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Effects of Seed-pelleting on Biochemical Characteristics of Rice

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Abstract. The effects on different planting methods and different proportion of pelletized wrapping material on physiological indexes of different rice varieties were studied, providing theoretical basis for rice direct seeding cultivation in northern China. Taking the Japonica rice varieties (Longyou 619) as materials, cultivating in Shenyang Institute of Technology field practice base. The experiment was divided into six treatments, respectively, control groups (ck: only soil, no fertilizer), group T1-80:1, group T2-90:1, group T3-100:1, group T4-110:1, group T5-120:1. We studied the optimum soil fertilizer ratio in different seeding methods and the changes of physiological indexes of rice. Different seeding methods and soil fertilizer ratio has different effects on rice pelleting, for it, drilling was compared with hill-drop, drilling was more suitable for rice seed planting, Chlorophyll and nitrogen, phosphorus and potassium content, and some physiological indexes of rice leaves were so higher, and the pelletized seeds' physiological indexes were higher than upelletized seeds', rice grew and developed differently under different soil fertilizer ratio. For rice variety Longyou 619, the most suitable seeding method was drill sowing, the best ratio of soil to fertilizer was group T3 which was equal to 100:1, Chlorophyll content in the whole group was high, nitrogen, phosphorus and potassium content in leaves was also high, the dry matter accumulation in the growth period was higher than the other two planting methods, it is more suitable for the Longyou 619 planting.

1. Introduction

In recent years, with the quickening of urbanization, what followed was a large number of main rural labor force was flowing out, leaving the elderly and children who can barely work, that leads to lower and lower field crops and grain intakes. So increasing grain intakes was the top priority at present. The seed pelleting technique was an agricultural high tech adapted to the requirements of fine seeding, which developed on the basis of seed film coating technology, it was a process technology by which seeds of certain crops were transformed from irregular, minute to uniform, regularly shaped spheres for precision seeding by hand and mechanization [1]. At present, almost all beet seeds and some vegetable seeds in Europe and parts of Asia were pelletized before sale; Beet seeds from the United



States and Western Europe had been pelleting; Most flower seeds in developed countries had also been pelletized [2-4]. The seeds were coated with seed coating agent, can improve the disease resistance and crop yield. It is an important measure of fine variety with fine cultivating method and the specific realization of seed pelleting [5]. Pelleting was mainly applied to small (usually refers to the 1000-grain weight was less than 10g) and irregular seeds, and according to different application purposes, it formed different types of pellets. Rice seeds were suitable for pelleting, it can be improved the resistance to adverse environment by pelleting [6]. Seed pelleting was an economical and effective seed treatment method developed on the basis of previous treatment techniques. The seed pelleting technology of rapeseed, forage grass and tobacco seeds had been studied in China, and great progress had been made [7-9]. In recent years, the accumulation and distribution of dry matter in wheat, maize, rice and rapeseed were studied from different angles [10-15].

This study selected conventional Japonica rice varieties (Longyou 619), starting with Chlorophyll content in leaves, Nitrogen, phosphorus and potassium content, dry matter accumulation and relative conductivity and other physiological and biochemical indexes, exploring its response to different pelletized wrapping materials with different proportions. To understand the best pelletized wrapping material of a variety of different proportions, and reveal its effect on physiological and biochemical indexes of rice, it provided an effective theoretical basis for exploring the best pelletized wrapping materials with different proportions among different varieties and further studies.

2. Material and method

2.1. Experimental material

The rice variety selected is Longyou 619 (high quality and aromatic rice, high yield, wide adaptability), was provided by Tianjin Tianlong Agricultural Science and Technology Co., Ltd. Ordinary soil and high clay for pelletizing were provided by Xusanyin concave soil technology co., LTD. Ordinary soil was also called concave soil, attapulgit was earthy, the was gray-white. The soil property was exquisite, strong water absorption, it is viscosity and plasticity when wet, there was no big cracks after drying, fertilizer that dispersed after the water had downed was a seedbed conditioner which was provided by Tianjin Tianlong Agricultural Science and Technology Co., Ltd. Its Nitrogen, phosphorous, potassium, zinc, sulfur, iron and so on were up to the national standard. After mixing the high clay and fertilizer for coating proportionally, the rice seeds were grouped and pelletized, the wrapping material could fill the rough seed surface after pelletizing, and then formed a smooth, uniform seed.

2.2. Experimental design

This test's seeds were cultivated in Shenyang Institute of Technology field practice base. Random grouping was used in the experimental field (the area is $34.2\text{m} \times 28.8\text{m} = 984.96\text{m}^2$), there were there sowing methods means namely drill seeding, four grain of dibbling, seven grain of dibbling. Four grain of dibbling was to put four seeds in each hole, seven grain of dibbling was to put seven seeds in each hole. Repeating three times for each seeding method and each soil fertilizer ratio was also repeated three times. Each seeding method was divided into six treatments, according to the proportion of soil fertilizer divided into the control groups (ck: only soil, no fertilizer), group T1-80: 1, group T2-90:1, group T3-100:1, group T4-110:1, group T5-120 :1.

2.3. Indexes and method

Chlorophyll content was measured by Chlorophyll meter.

Contents of nitrogen, phosphorus and potassium in leaves were measured by heating digestion method [16].

2.4. Data processing methods

Use Excel 2010 and SPSS18.0 for statistical analysis and tabulation, and analysis.

3. Results and analysis

3.1. Changes of chlorophyll content in rice treated by seed pelleting

As you can see from Table 1, the overall change trend of the three periods was roughly the same under the different seeding methods and soil fertilizer proportion. Changes of chlorophyll content in rice varieties with different seeding methods both showed tillering stage to booting stage ascending, booting stage to mature period decreasing trend. Tillering stage to booting stage can be seen at this growth stage, the biggest rise was in drill, it was significantly higher than four grain of dibbling and seven grain of dibbling at booting stage. The chlorophyll content of seven grain of dibbling was higher in booting stage, compared with the drill seeding and seven grain of dibbling, the rise of four grain of dibbling was small, Chlorophyll value was also lower at booting stage. The growth stage was from booting stage to maturity stage, Chlorophyll synthesis was blocked by ripening rice, as a result, chlorophyll content decreased. The three seeding methods showed similar declines, among them the amplitude was larger drill sow.

Different soil fertilizer ratio also showed the trend of increasing first and then decreasing in different growth periods. The chlorophyll value of the group T3 was higher in the three growth stages, especially drilling, obviously higher than four grain of dibbling and seven grain of dibbling. Compared the other groups with the control group, there was no significant difference in chlorophyll content.

Table 1. Chlorophyll content in rice leaves at different growth stages under different sowing methods

	Tillerling stage			Booting stage			Maturation stage		
	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing
C	33.3	33.2	32.4	42.3	38.7	40.2	34.2	35.2	38.0
K									
T									
1	33.9	30.5	32.9	43.9	41.1	42.1	37.0	37.1	39.2
T									
2	33.1	29.1	30.5	39.8	36.5	37.2	33.2	33.9	33.4
T									
3	35.7	33.5	35.1	45.5	42.5	43.4	32.5	35.4	32.9
T									
4	32.6	30.5	31.5	41.6	39.2	40.2	34.7	35.8	34.5
T									
5	33.0	30.1	31.1	41.5	38.4	39.7	33.2	35.4	33.9

3.2. Nitrogen content in rice leaves treated by seed pelleting

Table 2 showed the changes of nitrogen content in leaves measured by different soil-fertilizer ratios in different seeding methods at different growth stages of rice. As can be seen from table 2, the three different sowing methods showed the same trend in the three growth stages of rice. It showed that the tillering stage to heading stage was increasing basically, it decreased from heading stage to maturity stage. It's just a slight difference, but it's not significant. Among them, seven grain dibbling was relative to other two sowing methods, the overall trend is lower. Rice varieties with different soil-fertilizer ratios also showed a trend of increasing first and then decreasing. Among them, the group T3 had higher nitrogen content at all growth stages. Compare the three sowing methods, the highest nitrogen content was drill seeding, four grain of dibbling followed, seven grain of dibbling was the lowest. There was no difference in nitrogen content between the other groups and the control group, four grain of dibbling was centered, seven grain of dibbling was the lowest.

Table 2. Nitrogen content (g/kg) in different seeding methods at different growth stages of rice

	Tillerling stage			Booting stage			Maturation stage		
	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing
C	21.4	19.4	20.2	14.3	13.2	13.1	18.1	17.6	17.9
K									
T	20.1	18.2	19.0	12.9	12.9	13.2	18.4	16.2	15.5
1									
T	21.1	19.2	19.9	13.3	12.0	12.6	18.4	16.6	17.1
2									
T	22.9	20.1	21.2	14.2	12.4	13.1	20.8	18.1	19.6
3									
T	19.3	18.1	18.6	13.6	12.2	12.1	17.3	15.4	16.2
4									
T	20.3	18.1	20.1	12.3	11.1	12.2	18.5	15.6	17.2
5									

3.3. Phosphorus content in rice leaves treated by seed pelleting

The changes of phosphorus content measured by different seeding methods and different soil-fertilizer ratios at different growth stages of rice were shown in table 3. As can be seen from table 3, the changes of phosphorus content in different seeding methods were basically consistent, the tillering stage to heading stage, heading stage to maturity stage, both showed a tendency of rapid growth, slow growth. The change trend of nitrogen content in early growth stage was similar to that in early growth stage. Among them, the sowing method with the highest phosphorus content is drill sowing, four grain of dibbling was similar to seven grain of dibbling, and there was no obvious difference. By comparing the three growth stages, the group with the highest phosphorus content was the group T3. There was no significant difference between the other groups and the control group.

Table 3. Phosphorus content (g/kg) in different seeding methods at different growth stages of rice

	Tillerling stage			Booting stage			Maturation stage		
	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing
C	1.05	0.89	0.89	1.28	1.23	1.21	1.11	1.28	1.04
K									
T	1.09	0.92	0.93	1.26	1.19	1.17	1.14	1.16	1.12
1									
T	1.05	0.92	0.95	1.23	1.19	1.13	1.14	1.17	1.17
2									
T	1.16	1.06	1.07	1.23	1.19	1.14	1.18	1.18	1.19
3									
T	1.13	1.03	1.04	1.16	1.15	1.17	1.19	1.13	1.16
4									
T	1.01	0.84	0.85	1.09	1.03	1.06	1.05	1.01	1.00
5									

3.4. Potassium content in rice leaves treated with seed pelleting

The changes of potassium content measured by different seeding methods and soil-fertilizer ratio at different growth stages of rice were shown in table 4. As can be seen from the figure above, potassium content in rice leaves with different soil-fertilizer ratio decreased from secretion stage to heading stage, there was a slight upward trend from heading stage to maturity stage. It was the opposite of nitrogen.

The group with the highest potassium content was the group T3. Among them, the best sowing method is drill sowing, seven grain of dibbling was centered, four grain of dibbling was the lowest. The other groups were compared with the control group, the potassium content of drill seeding was similar to that of seven grain of dibbling. The potassium content of four grain of dibbling was lower.

Table 4. Potassium content (g/kg) in different seeding methods at different growth stages of rice

	Tillerling stage			Booting stage			Maturation stage		
	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing	Strip sowing	Hole 4 sowing	Hole 7 sowing
C	7.51	7.33	7.45	4.62	4.74	4.63	4.84	4.75	4.90
K									
T	7.25	6.86	7.13	3.96	4.77	4.05	4.18	4.92	4.28
1									
T	7.26	7.22	6.92	4.65	4.79	4.20	4.83	4.85	4.39
2									
T	7.93	7.35	7.37	4.58	4.93	4.35	4.98	4.95	4.53
3									
T	7.43	6.97	7.14	4.03	4.06	4.18	4.25	4.27	4.51
4									
T	7.29	6.89	6.98	4.14	4.23	4.28	4.27	4.40	4.37
5									

4. Discussion

4.1. Effect of chlorophyll content on pelleting of rice

Chlorophyll content in each leaf increased with leaf growth in the early stage of life, chlorophyll synthesis was blocked in late growth stage because of ear ripening, Causing the chlorophyll content to drop, presenting the change of unimodal curve. About the growth period when the photosynthetic rate of rice varieties is the highest, some reports were tillering stage, some reports were heading stage [17]. The experimental results of different sowing methods and different soil fertilizer ratios show that the maximum photosynthetic rate of rice varieties in the experiment was the heading stage when the chlorophyll content was the highest. One of the reasons may be that the photosynthetic feedback inhibition is caused by the uncoordinated relationship between photosynthetic products and their source, library and stream [18]. In the three growth stages selected in the experiment, the chlorophyll content of the pelletized rice seeds was basically higher than that of the control group without pelletized rice seeds. Actually, you can see from the picture, the group with the highest chlorophyll content was the group T3, that is, the soil-fertilizer ratio was 100:1. The chlorophyll content in the other groups was not significantly different from that in the control group. The chlorophyll content of drill seeding was higher than that of other two seeding methods. The results showed that the drill seeding method was suitable for seed pelleting cultivation.

4.2. Effect of nitrogen, phosphorus and potassium in leaves on pelleting of rice

Nitrogen is the main component of protein, which played an important role in the growth of stem and leaf and the development of fruit. The nitrogen content of leaves was different at different growth stages, the roots grow quickly when the supply was adequate, but excess inhibits root growth. The higher the nitrogen content in the plant, the faster the leaf area increased. The rice root system grow well and the metabolism was vigorous when the phosphorus was in abundant supply. Potassium exists almost entirely as an ion in plants, it could help nitrogen metabolism and protein synthesis. Proper nitrogen can increase photosynthesis and carbohydrate content so as to enhance plant resistance to disease and lodging.

The results show that the changes of nitrogen and phosphorus in the early growth stage were the same in the three breeding periods selected. They were both showed an upward trend, nitrogen rose slowly while phosphorus rose rapidly and greatly, it has the opposite tendency to potassium. In the later growth stage, the content of nitrogen showed a decreasing trend, and the changes of phosphorus and potassium showed a similar increasing trend. This change should be related to the life activities of rice. It can be seen from the three sets of pictures, among the three seeding methods, the nitrogen, phosphorus and potassium content of the drill seeding was higher than that of the other two seeding methods. The best soil fertilizer ratio was 100 to 1 for the group T3, the content of nitrogen, phosphorus and potassium in leaves was the highest.

5. Conclusion

Pelleting of rice had great influence on the growth and development of rice. The physiological indexes of pelletized rice seeds were higher than those of unpelletized rice seeds. Pelletized seeds were more nutritious at seedling stage. The pelletized seeds had more adequate nutrition at seedling stage and did not affect the biological characteristics of the seeds. For Longyou 619, the most suitable sowing method was drill sowing, the most suitable soil-fertilizer ratio was the group T3, i.e. 100:1 group. Its physiological indexes were higher than those of the other two sowing methods and soil fertilizer ratio. This also provides theoretical basis for the popularization of rice pelletization, the high and stable yield of rice and the optimal soil and fertilizer ratio of pelletization.

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