Shifting of Cropping Season of Rice Plant and Its Growth in the Warmer District in Japan

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A tendency toward the practical problems for the early and late season rice culture has been developed by the study conducted by Komoda et al. on the possibilities of shifting the cropping season and the rotation culture for rice plant. And still more, the rice-borer controlling technics with the organic phosphorous insecticide and the technical establishment for the protected semi-irrigated rice nursery have made it practicable to shift the cropping season of rice plant.

Based upon these technics, the Japanese Ministry of Agriculture and Forestry projected the paddy crop improving program in the south-west warm district in Japan in 1953, and the early season culture of rice plant was promoted over the confirmed afflicted areas in the warmer district.

Meanwhile, favorable varieties of rice plant and the more convenient cultivatable technics were investigated by the experiment stations in the south-west warm district. As the result, the early season culture of the rice variety for the cooler district not only protected the warm district from damage by storm and flood, salt injury, autumn decline (Akiochi) but also brought a remarkable increase of crop yield during August before the typhoon season. Therefore, the technics rapidly spread in the district[1),4),7)].

At the same time, the early planting culture method to harvest earlier than usual the early and medium rice varieties of the warmer district planted in early or middle days of May, has been promoted generally in the ill-drained regions since 1956. It has been popularized rapidly in the middle warmer regions, especially in Mie and Shiga prefectures. The effect and mechanism of the rice yield increase have been made clear[5),8)]. And on the other hand the late planting culture of medium and late rice varieties has spread gradually on the fields after cropping the fruit vegetables in the environs of towns. Thus, together with the rapid development of the technics, the studies on the ecological changes of rice plant by the shifting of the cropping season have progressed.

Since the improved machine for planting young seedlings became available, the studies on the transplantation of young seedlings have been developed and put to practical use. The transplanting season has become earlier and earlier according to the augmentation of the transplanting area of young seedlings.

Shifting of the cropping season and the stage and period of the growth of rice plant

The days from the sowing time (transplanting time) to the maximum tiller number stage or to the heading time and the total days for growth of rice plant would be shortened more and more in accordance with the delay of sowing time. But the varieties sown at the same period attain the maximum tiller number stage almost all at once in spite of the difference of the nature and

planting density.

When rice is cultivated in early season, the days from the sowing time to the productive tiller number stage or to the heading time are longer, but on the contrary the days from the heading time to the ripening stage are short[5),9)].

These phenomena are caused by the change of daily temperature, that is to say, when the rice plant is cultivated in early season, the temperature during the beginning stage of this season is rather low, so the vegetative period gets longer. But in later stage the temperature gradually rises higher and daytime becomes longer, so the ripening period gets short.

Shifting of the cultivation season and changes of temperature in the water and soil as well as changes of the oxidation-reduction potentials of soil

In the early season culture, the temperatures of water and soil are rather low at the transplanting stage and they rise gradually according to the increase in the atmospheric temperature. However, they are not so high because the high temperature of the air could not sufficiently go downward screened by the plants grown thick.

In the normal culture, on the other hand, the paddy temperature is rather high from the beginning of the stage, and that of the late season culture is higher.

These temperatures affect not only the roots but also the oxidation-reduction potentials (Eh.) of soil, that is, the Eh. of soil in the early season culture does not fall down so suddenly as that in the normal season culture, and can maintain rather high degrees until near the heading time by means of midsummer drainage, but in the late season culture it falls down suddenly[5)].

As the soil condition in the early season culture is not so bad as that of the normal

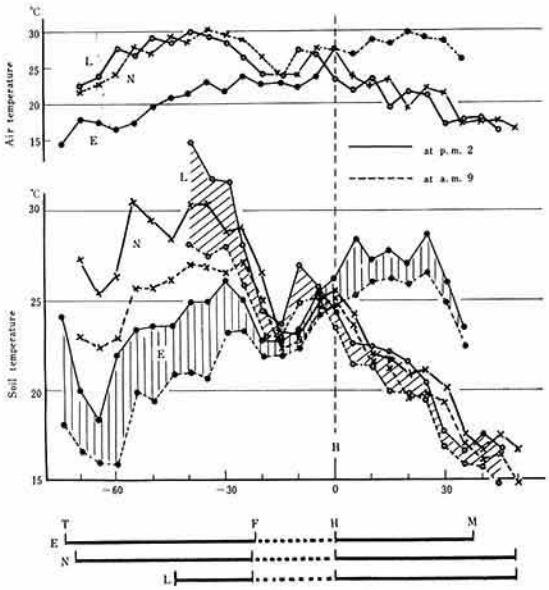

Fig. 1. Changes of air and soil temperature in paddy field (means five days) 1956

Note: E: Early season culture
L: Late season culture
F: Young panicle formation stage
H: Heading time
N: Normal season culture
T: Transplanting time
M: Date of maturity

or late season culture, it does not seem that the roots suffer so badly.

Shifting of the cultivatable season and the growth of rice plant

We can see some different phases of increasing the number of tillers by the difference of cropping season. In the early season cultivation, during some days after the transplantation, the number of tillers decreases slightly, or stops to increase but thereafter, it increases rapidly in accordance with the rising temperature and its maximum number becomes very large.

In the late season culture, tillering begins soon after transplantation and the number of tillers continuously increases rapidly, but the maximum number is not so large as that

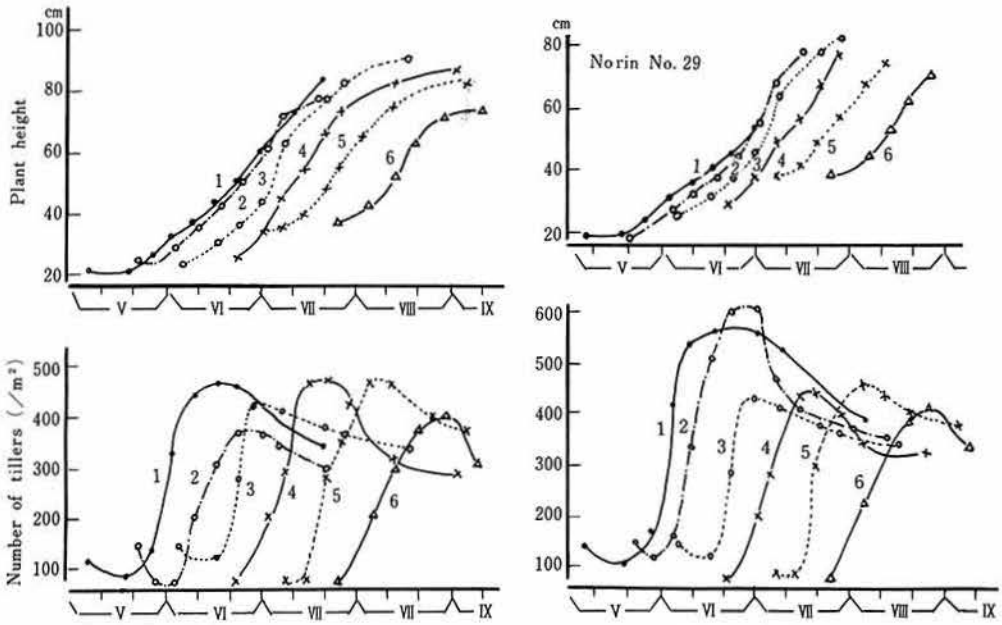

Fig. 2. Changes of plant height and number of tillers (1958)

in the early season culture.

In the early transplanted culture, there could often be found many withered tillers after the maximum tiller number stage so the percentage of productive tillers is generally not so high, but after all, the number of panicles in the early transplanted cultivation is the largest.

The rice plant, transplanted in the early season, does not show a remarkable growth in its height immediately after transplantation, but gradually it begins to grow up, keeping an almost straight growth line, but its growth rate is rather low in comparison with that in the late season transplantation. The culm length of the plant transplanted in earlier season is shorter and that of the plant transplanted too late is also short.

In the early season transplantation, it is believed that the principal cause bringing the number of tillers (number of panicles) to majority is the temperature during the vegetative period.

The dry weight of above ground parts of plant in the early season culture increases slowly after transplantation compared with that in the normal or late season culture because the temperature in the paddy field is not so high at the beginning.

But its augmentation gets high, influenced by the rising temperature after the active tillering stage. After the maximum tiller number stage, the dry weight of above ground parts of plant in the early season culture dominates those in the other seasons and its total dry weight augmentation shows an almost straight growth line until the time of maturity.

By the sudden decrease of dry weight of leaves and stems after heading time, it is conceivable that the transfer of starch and sugar stored up in the leaves and stems get in the panicles services for the growth of rice grain.

On the other hand, the root of rice plant in every season culture degrades gradually according with the growth[5),7),8)]. In the degraded paddy field accompanied by the root rot, the root degradation of early season culture progresses rather slowly than that in the normal or late season culture[5)].

In the early season culture, carbohydrate,

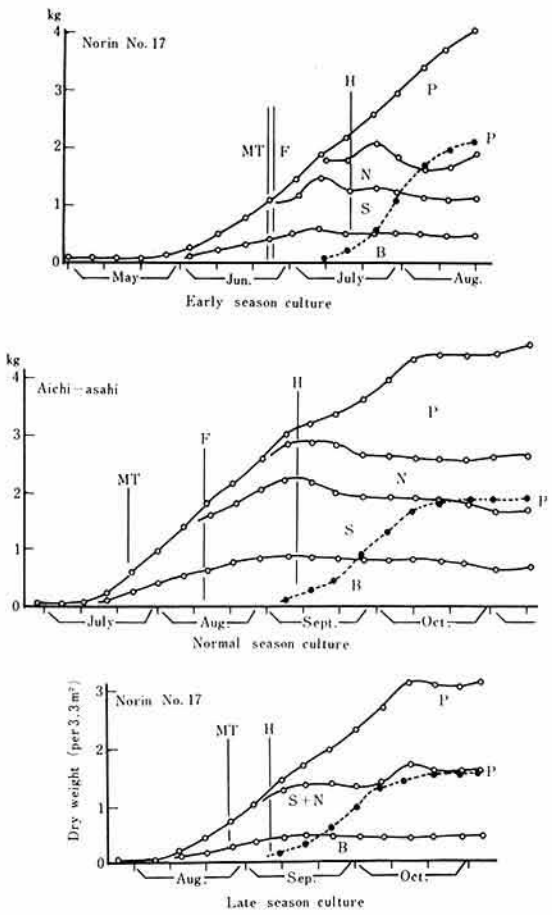

Fig. 3. Changes of dry weight of rice plants (1956)
Note: P: Panicle N: Internode
S: Leaf sheath B: Leaf blade
H: Heading time
F: Young ear formation stage
MT: Maximum tiller number stage

especially the starch, is accumulated in both parts above and under ground of the plant and the amount of sugar contained in root is most conspicuous in the early season culture and the least in the late season culture.

It seems that the respiratory activity under the influence of the amount of substrates supplied for such respiration[7] determines the resisting power of plant to the environments of soil. As mentioned above, the technics of machines to transplant young seedlings is now rapidly being put to more useful purpose. But as the young seedling transplantation culture needs longer days to attain heading time compared with the grown seedling transplantation, it is suggested that machine transplantation be carried out 7 to 10 days earlier than normal manual transplantation.

The phase of growth of rice plant transplanted at the young seedling stage to shift the culture season is not different from that at the grown seedling stage. That is, the plant transplanted in the early season shows a slow growth at the beginning stage and keeps longer tillering duration.

Its maximum number of tillers is great but the percentage of productive tillers is low while the number of panicles is considerably great. As to the plant transplanted later, the growth is rapid but the tillering duration is short and the number of tillers and panicles are not large.

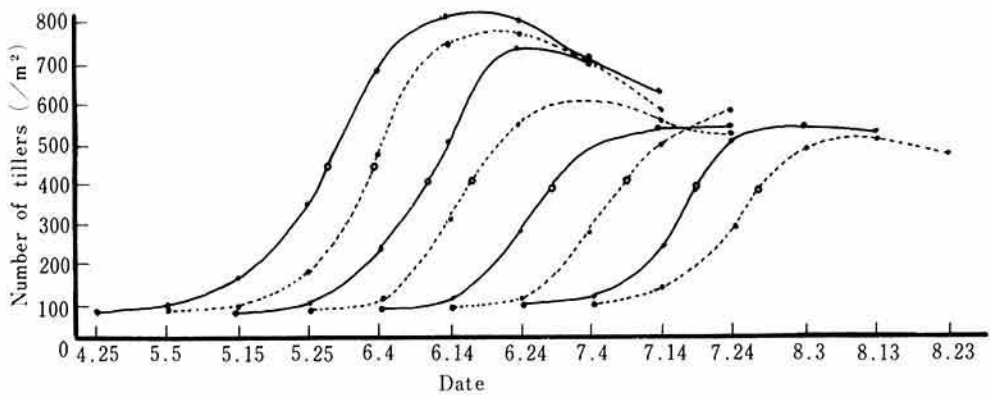

Fig. 4. Changes of number of tillers (sited from[3])

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