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Classification and Recognition of Crops Based on GIS Image

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Abstract: *Today, due to the rapid development of science and technology, new science and technology constantly change the status of agriculture, precision agriculture is developing rapidly. Precision agriculture is the combination of three new technologies: Global Positioning System (GPS), Remote Sensing Technology (RS) and Geographic Information System (GIS). In the 3S technology, GIS technology is the basis of realizing the other two technologies. It is a platform to achieve precision agriculture, supporting the input, analysis and output of agricultural resources data and other functions of precision agriculture. Classification and recognition of crop types is one of the most basic applications of precision agriculture. It can extract information from remote sensing images, accurately identify crop types and determine crop growth. In this paper, 7200 remote sensing image samples are divided into two groups: learning group and testing group. Combined with GIS image and RS technology, the characteristics of these four crops were summarized and counted through feature image extraction and feature data analysis of 5200 study group samples in GIS system. 2000 samples in the test group were used to calculate the recognition rate. Through experiments, we can know the recognition rate of peanut, spring maize, sweet potato and summer maize. The highest recognition rate is 98.60%, the lowest recognition rate is 90.20%, and the total recognition rate is 94.10%. It shows that in this experiment, the crop recognition rate of remote sensing image is very high in the application of classification and recognition based on GIS crop images. During the period when the spectral characteristics are very obvious, the recognition rate of crops in remote sensing images is higher, and the total recognition rate is increased by 3.98%. The NDVI values of crops in remote sensing images were analyzed and calculated, and the NDVI values of four crops in each growing period were obtained. By studying the NDVI value, we can determine the types of four crops and their growth period, and the accuracy of determining the types of crops is higher than that of determining the growth period of crops. Through the classification and identification of crop species and crop growth period, two experiments verify that the combination of GIS image and remote sensing image can improve the recognition accuracy of crop classification and identification, and the use of geospatial data in GIS can identify the differences between crops. By combining GIS images with remote sensing images, the development of precision agriculture can be promoted, and the reference for agricultural production and agricultural structure adjustment in designated areas can be provided.*

Keywords: *GIS Image, Spectral Characteristics, Classification and Recognition, Remote Sensing Image.*

1. Introduction

In today's society, medical science and technology are constantly increasing, the intensity of prevention and treatment of human diseases is also increasing, the life span of human beings is increasing, and the total population is also increasing. Agricultural resources are the indispensable material basis for people. Therefore, with the increase of population and the increasing demand for agricultural resources, agricultural production has become more and more important. Under such circumstances, precision agriculture came into being [1].

The total population of China is still very high, but the arable land area is decreasing. In the last century, many Chinese scientists began to explore how to accurately use land for agricultural production in order to maximize the benefits of limited arable land. However, due to the variety of crops, different planting time, different planting methods, and different farming habits in different

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regions, the promotion of precision agriculture is relatively difficult.

Today, with the rapid development of science and technology, new science and technology are constantly changing the current situation of agriculture. Among them, GIS image is the most widely used technology. After more than 30 years of continuous research, the theoretical research of GIS has gradually matured and improved. Now more attention has been paid to the integration of GIS and other technologies. Precision agriculture is the combination of three new technologies: Global Positioning System (GPS), Remote Sensing Technology (RS) and Geographic Information System (GIS) [2]. These three new technologies are collectively called 3S technology. The goal of information agriculture and digital agriculture has been achieved through precision agriculture. In the 3S technology, GIS technology is the basis of realizing the other two technologies [3]. GIS technology is a platform to realize precision agriculture. It can support the realization of precision agriculture functions such as input, analysis and output of agricultural resources data. In precision agriculture, we monitor crops, collect a large number of remote sensing image monitoring data, and use GIS technology to analyze and manage these data in order to achieve the purpose of managing agricultural areas. In agricultural production, the application of accurate agricultural monitoring crop information and scientific management [4] of agriculture can achieve greater economic benefits, create high-yield, high-quality crop industry, and ensure the safety of production process.

Classification and identification of crops is one of the most basic applications of precision agriculture. Classification and recognition of crops mainly refers to the recognition of different crops or different growing periods of the same crops in the designated region in remote sensing images [5]. Before recognizing remote sensing images, it is necessary to determine the crop types and the image characteristics of different crop growing periods in remote sensing images, and then extract the information of all crops in the image area from the remote sensing images of the designated area, and match the identified image features, we can identify the different growth stages of different crops or the same crops in the region.

In recent years, there are many methods to classify and recognize crops using remote sensing image data, such as hyperspectral remote sensing image, object-oriented decision tree and so on. Based on these methods, the combination of GIS and GPS non-remote sensing image data sources and remote sensing images can improve the accuracy of crop classification and recognition [6] [7]. In this paper, the combination of GIS image and remote sensing image is applied in crop classification and recognition [8]. The remote sensing image samples of peanut, spring maize, sweet potato and summer maize were divided into two groups: learning group and testing group to classify and recognize crop species and crop growth period. The characteristics of the four crops were summarized and counted by extracting the feature images and analyzing the feature data of the samples in the study group. Then the samples in the test group were tested and the recognition rate was calculated. In this paper, the combination of GIS image and remote sensing image is applied to crop classification and identification through experiments, which can improve the accuracy of crop classification and identification. Using geospatial data in GIS can identify the differences between crops, promote the development of precision agriculture, and provide reference for agricultural production and agricultural structure adjustment in designated areas.

2. Geographic Information System (GIS)

2.1. Concept of GIS

GIS is the abbreviation of Geographic Information System [9]. In simple terms, GIS is a spatial information system based on computer system, which can collect, manage, calculate and analyze geospatial data and images, and display the results of analysis to users. GIS has established a special geospatial database, which converts images and data into each other. Based on the analysis results, a geospatial model is established to update the dynamic changes of geospatial accurately and truly, and to provide services and analysis basis for the study of various geospatial resources and environmental information. Therefore, GIS is also called geoscience information system, or resource and environment information system. GIS combines computer science, geospatial science, environmental science and management science. The system has good application prospects in agricultural management, environmental assessment and land management.

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2.2. Composition of GIS

A complete GIS needs to include three parts: computer system, database system and management system.

(1) Computer System

The computer system is divided into hardware system and software system, which provides a basis for the processing of geospatial data, improves the efficiency of image processing, and provides an application basis for the realization of GIS functions. The biggest difference between a complete GIS and a general computer system is its spatial analysis function.

(2) Database System

The database system is a data platform for remote sensing monitoring and recognition. It can not only store the characteristic data of various crops, but also provide support for the follow-up function of data processing and analysis. It can realize the accurate and efficient operation of spatial data, has strong professionalism and expansibility, and is conducive to the later update and improvement.

The database system can be divided into two categories according to different storage data: spatial database and attribute database. Crop growth environment is complex and land conditions are diverse, so geospatial data is very important for crop research. Therefore, in the spatial database, there are geospatial coordinate systems, data and projection information that can reflect the spatial location of the location. Therefore, spatial database includes three main parts: RS data, GIS data and GPS data. Attribute database includes not only crop types at different growth stages and characteristic data at different growth stages, but also image data monitored by remote sensing. Therefore, attribute data can be divided into agricultural statistics, ground monitoring data and remote sensing image data.

(3) Management System

According to GIS analysis technology, statistical prediction ability and other RS technology, a management system is formed. The system is used to manage the types of crops and the characteristic information of different growth periods, so as to achieve the purpose of analysis, decision-making and assistance, and to provide a scientific theoretical basis for crop management, production and planning.

2.3. Functions of GIS

GIS mainly collects, manages, calculates and analyses the geospatial data and crop information in remote sensing images, establishes the geospatial model based on the analysis results, and presents the analysis results to users in the form of images. Therefore, the functions of GIS mainly include the following five aspects.

(1) Data Monitoring and Collection

The ground vegetation is monitored by satellite and other devices. The remote sensing image is acquired regularly and stored as the collected remote sensing image data.

(2) Data Processing

Because the collected remote sensing image data are the original image resources, after pretreatment of these original image resources, the image information can be transformed into an analytic data type, and then the feature data of the remote sensing image can be extracted according to the need, then converted into structured data, and stored in the database.

(3) Data Management

The feature data in remote sensing images are stored and retrieved by establishing a database.

(4) Data Analysis

Data analysis is the key function of GIS. This function is used to query and retrieve the processed feature data, analyze multiple data, analyze buffer data and model data. Among them, the feature data after query processing is the most basic analysis function.

(5) Data Output

After calculation and analysis, the processing results need to be output to users so that users can get the information they need. Therefore, the processed data are usually generated by the combination of remote sensing image data and geospatial data of GIS, and output to users through computer display screen.

2.4. Technology of GIS

In the past, GIS application program is to modularize the functional modules that need to be implemented, and then combine these modules together to form a complete software. However, full-featured software requires high hardware configuration. The software has fewer functions in practical application, so the GIS technology is constantly updated to improve the software utilization and work efficiency.

(1) ComG15 Technology

ComG15 technology is a standard component platform based on GIS technology in the past. In this platform, each component can be combined with other systems through different reorganization methods. The functions of the system are very flexible, and the scalability is very strong. To a certain extent, the efficiency and utilization ratio of GIS applications are improved. ComG15 technology has the characteristics of low cost, strong versatility and easy learning after modularization.

(2) WebG15 Technology

WebG15 technology is the product of the combination of GIS technology and Internet technology, which enables users to obtain spatial data related to GIS in the network for research. The application of network technology makes WebG15 have the same function as network. WebG15 can implement cross-platform applications, expand user groups and upgrade software. WebG15 technology based on Internet technology is widely used.

2.5. Integration of GIS and other Technologies

Since the 1980s, scientists have proposed to integrate the two independent systems of geographic information system and remote sensing technology. Remote sensing technology is used to update and load data sources of GIS data, while GIS provides analysis tools for information extraction of remote sensing images. The combination of the two methods can change the spectral information in remote sensing images, increase the amount of information in remote sensing images, improve the integrity of extracting information, improve the accuracy of crop classification and recognition, and promote the development and application of remote sensing images and GIS images.

3. Classification and Recognition of Crops

The classification and recognition of crops can be realized by extracting image features from spectral information of remote sensing images. Therefore, the key to improve the accuracy of crop classification and recognition is to acquire crop image features in remote sensing images.

3.1. Image Characteristics of Crops

The image features of crops in RS images are mainly spectral and texture features.

(1) Spectral Characteristics

Crops belong to green plants. The chlorophyll content in leaves will change with the growth period and health conditions. The content of chlorophyll in crop leaves will directly affect the activities of light absorption and reflection of crop leaves. The effects of leaves and light directly affect the spectral characteristics of crops [10]. By analyzing the spectral characteristics of crops in remote sensing images, crops can be classified, identified and monitored.

(2) Texture Features

Texture feature is the most commonly used feature in the previous image classification processing. Texture feature is formed according to the gray level of different spatial positions in the image. In remote sensing images, different crops have different texture features. Texture features can better classify spectral features and improve the accuracy of crop classification and recognition.

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3.2. Recognition Methods

According to the image characteristics of crop in remote sensing image, the suitable recognition method is selected.

(1) Target Detection

Target detection method is to extract information from remote sensing images, retrieve information according to the spectral characteristics of target crops, and carry out spectral matching to identify the crops with the spectral characteristics in remote sensing images.

The commonly used spectral matching methods include:

1) Matched filtering (MF) [11]

By matching filtering, the spectral response of remote sensing image is increased and other irrelevant responses are reduced. The spectral characteristics of the target crop are matched to detect the target crop.

2) Minimum Energy Constraint (CEM) [11]

Through FIR and its constraints, CEM minimizes the output capability, reduces other irrelevant responses and highlights the target spectrum. After CEM treatment, the spectrum was matched with the spectral characteristics of the target crop, and the target crop was monitored.

3) Adaptive Uniform Estimation (ACE)

After ACE processing, the gray level of remote sensing image is matched by interactive stretching tools.

4) Mixed Tuned Matched Filtering (MTMF)

Through MTMF, the unreasonable image is added to the matched filter, which reduces the easily confused spectrum and increases the accuracy of the matched filter.

(2) Decision Tree Classification

Decision tree classification is a judgment criterion for classification after analyzing and classifying a large number of data. In GIS, crops are classified and recognized according to the judgment criteria. In this method, the judgment criteria are generated into tree structure, and the information in remote sensing image is recognized in the order of top-down.

(3) Vegetation Index

In extracting information from remote sensing images, vegetation index is used as the characteristic index of crop classification and recognition. Vegetation index can not only reflect the spectral reflection characteristics of green vegetation, but also reflect the growth period of crops. After decades of development, vegetation index has also been emerging new achievements, such as SAHVI, ARVI, EHVI, NDWI, TMVDI, NDVI and so on. The spectral reflectance characteristics of different crops are different. Therefore, by calculating different vegetation indices, different kinds of crops and different growth periods can be distinguished.

Normalized vegetation index (NDVI) is used as an experimental evaluation index in this paper.

3.3. Remote Sensing Image Recognition

(1) Artificial Recognition

Remote sensing image contains a lot of information, including crop, environment and other information in the region at that time. People themselves have the ability of recognition. People can distinguish the crop species according to the image characteristics and their own cognition in remote sensing images, and analyze the growth period of the crop. Therefore, the use of human resources to classify and identify crops is too time-consuming and energy-consuming, and long-term work will make staff in a state of exhaustion, reduce the recognition rate. Therefore, artificial recognition is not conducive to the promotion of remote sensing image recognition technology, and artificial recognition can only recognize simple images, can not analyze and process image information.

(2) Computer Recognition

Because the information contained in remote sensing images is complex, the method of analyzing and processing such information is also complicated. Therefore, the analysis and processing of remote sensing images can only be accomplished by means of computer, and the classification and recognition of crops can be realized.

The characteristics of crop samples can be recorded in the database by the learning function of computer, and then the remote sensing images can be classified and recognized efficiently and quickly by computer. In some more complex geographic environments, it is also necessary to provide information for computer classification and recognition through maps, geographical reports and other ways, to help the computer to carry out classification and recognition, and to ensure the accuracy of computer classification and recognition.

3.4. Remote Sensing Image Recognition Based on GIS Image

Remote sensing image recognition based on GIS image is to superimpose RS image and GIS image for analysis. By extracting spectral features from remote sensing image, not only crops in remote sensing image can be classified and recognized, but also recognition accuracy can be improved. By matching the spatial geographic coordinate system of GIS image with the pixel coordinate system of RS image, the geospatial recognition of crops is realized by using the attribute data and spatial data of GIS system.

4. Experimental Results and Analysis

4.1 Sample Information for Participating in the Experiment

The sample of this paper is the OLI remote sensing image data of Landsat 8 satellite in the selected area, which comes from the cloud platform of geographical condition monitoring (http://www.dsac.cn/DataProduct/Detail/101900).The image resources of the satellite can be obtained free of charge on the network. The remote sensing image has high resolution and rich information. Its remote sensing image can not only classify and recognize crop species, but also classify and recognize crop growth period.

Because the collected remote sensing image data are the original image resources, it is necessary to pre-process these original image resources, and the processing results are shown in Figure 1.

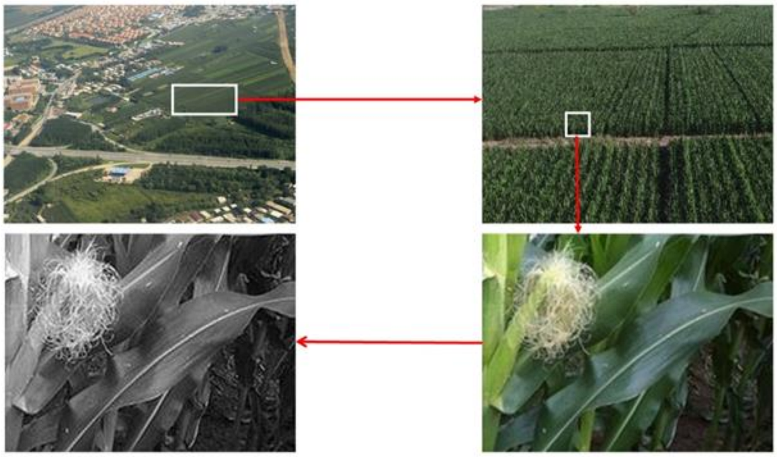

Figure 1: Preprocessing of the original image resource

Through the extraction and analysis of crop image features, the method of crop classification and recognition based on GIS image was tested. Because the monitoring interval of the satellite is 16 days, the satellite remote sensing images of summer maize, spring maize, peanut and sweet potato growing period in the selected area are selected as the samples for this experiment. The monitoring time of satellite remote sensing images ranges from April to 10, totaling 7200 remote sensing image samples. These samples are divided into two groups, learning group and testing group. Among them, there are 5200 sample images as learning group and 2000 samples as testing group.

Through the combination of GIS image and RS technology, the features of 5 200 samples of the

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study group were extracted, analyzed and processed in the GIS system. The characteristics of these four crops were summarized and counted, and the judgment criteria were formed. 2000 samples in the test group were tested and the recognition rate was calculated.

The number and category of samples are shown in Table 1.

Table 1: Number and Category of Samples

Category	Learning Group	Testing Group.	Total
Peanut	1562	500	2062
Summer Maize	1056	500	1556
Spring Maize	1952	500	2452
Sweet Potato	630	500	1130
Total	5200	2000	7200

The growth period of four crops is shown in Table 2. In July, peanuts, summer maize, spring maize and sweet potatoes were in the growth stages of flowering, jointing, heading and ridging respectively. Therefore, during this period, the chlorophyll content of leaves was the highest, photosynthesis was the strongest, and spectral characteristics and texture were relatively prominent. In this period, it is the best time to classify and recognize crops, and the accuracy of identification is the highest.

Table 2: Growth Period of Four Crops

Time (month)	Peanut	Summer Maize	Spring Maize	Sweet Potato
4				Sow
5	Sow		Sow	Branch
6	Jointing	Sow	Jointing	Pumping vine
7	Bloom	Jointing	Heading	Ridge closure
8	Pod	Heading	Mature	Seedling returning
9	Mature	Mature		
10				Mature

4.2. Classification and Recognition of Crop Species

The image features of four crops were summarized by selecting the samples of the study group. The image features of summer maize, spring maize, peanut and sweet potato were obtained. Then the samples of the test group were classified and identified by using GIS system. The results are shown in Figure 2.

In Figure 2, we can see that the order of recognition rate from big to small is peanut, spring corn, sweet potato and summer corn. The highest recognition rate is 98.60%, the lowest is 90.20%, and the total recognition rate is 94.10%. It shows that in this experiment, the application of crop classification and recognition based on GIS image has a high recognition rate for remote sensing image, and has a good application prospect. The difference of recognition rate for different crops may be due to the different image features of different crops, resulting in the low matching rate of feature data in the matching process in the GIS database, or the lack of image data for learning, which makes the feature data incomplete and unable to fully recognize various states. Crop characteristics. For the same crop recognition rate is different, for example, the recognition rate of summer maize and spring maize is 5%. The most likely is that the image data used for learning is a little less, which makes the feature data not comprehensive enough to fully recognize the crop characteristics in various states. Therefore, further research is needed in this experiment.

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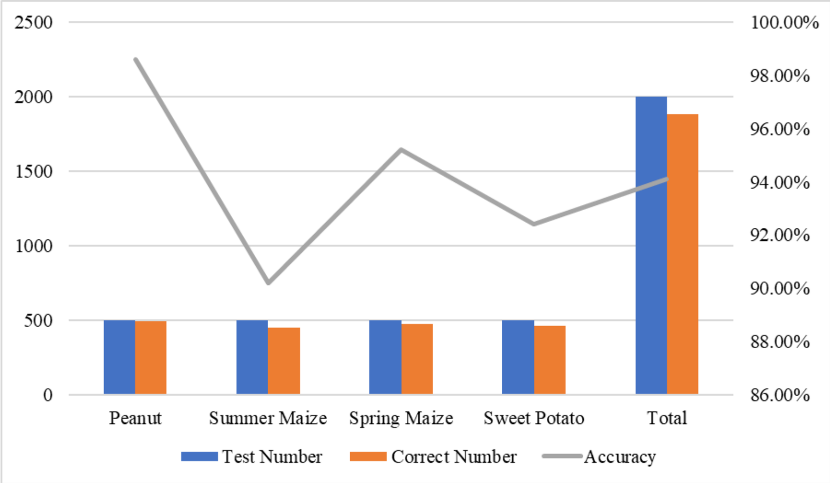

Figure 2: The results of classification and recognition of crop species for all samples of the test group

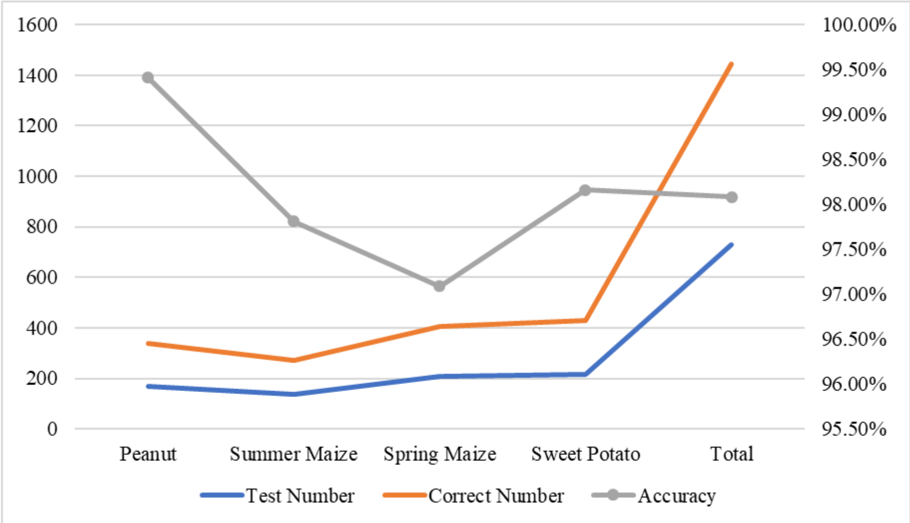

Figure 3: The results of crop classification and recognition for July samples in the test group

Because in July, peanuts, summer maize, spring maize and sweet potatoes are in the peak season of flowering, jointing, heading and ridge closure respectively. The leaves of each crop contain a large amount of chlorophyll, and the spectral characteristics and texture are very prominent. In this period, it is the best time to classify and recognize crops, and the accuracy of identification is the highest. Therefore, as can be seen from Figure 3, the recognition rate of the four crops in July has been significantly improved. Among them, the recognition rate of peanut samples in July is the highest, with the recognition rate of 99.41%, which is 0.81% higher than that of all test groups. The recognition rate of Summer Maize in July was 7.61% higher than that of all test groups. The recognition rate of Spring Maize in July was 1.89% higher than that of all test groups. The recognition rate of sweet potato samples in July was 5.76% higher than that of all test groups. Therefore, it is shown that the recognition rate of classification and recognition in remote sensing images is different when monitoring and collecting remote sensing images of crops in different periods.

4.3. Classification and Recognition of Crop Growth Period

Because the time interval of remote sensing image used in this experiment is sixteen days. Therefore, from April to 10, the time of remote sensing images is 4.3, 4.19, 5.05, 5.21, 6.6, 6.22, 7.9, 7.25, 8.10, 8.26, 9.11, 9.27, a total of 12 days of remote sensing images. After classifying and identifying the 12-day samples, the samples were divided into four groups: summer maize, spring maize, peanut and sweet potato. Then the NDVI values in each group were calculated. The average NDVI values of each group were calculated and the figure 4 was obtained.

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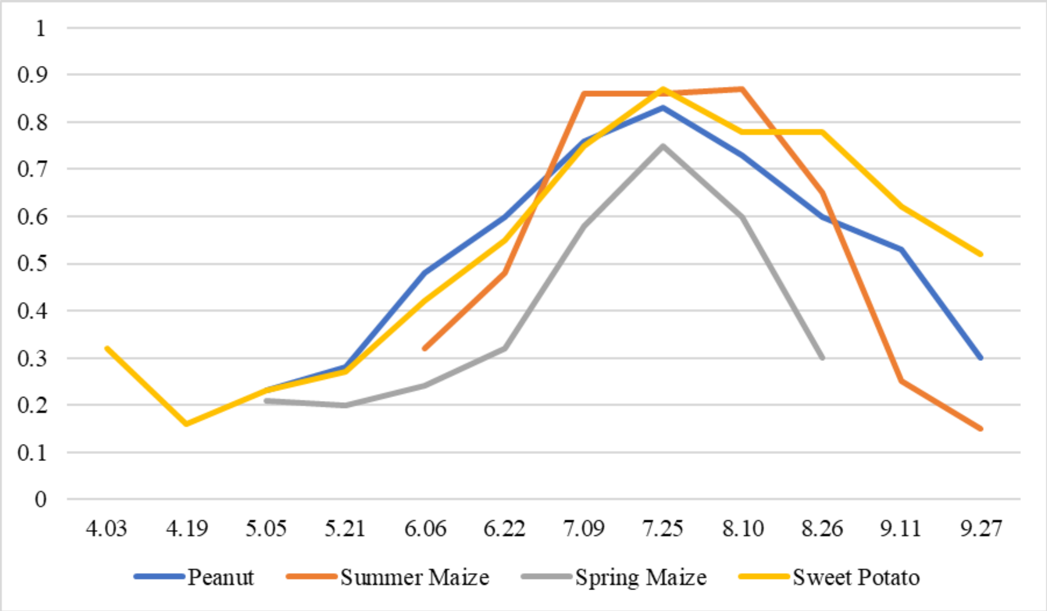

Figure 4: Results of NDVI detection for samples in the test group

In Figure 4, we can see that the NDVI values of these four crops are different in different time periods. NDVI value in crops will show a certain trend with the change of growth period. This trend changes obviously in different growth periods, which can be considered as a characteristic of different crops. Therefore, when classifying and identifying crops, the NDVI values of different crops at different growth stages can be used as a reference standard for identification.

Through the study of NDVI values of summer maize, spring maize, peanut and sweet potato in different time periods, we can find that the NDVI values of peanut begin from seedling emergence in May and end after ripening in September. The NDVI value of summer maize begins from seedling emergence in June and ends after ripening in September. The NDVI value of spring maize begins from seedling emergence in May and ends after maturity in August. The NDVI value of sweet potato was calculated from transplanting in April, and it ended after maturing in October. Summer maize, spring maize, peanut and sweet potato are four kinds of crops every year. Their NDVI values change little, but the changing trends of different crops are different. Because sweet potatoes are cultivated by transplanting seedlings, the NDVI value was higher in the first few days of April. After planting, due to the change of soil environment, sweet potatoes passed a period of adaptation, so the value of NDVI on the day of 4.19 became smaller. After the adaptation period, the NDVI value of sweet potatoes is the normal trend. During the branching period in May, the sprouting period in June will gradually increase and the ridge closure period in July will reach the maximum, then the seedling return period in August and the pod period in September will fall, until the maturity period in October will become smaller. The other three crops are planted in the form of seeds, so the trend of NDVI values of these three crops is basically similar. Summer maize is planted in June, jointing and heading for two months. These three months are full of sunshine, which can promote the photosynthesis of summer maize leaves, accelerate the growth of summer maize, and increase the chlorophyll content of summer maize leaves. Therefore, the NDVI value of summer maize is higher than that of spring maize, and reaches the highest value of NDVI value in July and August. During the maturity period of September, the leaves shrink and yellowing gradually, the ground exposes, and the NDVI value decreases rapidly. This is also the biggest difference between spring maize and summer maize in the trend of NDVI value. Spring maize and summer maize can be distinguished according to the size and trend of NDVI value. The change trend of spring maize is gradually increased according to the time change of sowing date, jointing date and heading date. At heading date, NDVI value is the largest, and then decreases after maturity. The trend of NDVI value of peanut is similar to that of spring maize. The NDVI value of peanut is larger than that of Spring Maize in the same period, which is also an important feature to distinguish spring maize from peanut.

However, the variety of crops, growth period, soil nutrients, atmospheric environment, human factors and other reasons will have an impact on NDVI value, changing the size of NDVI value, making the trend of NDVI value change obvious mutations and burrs, affecting the accuracy of crop classification and recognition. Therefore, after extracting the remote sensing image information, the data need to be processed, so that the calculated NDVI value curve has no obvious mutation and burr. The whole NDVI value curve presents a smooth and integrated trend, which is conducive to the output of the analysis results. The NDVI value between the sampling image time also meets the growth law of crops.

Therefore, the trend of NDVI values of different types of crops is taken as a feature to distinguish crop species and growth period.

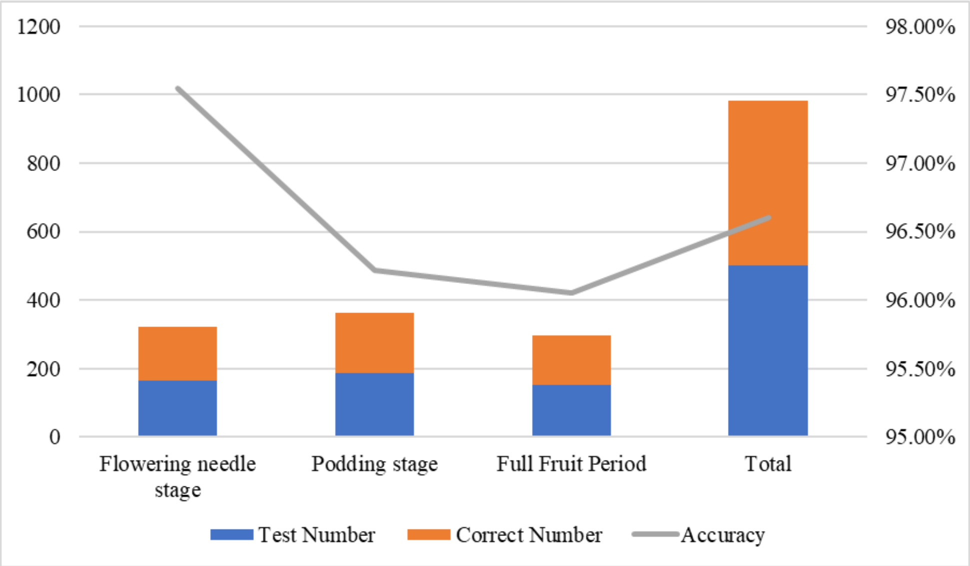

Figure 5: Growing-period classification of peanuts in samples

As shown in Figure 5, this is the result of classification and recognition of peanut growth period in the sample. Peanut blossoms in May-July, pods in the next month, and full fruits in September. From Figure 5, we can see that peanut leaves grow rapidly at flowering and needle stage, with high extensibility, covering the ground, and the chlorophyll content of the leaves is also very high. The NDVI value of peanut in this period is relatively large, which can clearly identify peanut at flowering and needling stage. At the pod stage and ripening stage, because peanut fruit is in the soil, the surface can not see the image of peanut pods, only the leaves are changing. During this period, the chlorophyll content in the leaves decreased, the leaves gradually shrank and yellowed, and the ground was exposed. The NDVI value in this period was smaller, and the recognition rate became smaller. According to NDVI value, the recognition rate of peanut growth period is 96.60%, which is 2.81% lower than that of direct identification of peanut species. Therefore, the accuracy of identifying crop species is higher than that of identifying crop growth period, and more samples are needed to learn the characteristics of crop growth period, which makes the data in matching database richer.

However, compared with RS technology alone, RS technology based on GIS image can improve the recognition rate in crop classification and recognition.

5. Conclusions

Classification and recognition of crop species is one of the most basic applications of precision agriculture. It can extract information from remote sensing images, accurately identify crop species and determine crop growth period. In this paper, 7200 remote sensing image samples are divided into two groups, learning group and testing group. Through the combination of GIS image and RS technology, in the GIS system, the characteristics of the four crops are summarized and the judgment criteria are formed by extracting the feature images, analyzing and processing the feature data of 5200 samples of the study group. 2000 samples in the test group were tested and the recognition rate was calculated. Experiments show that peanut, spring maize, sweet potato and summer maize are identified. The highest recognition rate is 98.60%, the lowest is 90.20%, and the total recognition rate is 94.10%. It shows that in this experiment, the crop recognition rate of remote sensing image is very high in the application of crop classification and recognition based on GIS image. In the period when the spectral characteristics are very obvious, the recognition rate of crops in remote sensing images is higher, and the total recognition rate is increased by 3.98%. By analyzing and calculating the NDVI values of crops

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in remote sensing images, the NDVI curves of these four crops in each growing period were obtained. Through the study of NDVI value, we can identify the four kinds of crops and the growing period of the sample, and the accuracy in identifying the types of crops is higher than that in identifying the growing period of crops.

The application of crop classification and recognition is validated by two experiments, namely, classification and recognition of crop species and classification and recognition of crop growth period. Combining GIS image with RS image can improve the recognition accuracy of crop classification and recognition. Using geospatial data in GIS can identify the differences between crops, promote the development of precision agriculture, and provide reference for agricultural production and agricultural structure adjustment in designated areas.

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