Study on Rice Culture Mode of Rice Duck Co Culture in Organic Rice Production Environment

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Abstract: Comprehensive cultivation in paddy field is a popular way in most large rice producing countries. At present, the cultivation of rice fish, rice crab, rice duck and rice shrimp is not perfect, which needs further research. This paper focuses on the rice culture mode of rice duck co culture, aiming to explore the effect of rice duck co culture environment on the quality of nitrogen and phosphorus in paddy soil under the production environment of organic rice. The experimental site of this paper is the demonstration base of mechanized rice planting technology of agricultural science research in Lianshan Zhuang and Yao Autonomous County. Three groups of control groups are set in the experiment, which are the conventional experimental group, the rice duck co breeding experimental group and the ecological interception experimental group, the content of nitrogen and phosphorus in paddy soil and its effect on soil quality loss under rice duck co breeding were studied. The results showed that the highest nitrogen concentration was 15.24mg/l in the conventional area and 13.27mg/l in the rice duck co breeding area before duck release; however, after duck release, the total nitrogen concentration of surface water in conventional area and rice duck co breeding field was the highest, reaching 15.25mg/l and 16.15mg/l respectively. In addition, the total phosphorus concentration in surface water of rice duck co breeding field was significantly higher than that of conventional area and ecological interception ditch after duck release. It can be seen that rice duck farming is conducive to rice cultivation.

1. Introduction

Rice duck co breeding technology is more popular in major rice industry countries, because it can make the beneficial organisms stored in the rice ecosystem have a better protection and survival conditions, and continuously promote the virtuous cycle and development of the rice ecosystem [1, 2]. The application of rice duck co breeding technology can increase the emission of total nitrogen, alkali hydrolyzed nitrogen dioxide and other soil nutrients and other microorganisms in paddy field, achieve a better effect of using soil to plant fertilizer, improve the soil fertility of cultivated land, and change the soil bulk density in the process of crop cultivation, The soil structure has been effectively improved, and the chemical properties of the soil have also been improved, which makes the soil environment of paddy field more optimized and benign development; And the goal of doing so is to greatly improve rice yield and rice quality [3, 4].

Many scholars have put forward the research on the rice planting mode of CO cultivation of rice and a kind of biology [5, 6]. For example, some scholars focused on the rice culture mode of rice shrimp cultivation. The researcher set up different C / N feeding modes and different cultivation densities of rice to observe the conditions of different growth stages of rice, and then studied the effects of crayfish on paddy field environment [7, 8]. There are also scholars who focus on the rice crab co farming model and analyze the benign effects between rice and river crab [9, 10].

The experimental site of this paper is the demonstration base of mechanized rice planting technology of agricultural science research in Lianshan Zhuang and Yao Autonomous County. Three groups of control groups are set in the experiment, which are the conventional experimental group, the rice duck co breeding experimental group and the ecological interception experimental group, The content of nitrogen and phosphorus in paddy soil and its effect on soil quality loss under

rice duck co breeding were studied [11, 12].

2. The Effect of Rice Duck Co Breeding on Rice Quality and Rice Disease Monitoring Index

2.1 Effects of Rice Duck Co Breeding Mode on Diseases, Insect Pests, Weeds and Ecological Environment Quality of Rice Field

The technology of rice duck co breeding is used to raise ducks in rice fields. Ducks can feed on the pests and step on the weeds. It has a good control effect on diseases, pests and weeds, and is also beneficial to the growth of rice. In this way, we will change the habit of using a large amount of pesticides and chemical fertilizers in traditional rice cultivation to prevent pests and feed rice, and make the rice and duck meat more green and safe. The ecological environment of paddy field will also be virtuous circle, and its ecological and economic benefits will continue to increase.

2.1.1 Effects of Rice Duck Co Breeding on Pests

The control rate of rice duck co breeding is 50% to 86%.

2.1.2 The Influence of Rice Duck Co Cultivation Technology on the Ecological Environment Quality of Rice Field

Using rice duck co farming technology can make the paddy soil be repaired to the natural direction with little or no application of pesticides and chemical fertilizers. The combination of rice duck breeding and traditional paddy field structure and mode has not only improved the ecological environment of paddy field, created a healthy living place for its biological community, but also greatly improved the economic production capacity of paddy field.

2.2 Effects of Rice Duck Co Cultivation on Soil Fertility and Rice Yield

2.2.1 The Effect of Rice Duck Co Cultivation on Soil Fertility

In the rice duck co breeding system, ducks directly row the manure in the paddy field, and they keep trampling on the duck feet. Then the fertility of the paddy soil mixed with the manure will be greatly improved. Therefore, the technology of rice duck co cultivation can improve the soil fertility level and reduce the fertilizer application.

2.2.2 Effect of Rice Duck Co Cultivation on Rice Yield

The co cultivation of rice and duck increases the green nutrition of rice growth, and also enhances the energy of rice resistance and insect pests. Therefore, it is also beneficial to the growth of rice yield. The results showed that the duck constantly touched the rice plants in the rice duck co breeding field, which stimulated the rice growth. The 1000 grain weight, effective panicle and the number of real grains per spike were higher than that of the conventional rice fields. Therefore, the long-term implementation of rice duck co breeding technology can effectively promote rice yield and improve the quality of rice and duck meat

2.3 Plant Indicators for Disease Detection

The optical characteristic parameters of plant leaves show obvious spectral differences. After the plant is attacked by the disease, it will change its internal structure and biochemical characteristics. The external phenomenon of leaf yellowing, withering and withering will be shown to a certain extent, and its spectral characteristics will also change. Moreover, the change indirectly reflects the physiological characteristics of plants under disease stress. Therefore, it is feasible to judge the growth of plants according to the difference of spectrum.

The plant disease indexes used for disease detection in spectral research are as follows:

$$S_D = \frac{I_{550nm}}{I_{550nm}+I_{690nm}} \quad (1)$$

The normalized vegetation index is:

$$NDVI = \frac{R_{NIR}-R_{RED}}{R_{NIR}+R_{RED}} \quad (2)$$

The vegetation index of soil adjustment is as follows:

$$NDVI = \frac{(R_{NIR}-R_{RED})(1+L)}{R_{NIR}+R_{RED}+L} \quad (3)$$

Where l is 0.5.

3. The Effect of Rice Direct Seeding Duck Raising on Rice Quality

3.1 Test Site and Materials

The experiment was carried out in the demonstration base of mechanized rice planting technology of Lianshan Zhuang and Yao Autonomous County from March to November 2020. In order to evaluate the effect of the experiment, a 20 mu conventional control area was set up in the experimental area, and the cultivation and management measures were completely consistent with the local agricultural production. In order to carry out cleaner production in the experimental area, the following technical measures are mainly adopted: first, increase the application of organic fertilizer and reduce the use of chemical fertilizer; Second, carry out green prevention and control of diseases and insect pests and reduce the use of chemical pesticides; The third is to carry out the ecological breeding of rice and duck to protect the farmland ecology; The fourth is to build ecological interception pond at the outlet of the experimental area to further absorb nitrogen, phosphorus and other pollutants in the farmland return water and reduce emissions; Fifth, planting green manure milk vetch to improve soil fertility.

3.2 Experimental Design

3.2.1 Design and Fertilization of Demonstration Base

1) Demonstration type:

Conventional control area: 20 mu, the total nitrogen and Phosphorus Input were 10kg and 3kg respectively. On June 4, 35 kg compound fertilizer with 40% (n, P, K 15%, 5%, 20%) was applied as base fertilizer, on June 9, machine transplanting, on June 22, topdressing with 6 kg urea, and on July 25, topdressing with 45% (n, P, K 20%, 12.5%, 12.5%) with 10 kg high N and K compound fertilizer.

Rice duck breeding area: 100 mu, 1000 ducks will be released on June 24, and the ducks will be transferred to pen raising at the end of August; the total nitrogen and Phosphorus Input were 10kg and 3kg respectively. On June 5, 200kg of commercial organic fertilizer (n, P, K 2.5%, 1.25%, 2.5%) was applied as the base, and the machine transplanting was carried out from June 6 to 9. On June 22, 40kg of fermented rapeseed cake (n, P 1.25%, 1.25%) was applied.

2) Demonstration performance:

In 2020, the base will plant 400 mu of rice in a single season, and 300 mu of green fertilizer ziyunying will be planted before. Among them, ziyunying was green by rotation in early April. All rice fields are planted with Conventional Indica rice, which are inserted by machine in early June and harvested in early October.

3.2.2 Implementation of Rice Duck Co Breeding

The ducks were released on June 14 and transferred to pen raising at the end of August.

3.3 Sample Collection

Field water samples were collected from the second day after each fertilization, and then collected once every other day for three consecutive times. Drainage samples are collected in time when runoff is generated after rainfall. There are two drainage sample collection points in the comprehensive application area of eco agricultural technology, one is before entering the ecological interception pond, and the other is after being intercepted by the ecological pond. When taking water sample, the sampler and sample bottle should be washed clean and free of special substances.

Before sampling, rinse the sample bottle with water for three times, and then take samples. Take 1000ml water sample each time and pack it into two bottles. One bottle was used as test sample and the other as spare sample, which was frozen after sampling.

3.4 Sample Number and Formulation Method

1) Field water samples

Field water samples are collected every two days within 10 days after each fertilization. The code consists of six parts: the first part is base code ahjd, the second part is typical plot code dxdk1, the third part is monitoring year, the fourth part is treatment code a (conventional treatment is control field), B (ecological treatment is experimental area), the fifth part is field water code SF, and the sixth part is field water sample collection batch 01 02、…….

2) Drainage sample

The code of drainage sample is composed of six parts: the first part is the base code ahjd, the second part is the typical plot code dxdk1 (the first typical plot), the third part is the monitoring year, the fourth part is the treatment code a (conventional treatment, i.e. control field), B (ecological treatment, i.e. test area), the fifth part is the drainage code SC, and the sixth part is the drainage sample collection batch 01 02、…….

3.5 Sample Determination

1) Determination content

The contents of ammonium nitrogen, nitrate nitrogen, total nitrogen, total phosphorus, soluble phosphorus and cod were determined; the contents of total nitrogen, total phosphorus, organic matter, available phosphorus, available potassium and pH were determined; Ammonium nitrogen, nitrate nitrogen and water content of fresh soil samples were determined.

2) Sample determination method

The sample test method is shown in Table 1

Table 1. Sample determination method

Sample type	Measurement index	Determination method
water sample	Total nitrogen	Determination by potassium persulfate digestion AA3 continuous flow injection analyzer
	Ammonium nitrogen	AA3 continuous flow injection analyzer
	Nitrate nitrogen	AA3 continuous flow injection analyzer
	Total phosphorus	Potassium persulfate flow injection analysis
	Soluble phosphorus	two point five μM membrane filtration potassium persulfate flow injection analysis
	COD	721 spectrophotometer method

3.6 Data Processing

Excel software is used to process the calculation data, and Origin software is used to draw.

4. Results and Analysis

4.1 Effect of Rice Duck Co Breeding on Total Nitrogen Concentration in Surface Water

Table 2 shows the change of total nitrogen concentration in surface water of rice duck breeding field in 2020.

Table 2. Variation of total nitrogen concentration in surface water of rice duck breeding field (mg/L)

	2020.6.5	2020.6.7	2020.6.9	2020.6.25	2020.6.27	2020.6.29
Conventional area	15.24	3.56	2.89	15.25	11.79	10.22
Rice duck breeding area	13.27	3.11	2.35	16.15	16.12	14.55
Ecological interception ditch	2.98	3.21	2.55	3.18	5.95	7.58

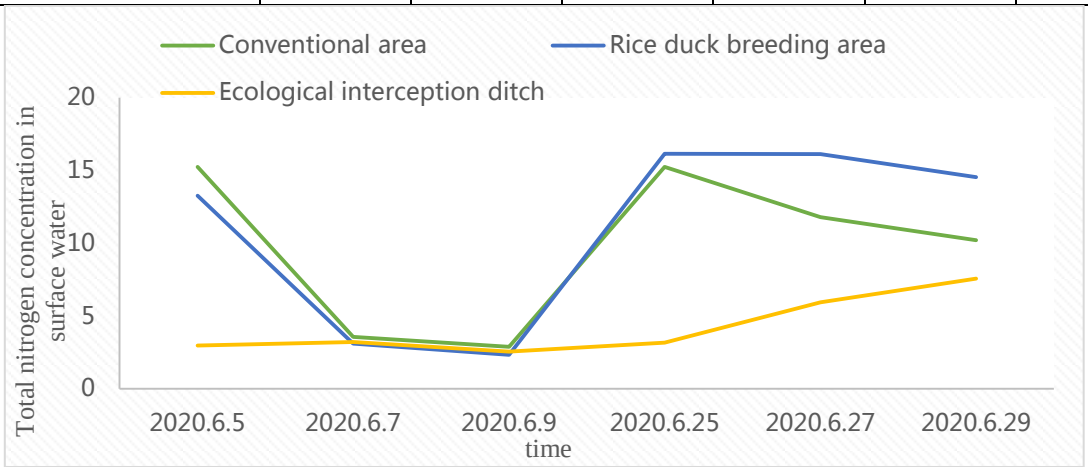

Figure 1. Variation of total nitrogen concentration in surface water of rice duck breeding field (mg/L)

It can be seen from Fig. 1 that the total nitrogen content and concentration of surface water in conventional paddy field were significantly higher than that in ecological interception ditch after applying base fertilizer before duck release, which was significantly higher than that in ecological interception ditch. With the shortening of fertilization time and days, the total nitrogen content and concentration of surface water in conventional paddy field and rice duck co breeding field decreased rapidly, and the change range of total nitrogen content and concentration in ecological interception ditch was relatively small; The total nitrogen content of surface water in rice duck co breeding field was significantly higher than that in conventional area, which was significantly higher than that in ecological interception ditch. With the increase of fertilization time and days, the total nitrogen content of surface water in conventional area and rice duck co breeding field decreased and decreased, and the total nitrogen content of ecological interception ditch also increased slowly.

The maximum concentration of total nitrogen in the conventional area did not change much after duck feeding, while the maximum concentration of total nitrogen in the rice duck co breeding area increased from 13 and 27 mg / L to 16.15 mg / L compared with that before duck feeding. It was obvious that the total nitrogen concentration of surface water after top dressing was higher than that after base dressing.

4.2 Effect of Rice Duck Co Breeding on Total Phosphorus Concentration in Surface Water

Table 3 shows the change of total phosphorus concentration in surface water of rice duck breeding field in 2020.

Table 3. Changes of total phosphorus concentration in surface water of rice duck co breeding field (mg/L)

	2020.6.5	2020.6.7	2020.6.9	2020.6.25	2020.6.27	2020.6.29
Conventional area	0.15	0.11	0.13	0.18	0.15	0.18
Rice duck breeding area	0.16	0.11	0.14	0.27	0.22	0.25
Ecological interception ditch	0.14	0.10	0.12	0.16	0.14	0.17

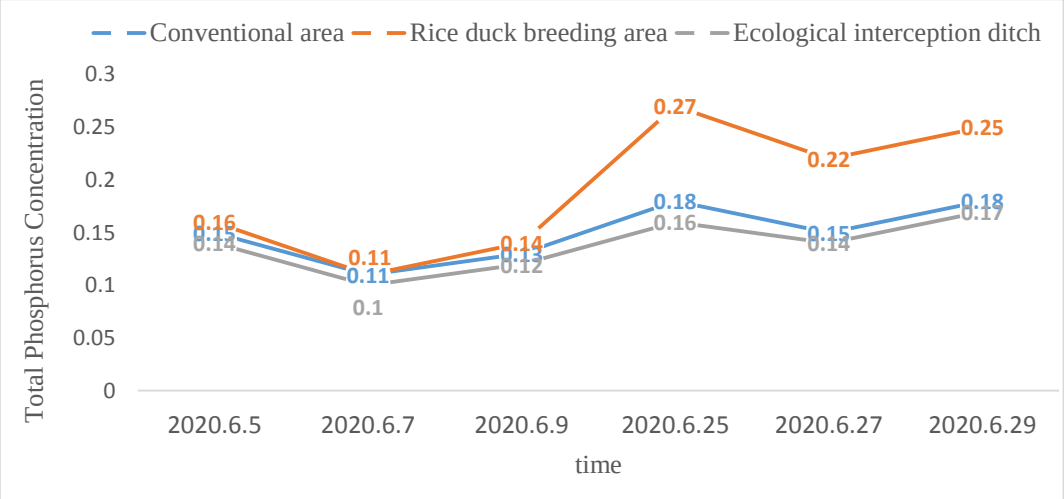

Figure 2. Changes of total phosphorus concentration in surface water of rice duck co breeding field (mg/L)

It can be seen from Figure 2 that the total phosphorus concentration in surface water of conventional paddy field was slightly higher than that of rice duck co breeding area, and also slightly higher than that of ecological interception ditch, but there was no significant difference among the three treatments, ranging from 0.103 mg / L to 0.159 mg / L; The total phosphorus concentration in surface water of rice duck co breeding paddy field was significantly higher than that of conventional area and ecological interception ditch, and slightly higher than that of ecological interception ditch in conventional area.

The total phosphorus concentrations in conventional area, rice duck breeding area and ecological interception ditch were controlled between 0.11-0.18mg/l, 0.11-0.27mg/l and 0.10-0.17mg/l, respectively; The total phosphorus content in surface water of three groups of experimental paddy fields was much higher after duck release than before; The total phosphorus content in rice duck breeding field was significantly higher than that in normal area and ecological blocking ditch. The main reason is that after ducks are released, ducks will trample and move in the field, and the mixing ability of soil in other places will also be enhanced, so the phosphorus concentration in the surface water of the field will be increased.

5. Conclusion

The effects of rice duck co breeding and ecological interception ditch on nitrogen and phosphorus concentration in surface water of rice field were significant. The total nitrogen of field surface water was higher after fertilization than before; After fertilization before duck release, the total nitrogen concentration in surface water of conventional treatment was higher than that of rice duck co breeding treatment, and after fertilization after duck release, the total nitrogen concentration in surface water of rice duck co breeding treatment was significantly higher than that of conventional treatment. The results showed that the total phosphorus and soluble phosphorus in surface water decreased within one week after applying base fertilizer before duck release, and then began to rise again, which may be caused by more rainfall this summer; The concentrations of total phosphorus and soluble total phosphorus in surface water of rice duck co breeding treatment were higher than those of conventional treatment.

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