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Studies on the low-carbon and high-yield cultivation technologies of super rice

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ABSTRACT

In this paper, on the based of the experience of research and extension on super rice for many years, the author discussed the techniques of water management, fertilization and pest control with super-high-yielding, and low-carbon, from taking into account on cutting down emission of greenhouse gas, decreasing inputs and increasing efficiency, which can be applied as reference.

KEYWORDS

Super rice; Low-carbon; High-yielding; Cultivation technology.

INTRODUCTION

There are some positive ecological effects[1-2], such as regulating atmospheric water and heat balance, purifying the air, as well adsorbing, shielding, degrading harmful substances in soil, but with some negative impacts, such as pollution on environment because of applying chemical fertilizers and pesticides[3]. Furthermore, some greenhouse gases will release from paddy field, such as methane, which is a major source of global greenhouse gas. China has successfully bred super rice and some excellent super rice combinations, such as Zhongzheyou 1, Y Liangyou 2 and Yongyou12, has been applied on a large scale. Super rice is not only with high yield, good grain quality and strong resistance to main deseases of rice, but also with some characteristics of a low carbon planting. As human beings pay more close attention to climatic and environmental issues, the release of greenhouse gas in rice production will be more attention[4-6]. In this paper, it has been put out on the low-carbon planting technologies of super rice with high yield.

THE LOW-CARBON FEATURE OF SUPER RICE

The high carbon sink capacity of plant with high yield potential

The planting rice in paddy field has duality with carbon sources and sinks. On the one hand, using rice seeds, fertilizers, pesticides, machinery and labor consumes substance and energy, and the respiration of rice plants and soil microbe and biomass conversion release CO2, CH4 and other greenhouse gases, so it is a carbon source. On the other hand, photosynthesis in rice plants assimilates CO2 to organic matter and releasing O2, so it is also a carbon sink. Compared to conventional rice, the super rice, with good plant type, more height of plant, vigorous growth, greener leaf color, longer leaf function period, strong photosynthetic capacity and high yield potential, has high function to convert more CO2 to organic material[7]. Therefore, the low-carbon cultivation of super rice can be achieved with higher output and smaller energy consumption by reducing the inputs of fertilizers and pesticides.

Reducing emissions of greenhouse gas with stronger absorbing ability to water and soil nutrients

Because of its enormous root system, the super rice has stronger ability to absorb soil nutrients. Therefore, the generation and emissions of greenhouse gases CH4 and NO are reduced in paddy field. Fu zhiqiang et al[8] have shown either directing planting seed or transplanting rice, the emissions of CH4 in super rice are lower than conventional varieties of rice. The root activity of super rice decreases slowly in the late period and still have a stronger ability to absorb the necessary elements from the soil for its growth after heading, which is a reason of high yield and fertilizer utilization.

Reducing pollution of pesticides for its stronger resistance to diseases

The applying combinations of super rice have strong resistance to major diseases of rice, such as Yongyou 6, Zhongzheyou 1 and Yongyou 9 applied in Wenzhou China have a strong resistance to two main deseases, bacterial blight and rice blast. There are relatively low humidity in paddy field planting super rice, because of its small population with big ears. But the pests and diseases of super rice has some change, for example, the damage of rice stem borer is more serious for its dark green leaves and some combinations is susceptible to rice false smut.

THE CULTIVATION TECHNOLOGYG OF LOW-CARBON AND HIGH YIELD FOR SUPER RICE

The saving water techniques with low carbon

Water-saving by much early drying practice

The much early drying practice is an important measure of a low-carbon cultivation, which can effectively controll the ineffective tillers and establish the high quality population. Furthermore, the much early drying practice also save water and put a significant reduction in methane emissions[9]. Generally, the lighter practice is applied, which ends every time at not caving feet in the middle of paddy field, or not white in soil or slightly fading leaf of plant, which brings just light mechanical damage to rice roots, and avoids increase of nitrogen losses and nitrous oxide (a greenhouse gas) emissions because of enhanced denitrification in soil by heavy drying practice[10]. By a comprehensive on the effect controlling ineffective tillers of super rice, conservation of water, the nutrient utilization and reduce of greenhouse gas emissions and other factors, the initial time of drying pracice for super rice can be put forward to 10 days after transplant of seedling, and, lightlier drying practice 3~4 times with about 15 days effectively drying practice period. By much putting forward and extended period of drying practice, it can save a lot of water.

Aerobic irrigation during the whole growth period

In the traditional cultivation of rice, the water level in the paddy field is kept in the most time of the whole growth period, which lead to the excess water lose by seepage of underground, evaporation and running off. However, the low-carbon cultivation technology field is kept the moist condition with no water level in the most time of the whole growth period, which not only save water but also promote the growth of plant roots and shoots by enhancing permeability and decreasing reducing substances in soil of paddy field. The water management of low carbon cultivation for super rice can be included as follows:irrigating 2~3cm shallow water level after transplanting, starting drying pracice from 10 days after transplanting of seedling, in the other time the paddy field is kept in moist situation before milk-ripe stage except for the field

should be kept 1~2cm shallow layer during meiosis stage of booting, during the milk-ripe stage, the intermittent irrigation should be used, during dough-ripe stage, the "paomashui" should be used and the irrigation should be stop from 5 to 7 days before the harvest.

Making a full use of natural precipitation

It has a lot of rainfall during rice growing season in southern China. Based on taking advantage of the weather precipitation forecast, it can be taken a relatively flexible water management measures by irrigating with a combination of natural rainfall and irrigation with not drain off in principle. The dynamic management techniques of water can further save water and reduce the loss of fertilizer pollution[11]. In production, you can control the level of water in paddy fields by adjusting the height of Tianque (water outlet)by the following methods: the water outlet is about 5cm high from transplanting to begin drying practice;the water outlet was excavated out during the period of drying practice, the water outlet is again set up about 5cm high until dough-ripe stage and then again dug out water outlet. Throughout the growing season, the time and depth of irrigating water is decided by the principle of full and effective use of natural precipitation and aerobic irrigation in paddy field.

Techniques controlling pest with low carbon

Emphasising on agricultural control

Reasonable agricultural control can reduce demage both diseases and pests and significantly reduce using amount of pesticide. I t should be applied to the combinations with strong resistance to the main disease as blast of rice, bacterial blight. The much early drying practice can reduce ineffective tillers, promote the development of root system and reduce the canopy density and field moisture. And the cultivation of wide-narrow row can improve the ventilation and light conditions and create a favorable microclimate in paddy field, both of which can also reduce diseases;The optimized cropping patterns, such as rotation planting both floods and droughts, can not only promote the productivity of soil but also reduce pathogens and insect source in soil[12].

Applying biological control

Biocontrol is friendship on environment, so in cultivation in super rice it should actively apply biological insecticides such as botanical Azadirachtin, Bacillus Thuringiensis. The techniques of rice-duck farming can not only effectively reduce the damage of planthoppers, leafhoppers, sheath bligh and other diseases, but also control weeds in paddy field, so the dosage of pesticides, fungicides, herbicides. Can be reduce. Rice-frog-fish farming can effectively control pests and weeds in paddy field, if Frequency Vibrational Lamps are installed in the rice-fish-frog, the traped and killed pests are feed on fishes and frogs, the insects can be further reduced.

Properly applying chemical control

The chemical control is necessary measures for cultivation of super rice, and the low toxicity, low residue and highly effective pesticides are recommended to use for the low carbon cultivation. For example, the control efficiency of fipronil to stem borer and *cnaphalocrocis medinalis* of is over 97%. The forecasting work to desease and pest should be strengthened and the application methods should be improved such as using pesticide at the most appropriate period and alternatly using different pesticides for greatly reducing the amount of pesticides and pest costs to control, which can indirectly reduced carbon emissions, achieve a low-carbon and high yielding cultivation and improve the ecological environment in paddy field.

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