SRI Experiments

The major soils under lowland rice cultivation range from loamy clay to clay soils. Lowland rice fields are located in inland valley swamps, riverine floodplains and old floodplains. These soils are relatively higher in organic matter content and are more fertile than the upland soils. Area under lowland cultivation constitutes 52 % of the total cultivated area of The Gambia.

Research Objectives and Hypotheses

The research objectives are as follows:

1. To identify to best rice seedling age for transplanting
2. To find out if SRI management practice is superior to conventional management practice
3. To find out if the current fertilizer recommended rate for The Gambia, meets the nutrient demand of SRI production
4. To promote SRI management practices on-farm

The research hypotheses are as follows:

1. Transplanting is best with younger seedlings
2. SRI will increase rice yields because the SRI management practices are superior to conventional ones
3. Rice yield can be increased with SRI using the current fertilizer recommendations in The Gambia

The field experiments were conducted during the wet seasons of 2000, 2001 and 2002. They were conducted at the Gambia National Agricultural Research Institute's irrigated rice experimentation fields and at the Integrated Rice Development Project tidal irrigation site in Sapu, Eastern Gambia. A total of 6 lowland rice experiments were conducted.

I. Diagnosing seedling growth rate and seedling quality

Two rice varieties IET 3137 and ITA 306 were used. Both of these varieties are widely grown in The Gambia and in West Africa. IET 3137 matures 10 days earlier than ITA 306, which is higher tillering than the latter.

A seedling nursery of the 2 varieties was prepared in August 2002, and 10 seedlings per variety were uprooted at 3, 7, 14, and 21 days intervals after emergence. The number of leaves were counted, and the seedling height measured. The roots of the seedling are then removed with a pair of scissors, and then placed in a jar of water for 7 days. The number of new roots re-growth is counted and bulk root length measured. The seedlings are then sun dried for a week and average seedling dry matter is recorded. The trial was conducted during the wet season of 2000.

II. Effect of seedling age at transplanting under SRI management practice

Three sets of rice nurseries were prepared at different intervals to produce seedlings of 5, 10, and 35 days of age at time of transplanting. Seedlings of different ages were transplanted on the same day in a split-plot design trial with 3 replications. Seedling age was the main plot, and variety was the sub-plot. Two rice varieties were tested, IET 3137, and ITA 306.

Seedlings were transplanted in plot sizes of 3 x 5 m, at plant spacing of 30 x 30 cm. Water control and weeding were done according to SRI management recommendations. Fertilizer was applied at a rate of 70-30-30 kg/ha NPK, of which 30-30-30 kg/ha NPK was applied as basal, and 20 kg/ha N was applied at tillering and again at panicle initiation growth stages. The trial was conducted in the wet season of 2002.

III. SRI vs. conventional management practices

The effect of three plant population densities and SRI management on rice grain yield was investigated in 2000 wet season. The planting distances between hills were as follows:

20 X 20 cm
30 x 30 cm
40 x 40 cm

Two sets of rice nurseries were prepared at different intervals to produce seedlings of 10 and 35 days of age at time of transplanting. Two types of management practices were used: SRI and research recommended local management practices. The trial design was a split-split-plot. The main plot was the management practice, the sub-plot was spacing, and the sub-sub-plot was variety. Two varieties, locally cultivated by farmers in The Gambia; IET 3137 and ITA 306 were used. Seedlings of different ages were transplanted on the same day in a split-split-plot design trial with 3 replications. Seedling age was the main plot, and variety was the sub-plot. Two rice varieties were tested, IET 3137, and ITA 306.

Water control and weeding were done according to SRI management recommendations in the SRI main plot, and in the other farmer management practice was used. Fertilizer was applied in both blocks at a rate of 70-30-30 kg/ha NPK, of which 30-30-30 kg/ha NPK was applied as basal, and 20 kg/ha N was applied at tillering and again at panicle initiation growth stages.

IV. SRI with different fertilizer application rates

This fertilizer trial with SRI management was conducted in 2001 and 2002 wet seasons. Different fertilizer application rates were tested with SRI management practice. The components of SRI used were as follows:

30 x 30 cm spacing
Repeated wetting and drying
1-week-old seedlings (2-3 leaf stage)

Three fertilizer application rates were investigated:

1. Normal: (The nationally recommended rate for lowland rice)- 70-30-30 NPK kg/ha
2. High: 140-30-30 NPK kg/ha
3. Very High: 280-30-30 NPK kg/ha

Two rice varieties, IET 3137 and ITA 306 were used in the trial. The trial was a split-plot design with 4 replications. The main plot was fertilizer application rate. Bunds, 15 cm high, were constructed between the main plots to restrict inter-flow of water and nutrients between the main plots. The sub-plots were the varieties. Plot sizes were 3 m wide and 5 m long.

Fertilizer was applied as basal and topdressing at tillering and panicle initiation. The 70-30-30 kg/ha NPK was applied as follows: 30-30-30 kg/ha NPK as basal, and 20 kg/ha N topdressing twice.

The 140-30-30 kg/ha NPK was applied as follows: 60-30-30 kg/ha NPK as basal, and 40 kg/ha N topdressing twice.

The 280-30-30 kg/ha NPK was applied as follows: 120-30-30 kg/ha NPK as basal, and 80 kg/ha N topdressing twice.

V. SRI with compost and different urea topdressing rates

This trial was conducted in the wet season of 2002. SRI management practice was tested with compost and urea application. Compost made out of rice straw, rice husk and farm-yard manure was applied at a rate of 5 t/ha. This provided approximately 60 kg/ha N. The fertilizer application rates were as follow: Compost alone

Compost with 40 kg/ha N topdressing from urea 46% N
Compost with 80 kg/ha N topdressing from urea 46% N
70-30-30 kg/ha NPK without compost from urea 46% N

The amounts of N topdressing rates were based on the amount usually applied by farmers. The components of SRI used were 30 x 30 cm spacing, repeated wetting and drying, and 1-week-old seedlings (2-3 leaf stage).

Two rice varieties, IET 3137 and ITA 306 were used in the trial. The trial was a split-plot design with 3 replications. The main plot was fertilizer application rate. Bunds, 15 cm high, were constructed between the main plots. The two varieties were transplanted in the sub-plots. Plot sizes were 3 m wide and 5 m long. Urea topdressing was applied 50 % at tillering and 50 % at panicle initiation.

VI. On-Farm SRI management trials

The on-farm trial was conducted in 2001. It was a researcher managed. Ten dabadas (households: the smallest divisible unit of a farm community in the Gambia) were selected at random to participate in the on-farm trial.

Each farmer did an SRI and their standard method of production.
A standard variety IET 3137 was supplied to all participating farmers. Ten days old seedlings are transplanted at 30 x 30 cm spacing. Fertilizer was applied at a rate of 70-30-30 NPK kg/ha which is the national recommended rate, 30-30-30 kg/ha NPK was applied as basal, and 20 kg/ha N was applied at tillering and panicle initiation growth stages.

The standard practice is continuously flooded. The SRI practice is intermittently flooded and dried. It is irrigated with enough water to saturate the soil, and is re-irrigated after 2 or 3 days or until the soil starts to show signs of slight water deficit.

Rice Varieties used in the trial:

ITA 306 was introduced by the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria. It is also known as Sahel 202. It is widely grown in the Sahel region. It matures in 110 -120 days. It is a high tillering variety, with plant height of 110-120 cm. It bears slightly chalky, slender and intermediate grains.

IET 3137 is an introduction from India. It was bred by the Indian Central Rice Research Institute (ICRRI) in Cuttack. It is widely grown in The Gambia for its highly appreciated slightly translucent, slender and intermediate grain. It matures in 100-110 days, and has a height 95-100 cm.

BG 90-2 is an introduction from Sri Lanka. It was bred by the Sri Lanka Department of Agriculture, in Batalagoda. It is widely grown in West and Central Africa. In The Gambia and Mali it is known for its record high yields of 9-10 t/ha. However, it has been documented that it is highly susceptible to nematodes and rice yellow mottle virus. It matures in 90-95 days. It is a high tillering variety, with plant height of 100-105 cm. It bears slightly chalky, slender and intermediate grains.

Land Preparation: The trial plot sizes were 3 x 5m. Primary land preparation was with a harrow plow drawn by a 4-wheel tractor, and secondary land preparation was with a 2-wheel power-tiller. Leveling was done with a power-tiller drawn leveling board and by hand shifting of soil. All plots were transplanted.

Weed control: In all trial inter-row weed control was carried out mechanically with a roto-weeder, and intra-row weeding was by hand, at 14, 28 and 48 days after transplanting. No herbicide, insecticide, or chemical disease control measures were used.

return to home page

Results

SRI management practices produced higher yields than the currently recommended management practices in The Gambia. Yields using SRI management practices are 2 to 3 times higher than national averages in The Gambia and the Sahel. The phenotype of the plant is better expressed with SRI management practice. Lodging incidence was not observed in any of the SRI trials. The major factors that contribute to better plant performance could be attributed in part to high nutrient availability associated with improved soil and water management practices of SRI permitting the soil to be repeatedly wetted and dried as well as using younger seedlings at transplanting.

Younger seedlings are more viable than older ones when uprooted and transplanted. Although older seedlings have a relatively higher bulk root density, they also have a relatively much higher above-ground biomass to supply nutrient and water. With SRI management in The Gambia 5 and 10 day old seedlings gave similar results. The 10 day old seedlings were relatively easier to handle. At 10 day old the seedlings will not have reached their fourth phyllochron of growth, the time when the plant begins to tiller.

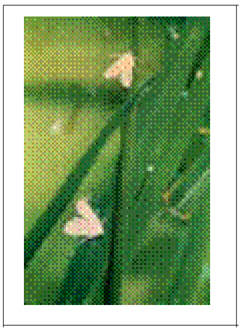
Except for plant height and tiller ability, no significant varietal effect was seen. Overall, water management practice did have an effect on plant height. A larger number of tillers per hill was not associated with repeated wetting and drying, as occurred in response to wider spacing.

An increase in SRI yields in subsequent years was observed. Yields in 2002 were higher than in 2001 by 42 % on average for the SRI fertilizer trial (6.2 t/ha and 9.5 t/ha respectively). This was probably due to improved soil conditions following 2001 crop, as a result of residual fertilizer and stover incorporation.

Application of compost with 80 kg/ha N as a topdressing gave better yields than compost alone, but was not significantly different from compost with 40 kg/ha N topdressing. In SRI management nitrogen is gradually released from decomposing organic matter during the growing season, so less N fertilization is required as soil organic matter levels increase. A continuously flooded rice field requires more N fertilizer than one that is repeatedly wetted and dried.

Under SRI management practice, the availability of nutrients to support high yields did not seem to be limiting in the soils where the trials were conducted. This may be due to the fact that the rate of mineralization is enhanced by the process of repeated wetting and drying and the enhanced development of microbial populations in the soil.

SRI water control acts a preventive measure against defoliator caseworm (*Nymphula stagnalis*) outbreak. The caseworms feeds on the rice leaves and in the process some part of the leaves fall in the water. A field infested with caseworms is easily detected by the large number of leaves floating in the water. Caseworms are semi-aquatic and move from one plant to another by swimming in the flood waters or floating on top of rice leaves in water. Draining the field restricts caseworm movement, thereby limiting their spread. Keeping a field drained for 3 days is enough to starve and eliminate any caseworm present.



Momodou Conteh's rice field in Sapu, The Gambia was infested by caseworms resulting in extremely low plant stand count

Caseworm laying eggs on a rice plant

The SRI water management practices of repeated soil wetting and drying were also found to be beneficial to rice plant growth probably through increased biological nitrogen fixation, more nutrient availability, profuse root development, increased tillering, and a high panicle setting ratio leading to higher grain yields.

return to home page