Pollution-Free Cultivation Techniques of Leafy Vegetables under the Background of Information Technology

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Abstract. China is one of the world's agricultural development powers, vegetables in agriculture is worthy of the majority of planting. With the improvement of people's living standard, "eating Chinese cabbage" has become the focus of people's general attention. This paper mainly studies the analysis of the pollution-free cultivation techniques of leaf vegetables under the information background. Aiming at the defects of the existing vegetable cultivation expert system in protected areas, such as single function and several vegetables, the vegetable network expert system for disaster mitigation and cultivation has no public cellar, and the design and implementation of the system are introduced. The development of the system is oriented towards the majority of agricultural technicians and farmers, and provides them with a service platform for the safe production of vegetables in protected areas, the identification and prevention of major diseases and insect pests, scientific management, and so on, has a strong practical value and development prospects of grassroots.

Keywords: Information Technology, Vegetable Cultivation, Pollution-Free Cultivation, Expert System

1. Introduction
Pollution-free vegetables refer to the producing area or market of pollution-free agricultural products with the label of vegetable products after being certified by relevant departments, whose production environment, production process and product quality meet the requirements of pollution-free relevant national standards or agricultural industry and the quality inspection institutions through inspection. The production of pollution-free agricultural products is the development direction of modern agriculture and an important symbol of high level. A high level of well-off society is the strategic adjustment of agricultural industrial structure, and the need to improve and increase farmers' income is the need for agriculture to participate in international competition and improve the competitiveness of agricultural products in the market after China's accession to the WTO [1]. Agricultural development has reached a new stage, the structural surplus of agricultural products, with the acceleration of the pace of building a well-off society in an all-round way and the improvement of people's living standards, the change of diet structure and the need for healthy, pollution-free agricultural production are more and more important.
An expert system is an intelligent system that stores the knowledge of a large number of experts in related fields, so that human expert knowledge can be used to solve specific problems. Expert systems have been applied in various fields. The CALEX/PEACHES Expert decision support system developed by Bajpai is used in peach Orchard management; The CALEX/RICE expert system is used for the management of RICE production processes, which can update real-time data on pesticides and weather conditions [2]. Neelam uses MICCS tools to develop the crop expert system, which is mainly used for the diagnosis of diseases and insect pests, applies the expert system to vegetable greenhouse cultivation and milk processing, and actively ADAPTS to the Internet era by combining network technology, so that the expert system becomes more practical and has better continuity [3].

Expert system is an important branch of agricultural expert system, which mainly solves various problems in the production of protected vegetables. In order to solve these problems, a web-based expert system for vegetable disaster reduction and pollution-free cultivation was developed.

2. Non-Pollution Cultivation Technique of Vegetables Based on Expert System

2.1 Overview of Pollution-Free Vegetables
The main pollution sources in the process of pollution-free vegetable production can be classified into air pollution sources, water pollution sources and soil pollution sources according to the main objects affected by their hazards. According to the classification of human social activities generated, it can be divided into industrial pollution sources, agricultural pollution sources, domestic pollution sources and traffic pollution sources, etc. [4].

(1) Air Pollution
Air pollution comes from the space around the above-ground parts of vegetable production. It is mainly caused by the waste gas from industry, the waste gas from the combustion of energy, the waste gas from transportation and the pollution caused by pesticides and chemical fertilizers.

(2) Pollution of Irrigation Water
Groundwater pollution in rivers, lakes and some areas is caused by large amounts of untreated wastewater and waste residues discharged from industries and cities, as well as large amounts of fertilizers and pesticides used in agriculture, and sewage is used to irrigate vegetable fields, resulting in indirect pollution of vegetables. The composition of these pollutants is very complex, such as hydrogen sulfide, mercaptan, fiber suspended solids, oil, plankton, protein, sugar, organic nitrogen, chloride, carbonate, ammonia, sulfuric acid, phenol, inorganic salts, alkalis, fluoride, cyanide and various heavy metals [5].

(3) Soil Pollution
There are two main channels of soil pollution: one is the soil pollution caused by urban and industrial "three wastes"; the other is the secondary pollution caused by the large-scale use of pesticides and fertilizers.

1) Heavy metal pollution. In terms of different heavy metals, tin content is the highest, followed by zinc and copper, mercury content is moderate, lead, arsenic and chromium content is the lowest. In addition, the absorption of heavy metals is also different under different soil conditions [6]. By their nature, heavy metals are hard to biodegrade or chemically degrade. They are easily deposited through the food chain in animals, plants and humans. In addition, they are highly toxic and pose a serious threat to the ecological environment, food safety and human health.

2) Pesticide pollution: Due to the heavy use of highly toxic, highly toxic and highly residual pesticides in vegetable production, the excessive use of low-toxic pesticides, and the disregard for the safety interval of pesticide use, the pesticide pollution becomes more and more serious [7]. The pesticide residues in vegetables were closely related to the kinds of vegetables, the kinds of pesticides, the application methods, the application times and the duration of the application.

3) Traffic pollution: Mainly refers to the pollution caused by traffic in vegetable fields near highways, mainly including lead pollution and PAHs pollution. Among them, the lead pollution comes
from automobile exhaust, while the pollution of polycyclic aromatic hydrocarbons (PAHs) comes from asphalt pavement and carbon black produced by automobile tires.

Through careful investigation and measurement of air, soil and water source, the base is selected in strict accordance with the requirements of pollution-free vegetable production standards.

2.2 Expert System Architecture

Expert system can share the knowledge of experts in many fields to users, and its level can reach or close to that of experts. The expert system has been widely used in many fields and achieved remarkable results.

(1) Overview of Expert System

The so-called expert system can be understood from two parts: "expert" and "system". The former reflects the authority of the expert system in this field, and systematically collects the experience and knowledge of experts in this field for many years to guide the production practice. The latter reflects that the expert system has more levels and a more complete architecture compared with the general computer program, because the expert system can not only complete the collection and input of knowledge, but also match the input information and output the corresponding conclusion according to its reasoning and decision-making function [8]. Common expert systems are generally composed of knowledge base, reasoning machine, interpreter, human-computer interaction interface, knowledge acquisition mechanism, database and other modules.

Knowledge base: the cornerstone of expert system, storing the processed systematic and formatted knowledge of this field, which can be divided into fact base and rule base. To some extent, the quantity and quality of knowledge base determines the professional performance and problem-solving efficiency of the system. Therefore, the key to the construction of expert system lies in the perfection of knowledge base.

Knowledge acquisition institution: it is a medium between human knowledge and knowledge base to collect the ideas of experts in this field and the opinions of engineers from different departments into the database. In the process of expert system construction, how to transform knowledge is the key and difficult point of the work, and adaptability in the process of reasoning must be considered in the process of knowledge transformation.

Reasoning machine: Under the control of a certain reasoning strategy, the existing logical reasoning rules in the database can be used to deduce and solve problems by matching current problems with existing data information, which is the core of simulating experts' problem solving [9]. There are three main reasoning ideas, namely, forward, reverse and mixed reasoning. On the one hand, the reasoning machine and the knowledge base are designed separately and do not affect each other; on the other hand, the representation of knowledge in the knowledge base affects the reasoning performance of the reasoning machine.

Comprehensive database: A large amount of data information will be generated during the operation of the system. These intermediate information will be stored in the comprehensive database, including system input information and inference intermediate results. When the inference engine selects knowledge, it needs to interact with the comprehensive database, and the comprehensive data also provides the inference path for the interpretation mechanism. Therefore, the integrated data plays a connecting role in the system.

Human-computer interaction interface: a bridge between users and domain experts or knowledge engineers, mainly responsible for information interaction and information transmission. The expert system acquires domain expert information through the human-machine interface and transforms it to form expert system knowledge [10]. Or the user inputs matching information in the human-machine interface, inferences through the expert system, and outputs decision conclusions to the human-machine interaction interface.

Interpretation mechanism: it is responsible for annotating and explaining the final output conclusion, from which users can see the complete path of matching reasoning. Interpretation
mechanism is not only a supplement to reasoning matching, but also can reflect the shortcomings of reasoning process, which can be taken as the basis for improving the system matching process.

(2) System reasoning Machine Judgment Method Operator

Let the vector composed of the absolute value of the weight in each field of an object be $|\{W_1, W_2, ..., W_i\}|$, the operator of the determination method of the object is:

$$OP(x) = \frac{x(|W_1|, |W_2|, ..., |W_i|)}{(1/CF_{T1}, 1/CF_{T2}, ..., 1/CF_{Tn}) \cdot (|W_1|, |W_2|, ..., |W_i|)}$$

(1)

All $CFT = L$ under the current domain calculation formula. Under the current simplification, the operator of the determination method is actually:

$$OP(x) = \frac{x(|W_1|, |W_2|, ..., |W_i|)}{\sum |W_i|}$$

(2)

The target value of the object is determined by the reliability of each field and the operator of the judgment method of the field: that is

$$CF(\text{object}) \begin{cases} 0, Wi < 0 & CFi = 0 \\ OP(x), \text{other} & \end{cases}$$

(3)

3. Cultivation of Vegetables without Pollution

3.1 Production Environmental Control

Good production environment is the premise and foundation of pollution-free vegetable production. According to relevant standards, strictly select and control the environmental quality of vegetable base, and grasp the first stage of pollution-free vegetables. Entrust province agricultural environment monitoring station and the city environmental sampling and comprehensive investigation on the station and quality standard reference base for soil environmental quality standard secondary standard, farmland irrigation water quality standards of the state, state of atmospheric environment quality standards and protect crops maximum allowable concentration of air pollutants and pollution-free vegetable production requirements.

3.2 Pollution-Free Cultivation Techniques

Compound biological fertilizer is a compound compound made of three kinds of soil beneficial microorganisms including nitrogen bacteria, phosphorous bacteria, potassium bacteria, organic matter, inorganic nutrients and trace elements.

(1) Chinese Cabbage Experiment

Test variety: Green star Chinese cabbage.

Fertilizer: Jiutai compound biological fertilizer, soybean meal organic fertilizer, Russian compound fertilizer, urea, potassium chloride, compound bacteria agent.

The test was carried out in a contracted field in this city, and 7 treatments were set for the test. Basal fertilizer of each treatment was applied 10 days before colonization.

(2) Chinese Cabbage Experiment

Test variety: Chinese cabbage 87115.

Fertilizer: Jiutai compound biological fertilizer, soybean meal organic fertilizer, Russian compound fertilizer, urea, potassium chloride, compound bacteria agent.

The test was carried out in a contracted field in this city, and 7 treatments were set for the test. The basal fertilizer of each treatment was applied 13 days before colonization.

4. Experimental Results of Pollution-Free Cultivation of Vegetables
4.1 Experiment of Cabbage

(1) Yield Comparison

![Comparison of Chinese cabbage yields](image)

Figure 1. Comparison of Chinese cabbage yields

As shown in Figure 1, it can be seen that the yield difference among all treatments is small. The main reason for the small yield difference is that the growth period of Chinese cabbage is short. In addition to the high temperature at that time, the nutrient released by the soil itself and the nutrient provided by fertilizers can meet the growth of Chinese cabbage, so the yield difference among all treatments is small.

(2) Nitrate Content

Table 1. Nitrate content in different treatments of Chinese cabbage

| Project     | 1    | 2    | 3    | 4    | 5    | 6    | 7    |
|-------------|------|------|------|------|------|------|------|
| Nitrate content | 2174.4 | 2026.5 | 1910.7 | 3217.5 | 3217.9 | 2401.7 | 2736.7 |

As shown in table 1, we can see that long tai compound fertilizer, all to be part of the basal using two soybean meal organic fertilizer processing low nitrate content were 2174.4 and 2026.5 mg/kg, this fully shows that long tai compound fertilizer all basal, soybean meal organic fertilizer all basal or long tai compound fertilizer and compound fertilizer as basal or long tai composite biomaterials applying topdressing urea, nitrate concentrations were significantly lower than control treatment of fertilizer.

4.2 Chinese Cabbage Experiment

Table 2. Experimental yield comparison of Chinese cabbage

| Project          | 1         | 2         | 3         | 4         | 5         | 6         | 7         |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Normal production(29m²) | 147.2     | 179.2     | 210.7     | 4         | 198.3     | 162.7     | 154.2     |
| Experiment production(667m²) | 3386.8    | 4117.8    | 8487.2    | 4554.2    | 3731.5    | 3542.7    | 3967.1    |
Figure 2. Experimental yield comparison of Chinese cabbage

As shown in Table 2 and Figure 2, it can be seen that the yield of treatment 3 is the highest, followed by treatment 4. In treatment 1, the single biological compound fertilizer was used as the base fertilizer. Due to the long growth period of Chinese cabbage and the large amount of fertilizer required, the nutrients provided by the compound biological fertilizer and the nutrients fixed or decomposed by three kinds of bacteria were not enough. Not only from the later growth potential, the old leaves were the first to wilt, but also the lowest in terms of the yield. It can be seen from treatment 6 that if phosphorus and potash fertilizer in the base fertilizer can basically meet the growth of Chinese cabbage, fertilization with nitrogen and potash fertilizer at the core stage has no effect of increasing yield, on the contrary, the yield is lower than that of the control group.

5. Conclusions

Full text main vegetables and mitigation and pollution-free cultivation expert system are introduced, the design and implementation of the system for vegetable cultivation from seed selection to harvest, divided into several phases, for each phase volume of pure index is put forward, through analyzing Dan, established index is given at this stage and the stage of remedial measures should be taken to make the vegetable cultivation has realized the more scientific management. However, the system needs to be further expanded and improved in the following aspects: the knowledge base of the system is not perfect enough, the database data is not enough, and the work of knowledge sorting and data accumulation needs to be further strengthened. In the next step, if the automatic acquisition of knowledge can be realized, the system will be more perfect.

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