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Study of non-pollution cultivation techniques of organic ecotype of melon crops considering population characteristics

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ABSTRACT

Due to the requirement of melon yield, the cultivated seeds are overused with pesticides during the melon planting process, and the population characteristics are not considered, resulting in serious soil pesticide pollution during the melon planting process. Therefore, this study proposes an organic ecological pollution-free cultivation technology of melon considering population characteristics. The population characteristics of melon crops were determined by DNA molecular marker technology. On this basis, the organic ecotype pollution-free matrix of melon crops was formulated, and the bulk density, total porosity and aeration porosity of the matrix were determined. The MNL model method was used to control the spraying amount of melon cultivation, and the light condition of the melon growing environment was determined by the leaf fluorescence of melon crops. There were significant differences in plant height, stem diameter and leaf area between melons grown in the studied substrate and common soil. With the change of planting days, the height of the melon grown in this technology was always higher than that of the melon grown in common soil, and the maximum value was about 20 cm. As planting days changed, the stem thickness of melon crops grown with the substrate was initially lower than that of common soil, but quickly exceeded the thickness of common soil over time. The surface areas of the third and fourth leaves of the melon crops grown according to this technology varied with the days of planting. Early differences between the two substrates were not significant. However, in later stages, melons grow faster. In the early stage of melon production, the chlorophyll content of pollution-free cultivation was higher than that of common cultivation methods. The flowering period was the period with the highest chlorophyll content in both cultivation techniques. However, the highest content of melon chlorophyll under this technology was about 2.0 mg, and the highest content of melon chlorophyll under common cultivation technology was about 1.4 mg, which verifies the effectiveness of the method. It has been verified that pollution-free cultivation technology can effectively improve the growth efficiency of melon crops and ensure the quality of melon cultivation.

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Introduction

Melon (*Cucumis melo* L.) belongs to *Cucurbitaceae* and is an annual herbaceous plant that consists of about 118 genera and 825 species. (1). China muskmelon has been cultivated for more than 3000 years as one of the world's agricultural origins. As early as the Northern Wei Dynasty, the melon was spread to China along with watermelon. It was widely cultivated in the Ming Dynasty (2). Melon has rich fruits, sweet taste, aromatic smell, fresh food, simultaneous interpreting, and can be made into dried fruits, preserved melon and other processed products, which is popular among (3). Melon is rich in nutrition, sweet taste and fragrant smell. It is mainly eaten fresh. It can also be made into the dried melon, melon brain and other processed products, which are deeply loved by people. In recent years, with the development of the economy and the improvement of people's living standards, people's daily consumption of fruits has increased year by year, and melon with beautiful appearance and good quality has been sold as high-grade melon and fruit, which has become a good gift for relatives and friends on holidays. As an important fruit crop, melon plays an increasingly important role in China's agricultural production (4). Melon industry, as a pillar industry to promote rural economic development, has become one of the effective ways to increase farmers' income and become rich. But in the cultivation of melon, in order to get a higher yield and improve the melon's sweetness, a large number of

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related pesticides were sprayed in the cultivation process, resulting in the damage of soil quality in the cultivation process of melon. This cultivation technology at the cost of the ecological environment needs to be improved to protect the environment, It is of great significance to study the organic ecological pollution-free cultivation technology for the development of the melon industry (5). Therefore, the research of pollution-free cultivation technology in the field of pollution-free cultivation has become a hot issue in the field of current research.

A study by Nerlich et al. (6) investigated on dynamically changing chemical properties and physical conditions of organic substrates influence the plant phenotype of lettuce. In research on Yang et al., 2020 (7), a method was proposed to analyze the effect of organic ecological cultivation substrate ratio on the growth and quality of lettuce. In order to obtain the most suitable substrate combination for lettuce cultivation, 12 kinds of substrates with different proportions were prepared by using traditional substrate peat, vermiculite, decomposed sheep manure and corn straw as raw materials, and commercial leafy vegetables as control, The plant height, leaf area, fresh weight per plant and dry weight per plant of all treatments were improved to varying degrees compared with the control group, and each index showed the best performance, increased by 31.80%, 47.15%, 59.43% and 79.53% respectively compared with CK; In terms of physiological and biochemical indexes, t_11. The content of VC in the treatment was the highest, which was 2.5 times of CK and 2.02 times of CK; The chlorophyll content of the treatment was the highest, which was 1.41 times of CK, and the nitrate content was the lowest, which was 74.59% lower than CK. The pollution-free cultivation technology can improve the nutrient demand of vegetable planting, reduce the amount of pesticide use, and protect the ecological environment. However, the research object of this cultivation technique is limited and needs further improvement. Guo et al., 2018 (8) put forward a study on the key technology of nitrogen fertilizer fine cultivation of pollution-free ginseng. Through the analysis of the main modes of ginseng cultivation in pollution-free farmland, the fine management of nitrogen fertilizer is the key link of the ginseng cultivation technology system in pollution-free farmland. In order to explore the effects of fine management of nitrogen fertilizer on the biomass accumulation and secondary metabolite synthesis of Panax ginseng in its growth stage, two-year-old Panax ginseng in the vegetative growth stage was used as the test material, and 0,10,20,40 mg · L ~ (-1) Hogland's medium was applied to observe the apparent changes of leaf color, stem diameter, chlorophyll content, and the dynamic changes of photosynthetic rate, The temporal and spatial expression of key genes PgHMGR and PgSQE in saponin synthesis were quantitatively analyzed. The results showed that there were significant differences in photosynthetic rate and chlorophyll content under different nitrogen concentrations, and the relative expression of PgHMGR and PgSQE genes in roots, stems and leaves. When the nitrogen concentration was 20 mg · L ~ (-1), the net photosynthetic rate and chlorophyll content of ginseng leaves were the highest, The relative expression levels of PgHMGR and PgSQE genes in roots were the highest. It was speculated that the optimal nitrogen concentration for the vegetative growth stage of Panax ginseng was 20 mg · L ~ (-1) (ammonium nitrate 57.14 mg/plant, pure nitrogen 20 mg/plant), which was the optimal nitrogen concentration for saponin synthesis of Panax ginseng. It is verified that the research on the key technology of nitrogen fertilizer fine cultivation of pollution-free ginseng in this method is conducive to the production of high-quality and efficient ginseng medicinal materials, and provides a scientific basis for the development of weight loss and efficiency and environment-friendly sustainable ecological ginseng planting industry. This method can reduce the amount of chemical fertilizer, improve the efficiency of chemical fertilizer, and has a certain impact on pollution-free cultivation. Research of Chen, 2018 (9) put forward the screening and experimental study of organic ecotype soilless culture substrate of Pseudostellaria heterophylla. Results: the best formula was rice straw: bagasse: cow dung: refined organic fertilizer = 2∶1∶0.95∶0.05, the bulk density was 0.16 g / cm3, the total porosity was 87.2%, the air-water porosity ratio was 1∶1.85, the hydrolyzed N was 2.810 g/kg, 484 g/kg, available K 2.651 g/kg, EC 2.48 MS/cm, pH 6.87; Taking the virus-free seedlings of Radix pseudo ginseng "zhe Shen 2" as experimental materials, the experiment of the ecological organic soilless culture of Radix pseudo ginseng has been

carried out. The results of the analysis of the yield and quality of Radix pseudo ginseng have shown that the incidence rate of soil-borne diseases in the 3 years of continuous cropping in the organic ecotype soilless culture is 0%, and the aboveground biomass yield increased 139% and the yield of root tuber increased 113%, compared with the CK in the field. It was significantly higher than that of garden soil (CK); 1~3 years of continuous cropping of CK, the incidence rate of soil-borne diseases increased year by year, the content of polysaccharides was 22.34% to 20.54%, and the total saponin content was 0.23% ~ 0.19%. With the increase of continuous cropping years, the contents of polysaccharides and total saponins in Radix pseudo ginseng decreased. The organic soil soilless culture substrates were continuously cropping for 1~3 years, the polysaccharide content was 22.87% to 22.52%, and the total saponins content was 0.23%. This technology can effectively improve the yield of Pseudostellaria heterophylla, and has little impact on the environment.

However, the addition of some chemical fertilizers such as nitrogen increases yield (10), not using or consuming fewer chemical pesticides and fertilizers has an important role in human health and the environment (11-13). In this regard, the use of organic fertilizers is more important (14, 15).

DNA molecular marker technology (16, 17) refers to the genetic marker technology based on the nucleotide sequence variation in the genetic material between organisms. DNA molecular marker technology should have stable and reliable characteristics, preferably functional marker sites, as shown in Table 1 for melon crops.

In this study, the characteristics of the melon population were analyzed according to DNA molecular marker technology, to provide gene support for improving the quality of pollution-free ecological cultivation technology.

Benefit analysis of non-pollution Cultivation Technology

(A) Environmental benefit analysis: In the process of melon planting, the use of pesticide fertilizer leads to soil consolidation, which leads to the reduction of melon yield, poor quality of melon and decrease income of growers (18). On the other hand, excessive use of nitrogen fertilizer will lead to the decrease of insect resistance of non-vegetable, and then increase the use of pesticides by farmers, which has a great impact on the edible safety of melon (19).

Table 1. Melon genes based on DNA Molecular Marker Technology; Repeatability (A), Polymorphism (B), Specificity (C), quality requirement (D), Muskmelon subsp (E), Cucumis melo subsp (F), Melon egg melon (G), Summer melon (H), Winter melon (I), Muskmelon Variety (J).

	RFLP	RAPD	SSR	ISSR	ALFP	CAPS	SNP	SSCR
A	high	high	middle	middle	high	low	high	low
B	middle	middle	middle	middle	middle	low	low	low
C	yes	non	non	non	non	non	yes	non
D	difficult	easy	middle	easy	middle	middle	easy	middle
E	√		√		√		√	
F			√		√		√	
G		√		√		√		√
H	√		√		√			
I			√	√		√		√
J	√		√		√		√	

Excessive use of chemical fertilizer and pesticide will have different effects on water and the atmosphere, which will cause eutrophication and groundwater pollution, and air pollution includes volatilization of nitrogen-containing oxidizing substances and so on. Therefore, it is very important to strictly operate in accordance with the technical standards of pollution-free planting, reduce the amount of pesticide and fertilizer, reduce the input of agricultural investment, maximize the benefits, minimize the environmental pollution and ensure the edible safety of melon (20).

(B) Economic benefits analysis: Pollution-free cultivation is the lowest threshold for the melon to enter the market, and economic benefit is one of the important goals of growers. Economic benefits directly affect the planting enthusiasm of growers (21). Pollution-free planting technology can effectively reduce the use of pesticides and fertilizers, save costs and increase income, and at the same time, it can be used in combination with organic fertilizer, which can not only enrich the soil, but also improve the quality and yield of melon, and increase the effectiveness of local brands, so as to achieve the strategy of melon going out (22).

Because of the variety of diseases and pests faced by melon planting and the spread speed of disease and insect pests is very fast and wide, it is easy to cause

serious diseases and insect pests in a short time once it is separated from the control of pesticides, which will greatly affect the growth and yield of melon crops, even cause crop harvest and other phenomena in serious cases, which will bring great economic losses to farmers (23). At present, as a substitute for pesticides, insect control networks and other measures are easy to cause potential disease threats due to human error and negligence. The difficulty and economic cost of harmless treatment of melon by farmers are too high, and they cannot get rid of the dependence on pesticides in a short time, which makes the situation of over standard of melon pesticide cannot be effectively solved (Zhou et al., 2019). In addition, due to the wide variety of pesticides, the same name pesticides are very common, but the real varieties that can be used in melon management are relatively few (24). It is easy for farmers to confuse their governance objects and scope when using, and then unreasonable use or wrong pesticide selection occurs (25). Therefore, in the cultivation of melon without pollution, we should control the pesticide reasonably and set up the dosage reasonably.

Based on the results of the above researches, this study puts forward a kind of organic ecological pollution-free cultivation technology of melon considering population characteristics. Firstly, the population structure of melon was analyzed. The population characteristics of melon crops were determined by DNA molecular marker technology. On this basis, the organic ecotype pollution-free matrix of melon crops was formulated, and the bulk density, total porosity and aeration porosity of the matrix were determined; via the MNL model, the spraying amount of pesticide in melon planting was controlled, and the light condition of melon growing environment was determined by the leaf fluorescence of melon crop, to realize the organic ecological pollution-free cultivation technology of melon crop.

Materials and methods

Analysis of population characteristics of melon crops

In order to realize the organic ecological pollution-free cultivation of melon crops, the population characteristics of melon crops were analyzed. Firstly, the genetic material was analyzed by ISSR molecular marker technology. For this pupose, DNA extraction method was Doyle and Doyle (1990) (26) with minor modification. 45 ISSR primers were used for PCR reactions, of which 20 primers produced the desired band pattern (Table 2).

Table 2. Sequence characteristics of primers used in this research

Primer name	Sequence (5'-3')	Annealing (°C)
UBC 818	CACACACACACACACAG	54.0
UBC 840	GAGAGAGAGAGAGAGAY*T	54.0
UBC A7	AGAGAGAGAGAGAGAGAGAGT	50.8
UBC 808	CACACACACACACAG	50.8
UBC 811	GAGAGAGAGAGAGAGAC	55.0
UBC 880	GGAGAGGAGAGGAGA	55.0
UBC 855	ACACACACACACACACYT	52.0
UBC 820	GTGTGTGTGTGTGTGTC	54.0
UBC 848	CACACACACACACACAR*G	54.0
UBC 866	CTCCTCCTCCTCCTCCTC	55.0
UBC 826	ACACACACACACACACC	50.0
UBC 857	ACACACACACACACACYG	50.0
UBC 836	AGAGAGAGAGAGAGAGYA	54.0
UBC 825	ACACACACACACACACT	54.0
UBC 827	ACACACACACACACACG	54.0
UBC 867	GGCGGCGGCGGCGGCGGC	54.5
UBC 426	CACCACCACCACCACCACCACT	54.0
UBC 812	GAGAGAGAGAGAGAGAA	54.0
UBC 864	ATGATGATGATGATGATG	54.0
UBC 885	AGAGAGAGAGAGAGAG	54.0

Study on the cultivation technology of ecological pollution-free organic

In order to realize the research of organic ecological pollution-free cultivation technology of melon crops, this paper realized through experiments, analyzed the influence of soil and other related substrates on melon crops, and determined the key cultivation indexes of organic ecological pollution-free cultivation technology of melon crops.

Organic ecotype non-pollution Cultivation Substrate Materials

In melon planting, soil fertility is an important factor to support its growth. Therefore, the matrix materials for melon planting were first prepared.

Humus: it is taken from the undergrowth of a pine forest on a forest farm. The unripe litter on the surface is removed, and the decomposed material sandwiched between the surface and the soil is filtered by a 1.0cm sieve, and the humus less than or equal to 1.0cm is collected in a bag;

Dead leaves: taken from maple trees on a forest farm, they are not decomposed and exposed to the

sun. After being exposed, the litter is crushed by stepping, pressing and kneading, so that the particle size is between 1-1.5cm, and collected for use

Plant ash: the ash fertilizer from the burning of firewood in the forest farm is collected for use after sufficient drying and cooling.

Peat: purchased from a scientific research institute.

The key of the melon crop matrix is to select the most suitable green medium according to the growth status of plants on different green substrates, that is, to analyze the plant growth and physiological indicators comprehensively. Because the experimental research under a natural environment will inevitably be affected by temperature, precipitation and other factors, the test site was selected in the greenhouse. The platform bed was built by using overhead wire mesh as the flat bed, that was, the four corners of the shelf are made of bricks with a height of 60-80 cm. The shelf was placed on it and hard wire mesh is laid on the shelf, and it was tied to the shelf with iron wire to make the net all contact with air, so as to achieve the air permeability of plant growth. At the same time, in order to prevent the green matrix material from leaking from the mesh of the steel wire mesh, the green matrix was put into the baseband material made of upper and lower non-woven fabrics. The selected melon seeds were sown on the substrate surface, and the surface of melon seeds was covered with a layer of the matrix, and the mouth of the bag was sewn. During laying, pay attention not to close each other, and leave a certain gap in the middle for later observation. After laying, water shall be carried out, and the first time, the water shall be poured through. The green matrix studied in this expriment is shown in Figure 1.

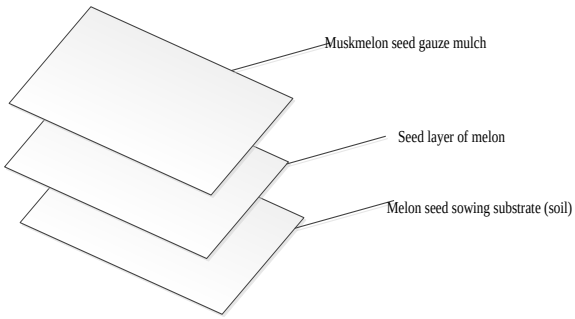

Figure 1. Matrix structure of melon crop

During the non-pollution planting of melon crops, it is necessary to set the bulk density, total porosity and should be reasonably set to improve the effective planting of melon crops.

The allowable weight calculation of the melon crop matrix was (Formula 1):

$$R = \frac{W - u}{A} \quad [1]$$

The formula R represents the bulk density of the melon substrate, g/cm^3; W stands for weighing u represents the weight of the container, A represents matrix volume.

The Formula 2 was used for calculating the total porosity of crop substrate is:

$$K = \frac{W_1 - W_2}{A} \quad [2]$$

The Formula 3 was used for calculating ventilation porosity of melon crop substrate is:

$$T = \frac{W_2 - W_3}{A} \times 100 \quad [3]$$

In the non-pollution planting of melon crops, the bulk density, total porosity and ventilation porosity of the substrate were determined, and the reasonable setting of the substrate of melon crops was completed.

It is necessary to analyze the composition of the organic matrix in the above-mentioned organic ecological pollution-free cultivation matrix. Among them, the N, P, Ca, Mg and S of the above-mentioned organic matrix were significantly higher than those of the general soil, and the metal substances in the above-mentioned organic matrix were also slightly higher than those of the general soil, as Table 3.

Table 3. Organic matrix components

Mg/L	N	P	Ca	Mg	S	Fe	Mn	Cu
Organic matrix	26.1	87.4	3654	496	410	10.2	8.1	0.3

Control of Pesticide Spraying in Organic Ecological Non-pollution Cultivation

Because of the current plant planting, chemical pesticide control methods were used, although it can solve the problems of crop growth and pest control low and efficient, but also due to the abuse of pesticides, a large number of pesticide residues will be produced.

In this study, the MNL model was used to control the amount of pesticide spray in melon planting, namely:

$$D_{ij} = \frac{\exp(s_i \delta_i)}{\sum_{k=1}^{J} \exp(s_i \delta_k)}, j = 1, 2...J \quad [4]$$

In Formula 4, D_{ij} is the probability of cumulative distribution of pesticides in melon planting, s_i represents a binary selection model, and δ_k represents control factor variables.

In the process of controlling the pesticide spray amount of melon planting according to the above MNL model, due to the different planting amounts and considering the different pollution degrees, further control is needed, namely:

$$V_{ij} = \frac{D_{ij}}{\sum_{k=1}^{J} \exp(s_i \delta_k)} \quad [5]$$

Formula 5, V_{ij} represents the accurate control of the pesticide spraying amount planted by melon.

Study on light condition of organic ecotype pollution-free cultivation

In the organic ecological cultivation of melon, there were differences in the illumination conditions in different stages of melon growth. In this study, the function leaves of melon were measured by fluorescence at the seedling, flowering and fruting stages, and the light condition of the melon growth environment was determined by leaf fluorescence (27).

Variable fluorescence measurements of leaves on the back of dark conditions were as follows (Formula 6):

$$FV = PM - PO \quad [6]$$

In the formula, PM represents the maximum fluorescence, PO represents the initial fluorescence.

The optical efficiency of variable fluorescence in dark-adapted leaves can be expressed as (Formula 7):

$$E = \frac{pv}{pm} \quad [7]$$

The transformation efficiency was as follows (Formula 8):

$$\frac{pv}{pm} = \frac{pm - po}{pm} \quad [8]$$

Based on the above analysis, the melon non-optical fluorescence is expressed as

$$: Q = \frac{\left(PM - PM^{'}\right)}{PM^{'}} \quad [9]$$

In the pollution-free cultivation of melon crops, the organic ecological pollution-free matrix of melon crops was formulated, and the bulk density, total porosity and aeration porosity of the matrix were determined; with the help of the MNL model, the spraying amount of pesticide in melon planting was controlled, and the light condition of melon growing environment was determined by the leaf fluorescence of melon crop, so as to realize the organic ecological pollution-free cultivation technology of melon crop.

Results and discussion

In this experiment, ISSS molecular marker was used to study the genetic structure of melon population. The results of PCR amplification of bands on agarose gel are shown in Figure 2

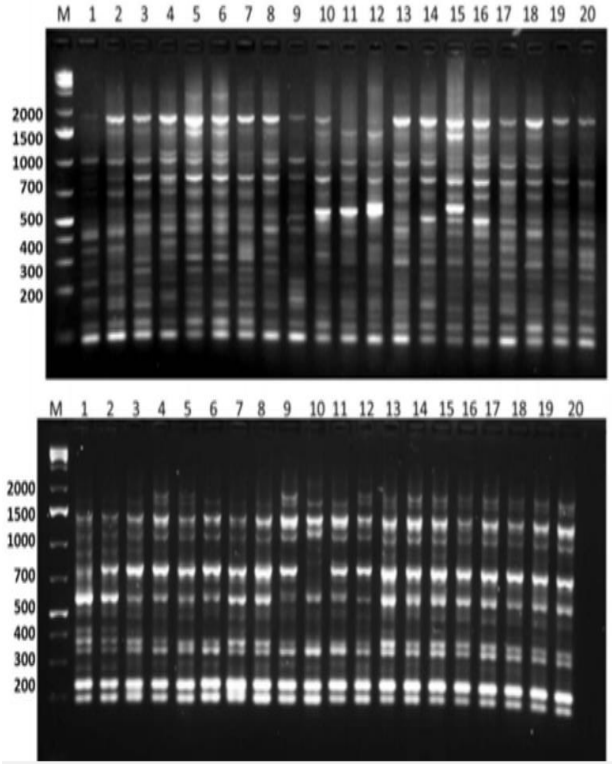

Figure 2. Amplified banding pattern by different ISSR primers on agarose gel. Where M: molecular marker; and other lanes are melon plants.

In order to verify the effectiveness of the cultivation techniques in this study, experimental

analysis was carried out. The melon seeds were sprinkled in the above-mentioned matrix, and the water was applied until the melon seedlings grow. When the melon grows to four leaves, the whole index was determined. The measurement was conducted once every five days for 4 times, and 10 melon plants were tested in each treatment. Analysis of the experimental samples of melon growth was evaluated under this technology and general conditions. According to the above results of melon planting, the changes of seedling, diameter and leaf area of Melon under different substrates were analyzed.

The results of the experiment in Fig. 3 show that with the continuous change of planting days of melon crops, there were differences in the plant height, diameter and leaf area of melon planted under the substrate and common substrate.

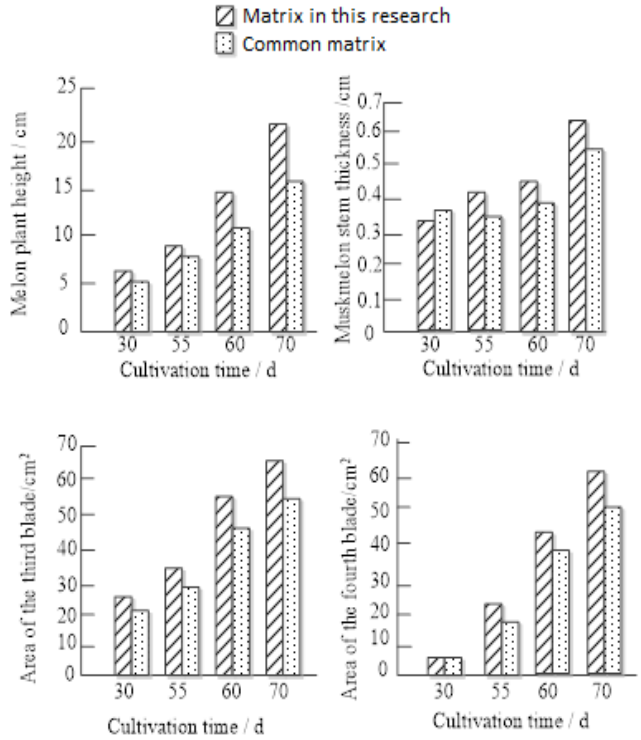

Figure 3. Comparison of different substrates on seedling, diameter and area of Muskmelon during planting

Among them, the height of melon crops planted in this study was always higher than that of common soil planting melon crops with the change of planting days, and the maximum value is about 20 cm; The stem thickness of melon crops planted with the substrate was lower than that of common soil at first with the change of planting days, but it quickly exceeded the thickness of common soil with time change. The surface area of the third and fourth leaves of melon crops planted based on this study has changed with the change of planting days. The difference between the two substrates in the early stage was not significant. However, in the later stage, the melon grows faster. It is verified that pollution-free cultivation technology can effectively improve the growth efficiency of melon crops, and the quality of melon planting is guaranteed.

The effect of a different light on chlorophyll content in melon leaves was analyzed. The results are shown in Figure 4.

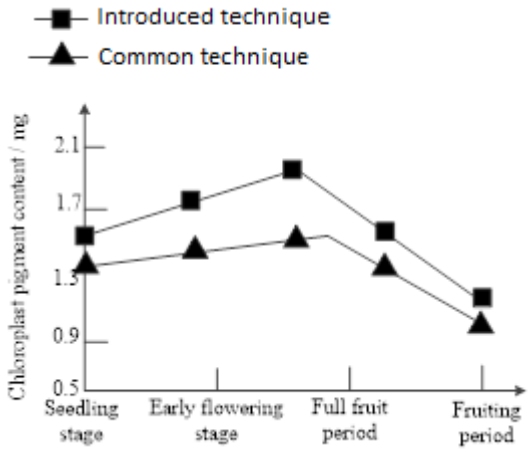

Figure 4. Effect of a different light on chlorophyll content of melon leaves

Light intensity and spectrum can affect plant performance as well as many activities particularly chlorophyll synthesis, chlorophyll a fluorescence as the maximum quantum efficiency of photosystem II (PSII), photosynthesis yield (ΔF/Fm′), and electron transport rate (ETR) (28-30). In the four processes of melon crop growth and flowering, the light condition was an important factor affecting the quality of the melon crop. Therefore, the experiment analyzed the chlorophyll content of melon crops under different planting techniques, reflecting the effectiveness of planting light conditions. In the early stage of melon production, the chlorophyll content of pollution-free cultivation was higher than that of the common cultivation methods. The flowering period is the highest period of chlorophyll content of the two cultivation techniques. However, the highest chlorophyll content of melon was about 2.0mg under this technique, and the highest chlorophyll content of

melon is about 1.4mg under the common cultivation techniques, the effectiveness of this method was verified.

Conclusions

With the development of the social economy, the melon crop as a key crop in agricultural cultivation, its pollution-free cultivation has become a key research object. Therefore, this paper puts forward a kind of organic ecological pollution-free cultivation technology of melon considering population characteristics. The population characteristics of melon crops were determined by DNA molecular marker technology. On this basis, the organic ecotype pollution-free matrix of melon crops was formulated, and the bulk density, total porosity and aeration porosity of the matrix were determined; With the help of the MNL model, the spraying amount of pesticide in melon planting was controlled, and the light condition of melon growing environment was determined by the leaf fluorescence of melon crop, so as to realize the organic ecological pollution-free cultivation technology of melon crop. The results showed that the highest growth height of melon was about 20cm, and the highest chlorophyll content was about 2.0mg at the flowering stage.

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Interest conflict

None.

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