Effects of Different Light and Temperature Treatments on Seed Germination and Seedling Growth of Vegetables

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Abstract. Vegetable refers to a kind of plant or fungus that can be used for cooking and becoming food. It provides a variety of vitamins, minerals and other nutrients necessary for human body. It is an important cash crop for people. Plant growth and development is greatly affected by light and temperature conditions, especially vegetables will directly affect the economic benefits. To explore light temperature conditions on the vegetable seed crop growth and development, the influence of this experiment will by creating the light of the different temperature conditions on the Thai water convolvulus, Tianjin 60 Chinese cabbage, Celandine wheat and precocious 8, four kinds of vegetable seeds processing, temperature different light on the conditions of the four kinds of vegetable seeds and seedling bud rate, root weight. Two experiments, respectively, set up four controls, the results showed that different vegetable seeds need appropriate illumination and temperature conditions vary, but most of the germination rate and grew well in about 25 °C, 18 hours of light and dark 6 hours under the condition of the most suitable for their growth.

Keywords: Vegetable Seeds, Different Light and Temperature Conditions, Seed Germination, Seedling Development

1. Introduction
Seed vigor is the sum of seed germination and emergence rate, production potential, and is an important indicator to measure seed quality and seed emergence in the field [1-3]. Seed vigor is often determined by monitoring seed germination potential, germination rate, germination index and vigor index. High germination index and vitality index are an important feature of high-viability seeds. In addition to the standard germination test, the level of seed vigor can also be monitored by methods such as identification of stress tolerance. Monitoring seed vigor status is extremely important for modern agricultural development and seed quality control of seed companies.

Light and temperature are important conditions that affect seed germination and seedling growth, are the main ecological factors that affect seed germination, and are also the basis for determining the normal germination of plant seeds. Different temperatures have a great influence on plant growth and germination [4-9]. Under the most suitable temperature conditions, the plants grow rapidly and grow
well. When the temperature is too high or too low, the seed germination will be inhibited to varying degrees, and the germination rate and germination index will be reduced, indicating that continuous high or low temperature will Activity to inhibit seed germination [10]. The influence of light on seed germination is the most important among various factors [11]. Light does not directly participate in the germination of seeds, but the signal stimulation to break seed dormancy [12]. Different light conditions have different effects on seed germination [13-15]. Therefore, it is of great significance to study the germination and growth of seeds under different light and temperature conditions [16-19].

Agriculture is the basis of human survival. Among them, seeds are the foundation of agriculture, the beginning of agriculture, and the cornerstone of agriculture. For human beings, the high and stable yield of crops is very important. At this time, the requirements for seed vigor are also increasing. Convolvulus, cabbage, oilseed rape is a kind of vegetables that are widely demanded by people in daily life. It is an important economic crop. Its economic nutritional value has always been judged according to the parts it is eaten, which is closely related to its own growth and development. This study explores the most suitable temperature and light conditions for seed germination and seedling growth of several common vegetables in daily life, so that farmers can avoid some wrong operations in the process of planting vegetables and cultivate the most suitable crops. Growing conditions, in order to reap the greatest economic benefits.

2. Test Materials and Methods

2.1 Test Materials
The seeds of Thailand swamp cabbage (Thai), Jin NO.60 cabbage (Jin), and Sijiqingxiangyoumai(Sijiqing) from this experiment were from Tianjin Xianyouda Seed Company, and the early maturing No. 8(NO.8) seeds were from Zhejiang Zhenong Seed Industry Co., Ltd. The experiment was conducted in the Seed Science and Engineering Laboratory of Tianjin Agricultural University in 2018.

2.2 Test Design
This experiment mainly explored the effects of light and temperature conditions on vegetable seed germination and seedling growth. The germination test of vegetable seeds under the same light conditions at different temperatures: the light conditions were uniformly set to 16h light and 8h dark, and the temperature conditions were set to three treatments, 15°C, 25°C, and 35°C, and each treatment was repeated three times. Experiments on the seed germination and seedling growth of vegetable seeds under the same temperature and different light conditions: the temperature condition is set to 25°C, and the light condition is set to four treatments, namely 18hr/6hr, 22hr/2hr, 12hr/12hr, 8hr/16hr, Each process is repeated twice.

2.3 Test Methods

2.3.1 The germination test of vegetable seeds under different temperature and same light condition
The test uses the germination method on paper (standard germination test). In each germination box, 50 randomly selected vegetable seeds are placed, the temperature of the incubator is set to 15°C, 25°C, 35°C, and the light conditions are 16h light/8h dark. Each vegetable seed test was repeated three times. Determine the germination rate. Put the randomly selected seeds into the beaker, add 90% alcohol solution, never vegetated the vegetable seeds, after soaking for 1 min, pour off the alcohol, add 10% sodium hypochlorite solution, rinse with distilled water 3-4 times after soaking and disinfection, wash Net residual sodium hypochlorite solution to avoid impact on subsequent tests. Wash and dry the germination box, and wipe the germination box with gauze soaked with alcohol. After the alcohol is completely volatilized, place two filter papers of appropriate size in the germination box, place them on the bottom of the box, moisten them with distilled water, and it is advisable to see no obvious water
traces on the filter paper. Place 50 seeds evenly on the filter paper. Close the lid. Then attach a label, put the vegetable seed variety, date and test conditions on the label, stick it on the side of the germination box, and put it in the incubator for later observation. Pay attention to the supplement of water during germination. After the seeds begin to germinate, check the seed condition every day and record the number of germination. Seed germination potential = number of normal seedlings in the early stage of germination test / number of test seeds x 100%; germination rate = number of normal seedlings in the end of germination test / number of test seeds x 100%

2.3.2 Experiments on seed germination and seedling growth of vegetable seeds under the same temperature and different light conditions

The experiment mainly uses soil culture method. Put the sterilized seeds in a pot with prepared soil for cultivation, and determine the germination rate, plant quality (dry weight and wet weight), root length and aboveground length. The temperature of the incubator is set to 25°C, and four different light conditions are set, namely 18hr/6hr, 22hr/2hr, 12hr/12hr, 8hr/16hr. Each variety is repeated twice under each condition. The vermiculite, nutrient soil, and loess were prepared according to the ratio of 1:1:1, and the soil required for the test was filled into the flower pot. Be careful not to press too tightly, otherwise it will not be conducive to seed germination and growth. The flower pot used in the experiment is 4*8. A large flower pot has exactly two rows for each variety, and 9 seeds per small cell. Hold one seed with tweezers, loosen it after inserting into the soil 1~1.5cm, and place 9 seeds evenly in each cell. Add water to the flower pot to keep the soil moist. After the seeds begin to germinate, begin to record the number of germination per day until stable. Carefully remove the plant from the soil, try to keep the plant intact, and do not break the root. Wash the residual soil on the roots and put them on the filter paper to absorb moisture. Three plants were randomly selected from each group of plants, and the total length and root length were measured with a ruler. Note that the root should be straightened and measured. After absorbing the water, the plants are weighed on the electronic balance to weigh the total fresh weight, and the average fresh weight of each plant is calculated according to the number of plants. Afterwards, the plants were placed in an envelope for drying. The secondary drying method was first used to dry at 105 °C for 30 minutes, the temperature was reduced to 80 °C, and the temperature was dried to a constant weight. After measuring the total dry weight of each group with an electronic balance, calculate the dry weight and vitality index of each plant.

Seed germination index $GI = \sum(Gi / Dt)$, Seed vigor index $VI = GI \times S$

In the formula, $Gi$-the number of germination per day, $Dt$-the number of days corresponding to $Gi$, $S$-dry weight of seedlings $[20]$.

3. Results and Analysis

3.1 Effects of the Same Light (16hr/8hr) and Different Temperatures (15 °C, 25 °C, 35 °C) On the Germination of Four Vegetable Seeds

![Image of seed germination under different conditions.](image)

**Figure 1.** The effect of different temperature treatments on the seed germination of the four vegetable
In order to explore the effects of different temperatures on the germination of vegetable seeds, three ambient temperatures of 15°C, 25°C, and 35°C were set, and the germination status of Thailand swamp cabbage was identified under a 16hr light/8hr dark photoperiod. As can be seen from Figure 1A, the difference in seed germination rate of Thailand swamp cabbage at 25°C and 35°C is not significant, but the seed can not germinate normally at 15°C, the results show that lower temperature seriously affects the germination rate of Thai water spinach In agricultural production, it is necessary to control the ambient temperature during seed germination.

As shown in Figure 1B, the germination rate of Jin 60 cabbage at three temperatures is not significantly different, but at 15°C, the young leaves of cabbage are light yellow, which is very different from the dark green at the other two temperatures. Under the stress of low temperature, the seedlings were thin and weak; and the seedlings of Jin 60 cabbage at 25°C and 35°C had a higher germination rate, and the seedlings were strong. As shown in Figure 1C, the germination rate of Sijiqingxiangyoumai at 35°C is extremely low, and most seeds cannot germinate normally. Under the conditions of 15°C and 25°C, the seeds of Sijiqingxiangyoumai have a higher germination rate, but at 15°C, the seedlings are thin, the leaves are not developed, and the roots are flocculent. The seedlings are seriously injured by low temperature stress; At 25°C, the leaves of the seedlings are green and healthy, and the roots are developed and strong. As shown in Figure 1D, the germination rate of early-maturing No.8 is 25°C>15°C>35°C. At 15°C, the leaves of the seedlings are thin and light yellow, and the roots are flocculent; at 25°C and 35°C, the seedlings The leaves are green and the growth of the roots is good.

**Figure 2.** Germination rate of four vegetable seeds under different temperature conditions

It can be clearly seen from Figure 2 that under the same light conditions, the seed germination is at the highest level at 25°C, and 25°C is the most suitable for the germination of these vegetable seeds. Sijiqingxiangyoumai is greatly affected by high temperature, and the seed germination and seedling growth of Thailand swamp cabbage and early maturing No.8 are affected by low temperature stress, and the seedlings are thin. Even when the germination rate is similar, the leaves are yellowish under low temperature, and increasing the temperature is conducive to the formation of chlorophyll in seedling leaves. The temperature condition of 25°C makes the optimum temperature for seed germination and seedling growth of several vegetables in this study. From the analysis of data, the germination rate of four vegetable seeds under the condition of 25°C is compared with that of Thai spinach at 15°C (P<0.05); the germination rate of Jin 60 cabbage at three temperatures There is no obvious difference under the temperature; the four seasons green oil wheat has a significant difference at 35°C compared to 25°C (P<0.05); at 15°C, early maturing No.8 has a significant difference compared to the other two temperatures (P<0.05).
3.2 Effects of Different Light (18hr/6hr, 22hr/2hr, 12hr/12hr, 8hr/16hr) Conditions at the Same Temperature (25°C) On Seed Germination of Four Vegetables

Based on the research results of different temperature treatments, 25°C is a relatively suitable temperature for the germination of most vegetable seeds. Therefore, in a further light test, the temperature was uniformly set to 25°C to explore the effect of different photoperiods on the growth of vegetable seed seedlings.

![Figure 3. Germination rate of vegetable seeds under different photoperiods](image)

We can see from Figure 3 that under 25°C, when the light condition is 18hr/6hr, the average germination rate of the four vegetable seeds is the highest compared with the other three conditions, followed by 8hr/16hr, the worst germination rate is 22hr/2hr. Thai convolvulus has the highest germination rate at 18hr/6hr and the lowest at 22hr/2hr; Jin 60 cabbage has the highest germination rate at 18hr/6hr and the lowest at 22hr/2hr; the four seasons green oil wheat germination rate at 18hr/6hr is the highest, the germination rate was the lowest under the conditions of 22hr/2hr and 12hr/12hr; the early germination 8 had the highest germination rate at 18hr/6hr and the lowest germination rate at 12hr/2hr. The results of this study show that light conditions also have a great effect on the germination of vegetable seeds. Only under suitable light and dark conditions can the seeds obtain the highest germination rate. Moreover, the light conditions also have an effect on the chlorophyll synthesis of vegetable seeds seedlings. Although the vegetable seeds have the highest bud rate under 18hr/6hr conditions, the color of the seedling leaves looks yellowish to the naked eye, and the dark green leaves under the other three conditions The difference is large. The effect of light on the chlorophyll synthesis of seedlings remains to be explored.

3.3 Effects of Different Light Conditions (18hr/6hr, 22hr/2hr, 12hr/12hr, 8hr/16hr) at the Same Temperature (25°C) on the Root Length of Four Vegetable Seedlings.

![Figure 4. Root length of seedlings of different varieties of vegetables under different photoperiods](image)
Figure 5. Variation characteristics of root length of four vegetables under different photoperiods

4. Discussion and Conclusion

4.1 Effects of Different Temperature Treatments on the Germination of Several Vegetable Seedlings

Thailand swamp cabbage has the highest germination rate at 25°C and the lowest germination rate at 15°C; Jin 60 cabbage has similar germination rates at three temperatures, but its seedlings are pale yellow at low temperatures, and its chlorophyll synthesis is significantly less than the other two temperatures; Sijiqing germination rate is extremely low under the high temperature of 35°C, the germination rate is higher at 15°C and 25°C, but the seedlings are yellowed and the root development is not strong enough at 15°C; early-maturing NO.8 germination rate was the highest at 25°C, followed by 15°C, and the lowest at 35°C, and had the same problems as the four seasons green oily wheat. Under low temperature conditions, the seedlings turned yellow and the roots did not develop well. It can be seen that the moderate temperature condition of 25°C is the most suitable temperature for the germination of most vegetable seeds.

4.2 Effects of Different Light Treatments on the Germination and Growth of Several Vegetable Seedlings

Under the condition of 25°C and light conditions of 18hr/6hr, the average bud rate of the four vegetable seeds is the highest compared to the other three conditions, followed by 8hr/16hr, and the worst bud rate is 22hr/2hr.

4.3 Effects of Different Light Treatments on Root Length of Several Vegetable Seedlings

In this experiment, the effect of light on root growth and development was not explored. It may be because the roots are in the soil, and there is no light. The length and robustness of the roots are related to the nutrients in the soil. It may also be that the results of photosynthesis on the ground part affect the growth of the underground part, but it does not seem to be directly related to the lighting conditions.

4.4 Effects of Different Light Treatments on the Weight of Several Vegetable Seedlings

In the research, with the exception of early-maturing No. 8, the other three varieties all had the highest fresh weight per plant when the light conditions were 8hr/16hr, and the dry matter accumulation was the largest when the light conditions were 22hr/2hr, the greater the dry weight.

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