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LETTER

Developmental status and problems of rice ratooning

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1. Developmental status

Rice ratooning cultivation is an imperative breakthrough technology for promoting supply-side structural reform of agriculture, implementing the national plan to reduce the area of double-cropping rice in the Yangtze River basin, China. While, at the same time, it also contributes to ensure the absolute safety of grain ration and optimize grain production structure in China. Rice ratooning is a cropping system in which we take advantage of the regeneration characteristics of the rice plant. For instance, the axillary buds grow rapidly into seedlings and then proceed to the stage of tillering, heading, grain filling and ripening through adopting different planting measures after the main crop (the first cropping rice) is harvested. Ratoon rice has a long history dating back 1700 years in China. Presently, two models are commonly employed for harvesting of ratoon rice, which are manual harvesting and mechanized harvesting of ratoon rice. However, with the migration of Chinese rural labor forces, mechanized technology for ratoon rice has now become the main planting and harvesting mode. Moreover, this is also the recommended cultivation technique with promising high grain yields and better economic efficiency and more importantly it has

become increasingly popular due to its beneficial aspects with the ongoing efforts of scientific research. The grain yield for both the main crop and ratooning crop is usually $15 \text{ t ha}^{-1} \text{ yr}^{-1}$ with a significant improvement on the economic benefits compared to the middle season and double season rice, respectively.

Upon comparison with the middle season rice, rice ratooning method was able to obtain the additional harvests by $4500\text{--}6000 \text{ kg grain yield ha}^{-1}$, which was further increased by $11000\text{--}15000 \text{ CNY output ha}^{-1}$ and $7500\text{--}11000 \text{ CNY net income ha}^{-1}$. We further recorded a higher rice quality with multiple saving benefits such as of seed, labor and water resources coupled with a 30–50% reduction in fertilizer use and a 40% decrease in pesticide application. Eventually, the grain yields of ratoon rice were almost the same or slightly lower than that of the double season rice in a year. Ultimately, all these beneficial aspects can lead to reduced costs, increased efficiency, and consequently can help in the enhancement of net income by 4500 to 8000 CNY ha^{-1} . Therefore, the development and extension of rice ratooning technology to suitable planting areas in China carries a positive significance to ensure a steady increase in grain output, and the higher economic efficiency of growing food crops for enhancement of the farmer's income. However, there is existence of some problems which need to be addressed.

2. Problems and suggestions

2.1. Insufficient policy support

Some local governments did not strategically pay any attention to rationing rice. Since, they possibly not fully understand the role of ratooning rice in ensuring a steady

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increase of grain output and improving the economic efficiency of food crop production for enhancement of the farmer's income. Therefore, they ignore the policy of supporting the rice ratooning cultivation. For instance, ratoon rice is characterized by high quality compared with the main crop and the same term late season rice. However, the best quality does not reflect the best price, and ratoon rice is usually not statistically considered like one season rice. Moreover, it is often not included in consideration of a long-term development plan. Therefore, many measures, especially fund investments are falling behind on this practice. In addition, the ratoon rice brand and its industrial development have not been well coordinated with each other. Consequently, the industrial development of ratoon rice has not kept pace with the production, and the brand creation has been apathetically slacking.

Therefore, we strongly suggest that the government should pay attention to rice ratooning technology and formulate supporting policies to promote healthy development of ratoon rice. The relevant departments should take the production of ratoon rice as an important system to ensure national food security. Furthermore, government/ departments should be keeping in mind about farmer's income by designing preferential policies for the production to protect the farmer's enthusiasm for planting ratoon rice. At the same time, agricultural institutes, universities and agriculture extension departments should be coordinated to carry out collaborative research work on rice ratooning technology. We also suggest that the government should actively persuade and encourage leading enterprises to establish cooperative relations to share benefits and risks with the farmers involved in ratooning rice cultivation. The cultural connotation and quality value of ratoon rice industry should be explored to enhance the industrial efficiency through the brand construction.

2.2. Variable yield performance in different rice ratooning areas

As mentioned above, a great progress has been made in rice rationing, but it still incurring some problems which need to be solved with immediate effect. For instance, there is

lack of much more ideal rice varieties with strong ratooning ability suitable for mechanized harvesting, therefore, there is urgency to solve this problem through effectively screening the ideal cultivars. The germination mechanism of axillary bud still remains unknown, which is very important for stable and high yielding cultivation. Consequently, further studies are required to decipher the mechanism in order to optimize the cultivation techniques for bud and tiller promotion in ratoon crop.

The major challenge is how to effectively overcome the rolling damage of the main crop that occurs due to mechanized harvesting. All these are the main factors due to which we cannot establish the standardized cultivation systems with high yield and better efficiency adaptive to different areas of ratoon rice, resulting in large differences in grain yields of ratoon rice grown in different parts of China. Therefore, it is necessary to strengthen the breeding and screening of rice varieties with strong ratooning capacity and to thoroughly reveal the germination mechanism and promotion of ratoon axillary buds. There is also a need to explore rhizosphere biology and regulation technology of ratoon rice. To protect the main crop from rolling damage, specifically designed harvester designated for harvesting ratoon rice crop must be employed. Accordingly, it is necessary to organize and compile the technical regulations for ratoon rice cultivation to promote scientific and standardized planting of ratoon rice.

Here it is worth mentioning, that the national government always takes grain security as the top priority, and farmers focus on increasing economic efficiency. Only through finding the balance point between increasing grain output and farmer's income can we achieve coordinated development.

3. Conclusion

Ratoon rice is the better way to achieve sustainable increases in grain output and steady enhancement in farmer's income. Therefore, we urge the government to put proper policies in place to strengthen research on the mechanisms of high yielding techniques such as ratoon rice cultivation.

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