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# Application and Prospect of New Media in Forecast of Plant Pests

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**Abstract.** Forecast of plant pests is a long-term foundation work for plant protection and it is of great significance for sustainable management of plant diseases, insects and other plant pests. Traditional media have played important roles in plant pest forecasting. However, with the rapid development of science and technology, various forms of new media are very suitable for plant pest forecasting. In this study, the limitations of the traditional media were analyzed and the advantages of the new media were revealed. Present situation of the applications of the traditional media in pest forecasting was introduced. And in the forecast of plant pests, the applications of the new media such as mobile phone short message, microblogging and WeChat, were also presented. The potential applications of the new media in plant pest forecasting in the future were prospected and some problems existing in the application of the new media that should be solved were discussed.

**Keywords:** plant pest, forecast, new media, plant disease epidemiology

## 1 Introduction

With the rapid development of computer technology and information technology, more and more people in the world can get access to networks. According to a statistical report on internet development in China from China Internet Network Information Center (CNNIC), up to December, 2013, the number of net citizens in China has reached 618 million and the popularity rate of internet was 45.8%. The number of mobile net citizens in China has reached 500 million. In particular, the number of rural net citizens has reached 177 million and the ratio of mobile net citizens among rural net citizens was 84.6%. The popularization and application of the networks provide the convenient conditions for agricultural informatization and agricultural knowledge dissemination. And this will play a significant role in solving 'the last mile' problem in agricultural informatization.

Various forms of new media are emerging along with the rapid development of digital technology, communication technology and internet technology, and have been

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becoming an indispensable part of people's daily life. Meanwhile, the new media influence people's lifestyles, behaviors and thinking modes. In this context, plant protection personnel should think about how to use the new technologies and the new media in plant pest management and plant pest forecasting, and should think about how to avoid the limitations of the traditional media in forecasting information release, forecasting information dissemination and forecasting information feedback. The rapid collection and analysis of the data and information that required for plant pest forecasting and the timely release and dissemination of forecasting results are very important for the control of plant pests. In general, the critical periods of plant pest prevention and control are short. Therefore, the timely dissemination of the information of plant pests is especially important. Compared with the traditional media, the new media have the characteristics, such as incomparable information transfer rate, excellent interaction, openness and sharing, etc. Therefore, the new media provide an excellent solution for plant protection personnel to conduct effective data collection and information release.

## **2 Traditional Media**

Generally, the traditional media include newspapers, periodicals, radio and television. The information released by the traditional media always is collected, screened and then released to the audiences by the professionals from newspaper offices, periodical offices, radio stations, TV stations, etc, and is highly professional and reliable. However, the released information is transmitted in the one-way mode without timely feedback from information audiences. Thus it cannot form an effective information transmission circuit, so the transmission and the use of the information are discounted. Although some traditional media also set feedback part for the audiences, the feedback mode is generally very cumbersome and the feedback cycle is very long. It always cannot meet the timely feedback requirements in our work. So the feedback information cannot play an effective role in improving the level of our work. After interpretation of the received information, individual audiences with different knowledge, life experience, personality, habits, etc, may get different understanding of the information. Sometimes the real information will be misinterpreted. Therefore, timely communication between the audiences and the information sources is very important. The new media with interactive feature can provide a good solution for these problems.

## **3 New Media**

The term 'new media' originated in the United States and was spread to other countries and regions. In fact, the so-called 'new media' is relative, and only in a specific period, some media are called as new media. Wired broadcasting appeared in 1893 and it became the new medium at that time compared with newspaper. Subsequently, the radio technology was developed, and the wireless broadcasting then became the new medium instead of the wired broadcasting. In view of the current

'new media', many definitions were put forward. Basically, the new media at the present stage refer to the media based on the digital technology and internet technology that can realize many-to-many communication. Now the new media include some media based on internet such as blog, podcast, microblogging, WeChat, network chat tools (e.g., Tencent QQ and MSN), search engine, websites, network television (web TV), internet protocol television (IPTV), online journals and the Internet of things, and some media based on mobile phone network such as mobile phone short messages, mobile phone MMS (multimedia messaging service), mobile phone TV, mobile phone newspaper, WeChat and mobile phone chat tools (e.g., Tencent QQ). Compared with the traditional media, the new media have timely, massive and interactive features, and the information can be disseminated in text, image, sound and multimedia. Thus the new media provide a bridge for the audiences to accurately get access to specific information in time and to perform real-time communication with the people who release the information. Through the new media, personalized information service can be provided, and the needs of the people at the present stage for personalized information can be met. The new media have played important roles in many fields, such as in education [1-5]. In particular, the new media have also been applied in agriculture [6], such as the dissemination of agricultural science and technology [7]. The new media can be used for forecasting information release, plant protection knowledge popularization and technology extension, reporting information and information feedback, timely information dissemination and communication, and prompt correction of plant protection information that can cause the social public security problems and crisis. The application of the new media in plant pest forecasting has very important significance.

#### **4 Forecast of Plant Pests**

Plant pest forecast is a prerequisite for the implementation of pest management measures and plays an important role in the modern integrated management of plant pests. Plant pest forecasting provides services for control measure making and pest management. According to the accurate forecast of plant pests, good preparations can be made for pest control and the risk of plant pests can be reduced; various control techniques can be applied more reasonable to improve the pest control effect and the pest control benefit; the unnecessary control cost and the environmental pollution caused by pesticide abuse also can be reduced [8]. Information collection and dissemination of forecasting results are the important parts of plant pest forecasting.

At present, plant pest forecasting in China mainly focuses on the major crop pests such as rice blast, wheat stripe rust, potato late blight, rice planthopper, corn borer. Generally, the information and the data used for plant pest forecasting in China are collected via the observation using forecast light, system investigation in pest observation field and field survey by local plant pest forecasting personnel. After the collection of the data and information by the personnel, it usually will take a long time before super administrative department can get the data and information. Then the data and information is analyzed to predict the trend of plant pests in the future, and finally the forecasting information is released through reports on plant pests,

newspaper, radio, TV and agriculture websites. In recent years, forecasting methods of plant pests are developing in the visual direction. China Central Television (CCTV) and local television stations release the forecasting information of some major plant pests at irregular intervals. Some television stations establish special TV columns of plant pest forecast. To guide the pest control in agricultural production, they regularly release the forecasting information of plant pests and provide the corresponding prevention and control measures. A large number of agricultural websites can also publish some forecasting information of plant pests. However, the agricultural websites often cover everything and contain a large amount of information, and pest forecasting information cannot be systematically released in time. Special agricultural websites focusing on plant pest forecasting should be established. The problem-solving agricultural science and technology knowledge service system can be developed and provide convenient and efficient one-stop problem solving services [9]. Some web-based plant pest forecasting systems have been established [10-14] and some of them have already played important roles in practice [10-12].

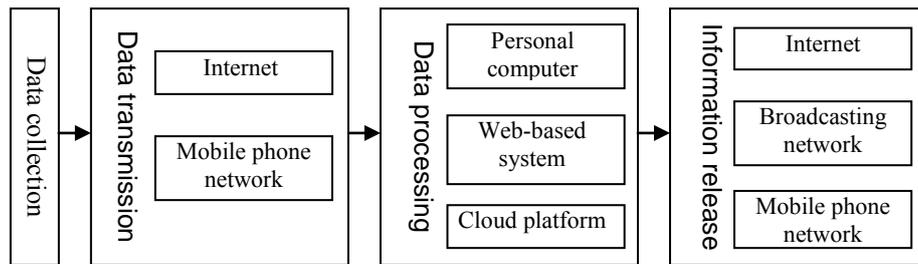
Although the limitations of newspaper, radio, television and other traditional media have been discussed above, only the limitations of agriculture websites were discussed here. The agriculture websites are run on the internet, but the influence of these websites is low. As well as the traditional media, the release mode of plant pest forecasting information is still one-to-many communication in the absence of interaction.

The collected information about plant pests and the released forecasting information of plant pests via the traditional media have played very important roles, but based on the previous discussion, the effects of plant pest forecasting should be influenced by the traditional media's congenital deficiency such as the traditional media's lack of good interactive feature. To make full use of forecasting information and to provide more timely and higher quality of plant pest forecasting information services for farmers, the new media should be used to collect and disseminate information. Thus the work on forecasting plant pests will be greatly improved. The new media have been applied in plant pest forecasting and control and have played important roles in the management of some plant pests [15, 16].

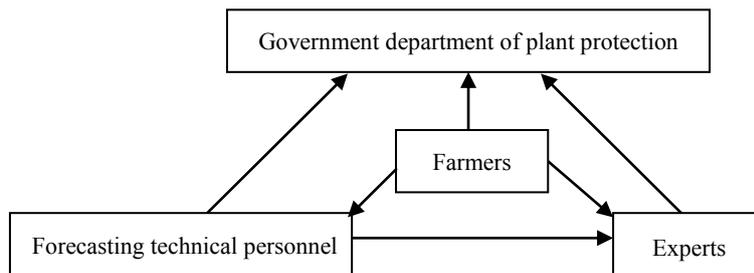
## **5 New Media and Plant Pest Forecasting**

At present, the new media applied in plant pest forecasting mainly include mobile phone SMS, mobile phone newspaper, the Internet of things and Wechat, etc. Wireless Application Protocol (WAP) is a protocol standard for accessing information and advanced value-added services over a mobile wireless network using a mobile terminal. Agricultural information network can be constructed using WAP in combination with internet technology and mobile phone technology, and no matter when and where, users can get access to the network resources using mobile phone terminals. It will be useful for the solution of 'the last mile' problem in the agriculture informatization. Pest information and forecasting information, the knowledge about control technology can be quickly spread to the farmers. Thus the farmers can learn about the incidence of plant pests in time and can effectively master the control

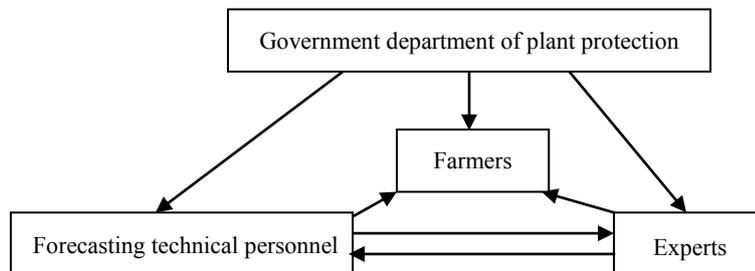
measures. Fig. 1 showed the information transfer process in plant pest forecasting using new media. Compared with the traditional media, there are many differences in the information transfer process in plant pest forecasting using new media. As shown in Fig. 2 and Fig. 3, the relationship between the different subjects including the government department of plant protection, forecasting technical personnel, experts and farmers, is more complex than that when the forecasting information is disseminated based on the traditional media. Some management service departments in China have developed agricultural information service using mobile phone text messages for local farmers. Farming issue information is released to guide the agricultural production. Among these applications, mobile phone short message and mobile phone newspaper are relate to plant pest forecasting, but plant pest forecasting is not a major service. Since the coverage of mobile phone in China is increasing, the new media based on mobile phone network will have many new applications in plant pest forecasting. Blog, microblogging, Wechat and the Internet of things will play important roles in plant pest forecasting. In recent years, extensive attention has been paid to the Internet of things. Radio frequency identification (RFID) and sensor network are used more and more widely in agriculture [17].



**Fig.1.** Information transfer process in plant pest forecasting using new media



**Fig. 2.** Information transfer between different subjects in data collection for plant pest forecasting using new media



**Fig. 3.** Information transfer between different subjects in information release for plant pest forecasting using new media

### 5.1 Application of Microblogging in Plant Pest Forecasting

Microblogging, namely microblog, is a broadcast medium that exists in the form of blogging, but its content is typically smaller than a traditional blog. A microblog contains up to 140 Chinese characters words including punctuations. Microblogging is a kind of new medium after blog and it relies on the relationships similar to that of the social networking to realize many-to-many information dissemination. Microblogging allows users to exchange small elements of content such as short messages, individual images or video links [18]. The users can build their own communities through WEB, WAP or a variety of clients, and then instantly update information and realize the sharing. Microblogging is developing rapidly and now there are many platforms such as Twitter and Facebook, FriendFeed, Plurk, Jaiku, Weibo and Tencent Weibo. Up to March, 2013, the registered users of Sina Weibo have reached 503 Million. In the whole process of microblogging information dissemination, the user can become a publisher of information and also become a recipient of information through concerning other users and being concerned by other users. This is so-called We Media. For microblogging, the threshold to get access is very low. The characteristics of microblogging are wide coverage, strong interaction and rapid information collection and dissemination. These characteristics are necessary for plant pest forecasting. Therefore, microblogging is an excellent means to collect information and disseminate information for plant pest forecasting.

Through concerning each other between forecasting technical personnel and farmers using microblogging, forecasting technical personnel release text messages or images of the symptoms caused by plant pests before the appearance of the symptoms and learn about the occurrence of plant pests according to the feedback information from farmers. Thus the workload of forecasting technical personnel can be reduced to a certain extent and the farmers can learn some knowledge about plant pests. Through concerning each other among forecasting technical personnel, microblogging is very helpful for the exchange of their experiences and the improvement of their forecasting level. In particular, during the critical periods of plant pests, information communication between forecasting technical personnel in adjacent areas is very helpful to improve the accuracy of forecasting. Mutual concerns between farmers also

can help to break the geographical limitations and to realize the exchange of the farmers' experiences in agricultural production. Similarly, mutual concerns between forecasting technical personnel and experts, that between farmers and experts and that among experts can play an important role in the collection and dissemination of forecasting information.

Microblogging has the properties of We Media, so the government department of plant protection, experts, forecasting technical personnel and farmers all can issue forecasting information on their microblogs. Concerning the reliability and extensive dissemination of the information, the official microblog opened by the government department of plant protection should be preferred to release forecasting information of plant pests. The plant pest forecasting information can be released by the official microblog opened by the government department of plant protection, and then the forecasting information can be rapidly communicated among experts, forecasting technical personnel and farmers through the network established based on mutual concern. Then experts, forecasting technical personnel and farmers can disseminate the information to others through their own networks. Thus the forecasting information can be disseminated widely. Therefore, if the reliability and accuracy of plant pest forecasting information released by the government departments can be guaranteed, the immediate spread of the information will no longer be a problem. In addition, to realize timely communication among experts, forecasting technical personnel and farmers and to quickly feedback the questions concerned by forecasting technical personnel or farmers, the official microblogging should be monitored in real time by the related professional personnel. Using the official microblog opened by government department of plant protection to release the forecasting information, the spreading width and the extent of application of the information will reach a high level that is hard to reach by other media.

## **5.2 Application of the New Media Based on Mobile Phone in Plant Pest Forecasting**

Now mobile phone short messages have been applied in plant pest forecasting. However, in the application processes, there are still three problems that need to be solved. First, the problem that the farmers need personalized information service is still not completely solved. Second, the information interaction between the information promulgator and the audiences is not as good as expected. Third, the publishing form of the forecasting information is still simple. Therefore, mobile phone short message services in plant pest forecasting in the future should made efforts to solve the above three problems. With large community of users and high rural coverage, the mobile phone short messages can have more extensive application in plant pest forecasting if the above three problems can be solved satisfactorily. In the same way, mobile phone TV and mobile phone newspaper are facing with some problems in the application in plant pest forecasting.

Now there are many kinds of smart mobile phones with video call function. Thus, a bridge has been provided for the remote diagnosis of plant pests and face-to-face communication among farmers, forecasting technical personnel and experts. The absence of technical personnel, their uneven ability to work, heavy workload of the

field survey, short critical period for pest control and the lack of knowledge about plant pests by farmers, etc, lead to the collection of first-hand data becoming the first problem met in plant pest forecasting. Through mobile phone video call with related experts, not only the remote diagnosis of plant pests can be realized, but also farmers can make real-time communication with experts and experts can solve the practical problems that forecasting technical personnel or farmers meet in the agricultural production in time. This will provide great supports for plant pest forecasting and plant pest control.

As a mobile text and voice messaging communication service, WeChat developed by Tencent in China was first released in January, 2011. It is an instant messaging client supported on Wi-Fi, 2G, 3G, and 4G data networks. The app is available on many operating systems including Android, iPhone, Windows Phone, etc, and multiple languages are supported including traditional/simplified Chinese, English, Spanish, Japanese, Italian, Thai, Korean, Indonesian, Russian, etc. Voice message, videos, pictures and words can be sent using the app. The app supports group chat and provides the functions of public platforms and friends circles. Now WeChat has won a large number of users in the world. Up to August 15, 2013, the users of WeChat outside China have reached over 100 million. In October, 2013, WeChat total users reached 600 millions worldwide. WeChat can be applied to exchange the information of plant pest information and pest control experiences inside the agricultural cooperation organizations through group chat or friends circles. Some experts, companies and plant protection personnel have used WeChat for the extension of plant protection technologies and the release of plant pest information. WeChat public platforms also can be built by the government department of plant protection. The forecasting information can be released on the public platforms and can be instantly transferred to users. Users also can feedback information whenever and wherever possible. As well as microblogging, the information on the WeChat public platforms should be monitored in real time.

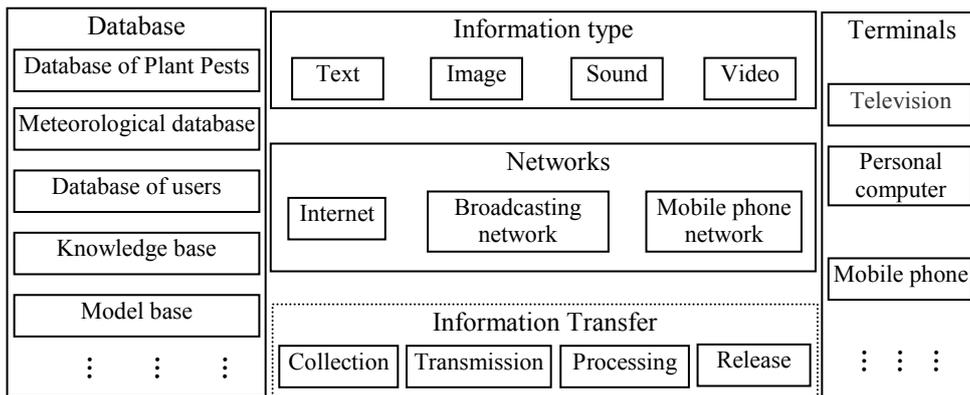
### **5.3 Application of Other New Media in Plant Pest Forecasting**

The forecasting information of plant pests can be released and disseminated via QQ group. In practice, many QQ groups focusing on regular crop advisory, plant protection and plant pest management have been built. Because of the limited capacity of group members, different QQ groups can be built for different individuals. Blogs and podcasts can be used to assist microblogging in plant pest forecasting. Compared with microblogging, blogs and podcasts have larger spaces for data uploading. They can be extended reading materials for users such as experts, forecasting technical personnel and farmers to get a further understanding of how the plant pests occur and develop and how to effectively prevent and control the plant pests. The Internet of things should be made full use to collect data and information about the occurrence of plant pests and then to provide more timely and accurate data supports for plant pest forecasting.

## 6 Prospect of Application of New Media in Forecast of Plant Pests

Now the application of the new media in plant pest forecasting is very limited because of the low rural net coverage, high internet access fees, farmers' lack of network knowledge, etc. With the development of economic in China and the improvement of rural living conditions, the new media will be increasingly used by farmers. It is very important to overcome the limitations of the traditional media in plant pest forecasting and to widely use the new media to carry out plant pest forecasting. Thus it will greatly promote the development of plant pest forecasting. Among many new media, the Internet of things will play an important role in the information collection of plant pests, and microblogging and WeChat will play important roles in the dissemination of forecasting information. The application of the new media in plant pest forecasting will promote the development of digital forecasting system of plant pests and the informatization of plant protection in China. It is expected that new media will be more widely applied in the plant pest forecasting in the future.

Based on internet, broadcasting network and mobile phone network, the national integrated information platform for plant pest forecasting can be developed using the advanced technologies including digital technology, internet technology, database technology, multimedia technology, communication technology, etc. The basic framework of integrated information platform for plant pest forecasting based on the new media was shown in Fig. 4. Now in the Big Data Era, cloud platform services should be made full use in plant pest forecasting. Then the coverage of the forecasting information can be improved, and the information can be more quickly transfer to users. According to their own needs, users can make information retrieval and screening at any time; they can subscribe or unsubscribe the required information at any time; and they also can perform the information feedback and effective communication at any time. Therefore, sustainable control of plant pests can be achieved.



**Fig. 4.** The basic framework of integrated information platform for plant pest forecasting based on new media

In the information transmission via the traditional media, as passive recipients, the audiences are usually in passive position. In the information transmission via the new media, the initiative of the audiences is enhanced, and they can conduct active searches and receive information of interest to them. They also can independently release information on the internet. To avoid the users' misunderstanding or wrong direction of public opinion caused by released incorrect forecasting information, it is critical to ensure that the released information is true and legal. The information verification is strict required for the release of forecasting information. The government department of plant protection as the 'gatekeeper' should strictly be responsible for information verification. The government supervision and legislation should be conducted to guarantee the correctness and effectiveness of the information.

The ability of audiences or users to use the services via new media should be improved. Farmers should be trained how to use mobile phone or computer to obtain forecasting information and to seek help through uploading information. The rural popularity and the rural coverage of mobile phones, computers and internet should be increased through financial subsidies and other means. Experts and forecasting technical personnel should learn to process the information used for plant pest forecasting and forecasting information using the new media.

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