27.5	13.07	12.79	+9.60
Yaza 2	226.5	229.0	83.2	27.5	11.87	10.61	-9.08
Pei'ai 64S/9311 (TRC methods)	203.2	238.3	92.2	26.8	11.97	11.67	—

Greater stress resistance

First, there should be strong ability to resist losses due to diseases and insects such as rice blast, bacterial blight, stem borer, and rice plant hopper. Second, there should be ability to endure adverse environmental conditions, such as resistance to cold in the early stage of medium-duration rice and the late stage of long-duration rice, and also tolerance of heat in the late stage of medium-duration rice and early stage of long-duration rice.

Enormous yield potential

The results of many studies have showed that hybrid varieties with enormous yield potential present the following main characteristics: very strong photosynthesis capacity, particularly from heading stage to maturing stage; ideal plant and leaf type; optimum canopy disposition from the 5th reverse leaf to the 1st reverse leaf at heading stage; a long, straight, narrow and thick flag leaf; long and large panicles; large grains; high percentage of grain-setting; and a full extent of grain ripening.

For example, the Taizhong 16 line which achieved a yield of 21 t/ha in Madagascar with excellent use of SRI methods had 280 effective panicles per square meter (4 plants/m² x 70 panicles/plant), with 260 grains per panicle, according to data from Association Tefy Saina.¹ This represents a 1000-grain weight of 28.3 g and a weight per panicle of 7.54 g. The Yaza 1 hybrid with a maximum yield of 12.79 t/ha as seen in Table 2 has 240 effective panicles per square meter, and 198 grains per panicle, with a 1000-grain weight of 27.5 g and

grain weight per panicle of 5.33 g. These and other such improved varieties possess enormous yield potential.

Wide ecological adaptability

Whether a hybrid variety of rice can give super-high-yields under various environmental conditions depends to a great extent upon its ecological adaptability. The growth duration of variety Taizhong 16 line with SRI methods at Madagascar was about 120 days, so daily grain yield achieved 121 kg/ha. This is above the usual achievement of TRC. The achievement of such maximum yield comes not only from the cultivator's mastery of the SRI techniques and from the enormous yield potential of the variety, but also from the suitability of the variety to the particular soil and climatic environment it is growing in.

Some Discussion of the Application of SRI Methods in China

Control of ineffective tillering

From the evidence on enhanced rice yields by using SRI methods, we conclude that accelerating tiller development and grain-filling are the key factors for increasing yield. For best use of SRI in China, it will be necessary to regulate the number of infertile tillers with these methods. We suggest the following:

- First, one should select hybrid varieties that have strong tillering ability, high biological potential, and high economic coefficients. Such varieties have the potential for raising area productivity by enlarging individual plants.

¹ Yuan Longping (2001). *The system of rice intensification (SRI)*. Hybrid Rice, 16:4, pages 1-3.

Research Report: China

- Second, cultivation practices should focus on creating high-yield populations through exploiting these individual plant potentials. This will be done by adoption of SRI and by coordination of SRI methods with irrigation and fertilizer management.

Selection of optimum planting density

Young, single seedlings planted sparsely and in a square pattern (25x25 to 50x50 cm) is an essential part of SRI. But how sparsely the seedlings should be planted needs to be determined empirically.

- First, there are varietal differences to consider. If the variety has characteristics of longer growth duration,

higher plant height, stronger tolerance to fertilizer, and stronger tillering ability, then sparse planting (25x25 cm or more) may be productive; with other varieties, narrower planting will be better.

- Second, planting density should be decided according to the soil fertility and irrigation conditions. This will usually need to be determined empirically.

As stated above, SRI is a possible path to achieve higher-yielding rice cultivation in China, but the extension of SRI should be adapted according to the local situations and optimum hybrid variety. Setting up experiments and demonstrations will be necessary to support SRI extension efforts.