

Experience in CUBA with the System of Rice Intensification

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In March 2000, the Scientific Commission of the National Geographic Society held its annual meeting in Havana, and among those participating was Dr. David Pimentel, who had been my professor of insect ecology in 1957 while I was studying at Cornell. Dr. Pimentel spoke of work that CIIFAD was doing with a rice methodology from Madagascar and got me in contact with its director, Dr. Norman Uphoff. Soon, five papers and reports on SRI, in English, that we received from him were condensed into a brief Spanish summary.

Two thousand copies were distributed throughout the country, first to farmers working in the 1,600+ sugar cane cooperatives and 156 sugar mills of the Ministry of Sugar (MOS), and later to others associated with Low-Input Rice (LIR) initiatives and the Rice Research Institute (RRI) of the Ministry of Agriculture (MOA), the Urban Agriculture (UA) program, the Cuban Council of Churches (CCC), the Cuban Association of Small Farmers (CASF), and the National Institute of Agricultural Sciences of the Ministry Higher Education (NIAS/MHE).

Evaluations

The first information on how to improve yields and other SRI-related issues began to circulate only during the last trimester of 2001. There are results to report from: (1) a resource-limited farmer (associated with the CCC) cultivating a small family plot in the central lowlands susceptible to sea-water flooding; (2) one hectare on a sugar cane cooperative of the Sugar Ministry in the western-most province (Pinar del Rio); and (3) an experiment inspired by SRI to study planting distance of direct-sown rice on the incidence of the mite/fungus complex, *Stenotarsonemus spinki* and *Sarocladium oryzae*, conducted by RRI.

Farmer experiment

Age of seedlings: 15 days, transplanted within 15-20 minutes after extraction from nursery

Number of seedlings/hill: 1

Variety: Caribe 1

Area: 20 x 20 m

Fertilizer: none

Planting distance: 35 x 35 cm, in water up to one-half the height of the seedling

Management practices:

No further water was added after transplanting; after 15 days the plot was dry, then it was left another 15 days with no water until the soil showed signs of cracking. Water and some rain kept the soil moist. Twenty days after planting, there were 2 tillers; at 90 days there were 50-60 tillers, and the rice was one meter or more in height.

Previously, the farmer had planted up to 10 plants/hill on this plot, 35 day-old seedlings that often were more than one-day old from the nursery, at a spacing of 20 x 20 cm.

Sugar cane cooperative

Date of planting: February 2001; harvest April-May 2001

Variety: VN 2084, short grain

Distance: 30 x 30 cm

Age of seedlings: 12-15 days

Soil: alluvial brown clay soil

Fertilizer applied prior to transplant: phosphorous and potassium 0.2 t

Fertilizer during vegetative stage: urea 0.4 t

Area: one hectare

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Country Report: Cuba

Management practices:

- Water was removed from the terraces 24 hours prior to planting, which meant that the seedlings were transplanted into very humid soil, but without any standing water.
- Precaution was taken so that the root and stem of the single seedling were not planted at right angles, but rather straight.
- The day following planting, and every 72 hours thereafter, enough water was applied to cover the seedlings during 20-24 hours. Beginning with the third watering, the seedlings were not covered with water.
- After 15 days, when the rice plants were 30 cm tall, the water was completely removed for a period of 12 days after which time the soil was cracked and the plants showed definite signs of stress due to lack of moisture. (Soil moisture should not be interpreted in terms of number of days, but rather in terms of soil cracking.)
- At that time, after the 12th day without water, 0.4 t/ha of urea was applied, followed immediately by water, which was left there during 6 days. At that time, there was an estimated 15% weed infestation.
- On the 18th day, i.e., six days later, a herbicide was applied to eliminate any weeds that protruded through the water. The area used was not considered very weedy.
- Five days after applying the herbicide, the water was removed. Thereafter, every 72 hours, water was provided for a period of 24 hours until the rice flowered and the grains were visible.

Institute of Rice Research

Presently, the most serious rice pest/disease problem in Cuba is the mite/fungus association, responsible since 1997 for a 30% reduction in yield. Chemical control is difficult, and five research institutes are actively engaged in developing an Integrated Pest Management Program to combat this problem. The traditional row distance for machine-seeded rice, both low-input rice (LIR) cultivated by farmers and high-input rice (HIR) grown in the public sector, is 15 cm. For this spacing, the seed requirement is 100-120 kg/ha.

Scientists at RRI, after analyzing data on SRI from Madagascar on the correlation between fewer plants and higher yield, hypothesized that one major SRI feature, increased distance between plants, if applied to direct sowing, might increase the exposure of mites to sunlight and wind flow, two mortal enemies, and thus reduce mite presence. The treatments were:

T₁ in rows, east to west, 15 x 45 x 15 cm (50 kg seed/ha);

T₂ in rows, north to south, 15 x 45 x 15 cm (50 kg seed/ha);

T₃ broadcast, 100 kg seed/ha; and

T₄ broadcast, 50 kg seed/kg

Results

Farmer experiment

These methods produced 21 5-gallon cans of paddy rice, equivalent to 5.8 t/ha. The first trial with SRI yielded 32 cans, which is the equivalent of 8.8 t/ha.

The next season, he increased the number of plots to 12, and a neighbor planted three. However, all of these were lost due to seawater intrusion during Hurricane Michelle in October 2001. This farmer now has a pump and is “cleaning” his land of salt to begin all over again.

Sugar cane cooperative

This co-op, considered by the Ministry of Sugar as one of the best for rice yields, has always transplanted its rice, planting between 13-14 ha yearly. In 2000, the yield was 6.6 t/ha. The first hectare planted according to the SRI methodology gave these results:

1. A 44% increase in production with SRI methods, reaching 9.5 t/ha the first season, and 11.2 t/ha the next season, a 70% increase;
2. Important savings in seedlings, seeds and water;
3. Less labor required for transplanting because of fewer and smaller seedlings;
4. Impressive early root development which meant that the water was more efficiently used in the period of greatest development of tillering, flowering, panicle formation, and in the initial stages of maturation; and
5. The co-op found that it can do two plantings/year and will double the area planted to SRI in 2002.

Institute of Rice Research

The results in Table 1 show that with wider row distance, inspired by SRI thinking, and an east-west row orientation (T₁), the incidence of mites was reduced by approximately two-thirds, fungus affectation was only about one-half, there were fewer infertile grains, and improved yield performance.

These preliminary results led RRI scientists to examine, in the presence of extreme mite infestation, the

relationship between population density and yield. Their findings, supporting SRI concepts, were the following:

Plants/m ²	Yield
21-25	9.3 t/ha
37-44	8.5 t/ha
70	8.5 t/ha
Over 80	4.2 t/ha

Learning

We have encountered various obstacles or resistances to getting SRI tried out. In the sugar cooperatives where 20,000 ha of rice traditionally been sown by machine or airplane, the introduction of SRI has meant that the workers for the first time must learn to transplant rice and set out seedbeds adjacent to the terraces. They are accustomed to planting sugar cane but not rice. However, with the prospect of increased yields with SRI, which could make more money for them, farmers are becoming interested. Various other observations have been made:

1. The use of small seedlings and the need to develop an appropriate substrate for growing them makes some farmers anxious about using a mixture of filter-press mud and cane trash ash in the nursery. The possibility of substituting commercial sources of potassium and phosphorous for filter-press mud and cane trash ash should be examined.

2. The manipulation of small seedlings is easier with smaller fingers to transplant, which might mean engaging women and children in this activity.
3. The lack of a culture of intensive cultivation for rice means that new attitudes are necessary, including the need to question tradition and accept discipline with implementing careful practices.
4. There is need to convince certain persons who categorically deny the possibility of producing rice profitably that this can be done with SRI.
5. There is need to learn how to make compost and to compare the results of using organic with inorganic fertilizer.
6. A lack of workers available to control weeds has led some farmers to associate SRI with wider row spacing and a return to oxen for cultivation, which may be feasible.
7. Finally we have to deal with the concern of one functionary who objective that with SRI there will be insufficient workers to harvest because SRI will produce more rice!

The RRI has emphasized, correctly, that rice transplanting culture is relatively new in the country. Since the mid-90s, farmers have begun to accept transplanting because:

- 1) It saves on seed.
- 2) Farmers, in contrast to the state farms, cannot acquire herbicides and must rely on water to control weeds.
- 3) Transplanting produces higher yields, meaning that less land is required.
- 4) Less water is used with intermittent flooding compared to immersion.
- 5) There are fewer insect pests with intermittent flooding.

RRI has openly and enthusiastically supported evaluation of the new SRI methodology, although it also recognizes that with SRI, unless farmers can learn to level their terraces correctly, there can be problems with using such small seedlings, with the wider distances between plants, and without using herbicides.

Table 1. Number of mites, associated fungus infestation, and yield performance related to different planting methods and plant densities *

Treat-ments	Total no. panicles**	Infertile grains (%)	Grains with fungus (%)	Mites per plant	Yield (t/ha)
T ₁	1190a	24c	6	94	6.57a
T ₂	1006b	31b	10	265	6.53a
T ₃	1049b	40a	10	295	5.97b
T ₄	1055b	31b	11	240	6.30b

*J. L. Hernández, P. J. Gómez, M. Vega, E. Botta, J. Martínez, M. Socorro, and J. Horsford, 2001. Efecto del marco y la dosis de siembra sobre la incidencia de *S. Spinki* Smiley en el cultivo del arroz. *Forum Ciencia y Técnica*, 2001, Habana (unpublished).

**Data refer to 10 panicles.

Prospects

The country requires 650 TMT of rice yearly. The present average yield of paddy LIR and HIR is 3.25 and 3.6 t/ha, respectively. Before the present economic crisis, all rice was HIR and machine- or airplane-sown. The country produced half its requirements, and rice was never transplanted. Beginning in 1996, a national movement known as LIR was created to produce rice locally, on smaller-scale holdings compared to HIR which was begun in the early 60s. Presently, 42% of LIR is transplanted while 58% is still direct-planted. By 2001, the production of LIR had increased to 195 TMT, or, two and a half times more than HIR.

Low-input rice

The movement to reduce rice imports has become so important that the government recently decided to create 13 provincial LIR bureaus, as well as assign a specialist in rice to each of the 157 municipal agricultural delegations. The first results with SRI in Cuba, more than 9 t/ha, have fortuitously coincided with this new development, and SRI will immediately be incorporated in a national program (RRI/MOA) to compare existing LIR technologies in the three principal rice-growing regions of the island. Also, with SRI, some farmers have already expressed an interest to study having three rice harvests from two plantings, i.e., after the harvest in August, harvesting a second or ratoon crop in November. This would leave one month to fertilize and prepare the soil.

Ministry of Sugar

In the sugar cane sector, beginning in March 2002, in the two westernmost provinces, 30 cane co-ops will plant a total of 70 plots (each 400 m²). Two cane co-ops have already planted two hectares each, and one sugar mill has, for the first time, switched to transplanting 26.8 ha, which is 10% of the 268 ha required to provide rice for its workers.

Research sector

The RRI, which sets the standards and monitors the production of both HIR and LIR throughout the country, has recognized that SRI, in addition to having the prospect of improved yields, has opened up a whole new line of thought for controlling mites. The Institute will immediately (3/2002) initiate an extension trial of 2 ha. to compare T₁ (rows east to west, 15 x 45 x 15 cm, sowing 50 kg/ha) with broadcast planting (100 kg/ha). The rice experiment station for Ministry of Higher Education (NIAS/MHE) is already studying the possibility to produce rice plants commercially for SRI in Urban Agriculture, using seeding blocks and mycorrhiza. Finally, information has been received to the effect that some farmers, only recently exposed to SRI methodology and with their rice already planted, have begun to let their fields dry up once a week and are already observing better results!