

## Studies on the Application of High-Yielding Techniques for Rice Production in Cold Areas by Upland Nursery and Low Density Transplanting Practice

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The present paper dealt with results of RUNLDT<sup>2</sup> experiments carried out in 1982-1986. The technique was introduced from Japan, under the conditions prevailing in the Heilongjiang province in China. The experimental results were treated statistically with a microcomputer. Data on the meteorological conditions and rice production of the province were also analyzed.

During the period from 1949 to 1986 rice production of Heilongjiang province changed drastically after 1983. The acreage, yield per hectare and total yield increased 3.54, 1.37 and 9.78 times as against 1949 or were 192%, 124% and 241% over the values of 1983, respectively, due to the application of HYCRUNLDT<sup>3</sup>. The main aspects of the system involved the use of 1) high-yielding cultivars and 2) vigorous seedlings; 3) early transplanting at a low density; 4) high level of fertilizer application and shallow irrigation; 5) pest control.

Among the yield components, the increase of the panicle number per unit land area to reach a yield level of 7.5 ton per hectare in Heilongjiang province (continental climate and high latitude cold area) was considered to be the key factor. The panicle number derived from tillers played a leading role in the panicle number per unit land area and all the cultural practices were centered on this characteristic.

1. Cultivars. Cultivars with medium maturity are recommended. Cultivars with a Y number of leaves on the main stem can be determined by the following equation ( $Y = (X + 8.0672)/10.9822$ , or  $Y = (X - 407.6531)/165.2102$ ) where X: is the number of growing days or X the 10°cumulative temperature in the region. The cultivars must be high-yielding with a high quality, resistant to diseases, highly responsive to fertilizer application and exhibit strong tillering characteristics.

2. Transplanting time. Early transplanting is preferable to late one. Sowing should be performed when the air temperature remains stable at 6°C and stronger medium-sized 30-days old seedlings can be used. At this time, the average air temperature in the province reaches 14°C. This cultural practice ensures good seedling establishment, panicle formation and heading under high temperature conditions, and grain-filling completion normally before the air temperature drops to below 13°C. Early sowing and transplanting resulted in the increase of the panicle number and grain number per panicle.

3. Transplanting density. Since the distance between holes has a more appreciable effect on tillering than the seedling number per hole a distance of 30cm between rows was adopted. The tillering was quicker and the number of tillers increased as the distance between the rows increased and the seedling number per hole decreased. The maximum number of panicles from tillers was positively correlated with the number of fertile tillers. The regression equation of the maximum number of tillers and the yield (T/ha) was  $Y = -16.1151 + 2.0888X - 0.0558X^2 + 0.00046X^3$  ( $F = 5.0531 * *$ ). Therefore, when the conditions of 30cm × 13.2cm × 3 seedlings per hole were adopted, the maximum number of tillers ranged between 23-28 per hole, a number of 550 panicles per square meter (6.4 panicles per plant) could be obtained and a yield of 8 per hectare could be reached.

4. Fertilizer. The application of 57.5-150kg N/ha (N:P:K) = (1:0.7:0.5) was adopted. The

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<sup>2</sup> RUNLDT-Rice Upland Nursery and Low Density Transplanting

<sup>3</sup> HYCRUNLDT-High Yield Cultivation of RUNLDT

increase in the fertilizer rate resulted in the increase of the yield per unit land area, improvement of the soil nutrition, and enhancement of tillering. However, the effects of the fertilizer depended on the methods of N fertilizer application. When all the N fertilizer was applied as basal fertilizer(100%), the content of the effective N in the soil remained high during the growing period, the tillering speed was higher and the number of tillers was larger than when N fertilizer was applied as basal fertilizer, 60%; fertilizer to promote tillering 30%; and fertilizer to increase the number of panicles, 10%. The available nitrogen content in the soil at harvest was higher than that of all the nitrogen fertilizer used as basal fertilizer, or as basal fertilizer(70%) + fertilizer to promote tillering, (30%) due to the delay in the onset of tillering and completion of effective tillering, which resulted in poor tillering and low yield. Fertilizer application is determined by the high latitude and continental climate in the Heilongjiang province and nitrogen fertilizer should be applied once or twice.

Based on analysis described above, along with the data from the experiment conducted in 1982-1986 and the conditions prevailing in the Heilongjiang province, to achieve the high-yielding model of more than 8 ton per hectare the following conditions should be met: 1) cultivars with 12 leaves on the main stem, 2) a frost-free period of 125 days, 3) a cumulative temperature of 2500-2700°C ( $\geq 10^{\circ}\text{C}$ ) and 4) medium or high soil fertility level.

The experimental results showed that the average percentage of seed set was below 80%. Therefore, how to raise the seed setting percentage will be the main problem for achieving high yields of rice in Heilongjiang in the future.