Research Article

Synthesis and Properties of Supramolecular Crops Based on PNZST Antiferroelectric Film

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With the rapid development of ecological agriculture and the continuous changes of the ecological environment, crops are facing tremendous challenges. At the same time, people’s demand for the number and variety of crops is gradually increasing, so the synthesis and performance improvement of crops is imminent. The emergence of supramolecular crops has brought about huge changes in the yield of crops. In this paper, for the purpose of reducing the cost of crops and enhancing the ability of crops to adapt to the environment, PNZST antiferroelectric film materials are used to study the synthesis of supramolecular crops. Among them, rice, corn, and soybeans are used as reference objects for synthetic crops. Experiments were carried out in four aspects: growth rate, growth cycle, and yield. The growth status of the three crops in the past four years was monitored and recorded and analyzed.

The survival rate of traditional rice was 86.3%–89.5%, the growth cycle was 86–90 days, and the yield was 69–77 kg/ha; the survival rate of traditional corn was 85.6%–89%, the growth cycle was 105–114 days, and the yield was 38–43 kg/ha; the survival rate of traditional soybean was 85.6%–89%, the growth cycle was 85–90 days, and the output was 14–16 kg/ha. The survival rate of synthetic rice was 95.5%–96.9%, the growth cycle was 63–66 days, and the yield was 83–86 kg/ha; the survival rate of synthetic corn was 97.3%–98.7%, the growth cycle was 85–95 days, and the yield was 53–56 kg/ha; the survival rate of synthetic soybeans was 96.3%–98.3%, the growth cycle was 59–68 days, and the yield was 29–33 kg/ha.

1. Introduction

Antiferroelectric materials also have the possibility of application in infrared detection, parameter amplification, and high voltage generation. Lead zirconate, lead hafnate, sodium niobate, ammonium dihydrogen phosphate, ammonium iodate, and tungsten trioxide are all typical antiferroelectric materials. Although antiferroelectric materials are a kind of ferroelectric materials and have been widely used in the field of electrostatic energy storage, they still have shortcomings compared with the widely studied and applied ferroelectric and ferromagnetic materials. Due to the complexity of its own structure, people’s research on antiferroelectric materials is far from thorough and comprehensive. For example, in the middle of the last century, the phenomenological theory of ferroelectric materials has been basically perfected, but it was not until 2016 that researchers established a more reasonable antiferroelectric phenomenological model, and they failed to give experimental results, especially the explicit expression of atomic-scale electron microscope images of complex oxide systems for quantitative analysis, which limits the application prospects of this model. On the other hand, researchers often use element doping to improve the energy storage performance of antiferroelectric materials. For example, after doping 15 mol% of tantalum, the energy storage density of silver niobate can be increased from 2.1 J/cm³ to 4.2 J/cm³. If we can start from the phenomenological theory and find the determinants of its performance, we will be able to significantly promote the development of this field. Antiferroelectric thin film materials bring the possibility of the synthesis of supramolecular crops.

Supramolecular material is a supramolecular system formed by the combination of supramolecular force and supramolecular structure. It has special functions, such as elastic single crystal material, flexible porous material, oil/
water and water/oil convertible separation membrane, spiral channels with different apertures, full-color mononuclear electroluminescent materials, nanotubes with switchable apertures, self-healing materials, molecular motors, and nanomachines, and there is a lot of room for innovation.

For the research of PNZST antiferroelectric thin film materials and supramolecular crops, experts at home and abroad have done a lot of research. In this work, Patel S studied the high energy density (collection and storage) of Pb_{0.99}Nb_{0.02}[(Zr_{0.57}Sn_{0.43})_{0.92}Ti_{0.08}]_{0.98}O_{3} (PNZST). At the temperature of 303 and 403K, a large energy collection density of 1.0 MJ/m per cycle is obtained, and the electric field is circulated between 1 and 9 kV/mm. The estimated high energy harvesting is the result of the polarization change caused by the phase transition from ferroelectric (diamond) to antiferroelectric (tetragonal). Under an electric field of 9 kV/mm, a high energy storage of 0.9 J/m and an energy efficiency of 81% were obtained at 403K [1].

Several unknown, low-energy, dynamic, and stable phases are predicted by Barabash. One of the predicted metastable phases has limited ferroelectric polarization and may be a potential cause of the ferroelectric and/or antiferroelectric behavior recently reported in thin-based films. The other phases predicted here may form competitive nonferroelectric phases in the film. The possibility of their formation should be considered when analyzing the experimental film characterization data. The proposed method is superior to the existing theoretical structure prediction methods, including evolutionary algorithms. These methods have been applied to the same problem before, but most of the possible metastable phases found in this study have not yet been determined. This indicates that the structure enumeration technique may be essential for the actual structure prediction problem that seeks to identify all low-energy metastable phases instead of a single stable (lowest energy) phase [2].

Vlasenko studied the effects of tebuconazole and plant polysaccharide supramolecular complexes on the infection and germination of newly harvested spring wheat grains. The trials (2018, 2019) were carried out on Novosibirsk 31 and Obskaya2 varieties in the forest steppe area of Western Siberia. The crops were treated with tebuconazole mechanical complex and licorice root extract (ratio 1:5, 1:10) and arabinogalactan (1:10) at a flow rate of 0.5 kg/ha at the ear stage. When the two wheat varieties were treated with a complex of tebuconazole and licorice root extract (1:5), the best germination rates (95.0 and 89%) were obtained, which exceeded the standard. The complex of tebuconazole, licorice root extract, and arabinogalactan produced by mechanochemo-chemical methods is designed to protect wheat plants from leaf diseases, has a significant healing effect on newly emerging grains, and improves its seeding quality [3].

Zhang successfully prepared antiferroelectric (AFE) Pb_{0.94}La_{0.04}Zr_{0.97}Ti_{0.03}O_{3} (PLZT) thick film on nickel foil using the sol-gel method. The AFE film with high discharge energy storage density and fast discharge time provides a strong potential for the application of modern electronic and power systems [4]. Martinez studied the synergistic maltogenic amylase and branching treatments in extruded flour. Resistant molecules and supramolecular structures are created in the extruded flour. Combined enzyme treatment increases the short-range and long-range molecular sequences. Ethanol as an extractant is effective in retaining isomalto-oligosaccharides [5].

Vlasenko Ng studied the possibility of the supramolecular complex of tebuconazole and plant polysaccharides to prevent and control spring wheat leaf diseases. The experiment (2018, 2019) was carried out in Novosibirsk 31 and Obskaya2 crops in the forest steppe area of West Siberia. Using a mechanical complex of tebuconazole, licorice root extract, and arabinogalactan, the consumption rate of active ingredients is reduced by about 2.9 and 5.6 times, ensuring that the efficiency is not lower than that of the commercial fungicide Folicur, but in some cases even higher [6]. These studies provide an effective reference for our experiments. At the same time, the studies also have shortcomings and cannot be popularized very well.

Compared with traditional crops, supramolecular crops synthesized based on PNZST antiferroelectric film have low cost, fast reproduction, strong adaptability, large yield, and easy survival which can increase crop yields; can reduce production costs; can enhance crop resistance to insect pests, virus resistance as well as improve the storability of agricultural products; shorten the time of crop development; get rid of the supply of four seasons; break the boundaries of species, continuously cultivate new species, and produce food conducive to human health. However, the so-called increase in the production is based on conditions that are not affected by the environment. If natural disasters such as rain and snow are encountered, the production may be reduced even more severely. In addition, the test environment of this product is not comprehensive, so it cannot be guaranteed that the research is applicable to most countries in the world.

2. Research Methods of Synthesis and Performance of Supramolecular Crops Based on PNZST Antiferroelectric Film

For this research topic, we mainly study methods from two aspects of PNZST antiferroelectric thin film material and supramolecular material synthesis. Among them, the research part of PNZST antiferroelectric thin film material mainly explains its principle and function in the process of synthesizing crops. The research part of the synthesis of supramolecular materials mainly analyzes how to synthesize crops from its structure, characteristics, and synthesis methods. The combination of the two can promote the synthesis of crops. Therefore, the application and research methods of PNZST antiferroelectric thin film materials and supramolecular materials will be introduced below. The synthesis of crops stem from antiferroelectric thin film materials, as well as computer technology and chemical synthesis technology. The specific synthesis framework diagram is shown in Figure 1.

2.1. PNZST Antiferroelectric Thin Film Material. Antiferroelectric materials have antiferroelectric characteristics. From a macro perspective, antiferroelectric materials will not have spontaneous polarization.
materials will show some obvious performance characteristics according to temperature changes. At the phase transition temperature, the dielectric stability has a general value. Above the phase transition temperature, the relationship between the dielectric stability and the temperature follows the Curie–Weiss law [7]. The induction of temperature in the phase change and the induction of electric field in the phase change are synergistic. As the temperature increases, the film only needs to apply a lower electric field to complete the phase change process. When the antiferroelectric material is lower than the transition temperature of the antiferroelectric material, the adjacent unit cells are easily polarized in directions parallel to each other. There is no residual polarization in antiferroelectric materials macroscopically, but under the action of a strong external electric field, they can move to the ferroelectric phase, presenting a double electric hysteresis loop [8]. The double electric hysteresis loop of antiferroelectric material is shown in Figure 2.

The film exhibits double electric hysteresis loop characteristics at room temperature, and a small amount of residual bias remains after the electric field is removed, indicating that it is a specific antiferroelectric at room temperature. Under weaker electric field conditions, there is an approximately linear relationship between the polarization \( P \) of the film and the applied electric field \( E \). With the further increase of the applied electric field intensity, the polarization value of the film suddenly increases, and the polarization increases. The relationship between the intensity \( P \) and the electric field \( E \) no longer presents a linear relationship, and the antiferroelectric-ferroelectric phase transition begins. When no electric field is applied to the antiferroelectric material PNZST, the dipoles on the adjacent ion wires are arranged in antiparallel within a certain temperature range. Macroscopically, they have no external polarity, that is, the spontaneous polarization intensity is zero. After the electric field is applied, the opposite polarity of the electric field direction is redirected to match the electric field direction.

The energy \( M \) per unit volume of the antiferroelectric thin layer material corresponds to the following formula:

\[
M = \int_0^{P_{\text{MAX}}} EdP. \tag{1}
\]

In formula (1), \( M \) is the energy density that the antiferroelectric material can store per unit volume, and \( P_{\text{MAX}} \) is the maximum polarization intensity that the material can achieve. The P-E curve line of the nonferroelectric capacitor is linearly connected, and the energy density that can be stored is quadratic with the electric field, and it can be used as an ordinary energy storage device.

In order to obtain an antiferroelectric material with a large temperature change value and good energy storage performance, it can be achieved by adjusting the phase change switch and the polarization value of the antiferroelectric material. The calculation of the energy storage density of antiferroelectric materials is mainly based on the application of a critical electric field that is much larger than
the antiferroelectric-ferroelectric phase transition. The antiparallel dipoles in the material flip in the same direction as the electric field, and the iron with stored electric energy is obtained. Then, by applying a small external force to force the ferroelectric phase to return to the antiferroelectric phase, a pulse of large electricity is formed during this depolarization process, so as to achieve the purpose of storing energy. Energy storage capacitors are components composed of two metal plates and insulating dielectric materials. The greater the applied electric field strength the dielectric material can withstand, the greater its energy storage density. Since the energy stored in the material can only be released and only part of it can be used, the energy storage density in this article refers to the energy density that the material can release and use under a certain electric field strength. Under the action of an electric field, the internal lattice of the antiferroelectric film undergoes a phase change resulting in a change in the volume of the film, resulting in a large nonlinear bistable deformation, and the phase transition time is very short. The use of antiferroelectric thin film materials will bring a huge increase in the yield of crops.

2.2. Synthesis Methods of Supramolecular Materials.
Supramolecular materials usually refer to the combination of two or more molecules relying on intermolecular interaction to form a complex and organized aggregate and maintain a certain integrity in order to have clear microstructure and macroscopic characteristics. The main body of the supramolecular macrocycle includes DNA, crown ether, cyclo-dextrin, calixarene, calix pyrrole, calix carbazole, cucurbituril, and columnarene [9]. The structure diagram of supramolecular materials is shown in Figure 3.

Supramolecules are formed by three factors: energy, entropy, and molecular recognition. The specific relationship is shown in expression 2:

\[
\Delta S = \Delta R - T \Delta H. \tag{2}
\]

Among them, \( \Delta R \) represents the interaction and \( \Delta H \) represents the entropy factor [10].

Supramolecular materials integrate the structural information and functional information of the molecules themselves, and also use the intermolecular interactions to achieve dynamic control and functional coordination of molecular assemblies. It not only has a macroscopic performance but also can control the structure at the micronano scale, which is the future, and is considered as a breakthrough and a new starting point for high-performance materials. As a new material with great potential, supramolecular materials can be summarized as follows:

(1) Weak interaction force between molecules (abbreviated as supramolecular force) is additive and synergistic. The added supramolecular force is very strong, which can make the material form a stable topological structure, and the strong effect can be resolved under the action of an external field. Moreover, supramolecular force also has high stimulus responsiveness and strong environmental dependence [11].

(2) Supramolecular forces form supramolecular structures through assembly and self-assembly processes. The assembly process of supramolecules is the process of combining structural elements through supramolecular forces, or the process of dynamic molecular recognition. This process has the properties of dynamic equilibrium, so that the supramolecular structure has the characteristics of multiple structures, forming special assemblies with different structures, different states, and different compositions [12]. The assembly process mainly includes assembly and disassembly, interface assembly, and nonequilibrium assembly process with dissipative structure. Different assembly processes can produce different supramolecular structures and related structural details [13].

(3) Supramolecular structure and molecular structure are interdependent in a multidimensional space, forming a supramolecular system. Supramolecular system is a combination of multiple structures and functions, which can combine structures with different functions, such as the combination of organic and inorganic, rigid and flexible, and hydrophilic and lipophilic, linking a variety of structures with different or opposite properties [14]. The combination of dynamic and static functions makes the dynamic transformation and dynamic balance between nanorings, spiral fibers, nanotubes, and two-dimensional materials, so that the supramolecular structure in natural and synthetic material systems such as proteins also has self-repair and self-adaptation [15].

As an alternative to traditional covalent polymerization, supramolecular polymerization connected by noncovalent bonds is now a commonly used material synthesis method in scientific research and technological development. In the fields of molecular recognition, molecular self-assembly, supramolecular equipment, and supramolecular materials, supramolecular polymerization has become a powerful tool and preparation platform. The synthesis of supramolecular materials is a complex chemical reaction, and it is mainly the direct combination and splitting of chemical bonds that make the formation of supramolecular materials possible. The specific framework of supramolecules is shown in Figure 4.

This supramolecular synthesis research adopted the interaction stimulus response method and the π-π stacking method [16]. Among them, the interaction stimulus response method is divided into two kinds based on hydrogen bond and based on host-guest interaction. The above two methods are used in the synthesis process of this crop, so as to make the composition more stable. Supramolecular composites formed by intermolecular hydrogen bond
interactions are very important components in this field. Among all noncovalent interactions, hydrogen bonds are called “universal effects in supramolecular chemistry.” Hydrogen bond is essentially electrostatic. As a long-range force with moderate strength and directionality, it is more conducive to molecular orientation than charge interaction and Van der Waals force. It plays a huge role in the formation of supramolecular structure. Assembled, supramolecular compounds with various spatial configurations can be obtained. The use of hydrogen bonds to assemble organic molecules into molecular assemblies with special supramolecular structures is a very active research field in recent years. The strength of the hydrogen bond is very high, up to 120 kJ/mol, and the hydrogen bond also has a very good directional effect and can be oriented to construct a variety of supramolecular composites. Therefore, in recent years, hydrogen bonds have been widely used in the research and development of supramolecular composites. The host-guest interaction refers to the process in which the host (receptor) molecule selectively binds to the guest (substrate) and produces a specific function. The main body is usually a convergent bonding site and a cavity of a certain size, such as enzymes and synthetic macrocyclic molecules. The main macrocyclic molecules are crown ether, cyclodextrin, and calixarene [17]. The guest usually refers to a pair of cations and inorganic anions with divergent bonding sites. Common guest molecules include adamantane, paraquat, and ammonium salts. The π–π stacking effect refers to the weak interaction between two aromatic hydrocarbons, which exists in the interaction force between the electron-negative gene and the electron-deficient gene. Stacking methods can be divided into face-to-face stacking and face-to-side stacking [18]. Supramolecular composites based on π–π stacking have a wide range of applications in the field of crops.

The π–π stacking effect refers to the attraction between molecules containing the π system. Many experiments have proved that in the crystal packing structure of aromatic molecules, the arrangement of adjacent aromatic rings often takes a special orientation. This overlapping effect between aromatic rings brings considerable extra stability to supramolecular compounds. The use of supramolecular
materials is the most suitable combination found only in previous knowledge and many experiments and discussions. The random combination and use cannot bring good cost performance to the product.

3. Experiments on the Synthesis and Performance of Supramolecular Crops Based on PNZST Antiferroelectric Film

Methods and systems for evaluating the performance of large-area cultivated species are estimated using linear mixed models. The model has geostatistical components, including defined effects, random effects, and covariance parameters [19]. Fit the linear mixed model with the data in the field database to estimate the parameters of fixed effects, random effects, and covariance. Using the results of parameter estimation, the expected long-term performance of cultivated species can be estimated. Using the results of parameter estimation, the average performance of cultivated species can be predicted within a specified time period.

3.1. Measurement of Crop Performance Indicators. Select an area to establish a crop balance model, which is the basis of the entire experiment and plays a vital role in the collection and analysis of the experiment. In this study, rice, corn, and soybeans were used as the research objects of synthetic crops, and the three indicators of growth cycle, survival rate, and yield were tested. These three indicators can more comprehensively reflect the performance parameters. At the same time, the three indicators can be said to cover the entire process of crops from seedling to maturity [20, 21]. Therefore, the monitoring of the three indicators has become a focus of this research. This study adopted a monitoring method for the monitoring of the three indicators and recorded the data for subsequent data processing. The following is a detailed introduction to the specific steps of the monitoring method.

This article uses a crop growth cycle identification system when detecting crop growth cycles. Use the time prior of the crop growth cycle to obtain a plot image sequence of a plot in the crop growth period; perform adaptive segmentation on each plot image in the plot image sequence; input each sub-image after the segmentation into the volume product neural network to obtain the image features of each sub-image; input the image features of each sub-image into the hyperparameter neural network to obtain the image feature weight of each image in the sequence of plots; use the time of the crop growth cycle first experiment, constructing the image feature weight sequence of the plot image of the plot in the crop growth cycle; input the image feature weight sequence into the long- and short-term memory network to obtain the crop growth cycle identification result of the plot. In this method, the residual neural network can be trained to extract the image features of the sub-image [22]. Residual neural network is a structure that is widely used in convolutional neural networks. Its basic unit is residual block, which can be expressed as follows:

\[ W(r) = M(r) + r, \]

where \( M(r) = W(r) - r \) is the residual, and the final residual neural network output is shown as follows:

\[ H = M(r, [a1]) + a2r. \]

Among them, \( a1 \) and \( a2 \) are the training parameters that need to be learned.

For the detection of crop survival rate, this article adopts the average statistical method. The survival rate is measured on 10 representative fields evenly distributed in the selected area, and then the average value of the survival rate of the crops in the 10 fields is taken as the final detection result [23]. As a quantitative analysis method, statistical analysis is the materialization and quantification of survey data and provides data support for further theoretical analysis. In the analysis and processing of psychological information, mathematical statistics must be used. Only in this way can we draw correct conclusions from the collected data, derive unknown data from known data, and increase the possibility and initiative of scientific foresight in public relations work.

The method of measuring the yield of rice: according to the natural ecological area (range and plot), select 10 representative areas evenly distributed in the product measurement area, and sample at 3 points on the diagonal of each area. For transplanting rice, sample 21 rows at each point and measure the row spacing; select 21 plants to measure seedlings, measure the distance between plants, and calculate the number of holes per acre; select 20 holes to count the number of acres. For no-tillage and seed-to-seed rice, take the number of effective panicles above 1 square meter per position, and select 2–3 hole rice plants with an average panicle number [24]. The rice calculation formula is shown as follows:

\[ M = X \times Y \times \alpha \times N \times 10^{-6} \times 85\%, \]

where \( M \) is the yield per mu, \( X \) is the effective ear per mu, \( Y \) is the number of grains per ear, \( \alpha \) is the seed setting rate of the rice ear, and \( N \) is the weight of one thousand grains.

Yield per unit area (kg/mu) = number of ears/square meter \times number of ears/ear \times thousand-grain weight (g) \times seed setting rate (%) \times 666.7 (square meter) \div 1000 (grain) \div 1000 (g) [25]. The equation is shown as follows:

\[ T = A \times B \times N \times \alpha \times 666.7 \div 1000 \div 1000, \]

where \( T \) is the yield of rice per mu, \( A \) is the number of ears per square, and \( B \) is the number of grains per ear.

Maize yield calculation method: according to the natural distribution of the plots, 10,000 acres of display area is divided into 10 natural plots, each plot is randomly selected into 3 plots, and each plot is randomly selected for sampling at 3 points. The number of samples is 10 rows to calculate the average row spacing. Select 10 rows and 20 meters representative double rows, calculate the number of plants and ears, and calculate the number of ears per mu; in each measurement sample, collect 1 ear for every 5 ears, a total of 20 ears as a sample, determine the number of grains per
spike [26]. The calculation formula of corn yield is shown as follows:

\[ W = Z \times Y \times \beta \times 10^{-5} \times 85\% \]  

where \( W \) is the corn yield, \( Z \) is the number of ears per mu, and \( \beta \) is the 100-grain ear weight of the tested variety in four years.

Soybean yield measurement method: according to diversity, soil fertility, and crop growth, the field is divided into 5 natural blocks, and each block is selected from 1 to 3 representative blocks, and each block is selected in a certain pair. Take 3 samples, each production point adopts 3–5 point diagonal sampling method, and each sampling point is above 5 m from the ground, randomly selected. For planting in even rows or wide and narrow rows, measure the distance of 11 rows continuously at the sampling point, divide by 10, and calculate the average row spacing (m). Based on the average row spacing, calculate the row length of 2 square meters and the number of square meters of plants in two adjacent rows. The yield is calculated based on the weight of 100 perennial seeds of different varieties, and 90% is converted into the measured yield. Take the average output of 5 points as the average output of the representative area [27]. The calculation method of soybean yield is shown in the following formula:

\[ E = P \times H \times J \times 10^{-5} \times 0.9 \]  

where \( E \) is the measured soybean yield, \( P \) is the number of soybean plants per mu, and the number of plants/\( \text{mu} = 666.7 \) square meters/(average row spacing \( \times \) average plant spacing), average row spacing and average plant spacing refer to the average number of sampling points, and \( J \) is 100 which is the weight of the soybeans.

Any crop needs moisture, air, and suitable temperature. However, different crops have different requirements for these three conditions [28]. We have monitored the growth of rice, corn, and soybeans in an environment adapted to the growth of synthetic crops. The specific testing data are shown in Tables 1–3.

Table 1 shows the monitoring data of rice growth. The data in the table show that the plant height of rice is generally about 70 cm, the number of stems is 23–35, and the leaf age has reached 10.2 or more. Overall, the growth status is good.

Table 2 shows the monitoring data of corn growth. The data in the table show that the plant height of corn is generally around 220 cm except for a few exceptions, and the number of blades has reached more than 17 pieces. Compared with traditional corn, the overall growth of synthetic corn is good, and it is relatively good.

Table 3 shows the monitoring data of soybean growth. The data in the table shows that the plant height of soybeans is generally about 58 cm except for a few. The number of three compound leaves has reached more than 17, and the leaf growth of synthetic soybeans is very vigorous.

3.2. Comparison of Experimental Results. In order to be pertinent, the research objects selected for this study are rice, corn, and soybeans in crops that not only can we better observe the changes in the growth of different crops but also can reflect the performance of traditional crops and synthetic crops [29]. Performance aspect is mainly to monitor the survival rate, growth cycle, and yield of crops [30]. Finally, statistics and comparisons are performed on the monitored data results [31]. The specific crop performance data will be presented in the form of statistical graphs to show the changes of the data in a simple and clear way and analyze the dynamics of the data [32]. The comparison result of crop survival rate is shown in Figure 5.

Figure 5 shows the survival rate of traditional crops and synthetic crops in different years, where statistical graph a represents the survival rate of traditional crops in different years, and statistical graph b represents the survival rate of synthetic crops in different years. It is obvious from the statistical chart that the survival rate of synthetic crops is
higher than that of traditional crops, and the survival rate has increased by more than 10%.

The growth cycle of crops depends on climatic reasons, including sunshine, temperature, and humidity, and also the conditions required to control plant growth. Long sunshine time, high temperature, and high humidity will shorten the growth cycle of plants, otherwise, it will be long [33]. Even the existing biotechnology affects the growth cycle of plants from these aspects. The crop growth cycle of this article is shown in Figure 6:

Figure 6 shows the growth cycle of traditional crops and synthetic crops in different years, where statistical graph a represents the growth cycle of traditional crops in different years, and statistical graph b represents the growth cycle of synthetic crops in different years. It is obvious from the statistical chart that the growth cycle of synthetic crops is faster than that of traditional crops, and the growth cycle is basically shortened by more than 15%.

Figure 7 shows the output of traditional crops and synthetic crops in different years. Statistical graph a represents the output of traditional crops in different years, and statistical graph b represents the output of synthetic crops in different years. It is obvious from the statistical chart that synthetic crops have more output than traditional crops, and the output has increased by more than 10%.

4. Discussion

This article is based on a familiarity with the general background, draws on some theoretical knowledge summarized by the predecessors, analyzes the core part of the research topic, and also determines the research direction of this article. The core of this paper is the analysis of PNZST antiferroelectric film, the synthesis of supramolecular crops, and the research of crop performance. First of all, through the understanding of the principle of PNZST antiferroelectric film material, it is not difficult to see that PNZST antiferroelectric film is not only widely used in molecular devices but also has advantages in crop synthesis.

In the analysis of the structure and characteristics of supramolecular materials, the interaction stimulus response method and the $\pi-\pi$ stacking interaction method are used for the synthesis of supramolecular crops. The crops synthesized by the two methods of supramolecular materials not only meet our requirements for crop performance but at the same time the crops themselves are also suitable for most environments and will not change the performance of crops due to environmental differences. If only one of the interaction stimulus response method or the $\pi-\pi$ stacking method is used, the performance of the synthesized crops cannot reach the desired result. Antiferroelectric thin films provide a synthetic basis for supramolecular materials, and supramolecular materials maximize the role and value of antiferroelectric thin films.

This article is based on the synthesis of three types of crops: rice, corn, and soybeans. The three indicators of the survival rate, growth cycle, and yield of the three types of crops are tested and counted. Among them, the average statistics are used when testing the survival rate of crops. Although the results obtained in this way cannot guarantee precise reliability, relatively speaking, there will be no chance. When detecting the growth cycle of crops, the convolutional neural network algorithm is used [34]. The advantage of this algorithm is to save manpower and material resources, and the data obtained are very accurate.
The disadvantage is that the demand for experimental data is large, but you can try to increase it through data, and other methods to avoid potential defects. In the detection of crop yield, because of the different characteristics of the three crops, different calculation methods are used to calculate the yield, but in general, the diagonal algorithm is still used [20]. This algorithm has a clear idea and simple process and is widely used in real life.
Finally, the analysis of the experimental data is also as comprehensive as possible. Although it is only monitoring the three aspects of the crop performance indicators, it cannot fully explain the comprehensive improvement of the synthetic crops in terms of performance, but this part of the data is already very representative. It can reflect the reliability of our research and avoid the contingency of experimental results as much as possible. Antiferroelectric thin films and supramolecular materials will be used more frequently in the future, not only because of the popularity of emerging materials but also because of the inevitable trend of future social development.

5. Conclusion

This paper studies the synthesis and performance of supramolecular crops based on PNZST antiferroelectric film. The synthesis of supramolecular crops through PNZST antiferroelectric film not only uses the super energy storage function of antiferroelectric film but also uses a combination with supramolecular chemistry technology to complete this research. Although there are some twists and errors in the research process, this does not affect the final results of the experiment. It is not difficult to see that the overall performance of synthetic crops has improved by at least 10%, and also the adaptability of synthetic crops is very strong. The crops have shortened the long growth cycle, and at the same time the yield of crops has also increased a lot. The improvement of crops is not very large, but the agricultural industry chain is relatively extensive. If it is fully promoted, it will inevitably cause quantitative changes due to this qualitative change, so crops are worthy of large-scale promotion. We cannot change the environment, but we can only improve the performance of crops while adapting to the environment as much as possible.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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