A Preliminary Study of the Key Technologies in Rice Seed Production

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Abstract To study the production technology of rice seeds, with Lianjing 7 as test material, this paper explores the effects of the key rice seed production, processing and storage technologies (such as nitrogen fertilizer application and management, weeding mode in seed breeding field, temperature control of mechanical drying and water control on seed storage) on the quality of rice seeds. The results show that the optimal application proportion of tillering stage dressing and earing fertilizer is 8∶2, followed by 7∶3; the best time of weeding is booting stage, with the highest purity; the effect of drying and germination rate is best when the temperature is controlled at 44℃ in mechanical drying process; the seed storage quality and storage costs can be guaranteed when the water content of rice seed is controlled at 18%.

Key words Rice seed, Nitrogen fertilizer application and management, Weeding period, Mechanical drying, Water content

1 Introduction

Rice (*Oryza sativa* L.) is the most important crop in China, and its seed quality is particularly important. With the adjustment of agricultural structure, rural land transfer and seed drying area reduction as well as changes in seed drying way and planting methods, the seed production is facing new issues. Especially for the direct sowing rice, the storage time is prolonged after the farmers purchase seed, posing a higher demand on seed quality. Seed quality control is a systematic project consisting of cultivation technology, packaging and storage technology and storage technology, and the mistake in any part will make it difficult to ensure the seed quality[1-2]. The promotion of new transplanting technology and direct seeding technology brings new problems for the seed quality study[3]. In this study, from application methods of nitrogen fertilizer, weeding period control, mechanical drying and water content control, we make a preliminary study on the key technologies in rice seed production, in order to provide theoretical guidance for the seed companies to improve rice seed breeding techniques and seed quality.

2 Materials and methods

2.1 Materials The rice variety for experiment is Lianjing 7, provided by Jiangsu Jinwanhe Agricultural Science and Technology Co., Ltd.

2.2 Nitrogen fertilizer application and management The original seed of Lianjing 7 is used for transplanting rice seedling by hand; the best sowing period is May 12; the transplanting period is June 20. The plot area is 2.4 × 6.5 m^2, and the spacing in the rows and between rows is 13 cm × 25 cm. The randomized block design is used and repeated three times, and the base fertilizers P_2O_5 and K_2O are applied before sowing (9 kg/667 m^2). The application rate of conventional pure nitrogen is 22 kg/667 m^2, and the ratio of nitrogen fertilizer to tillering stage dressing and earing fertilizer is 1∶1. 5 treatments are set for the application proportion of tillering stage dressing and earing fertilizer: 5∶5, 6∶4, 7∶3, 8∶2 and 9∶1 (labeled as A_1, A_2, A_3, A_4, A_5). The tillering stage dressing is applied once; earing fertilizer is divided into spikelet promotion fertilizer and spikelet protection fertilizer, with the application ratio of 3∶1. In the rice maturity period, the actual yield per unit area, thousand-grain weight, blue-and-white grain rate and germination rate under each treatment is measured.

2.3 Seed field weeding Improved variety of Lianjing 7 is used for transplanting rice seedlings, and three ways are used to weed (weeding at the jointing; weeding at the heading stage; weeding at the maturity stage). Each weeding way sets three replicates, and each replicate is 667 m^2. The randomized block design is adopted, and the hybrid strain number and types are computed during weeding. The plot yield is measured at maturity.

2.4 Drying test The newly harvested seed (Lianjing 7) is dried by mechanical drying, and the temperature of drying machine is set at 42℃, 43℃, 44℃, 45℃, 46℃, 47℃ and 48℃, respectively. 1000 kg of seeds are taken from the same group of newly harvested seeds (water content of 22%), respectively, and dried to water content of 14.5 % according to the set temperature. The drying time of each sample is recorded, and the germination rate of each sample is tested.

2.5 Effect of water content on rice seed storage After 100 kg of newly harvested rice seeds (Lianjing 7) are weeded (October), they are dried at 44℃ to water content of 15%, 16%, 17%, 18%, 19%, 20% , 21% and 22%, respectively, packaged with plastic woven bag and placed in the warehouse. In each treatment, it is covered with film, and stored at room temperature. In April of the following year, the germination rate is examined.

2.6 Data processing The origin 8.6 software is used for statis-

Received: November 15, 2015 Accepted: December 16, 2015

Supported by Special Project of Scientific and Technological Achievement Conversion in Jiangsu Province (BA2011098).

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tical analysis of experimental results and mapping.

3 Results and analysis

3.1 Effect of different nitrogen fertilizer application methods on yield and quality of rice seeds From Table 1, it can be found that different nitrogen fertilizer application methods have a certain effect on the yield and quality of seeds, and the yield is highest under A_3, followed by A_4 and A_5, and the yield is low under A_1 and A_5. Different application methods have a small effect on kernel weight. The blue-and-white grain rate is highest under A_1, followed by A_2, A_3 and A_5, indicating that the higher the application rate of earing fertilizer, the higher the blue-and-white grain rate. The germination rate is high under A_3, A_4 and A_5, up to national standard; the germination rate under A_1 and A_2 is not up to national standard, but it is still more than 80%. The thousand-grain weight is highest under A_4. It can be found that A_1 and A_2 have low yield, high blue-and-white grain rate and low germination rate (not up to the national standard), so they are not used for seed production; A_5 has high germination rate and low blue-and-white grain rate, but the yield is too low, so it is not suitable for seed production; using the nitrogen fertilizer application methods of A_3 and A_4 can provide ideal seed reproduction, high yield, better commodity features, standard thousand-grain weight, low blue-and-white grain rate and high germination rate.

Table 1 Effect of different nitrogen fertilizer application methods on yield and quality of rice seeds

Application of tillering stage dressing and earing fertilizer		Thousand-grain weight//g	Yield kg	Blue-and-white grain rate//%	Germination rate//%
Mark	Proportion				
A_1	5:5	26.09 c	16.97 c	8.41 a	81.2 d
A_2	6:4	26.15 c	17.22 bc	5.28 b	84.4 c
A_3	7:3	26.38 ab	18.95 a	3.82 c	88.3 b
A_4	8:2	26.43 a	18.63 a	3.56 c	89.1 b
A_5	9:1	26.32 b	17.53 b	3.45 c	91.9 a

Note: Different lowercase letters represent the significant difference at the level of $P<0.05$.

3.2 Effect of weeding period on rice seed purity and weed type As can be seen from Table 3, at the booting stage, the variants, autogeny rice and other weed types are removed most; at the tillering stage, various types of weeds are removed least; various types of weeds removed at the milk stage are more than at the tillering stage but less than at the booting stage; after removing weed, the rice seed purity at the booting stage is significantly higher than at the other two weeding stages ($P<0.05$). It suggests that the weeding effect is best at the booting stage, and the weeding effect of variants, autogeny rice and weeds is best, and the purity after weeding is highest; it is followed by the weeding effect at the milk stage, and there is a certain effect on variants and autogeny rice; the weeding effect at the tillering stage is poor, the weeding effect of autogeny rice is good, but the weeding effect of variants and other weeds is poor.

Table 2 Effect of weeding period on rice seed purity and weed type

Weeding period	Variants %	Autogeny rice//%	Other weed types//%	Purity %
Tillering stage	0.04 c	0.14 b	0.03 b	99.15 c
Booting stage	0.25 a	0.22 a	0.06 a	99.43 a
Milk stage	0.19 b	0.17 b	0.05 ab	99.28 b

Note: Different lowercase letters represent the significant difference at the level of $P<0.05$.

3.3 Effect of drying on the germination rate of rice seed As shown in Fig. 1 (a), when the temperature is set at 42℃, the germination rate is highest after drying, but the drying time required is longest; when the temperature is set at 44℃, the germination rate after drying is not significantly different from the germination rate when the temperature is set at 42℃ and 43℃ ($P<0.05$), but significantly higher than the germination rate when the temperature is higher than 44℃, and the time required for drying is relatively short. Therefore, the best mechanical drying temperature is 44℃.

3.4 Effect of water content on the germination rate of rice seed As shown in Fig. 1 (b), when the water content is 19%, the germination rate is 86%, just one percentage point higher than the national minimum standard; when the water content is 18% and 17%, the germination rate is 92% and 93%, respectively, and there is no significant difference between the two; when the water content is 16% and 15%, the germination rate is 95% and 96%, respectively, and there is no significant difference between the two. Taking into account other risk factors and cost factors, the appropriate water content is 18%.

4 Conclusions and discussions

The nitrogen fertilizer application and management can have a great impact on rice growth and yield, and plays an important role in controlling the blue-and-white grain rate of rice seed[3]; the weeding effect is different at different weeding stages[4]; the setting of mechanical drying temperature not only affects the drying efficiency, but also affects the seed germination rate[5]; water content is a major factor affecting the seed storage quality[6-7]. With Lianjing 7 as test material, this paper explores the effects of the key rice seed production, processing and storage technologies (such as nitrogen fertilizer application and management, weeding mode in seed breeding field, temperature control of mechanical drying and water control on seed storage) on the quality of rice seeds. The results show that the optimal application proportion of tillering stage dressing and earing fertilizer is 8:2, followed by 7:3; the best time of weeding is booting stage, with the highest purity; the effect of drying and germination rate is best when the temperature is controlled at 44℃ in mechanical drying process;

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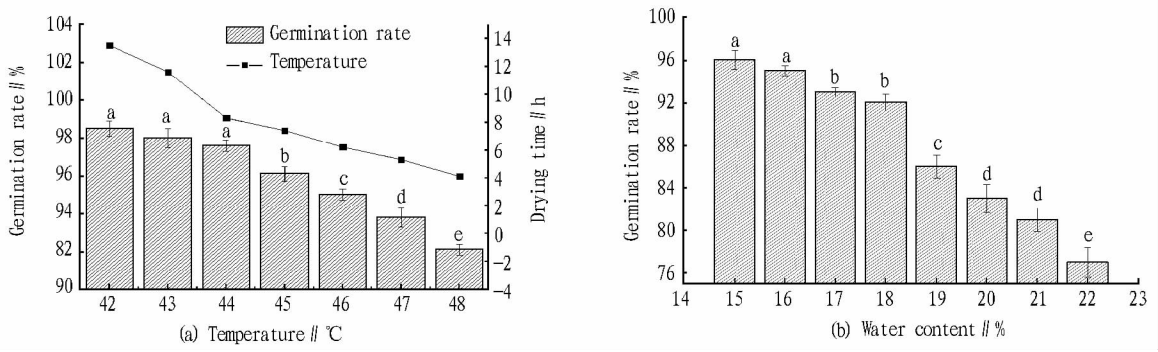

Fig. 1 Effect of drying and water content on the germination rate of rice seed

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5.2 Establishing the feedback-control mechanism about the policy The feedback-control mechanism about the college-graduate village official policy is in charge of delivering the evaluating outcome of the policy and other relevant information to the policy makers through the specific ways so that the policy makers are able to readjust the policy content on the basis of analyzing the feedback information. In the process of consummating the policy, the policy makers should focus on the authenticity and comprehensiveness of the feedback information so that the information is capable of truly reflecting the implementing results and the real effects of the policy from multi-dimensions, and then decide which part of the policy content to be innovated and retained. In addition, the policy makers should focus on the supervision aimed at the policy evaluation so that the transparency and fairness of the policy evaluation's procedure can be ensured and the policy's evaluating outcome is capable of reflecting the real situation, and these efforts will create the beneficial premise for the adjustment and innovation of the policy content.

6 Conclusions

The article attempts to provide a basic analyzing framework for the analysis of college-graduate village official policy, and the target group and the objectives are mentioned in this framework. At the same time, the recruitment of these village officials, the stipulations about their obligation, training and living support are brought into the framework as well. Of course, the analysis of college-graduate village official policy is not restricted to the factors above. Other factors related to the growth of these village officials are also supposed to be taken into account when the analysts start to analyze this policy.

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