**Report on SRI experiments at Sukamandi, 2002, from Dr. Anischan Gani**

Four plots, 6x8 m2 each, were used to raise 15-day-old seedlings of Ciherang variety. Seedlings were transplanted in the four plots with different spacings -- 20x20, 30x30, 40x40, and 50x50 cm -- having 25.0; 11.1; 6.3 and 4.0 plants per m2, respectively.

Nitrogen, phosphorus and potassium (urea, SP-36 and KCl) were applied at rates of 125, 50 and 45 kg of N, P2O5 and $K_2O$ $ha^{-1}$. All of the P and half of the N and K fertilizers were applied at 14 day after transplanting (DAT). The rest of the N and K fertilizer was applied at 42 DAT. Intermittent irrigation was applied from 4 DAT to 50 DAT.

Twelve plants (hills) for each spacing were randomly selected for measurements of plant height, tiller and panicle number. Light interception (using lux-meter) was recorded at 8 points in each plot, with light interception recorded at 10 cm above the canopy and at 30-40 cm above the soil surface (the difference was the radiation intercepted by the canopy). At harvest, yield components were recorded from 12 hills per plot, as well as yield from 4x5 $m^2$ area.

Analysis of variance was applied to the data, with respective replications (12 or 8), using completely randomized design. The differences between average values were judged using the Tukey test for significant difference. Data are presented in tables below.

**Table 1 Tiller and panicle number, with Ciherang variety at different spacings [a)], Sukamandi, dry season 2002.**

| Spacing | 20x20 | 30x30 | 40x40 | 50x50 |
|---|---|---|---|---|
| Plant population | 25 | 11.1 | 6.3 | 4 |
| Max. tiller number | 23.4a | 34.3b | 43.3c | 50.8d |
| Panicles/hill | 15.6a | 24.9b | 37.5c | 46.1d |
| % Productive tillers | 66.7a | 72.5b | 86.6c | 90.6c |
| Tillers/$m^2$ | 380.0 | 243.1 | 236.6 | 184.4 |

[a)] Tiller and panicle values are averages for 12 hills per plot. Values in a column followed by the same letter are not significantly different at 5% with Tukey test.

The wider the spacing (the lower the planting density), the more were the number of tillers and panicles per hill (the differences were all significant). In addition, the percentage of productive tillers was significantly increased by widening the spacing (or decreasing population). This is the impressive result, since general belief is the opposite: the more the tillers, the less is the percentage of productive tillers (Table 1).

Table 2 shows the higher radiation use efficiency that could explain why the relatively wider spacing with SRI gives good results, in terms of plant growth, tillering and panicle formation. As was expected, wider spacing at 40x40 or 50x50 cm gave better plant growth compared to closer spacing. This is associated (in part) with the faster plant canopy closing in 20x20 and 30x30 cm spacing.

If the canopy is closed, percentage of radiation reaching the leaves lower in the canopy (about 30-40 cm above soil surface) decreases; at 20x20 cm spacing, this was only 33.2% of the incidence radiation. This value increased with widening of the spacing; at 50x50 cm spacing, it was 60.2%. So, radiation use efficiency in wider spacing was higher. It contributed to the vigorous plant, more tillers, more panicles, and more grain per panicle.

With conventional methods, with 3-10 seedlings per hill and 20x20 cm spacing, the canopy closed faster, maybe 2-3 weeks after transplanting. As a result, the process of photosynthesis in which starch is constructed as the building blocks for macro-molecules, as well as as an energy source, was operating inefficiently. Photosynthesis in the lower leaves was lower, not enough for self-sufficiency of these leaves. They must be supplied by assimilates from the top leaves having higher photosynthesis activity. This is an inefficient system as the supplying ability of leaves to the developing panicles and kernels will decrease substantially. With SRI, with single, younger seedlings and wider spacing, the canopy was open longer; 60.2% of incidence radiation was still reaching the lower leaves in the canopy at 90 days after transplanting. This accounts for the higher radiation use efficiency in SRI. So SRI should recommend wider spacing wherever the fertility of the soil is good. From my field experience, grain yield per ha was decreasing with an increase in spacing, from 25x25 to 50x50 cm.

**Table 2 Radiation intercepted (lux), at heading stage, with Ciherang variety at different spacings [a], Sukamandi dry season 2002.**

| Spacing | 20x20 | 30x30 | 40x40 | 50x50 |
|---|---|---|---|---|
| Radiation above canopy | 235a | 235a | 243a | 254a |
| Radiation below canopy | 78a | 88ab | 127bc | 153c |
| % of radiation below | 33.2 | 37.4 | 52.3 | 60.2 |
| % of radiation intercepted | 66.8 | 62.6 | 47.7 | 39.8 |

[a] Radiation intercepted above and below the canopy was averaged for 8 points measurement in each plot, observed at 9:24 - 10:40 am, 14 July 2002.

Values in a column followed by the same letter are not significantly different at 5% with Tukey test.

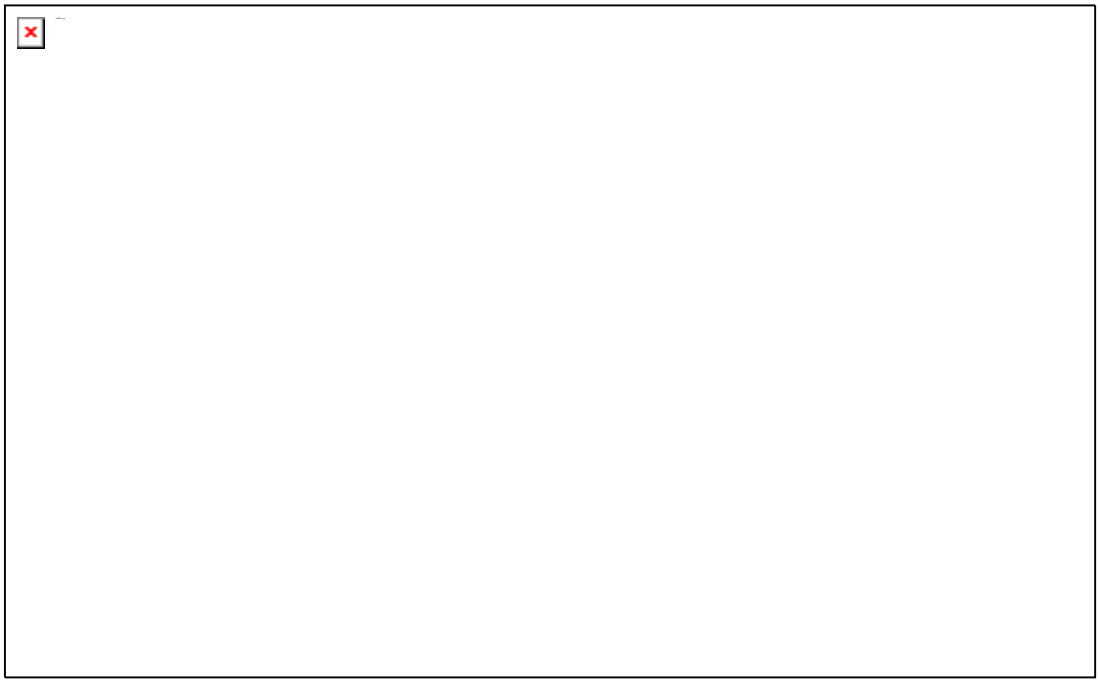
Observation also showed that with wider spacing, panicles grew longer. The number of total and filled grains per hill was significantly and consistently increased by increasing the spacing. Unfortunately, the number of empty grains was significantly increased by widening the spacing too, however the percent of empty grains decreased from 19.4% to 13.9% as spacing was widened. The 1000 grain weight, a relatively permanent yield component, was significantly increased by wider plant spacing between 20x20 and 50x50 cm spacing. The quality of the grain was also better with wider spacing (various quality parameters not included in Table 3).

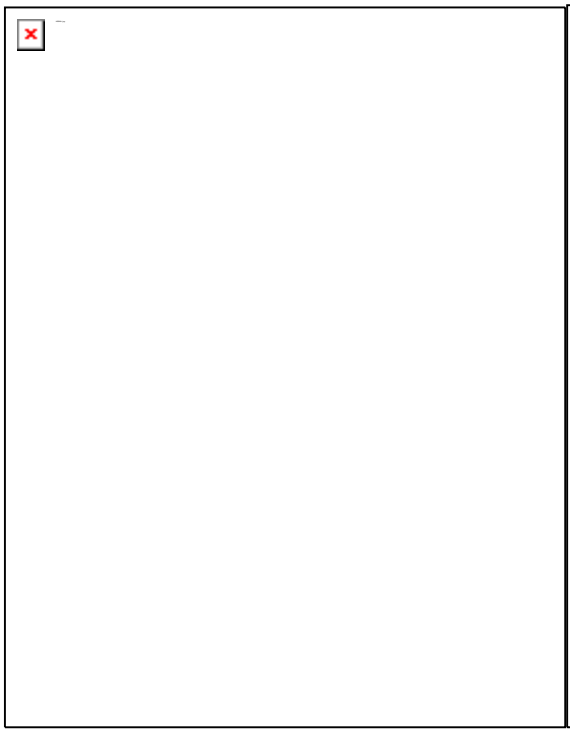
**Table 3. Grains per hill, weight of 1000 filled grains [a)] and grain quality, with Ciherang variety at different spacings, Sukamandi dry season 2002**

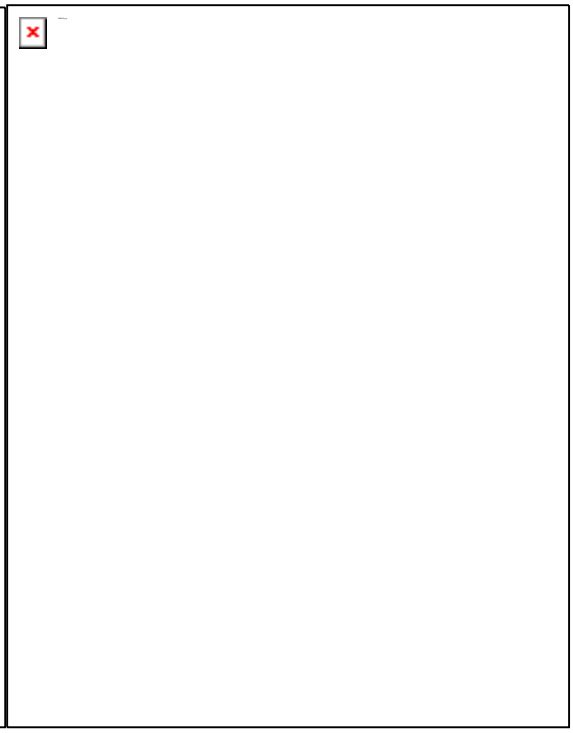
| Spacing | 20x20 | 30x30 | 40x40 | 50x50 |
|---|---|---|---|---|
| 100 grain weight | 26.27a | 26.70ab | 27.13ab | 27.53b |
| Total grains | 1432a | 3050b | 4829c | 6158d |
| Filled grains | 1153a | 2454b | 4098c | 5298d |
| Empty grains | 279a | 596b | 731bc | 861c |
| % empty grains | 19.4% | 19.5% | 15.1% | 13.9% |
| Whole rice | 90.38 | 91.32 | 96.54 | 96.96 |
| Broken rice | 9.37 | 8.41 | 3.31 | 2.93 |

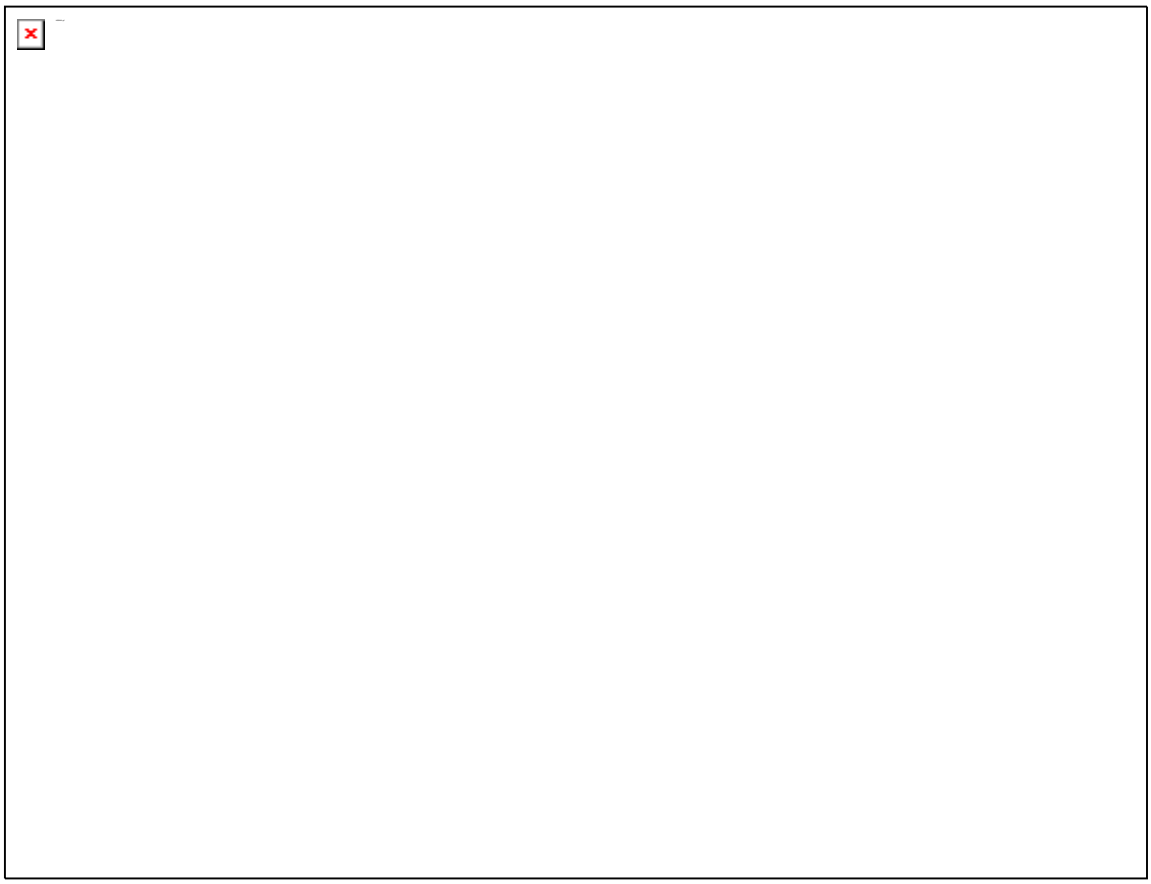
[a)] Values in table are averages for 12 hills per plot. Values in a column followed by the same letter are not significantly different at 5% with Tukey test.

[b)] Averages of 2 observations for each spacing.

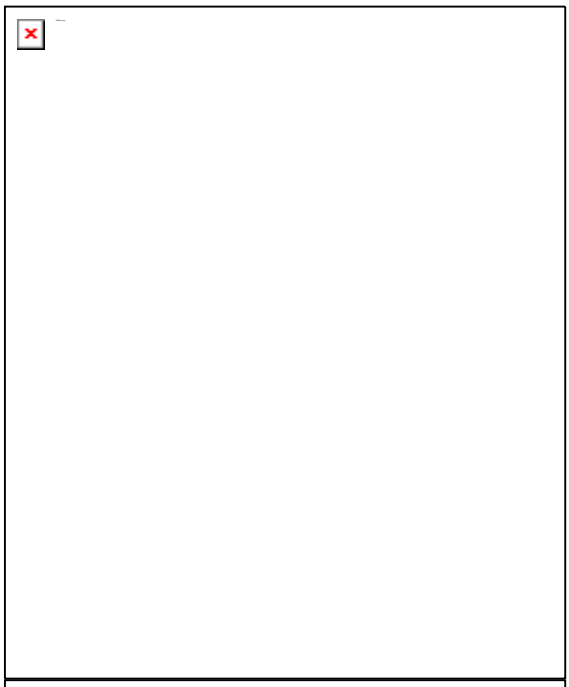


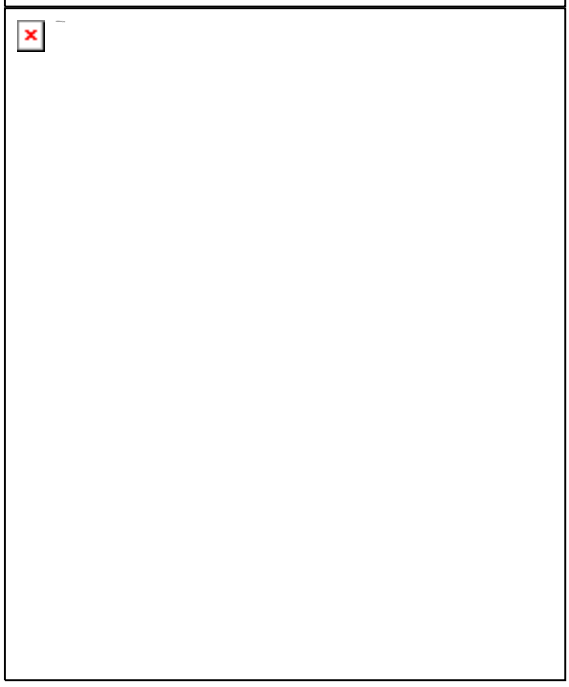


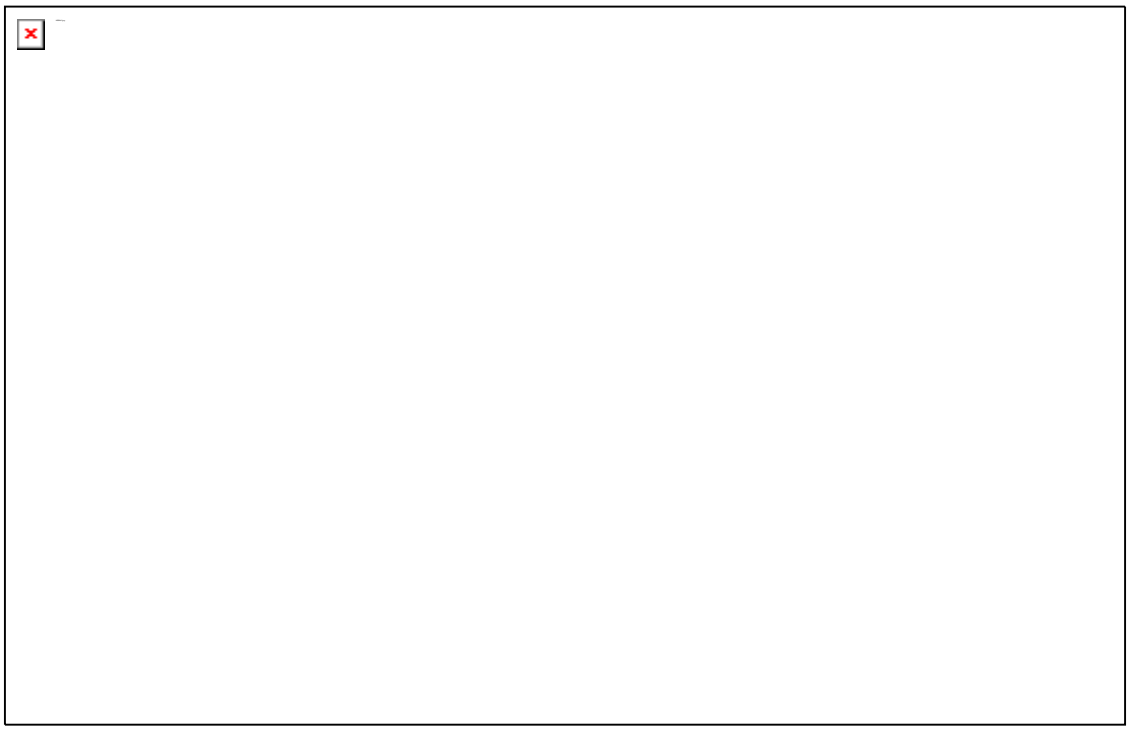




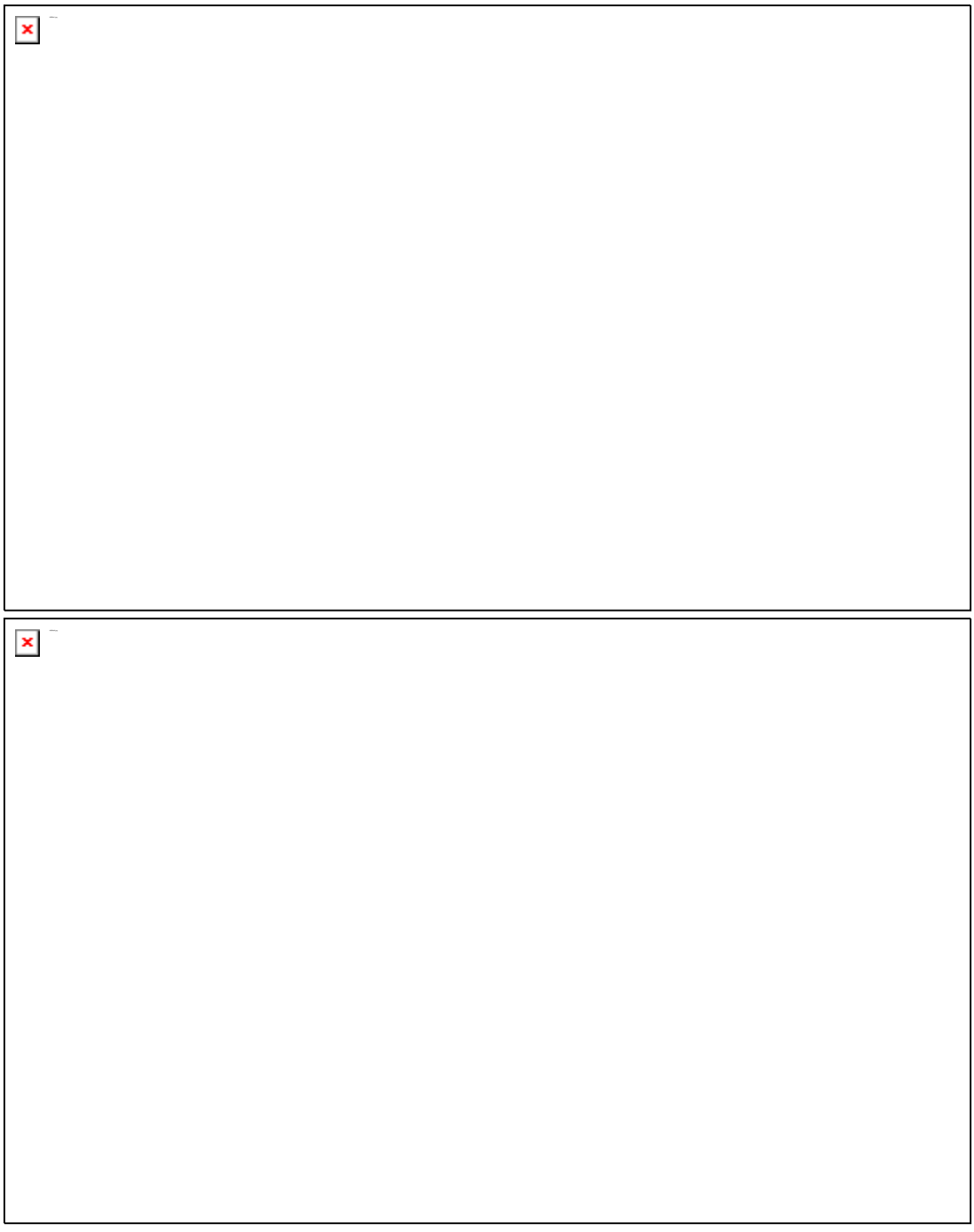
Picture 2. Panicles of Ciherang variety produced in closer, 20x20 cm (left), and wider, 50x50 cm (right) spacings. Observe also the greener leaves at wider spacing.







Picture 3. Comparison of wider (50x50 cm, right), and closer (25x25 cm, left) spacings, at active tillering stage (A) and early grain filling stage (B). Both spacings use same variety (Ciherang), same fertilizers, same planting time, as well as same method (SRI with single, 15-day-old seedlings).



Picture 4. Hill performance at different plant spacings of Ciherang variety, at flowering stage.

**NOTES:**

Picture 1: This showed a very good growth performance of Ciherang variety, maybe this was the best performance yet of this cultivar in Sukamandi research station. This is probably the first time that rice plants have been transplanted at such wide spacing, 50x50 cm, and with one younger seedling per hill.

Picture 2: The farmer was very glad with the result and was happy like I was. Unfortunately, he himself has no land to cultivate this way. This was the first time that the Ciherang variety gave so many tillers and panicles per hill, just from a single, young seedling, he said. The highest number of panicles per hill recorded was at 50x50 cm spacing -- 63 panicles.

Picture 3: The crop on the left side of the photos (A and B) was from a water-saving experiment funded by Plant Research International WUR. The long plot on the right side was planted with the same variety, at 20x20 to 50x50 cm spacings. Both plots used 15-day-old seedlings, one per hill, and the same agronomic practices (except in the PRI-WUR experiment where we used 25x25 cm spacing). It was seen that from vegetative growth stage until harvest, wider spacing always performed better. The harvest time for 50x50 cm planting is 4-6 days longer.

Picture 4: Comparison of hills sampled from different spacings at flowering stage. This shows visually the reasons for the impressive quantitative results.