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Research Article

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Utility Research on LED Light Source in the Flue Cured Tobacco Seeding

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ABSTRACT

as an important ecological factor, the illumination plays an important role in the quality of the flue cured tobacco seeding; in the experiment, LED light source is used to conduct the short- distance irradiation and conducted the irradiation on the tobacco seeding point by point with different wavelengths at different positions and spaces, for the flue-cured tobacco seedling with intensive cultivation at low position, it is needed to fill the light, and to adjust the light environment for the growth of flue-cured tobacco seedlings in the process of greenhouse seedling. The research on the photosynthetic productivity, photosynthetic characteristics of tobacco seedlings and the measures to fill light in different light environments has an impact on the quality of the flue-cured tobacco floating seedling sprout and the growth of tobacco seedling.

Key words: Tobacco seedling; LED; light environment; fill-in light

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INTRODUCTION

Cultivation of strong tobacco seedling is the basis of the tobacco with high quality, and is also one of the key technical measures of tobacco production. Flue-cured tobacco is a very bright light plant, only the enough light conditions can be good for photosynthesis, improve quality and production. The stage of flue-cured tobacco seedling lasts for 65 days or so, light as an important ecological factor, the illumination plays an important role in the quality of flue-cured tobacco seedling, when the illumination is insufficient, the photosynthesis of tobacco suffocates, the growth is slow, mechanical tissue is in poor development, and the plant is delicate, delaying in seedling stage; the accumulation of dry matter decreases, thus affecting seedling quality and slow seedlings process after its transplanting [1]. Taking someplace in Huizhou Province of China as an example, through the way of artificial LED light source to fill light so as to regulate the light environment of flue-cured tobacco seedlings growth in the process of greenhouse seedling, the author in this paper studied the impact of LED fill-in light measures on the quality of the flue-cured tobacco floating seedling sprout and tobacco seedling growth, which further improved the seedling management measures, provided theoretical basis and practical experience, so as to provide the appropriate light environment for flue-cured tobacco seedlings.

LIGHT ENVIRONMENT OF TOBACCO SEEDLINGS IN THE PROCESS OF GROWTH

Light environment is the most important factor affecting plant photosynthesis. It not only provides the radiant energy for plant photosynthesis, but also provides the signal transduction regulation to the development process. Plant is always in a constantly changing light environment throughout its life cycle. Light environment is divided into three parts: the light intensity, the spectral distribution and the optical cycle [2]. What kind of light environment is needed in the process of the flue-cured tobacco seedlings in the different stages of development is the main technical difficulty to be solved.

Tobacco seedlings often undergo complex and changing light environment in the growth process, light intensity saturation point needed in the stage of the flue-cured tobacco seedling is 10000 lx - 20000 lx. This directly affects the photosynthesis, physiological metabolism and growth of tobacco seedlings. Because it belongs to the subtropical humid monsoon climate zone, the monsoon effect is especially notable. In winter and spring of tobacco seedling, it

is often affected by cold wave or cold air from the northern hemisphere, the clouds are thick and low, dominated by the rainy weather. For the recent 30 years, for example, the average sunshine hour of the central downtown of the region is 29.4 h, in February, 55.1 h in March and 90.0 h in April, belonging to the region with poor sunshine in China [3]. Flue-cured tobacco uses insulation greenhouses in the process of intensive seedling, and is covered by plastic film, or even uses insect nets to control pests, which greatly weakens the illumination intensity of seedling in the greenhouse. In the sunny days, the cutting light rate of greenhouse plastic film is 35.4%; the cutting light rate is 30.7% in the cloudy days. And with the service time prolonging and the accumulation of dust and debris on the film, the cutting light level will increase, seriously affecting photosynthesis intensity, botanical characters, chlorophyll content, matter accumulation, moisture content, stress resistance and chemical composition of the flue-cured tobacco seedlings in the greenhouse, thereby affecting the physiological metabolism, growth development and quality of seedlings of tobacco seedlings. There exists insufficient illumination in the process of intensive greenhouse seedling.

EXPERIMENT DESIGN

In the winter and spring during which the flue cured tobacco floating seedling is conducted, the fill-in light research on tobacco seedlings with LED light source for the tobacco is conducted. 2 flue-cured tobacco floating seedling greenhouses are rented, 7 sets of contrasting samples were set up in each greenhouse, there is 1 nursery seedling plate in each sample, and the variety of flue cured tobacco used in the experiment is NC82 suitable for planting in the north of Guizhou. The nursery seedling plate of the contrast samples is the same as those of others in the greenhouse, the flue-cured tobacco seeds planted of the same variety sprout, grow, are mature. During the experiment, the tobacco seedlings of the contrast samples are the same as those of other tobacco seedlings in the greenhouse, which are the same in the nursery substrate, nutrient solution and all kinds of nutrient components. The temperature, humidity, natural light, moisture, seedling spacing and ventilation and other environmental conditions of the seed germination and seedling growth are controlled to the same level by human beings, to make every seed and every tobacco plant get the nutrients as much as possible and the environment is the same [4].

Appropriate measures are taken to control the LED light source illumination, spectral distribution (light quality) and light cycle. The growth condition of flue-cured tobacco seedling plants in different LED light source fill-in lighting state and in natural light condition is measured to conduct the comparison experiment. The main experiment projects are as follows: the determination of flue-cured tobacco seedlings leaves absorption spectrum; determination the effects of different LED light source fill-in light on chlorophyll content of flue-cured tobacco seedling leaves; determination of the effects of different LED lights fill-in light on the accumulation of dry matter flue-cured tobacco seedlings. The condition from the maturity to the harvest of the flue-cured tobacco seedlings transplanted to the field is traced, including: recover period, root period, vigorous growing period and mature period. The corresponding database file system is established, a large amount of experimental data are analyzed by using computer. After analyzing the experimental data, the light environment of flue-cured tobacco seedlings in different development stages is obtained.

LED Light Source. With the development of modern agriculture, seedling growth industry has gradually separated from the traditional farming, and formed a new industry. The amount and type of intensive, professional and commercial seedling increased dramatically, the use of the artificial lighting with low energy consumption, high efficiency and appropriate light quality is one of the important direction of closed seedling growth industry. The light principle of LED is to directly convert the electric energy into light by using a solid semiconductor chip as a light-emitting material, which belongs to the cold light source. The inherent characteristics of the LED makes it have the advantages of small volume, low power consumption, long service life, high brightness, low quantity of heat, environmental protection, durability, strong controllability, is the ideal cold light source, so it has a wide range of applications.

The light source of LED can save a lot of energy when it meets the demand of plant photosynthesis. Fujiwara et al studied and found that red LED can easily affect the formation of photomorphogenesis and growth and development of the culture seedlings in the group. Tanaka, et al studied and found that red light LED can promote the growth of the orchid culture seedling leaves, and blue LED can raise the chlorophyll content of orchid growing seedling leaves. Lian et al concluded form the experiment that the red + blue LED composite light is more suitable for the growth of lily bulbs. Feng Pingsheng et al used the combination of red + blue fluorescent lamp to fill the light for the plants in the greenhouse. Although Zhou Yicai, Shen Rongfa, Shenzhen City Baisheng Photoelectric Technology Co., Ltd., Taiwan Branch of Meishangzhi Photoelectric Co., Ltd., Weifang Guangsheng New Energy Co., Ltd., Jingmen Xingkai Photoelectric Technology Co., Ltd., designed the plants lamp light with LED light source, according to the light environment needed in the process of flue-cured tobacco floating seedling in different development stages for the flue-cured tobacco seedlings, there is no LED plant light which can create a light environment conducive to the flue-cured tobacco seedlings growth.

METHODS

Related studies have shown that the wavelength of sunlight to the ground is about 300 ~ 2600 nm, in which, the effective wavelength for the photosynthesis is about 400 ~ 700 nm, wherein, 425 ~ 490 nm blue light and 490 ~ 700 nm red light make the greatest contribution to photosynthesis, and the 520 ~ 610 nm green light is has a lower absorption rate by the plant. It can be seen that not all of the lights can help the photosynthesis of plants. Flue cured tobacco has a wide spectrum range; it has the absorption rate more than 40%from the 380 nm (purple area) ~ 650 nm (red area). In which, the absorption rate at the major peak of 461 nm (blue light) is the largest, up to 89.20%; Followed by a wavelength of 521 ~ 563 nm (green light), with the absorption rate of 75.60% ~ 79.31%; then is the red light with a 656 nm wavelength at the major peak, the average absorption rate is 69.65%; the wavelength is 380 ~ 420 nm (purple area) has the least absorption of 46.32% on average. The intensity of the flue cured tobacco leaves in the light quality is blue light > green light> red light > purple light in turn.

Therefore, the blue light with a light-emitting wavelength about 461 nm and the green light with a light-emitting wavelength of 521 ~ 563 nm and the red LED with a light-emitting wavelength about 610 ~ 700 nm are used in the experiments as fill-in light source. The LED lighting lamps designed for the flue-cured tobacco seedling should satisfy the following main technical indicators, the LED light source: blue LED, green LED, red LED, blue LED+ green LED + red LED, blue LED+ green LED, blue LED+ red LED, green LED + red LED; the luminous efficiency: 30 ~ 50 lm/W; the initial luminous flux of LED: 3000 lm; the efficiency of light source: ≥ 80%; input voltage: 260V ~ AC160; input voltage frequency: 50 ~ 60Hz; light angle: 1600; service life: 30000 ~ 50000 h; the specifications of lamp holder: E27 screw; working temperature: - 20 ~ 60 □. When the tobacco seedlings are in the late part of cross-seedling stage, it is needed to conduct the fill-in light experiment to the rooting period - until the end of the growth time so as to study the impact of LED light source fill-in light on the growth of flue-cured tobacco seedlings. In the whole experiment, the fill-in light experiment is conducted for 6 groups every three days, each experimental group is separated with cloth veil from each other to avoid mutual influence. In order to avoid the illumination impact of lamp holder on the tobacco seedlings in the daytime, according to the mobile way, the LED lamp is fixed on the mobile lamp frame, during the day, the lamp frame is removed from the right above tobacco seedlings; when it is time to start to fill the light and then move the light right above the tobacco plant at the top. After the daily fill-in light experiment, the cloth veil and lamp holder are removed, making the tobacco seedlings in contrast sample are in the same environment with other tobacco seedlings in the greenhouse.

When the light is filled in, seven groups are as follows: the blue LED group, the green LED group, the red LED group, the blue LED+ green LED + red LED group, the blue LED+ green LED group, the blue LED+ red LED group, and the green LED + red LED group; corresponding to each nursery seedling plate. The light is filled-in from 19:30 to 23:30 for 4 hours every day, lasting for 23 days, from the last part of cross-seedling stage of tobacco seedlings to rooting period - until the end of the seedling stage so as to study the impact of the fill –in light on the flue-cured tobacco seedlings in different growth periods.

Determination of the Projects. The fill-in light has an impact on the plant condition of the flue-cured tobacco floating seedlings, the growth condition of the flue-cured tobacco seedlings is measured; the growth of tobacco seedlings was measured every 5 days, the contents of measurement include: the diameter of the stem base of every tobacco seedling, the number of leaves of every tobacco seedling, and number of every tobacco plant.one leaf is randomly selected from the central of the plant physiological height, the largest length and width on 3 leaf blades are measured, and the leaf area is roughly calculated, finally, the data obtained is averaged after statistics and analysis, and the average value of each data in each experimental group on every measuring day is obtained. Every 7days, the impact of the fill-in light on the chlorophyll content of tobacco leaf is determined; the impact of the fill-in light on the dry matter accumulation of the seedlings is determined; the absorption spectrum of the tobacco leaf is determined to continue to explore the absorption parameters of visible light to the tobacco leaves.

The impact results of the fill-in light on the quality of the flue-cured tobacco floating seedling sprout were analyzed, the 14 contrast samples of flue-cured tobacco floating seedlings transplanted to the field after light-filled were traced. The botanical characters and biomass of seedlings was determined; the healthy index of the sample seedlings was determined; the physiological index of the sample was determined; the moisture index of the samples seedlings was determined; the chemical composition content of the sample seedlings was determined. Compared with and analyzed the flue-cured tobacco seedlings, the results of fill-in light samples were obtained, which promoted the impact of the flue-cured tobacco in the mature period and the mature quality of the flue-cured tobacco.

CONCLUSION

The experimental region belongs to the subtropical humid monsoon climate zone; the monsoon effect is especially notable. In winter and spring of flue cured tobacco seedling, it is often affected by cold wave or cold air from the northern hemisphere; the clouds are thick and low, dominated by the rainy weather. This directly affects photosynthetic intensity, botanical characters, chlorophyll content, matter accumulation, moisture content, stress resistance and chemical composition of the flue-cured tobacco seedlings in the greenhouse, thereby affecting the physiological metabolism, growth development and quality of seedlings of tobacco seedlings. In view of the insufficient illumination of the flue-cured tobacco seedling in the process of intensive greenhouse flue-cured tobacco seedling, the experiment took the intensive seedlings in the insulation greenhouses of the science and technology park as the research object, the impact of different LED light fill-in light measures on the quality of the flue-cured tobacco floating seedling sprout was studied, which has provided theoretical basis to fill the light for the flue-cured tobacco floating seedlings, and provided scientific guidance for the adjustment of the production technical measures for tobacco leaves.

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