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Development of Cotton Pest App for Decision Making among Cotton Farmers

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Authors' contributions

This work was carried out in collaboration among all authors. MK designed the study, performed the analysis, wrote the protocol, and wrote the first draft of the manuscript. MK and KS managed the analyses of the study. PL managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: In this paper Cotton Pest App is designed to identify the leaf disease in cotton at early stage. Cotton Pest App is an innovative application that is useful for farmers.
Methodology: The farmers can capture the images in the cotton field and upload the images. Cotton API is created and placed in cloud services. Images taken from farmers field matches with Cotton API and gets the TNAU recommendation for the cotton leaf diseases.
Results: Cotton Pest App for pest management in cotton will analyze and provide an accurate recommendation to farmers about the type of pesticide for the symptoms given through the images.
Conclusion: This paper expresses the idea about the creation of Cotton Pest App, an android application that helps to make management decision for cotton leaf symptoms. The study would provide a better understanding of the management practice required for the cotton leaf disease.

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Keywords: Bacterial blight; anthracnose; leafhopper; Cotton Pest App; TNAU recommendation.

1. INTRODUCTION

India cultivates cotton in largest area in the world; also it is the 2nd largest cotton producer in the world. Cotton is the 1st important cash crop in India. Cotton cultivation is largely traditional and practiced by smallholders and marginal farmers, predominantly rain-fed, has low-yielding production and lacks access to critical information about pests' management. Considering its importance, and also in recent years the crop was affected by various pests. Mobile communications have created opportunities for economic growth, social empowerment and had made the greatest contribution to agricultural and rural development. In the field of agriculture, mobile phones can make delivery of content most efficiently and easily to the farming community. In particular, a smart phone combines the utility of a cell phone and a PDA into one device. Smartphone's are now equipped with high resolution touch screen display, innovative sensors, camera, more memory and processing capabilities as well as effective mechanisms for saving power. The Mobile application for pest management of cotton crops is an application that allows farmers to identify pests and diseases using their mobile phones and provides remedial measures is the latest addition to use modern digital tools to benefit smallholder farmers. High-resolution images and videos will be taken for each pest for the benefit of the farming community. Jain *et al*., (2014), suggested that "agricultural information system needs to be developed based on the mass communication technology such as mobile systems" [1]. When people go for meeting, they may put their mobile phones in silent mode and their phone even don't vibrate. Flash Alert Notification is very much used in Android phones [2]. Android Mobile Application is build using Eclipse which helps to know the development of an android app for mobile platforms. Gives a complete knowledge of how to start working on eclipse, develop an application and get it run on emulator [3].

The developed Cotton Pest App is easy for the user to find information in a convenient and simple process. The android application for pest management in cotton will analyze and provide an accurate recommendation to farmers about the type of pesticide to be given to the symptoms given through the images. With the use of such apps, farmers could know which type of pesticide should be applied for the symptoms in field. The mobile application will be interlinked with all details related to pest management in cotton. Pest-wise link and image wise-link will be connected with the local web server and the final recommendation will be given to the farmers.

2. REVIEW OF LITERATURE

The agricultural sector is the most important sectors in India since it is the main food supplier. However, the agricultural sector is one of the business sectors that have been left aside in terms of the application of innovative technologies. Maha Farm is a mobile app used by farmers which includes crop information, daily price in market, weather updates and loan information [4].

Cotton Smart Irrigation App is developed to know the ET-based soil water balance model. Cotton Pest App uses meteorological data. The Cotton App was designed using both iOS and android operating system and release during March 2014. The Cotton App was evaluated in field trials and performance is good [5].

Cotton crop is affected by several disease, reduces the yield. Root-rot, fungal wilt, anthracnose, cotton leaf curl and bacterial blight are the major diseases of cotton. Bacterial blight of cotton is one of the diseases which are spread around the world. The pathogen attacks the host plants in all growth stages [6]. Bacterial blight can reduce the yield of the crop up to 50% in favorable conditions of the disease development [7], however, in severe conditions the losses may exceed up to 90%. Yield losses arise due to bacterial blight with the range between 1% and 27%, depends on the cultivar and crop age [8]. Under natural bacterial blight infection, boll yield losses up to 35% have been reported [9]. Diseased symptoms include circular, dark-green and water soaked spots with red to brown margins that will finally turn into dark-brown or black necrosis and death of infected tissues will happen. In case of severe attack defoliation occurs. Disease damaged boll has round water soaked spots causing it to rot [10].

Cotton anthracnose disease caused by *Colletotrichum capsici* (Syd.) Butler and Bisby first reported the anthracnose disease of cotton from the state of Bihar. Later, it was reported in 1927(Bombay), 1920 (Madras), 1929 (Bengal)

and 1930 (Madhya Pradesh) [11]. Verma (1995) reported that the annual yield losses due Anthracnose of cotton disease varies from 5 to 25 percent [12]. The most common symptom is boll spotting. Losses due to anthracnose in cotton were serious since many years. The attacks of the disease vary with seasonal conditions and more in wet season. Maximum severity of anthracnose caused by *Colletotrichum capsici* was observed in Parbhani with 41.0 percent leaf infestation and 35.8 per cent green boll damage [13].

Convolutional Neural Networks (CNNs) is very successful tool in computer vision tasks, such as object recognition, detection biometry and classification. CNN can match filters that are directly derived from the data. The first research was used with CNN to classify and identify plant disease and the performance of the model is 96.3% for 13 different types of plant disease with healthy leaves to differentiate the leaves from its surroundings [14]. CNN model was based on single classifier which is developed for detecting plant diseases for plantation. CNN was used to get top 5 errors of 16.4% for image classification with 1000 category of data classes [15].

Digital technology and agricultural expertise and knowledge have been merged, thus an assortment of smart phone apps according to the needs of farmers has been evolved. These apps can be grouped into the following main categories, namely agriculture management information apps; agriculture information resource apps; agriculture calculator apps; agriculture news apps, weather apps and m-government apps.

Farmers need crop recommendations on hand. Around 80% of Tamil Nadu farmers having the android supported mobile phones. In this situation, they expect mobile apps for cotton pests' management. Keeping this into consideration, the mobile application namely, "Cotton Pest App", is developed, as a pest's diagnostic tool for major pests of cotton in India. The application will be developed using android supported Language.

3. DESIGN OF COTTON PEST APP

3.1 Input

The inputs for the Cotton Pest App are the image collected from cotton field. The images related to leaf disease in cotton. They are

- Leaf downward cupping (Insect : Leafhopper)
- Leaf angular spot (Disease : Angular leaf spot)
- Leaf burned appearance (Disease : Anthracnose)

3.2 Cotton Pest App Algorithm

Cotton Pest App architecture is shown in Fig. 1

Step 1 Capture the image from farmer's field.
Step 2: Image may be capture 1. Camera 2. From gallery
Step 3: Cotton API is created and placed in cloud services
Step 4: Images taken from farmers field matches with Cotton API.
Step 5: Final recommendation to the farmers

3.3 Cotton API

Cotton API is created using Convolution Neural Network with python programming. Images are split into training (80%) and test (20%). Number of images taken for leaf diseases are 13,372. The training images are 11,042 and test images are 2330. Cotton API is evaluated from the image captured from the cotton field to check the accuracy of the model. The accuracy of the model is 93.89%

3.4 Output

Cotton Pest App gives the TNAU management practice as recommendation, shown in Table 1. The Cotton Pest App advisory was based on crop production guide 2020.

4. EXPERIMENTAL RESULTS

Cotton Pest App was implemented using an android operating system with Oreo as a minimum operating system requirement. Cotton Pest App is an android application that provides farmers to identify the cotton leaf disease such as bacterial blight, anthracnose and leafhopper. Cotton Pest App features have API with the model generated from python which helps to give the TNAU recommendation to the cotton farmers regarding the leaf diseases in the text format.

The farmers start interacting with Cotton Pest App by uploading the images captured in the cotton field either through their mobile camera or

from the gallery (image already captured). The images may be leaf diseases such as bacterial blight, anthracnose and leaf hopper are displayed on the home page of the App. By a click, the images are posted and the TNAU recommendation is given to the farmers. Image captured from the field is compared with Cotton API and identifies the leaf diseases. Based on the leaf disease the TNAU recommendation is displayed as text in Cotton Pest App.

The icon for the Cotton Pest App and homepage is shown in Fig. 2 and 3. In Cotton Pest App, the image of bacterial blight, anthracnose and leafhopper are captured through camera and gallery as shown in Fig.4. The image is ready to match with Cotton API is shown in Fig. 5. The image capture is compared with the Cotton API and identifies the diseases. The disease identified from the API gives the recommendation as text to the farmers through Cotton Pest App is shown in Fig. 6.

Table 1. TNAU recommendation for cotton leaf disease

S. No	Disease Name	TNAU பரிந்துரைகள் மேலாண்மை
1.	பாக்டீரியா ப்ளைட்டின் நோய் பாதிக்கப்பட்டுள்ளது	• பருத்தி விதைகளை செறிவூட்டப்பட்ட சல்பூரிக் அமிலத்துடன் 100மில்லி / கிலோ விதைக்கு வடிகட்டவும். • பாதிக்கப்பட்ட தாவர குப்பைகளை அகற்றி அழிக்கவும் • தன்னார்வ பருத்தி செடிகள் மற்றும் களைகளை அகற்றவும் . • அறிகுறி தோன்றிய உடனேயே ஸ்ட்ரெப்டோமைசின் சல்பேட் @ 300பிபிஎம் + காப்பர் ஆக்ஸிகுளோரைடு @ 2.0 கிலோ / ஹெக்டே தெளிக்கவும், 10நாட்களுக்குப் பிறகு மீண்டும் செய்யவும்.
2.	ஆந்த்ராக்னோஸ் நோய் பாதிக்கப்பட்டுள்ளது	• கார்பென்டாசிம் @ 500கிராம் அல்லது மான்கோசெப் @ 2000கிராம் அல்லது காப்பர் ஆக்ஸிகுளோரைடு @ 2500 கிராம் / எக்டர் மற்றும் பூச்சிக்கொல்லியுடன் 45 வது நாளிலிருந்து இரண்டு வாரங்களுக்கு ஒரு முறை தெளிக்கவும்.
3.	இலை கருகல் அறிகுறி (பூச்சி)	• வேப்ப எண்ணெய் 1.0% + வேப்ப விதை வடி நீர் பிரித்தெடுத்து 5.0% + 0.05-0.1% சோப்பு கலந்து தெளிக்கவும். • கமான உற்பத்தியாளர்களிடமிருந்து கிடைக்குமிடத்தில் வெர்டிசிலியம் லெக்கானி 10 கிராம் / லிட்டர் தண்ணீர் கலந்து தெளிக்கவும் • டயாபென்டியூரான் 50WP 800 கிராம் / எக்டர், டி. ஃப்ளோனிகாமிட் 50 WG 200g a.i / ha அல்லது e. புப்ரோ ஃபெசின் 25% எஸ்சி 200 கிராம் a.i / ha.

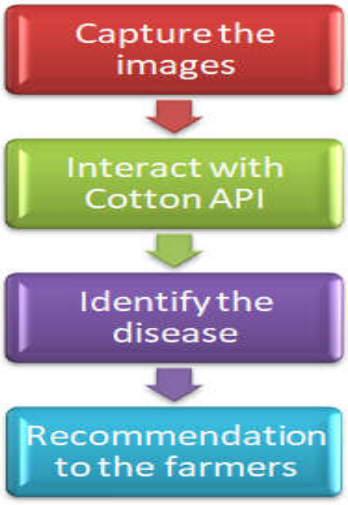

Fig. 1. Architecture of Cotton Pest App

Fig. 2. Cotton Pest App installed in android mobile with icon

Fig. 3. Home page of Cotton Pest App

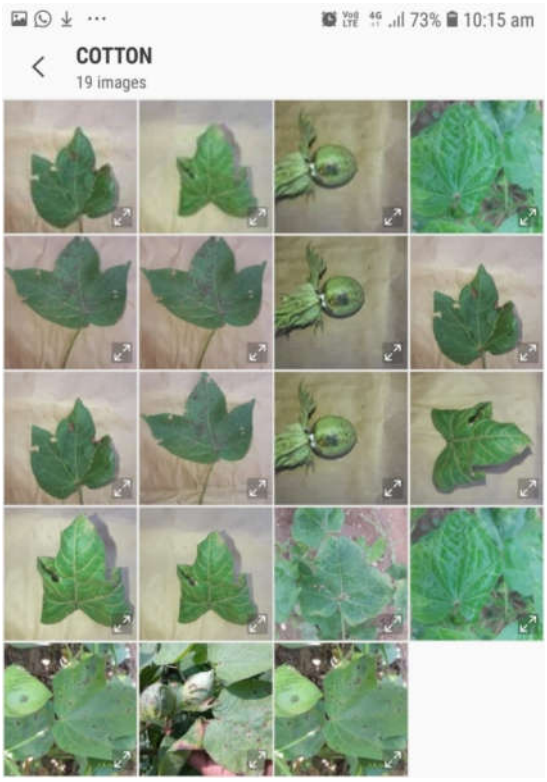

Fig. 4. Leaf disease selected from gallery

Fig. 5. Selected leaf disease image is displayed

Fig. 6. Output screen – TNAU recommendation for cotton leaf disease

5. CONCLUSION

India is an agricultural-based country. In recent trends, knowledge is upgraded by mobile enabled information services. Farmers need guidance to decide on their farming activities. The application of required management practice at the proper time will help in increasing the overall productivity of the cotton. This paper expresses the idea about the creation of Cotton Pest App, an android application that helps to make management decision for cotton leaf symptoms. The study would provide a better understanding of the management practice required for the cotton leaf disease. The app for pest management in cotton will analyze and provide accurate recommendations to farmers about the cotton leaf diseases. Cotton Pest App is used for decision making tool among the cotton farmers. The future scope of the Cotton Pest App is to incorporate the entire cotton disease to help the farming community for early detection of disease and reduce the cost incurred in the application of pesticides.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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