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Study on the Effect of Different Light Quality and Illumination on the Quality of Rice Seedlings in Greenhouse

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ABSTRACT: *Taking three-dimensional seedling raising as the breakthrough point, based on a brief introduction of rice planting situation, this paper studies seedling quality and related indicators from light quality and illuminance, including seedling layer spacing, illuminance, etc., hoping to help others, so as to provide theoretical data for future work.*

KEY WORDS: *light quality; Illuminance; Three-dimensional seedling raising; Rice seedling quality*

Introduction

As we all know, rice is a typical light-loving crop, and the key to make it have ideal yield is to adjust the light quality and illuminance.The research shows that dust, covering materials and structure shading are the main reasons why the greenhouse cannot have good illumination. Only by artificially supplementing light to create a good growth environment for rice seedlings can they have both ideal quality and considerable economic benefits. The social value of this research topic is obvious to all.

1 Research Background

The rice planting area in China has reached more than 30 million hm^2, which is about 1/3 of the total grain planting area and 1/5 of the total rice planting area in the world.The research shows that the decisive factor for rice yield is seedling quality, and only by mastering scientific and effective seedling raising methods can high yield be achieved.In recent years, rice transplanting by machine has been regarded as a key popularization technology in southern China. On this basis, the exploration work of factory seedling raising mode has been put on the agenda, aiming at solving the problem of occupying a large amount of space for flat-bed seedling raising, and with the land saving, the waste of resources will be alleviated [1]. In addition, that positive influence brought by this include helping to achieve the goal of commercialized seedling supply and standardized seedling raising, so that food production has the possibility of sustainable development.

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2 Test and Conclusion

2.1 Test flow

2.1.1 Determining the materials

The temperature in the greenhouse is 18℃ at night, 29℃ at day and 70% relative humidity. The material selected by relevant personnel is Huahang No.31 cultivated by a university, which uses LED light source with controllable light quality and illuminance. The wavelength of blue light is about 454nm, the wavelength of red light is about 622nm, and the range of illuminance adjustment is 30lx to 300lx. Professional personnel shall install and fix the fill light on each floor of the three-dimensional seedling rack. In this experiment, a plurality of seedling racks were used, and the interval between any two seedling racks was 60cm, so as to ensure that relevant people could pass smoothly. The seedling rack was divided into a plurality of seedling layers, and the distance between seedling layers was not adjustable.There are three factors to be considered when choosing the spacing between seedling layers, namely, the height of seedling tray of 3.5cm, the height of seedling of about 18cm, and the space of about 10cm for installing fill lamp. According to the calculation, the maximum value of the above factors is 31.5cm. Therefore, the minimum level is fixed at about 35cm in this experiment. This is because the radiation range is too large, which not only wastes a lot of light energy, but also reduces the seedling layer, which runs counter to the original intention of three-dimensional seedling raising. Based on this, the relevant personnel comprehensively consider various factors and determine the seedling layer spacing as 35cm, 45cm and 55cm.When the above links come to an end, the seedling raising frame can be arranged around the three-dimensional seedling raising frame according to the requirements of seedling raising, and the seedling raising frame can be shielded by a partition with a certain height to ensure that the seedling raising has the same position and light environment before and after the light supplement. In addition, the processing light source used in the experiment only irradiates the lower seedling tray, and there is no possibility of mutual interference.

2.1.2 Test method

On the basis of the above mentioned contents, the researchers selected the research factors as the ratio of blue light to red light, the distance between seedling layers and the illuminance, among which the ratio of blue light to red light was 1:6, 1: 8 and 1:10 respectively, the distance between seedling layers was 35cm, 45cm and 55cm, and the illuminance was also divided into three groups, namely 500lx, 1500lx and 2500lx. After the seed selection is completed, the rice seeds are sterilized by professionals using a germination machine. In a constant humidity and constant temperature environment, the germination, air drying and sowing work are carried out step by step, and the sowing amount of each plate is controlled at about 120g. With hymexazol, the bed soil was completely disinfected and sterilized. Then, the

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seedling trays were moved to the three-dimensional seedling rack, and cultivated in two groups, including three trays in the experimental group, three trays in the natural light control group and two trays in the non-lighting control group under the same conditions.

3.1.3 Data processing

The leaf age, root length, seedling height, strong seedling index and stem base diameter can only be measured when the seedlings are cultivated to the transplanting stage under the premise of different ratio of blue light to macro, different spacing between seedling layers and different illuminance.Using the weight scale, steel rule and vernier caliper, complete the measurement of each index. In addition, the relevant personnel should also use the illuminance recorder to calibrate the illuminance corresponding to the fill light in detail for reference in subsequent links.

2.2 Test results

2.2.1 Analysis of variance

In order to judge the influence of each factor level on the test results, the relevant personnel analyzed the leaf age, root length, seedling height, strong seedling index and stem base diameter of the treated seedlings in transplanting period based on variance method, and reached the following conclusions:

First, under the premise of different ratio of blue light to red light, there are significant differences in root length, seedling height and stem base diameter, while the difference of strong seedling index is more significant than the above indicators. When the ratio of blue light to red light is 1:8, the maximum root length can reach about 7cm, and the maximum diameter of stem base can also reach about 1 mm. Leaves are thick and green, and the seedlings are straight and strong, with a large number of roots.

Secondly, under the condition of different seedling layer spacing, the root length and strong seedling index show significant differences, while other indexes represented by seedling height and stem base diameter are generally less affected.With the increasing of the inter-layer spacing of the seedling racks, the above-mentioned seedling indexes all show a trend of increasing first and then decreasing. When the inter-layer spacing reaches 45cm, all the indexes are in an ideal state. Based on this, after considering the cost, the number of layers of the seedling racks and other factors, the relevant personnel decided to fix the inter-layer spacing at 45cm.

Thirdly, under the condition of different illumination, the root length, seedling height and strong seedling index can often achieve significant differences, while the leaf age and stem base diameter have no obvious changes. If people concerned continue to increase the light intensity, not only the number of roots will increase,

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but also the root length will become longer, which has a positive effect on the root soil of seedlings.Compared with other illuminations, the illumination intensity of 2500lx is more suitable for the increase of root number and root length. In addition, seedlings will show more ideal carpet forming characteristics.Once there is insufficient illumination or similar conditions, there will be problems such as leaf tip rolling, short roots and thin stems of seedlings, which will usually negatively affect carpet forming.

2.2.2 Range analysis

The representative strong seedling index and root length were selected as evaluation indexes. Through range analysis, the following conclusions were obtained: Among the indexes affecting seedling quality, the ratio of blue light to red light was the most prominent one, followed by illumination, and finally, the distance between seedling layers, and the influences of illumination and distance between seedling layers were very close. In addition, whether the ratio of blue light to red light or the distance between seedling layers increases continuously, the strong seedling index and root length of seedlings will increase first and then decrease.The research shows that in order to make the strong seedling index show the above trend and the root length increase continuously, the relevant personnel should increase the illumination. After the illumination reaches 2500lx, both the strong seedling index and the root length will reach an ideal level.To sum up, in order to give full play to the advantages of three-dimensional seedling raising, relevant personnel should control the ratio of blue light to red light at 1:8, the distance between seedling layers is about 45cm, and the illuminance reaches 2500lx.

2.2.3 Impact analysis

First of all, the experiment proves that the rice seedlings can grow faster by properly supplementing and regulating the light. No matter the appearance growth or other indicators, the seedlings that did not receive supplementary light could not reach the red and blue combined light. If natural light was used as the control group, the red and blue combined light studied in this paper had a positive effect similar to that of natural light, which could make the roots of seedlings show a more ideal growth speed.Among the red and blue combined lights, the experimental group with the ratio of blue light to red light of 1:8 has the closest performance to the control group in terms of strong seedling index, seedling root length and stem base diameter, while the experimental group with the ratio of 1:10 is usually closer to natural light in terms of leaf age, seedling height and number of treated roots.However, it should be made clear that the ratio of blue light to red light applied by different plants often has significant differences. Only by adjusting the ratio of blue light to red light based on actual demand can plants have a good growth environment [3].

Secondly, the influence of inter-layer spacing on seedling growth is usually similar to that of illumination, that is, the relationship between inter-layer spacing and illumination is negatively correlated on the premise that the requirements of

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inter-layer spacing for seedling growth are met. On the premise that the distance between seedling layers keeps increasing, the unit area of seedling trays in each layer can only receive smaller luminous flux. If the distance between seedling layers is small and the distance between seedling layers is too close, it will easily lead to the continuous reduction of irradiation area, resulting in high heat and uneven irradiation, which will slow down the growth of seedlings.

Finally, there is a close relationship between seedling growth and light intensity.The experimental results show that when the net supplementary light has an illuminance of 2500lx, the corresponding ambient light illuminance of each layer of the seedling frame is in the range of 3000lx to 3750lx under the condition of shading.Comparing different seedlings, it can be seen that the illumination of 2500lx is more suitable for the growth of seedlings, and its morphological indexes are usually more ideal than other treatments, namely, seedlings are thick green, with longer roots and more roots.To sum up, the illumination of 2500lx can meet the demand of net supplementary light for three-dimensional seedling raising.

Conclusion

By analyzing the above contents, it can be seen that although the ratio of blue light to red light, the distance between seedling layers and the illuminance will all influence the quality of seedlings, there are obvious differences among them. Among them, the ratio of blue light to red light should be paid more attention, and the distance between seedling layers has less influence. If the conditions permit, the relevant personnel should strictly control the above indicators.

References

[1]Chen Guisheng, Li Zehua, Sun Guodong, et al. Experimental study on seedling quality of hybrid rice under the condition of three-dimensional seedling raising in greenhouse [J]. Research on Agricultural Mechanization, 2018,40(06):189-193.

[2]Wu Kening, Liu Haoran, Li Chenxi, et al. Revision of light and temperature productivity potential index of rice based on greenhouse seedling raising —— A case study of Fujin City, Heilongjiang Province [J]. Crop Journal, 2017(03):138-145.

[3]Lin Chao-hui, Chen Gui-sheng, Tan Yong-kan, et al. Experimental study on night light supplement technology of rice greenhouse three-dimensional seedling raising [J]. Agricultural Mechanization Research, 2016,38(05):208-212.