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CTRI- FCV TOBACCO: AN ANDROID BASED MOBILE APP ON GOOD AGRICULTURAL PRACTICES FOR FCV TOBACCO

H. RAVISANKAR, D. DAMODAR REDDY, K. SARALA, C. CHANDRASEKHARA RAO, M. ANURADHA, U. SREEDHAR, S. KASTURI KRISHNA, B. HEMA AND B. SAILAJA JAYASEKHARAN

ICAR-CENTRAL TOBACCO RESEARCH INSTITUTE, RAJAHMUNDRY – 533105, A.P.

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ICAR-Central Tobacco Research Institute established in 1947 has done yeomen service to farming community through technology backstopping on myriad aspects of tobacco cultivation. Availability of latest technology in crop cultivation is essential in reaching the goal of doubling the farmer's income as envisaged by Government of India. Latest technology need to be disseminated in a way that it reaches the doorstep of farmers rapidly and can be accessed instantly even in their fields. Currently, with the availability of ICT tools viz., mobile app and e-portals, technology can be transferred more effectively with text, pictures, interactive software's for instant crop advisories etc. right into the hands of farmers. Such applications are more effective in case of tobacco crop as majority of the tobacco farmers are well educated and progressive. Now-a-days the farmers are using smart mobiles, hence, technology dissemination strategies through mobile phones will be an effective tool in real time for transmitting required agro techniques and contingency measures. Most of the farmers use smart mobiles with internet facility and are contacting the scientists even utilizing WhatsApp for finding solutions to their day to day crop advisories.

Hence, technology dissemination strategies through mobile phone will go a long way in transmitting latest agro-techniques and contingency measures, if any, to the tobacco farmers at a faster rate and instantly. It is against this backdrop, ICAR-CTRI has developed a bilingual (English and Telugu) android based static mobile application on Good Agricultural Practices for FCV tobacco with title as CTRI-FCV TOBACCO and hosted in Google Play Store for the benefit of the farmers. It has the capability to transfer location specific technology & advice to the farmers efficiently and effectively.

INTRODUCTION

Information and Communication Technology became an essential component in day-to-day human life. ICT (Information and Communication Technology) in agriculture is an emerging field focusing on the agricultural development and rural development in India. Mobile application is one of the ICT tool in agriculture acts as a bridge to fill the gap between the availability and delivery of agriculture inputs and agriculture infrastructure available. The progression in the agriculture production straight increases the Indian Economy and vice-versa is also true. Mobile apps in the arena of agriculture can be the best option to increase countries agriculture production. The inventions in technology in agriculture domain are not getting to the farmers; because of either most of them are illiterates or due to unawareness of the location from where they can have information. The information disseminated through mobile application facilitates the farmers to decide what and when to plan, how to cultivate, when and how to harvest, what post-harvest management practices to follow, when and where to market the produce etc. The income of 70 million small scale farmers in the country can be increased by Rs. 56,000 Cr over the next 5 years by introducing mobile phone-based services (Mittal *et al.,* 2010). Mobile devices / Smart phones are the devices in use to install and access the mobile application developed in agriculture. With easy user interface, local language access and touch screen facility, the farmer is able to operate the Mobile Apps easily even not enough educated. The cost of the smart phone is also economic and able to purchase by the farming community to get the updated

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information on Weather, Crop Advisory, Market Prices and News in right time. Several mobile applications have been developed for acquisition of data in the field (Lantzos *et al.,* 2013), livestock management (Voulodimos *et al.,* 2010) AgroMobile (Prasad *et al.,* 2013), Krishiville (Singhal et al., 2011) etc.

Moreover, farming apps (Patel *et al.,* 2014; Rachana and Jadev, 2015; Bhave *et al.,* 2015; Monali *et al.,* 2016) are the most convenient and useful medium to guide farmers in farming. It gives the guideline for doing the proper scientific way of farming, crop cultivation, sowing or harvesting of any crop or vegetables. Farmers can easily solve their farming problems related to pest or insect attack or any problems which put them in a difficult situation. A farming app can be the best friend of farmers in farming which can enhance their productivity without spending a single amount of money. They can easily download it from Google play store without paying a single rupee. With this background, ICAR-CTRI has developed a bilingual mobile application on package of practices for FCV tobacco in English and Telugu languages. This in turn helps to take steps on diseases and pests management, package of practices, post-harvest management and to improve overall productivity and economic benefits to the farmers.

Mobile Applications in Agriculture

The basic information needed by the farmers are about information of soil, type of seed, required pesticide for the particular crop in all stage of its growth, fertilizer type, crop diseases and its selling. Under ICAR, various research institutes have developed 112 mobile apps on various crops, animals, fisheries, engineering, education, extension, horticulture and natural resource management. Information about some of the apps developed on various crops are given below.

'Solapur anar' is an app developed by ICAR-NRC on Pomegranate, Solapur. The app includes the information about pomegranate production and detailed information about quality planting material, orchard establishment, nutrition management, plant protection, irrigation management, post-harvest management and value addition etc. 'Fertilizer calculator' is an app developed by ICAR-CCARI, Goa. It is completely offline soil test-based fertilizer recommender (STFR) app for Android based system and perform calculations according to the area of farm or the number of plants/trees. 'Rice-Xpert' app is developed by ICAR-NRRI, Cuttack to provide information to farmers in real time on insect pests, nutrients, weeds, nematodes and disease-related problems, rice varieties for different ecologies, farm implements for different field and post-harvest operations. ICAR-IGFRI, Jhansi has developed a mobile app titled 'Farm Tree' that provides basic information on 20 commonly grown promising agroforestry tree species by farmers at their farm. Apart from this, there are number of apps developed in agriculture for the benefit of farming community. Some of the apps developed in India for agriculture sector are given below.

Kisan Suvidha app provides information on current weather and also the forecast for the next five days, market prices of commodities/crops in the nearest town, knowledge on fertilizers, seeds, machinery etc. and it was launched by the PM Narendra Modi in 2016.

AgroMobile: A Cloud-Based Framework for Agriculturists on Mobile Platform was developed by IIT, Roorkee, especially for the Indian farmers to assist them in agricultural needs. It is used for botanical species recognition and disease detection using a simple mobile phone with camera (Prasad et al. 2013). Singhal et al. (2011) developed android based solution for Indian agriculture named Krishi Ville. This app takes care of the updates of the different agricultural commodities, weather forecast updates, agricultural news updates. Intaravanne and Sumriddetchkajorn (2012) developed a mobile device-based application 'BaiKhaoto' analyse the colour level of the rice leaf for nitrogen estimation. A monitoring system for intensive agriculture based on mesh networks and the android system was developed in 2013 by Montoya et al. Farm Manager for the management of small farms was developed by Lantzos et al. in 2013. Nitrogen Index app was developed by Kongsombut and Chaisricharoen in 2013 for orchid. Tate et al. (2014) developed an app to control drip irrigation system via mobile. 'E-agree' is an app (Patel et al. 2016) used to detect leaf

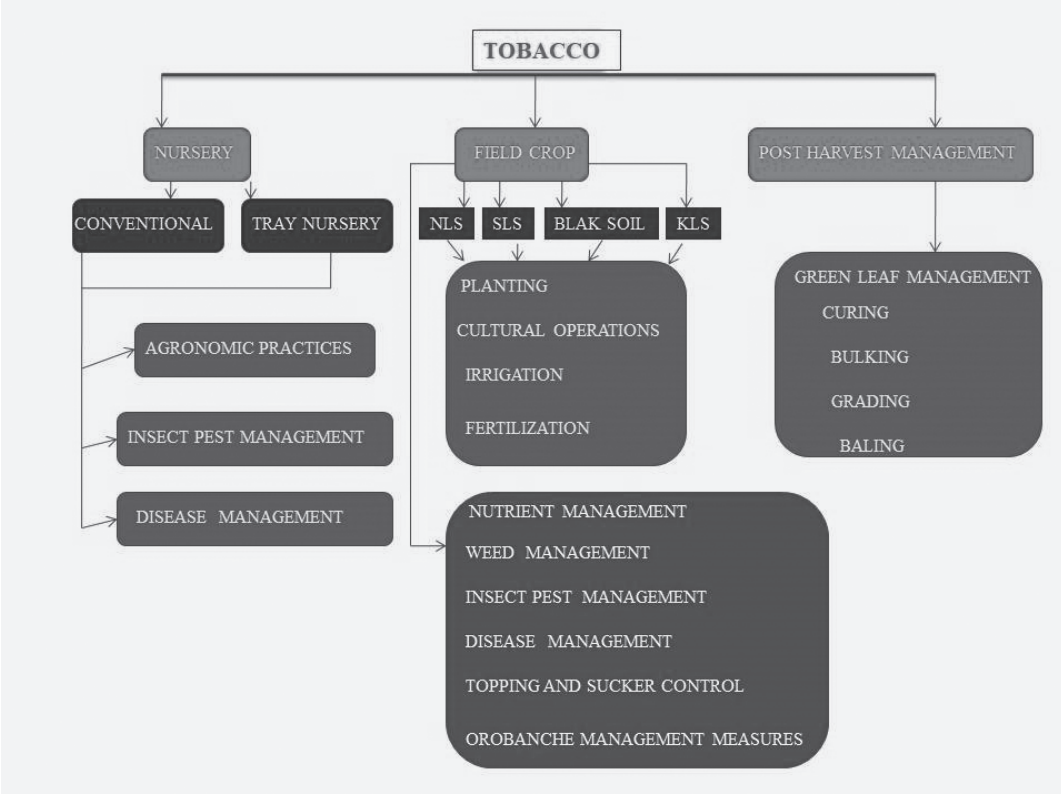
diseases and provides online market place, market rate guide, weather report and soil information to the farmer.

There is more than one app developed for each crop by different institutes in various countries across the globe. But for FCV tobacco, it is first of its kind to develop a mobile app on good agricultural practices with complete details and photographs for easy understanding and accessing through Google Play Store which is useful for the tobacco community.

MATERIALS AND METHODS

A flowchart was designed (Fig. 1) for identifying the sequence of modules to be executed and their connectivity before developing the templates. Three main modules viz., Nursery, Field Crop and Post-Harvest Management are the first level hierarchy systems from which the top-down approach was followed for creating sub-modules and their components. Based on this, various templates were designed and provided connectivity between the modules with the code.

The Mobile App was developed using HTML, JAVA and XML languages. Programming languages used to develop the android mobile application are eXtensible Markup Language (XML), HTML and Java. XML is used in designing each activity, i.e., each page of the app. Various XML tags and elements are used for this purpose. Java is a platform independent object oriented programming language which is used to write programs for every activity. Each and every activity in the android application is a java class. Application development environments are Android Studio and HTML. The app has been developed on Android Studio 4.1.3 integrated development environment (IDE) and the minimum requirement for the app is a device running on API 15: Content. The software consists of 221 Java programs, 226 XML programs and 167 HTML programs. Some of the classes provided by Android which is imported in the package are android.app.Activity, android.content.Intent, android.os.Bundle, android.view.View, android.support.annotation.Nullable, android. webkit. WebView, android. widget. Button, android. widget.ImageView.



The main menu of the app displays the title i.e., 'Good Agricultural Practices for FCV Tobacco' and four items namely 'Tobacco, About, Share and Contact'. In the 'res' (resource) folder a new XML file has been created to declare all the items of overflow menu and the overflow menu itself. The Home item is nothing but the Main_Activity. Each and every activity has an XML file in the subfolder 'Layout' of the folder 'res'. These XML files design the layout of the activity then show the preview of the activity. 'Assets' folder contains the code for the content of each page and their images which was written in HTML. 'Gradle, a pre-installed build system, was used for code compilation, testing, deployment and conversion of the code into. dex files to run the app on the device.

RESULTS & DISCUSSION

The app consists of four main modules viz., 'Tobacco, Share, Contact and About' as shown in Figure 2. The first module 'Tobacco' provides technical information about 'Good Agricultural Practices of FCV Tobacco' which in turn consists of three main modules viz., Nursery, Field Crop and Post-Harvest Management. 'Nursery' consists of two sub modules viz., 'Conventional method and Tray Nursery' embedded with information on 'agronomic practices, Insect pest and disease management' supported by good photographs. In 'Feld crop' module, information on 'Planting, Cultural operations, Irrigation and Fertilization' was provided based on soil type viz., Northern Light Soils (NLS), Southern Light Soils (SLS), Black soils and Karnataka Light Soils (SLS) (Fig. 4). In addition to this, information on 'Insect pest management, Disease management, Nutrient Management, Weed Management, Topping and sucker control, Harvesting and Orobanche Management Measures' in field crop was also provided. 'Nutrient Management' module is developed as a decision support system which allows the user to view the visual deficiency symptoms along with Corrective Measures. 'Weed Management' module is a knowledge-based system which provides the information on Weed Description with good photographs and control. 'Post-Harvest Management' module provides the information on "Green leaf management, Curing, Bulking, Grading and Baling' of FCV tobacco with good photographs. The second module 'SHARE' provides hyperlink to access CTRI website. 'CONTACT" module provides contact details for receiving suggestions given by the user, if any.

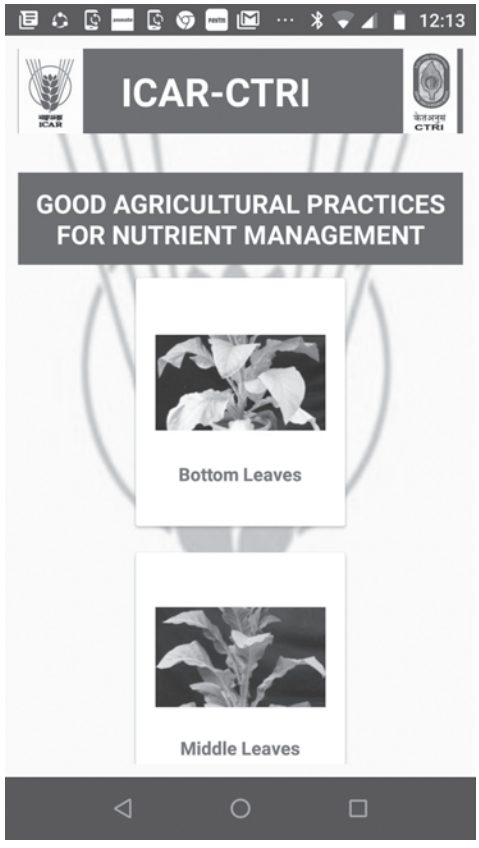
The module 'ABOUT' provides the general information about CTRI viz., Vision, Mission, Mandate and Research Programmes.

Nutrient Management Module: To execute this module, the user has to select Tobacco, Field Crop followed by Nutrient Management option from the home screen of the App.

The first screen of this module displays three selections for the user i.e., 'Bottom Leaves', 'Middle Leaves' and 'Top Leaves' with the images of the leaf (Figure 5). By selecting 'Bottom' option, a screen with two buttons viz., 'Localized' and 'Uniform' gets displayed. If the user selects 'Uniform' button, 'Nitrogen Deficiency' and 'Phosphorous Deficiency' images with their functions, Visual Symptoms, predisposing factors and Corrective measures gets displayed. If the users select the 'Localized' button, 'Potassium Deficiency' and 'Magnesium Deficiency' images with descriptions will be displayed. If the user selects the 'Middle' option from the opening menu, 'Zinc Deficiency', 'Copper Deficiency' and 'Molybdenum Deficiency' information gets displayed. If the user selects the 'Bottom' option, Information for 'Calcium Deficiency', 'Boron Deficiency', 'Manganese deficiency' and 'Iron deficiency gets displays with good photographs. This module is useful for researchers and farmers to identify a particular nutrient deficiency symptom and its characteristics with the help of selection by photo of the deficiency.

Weed Management Module: To execute this module, the user has to select Tobacco, Field Crop followed by Weed Management option from the home screen of the App.

The first screen of this module displays names of tobacco weeds viz., Cynodon dactylon, Cleome viscosa, Portulaca oleracea, Euphorbia hirta, Phyllanthus niruri, Cyperus rotundus, Panicum repens, Trainthema portulacastrum, Dactyloctenium aegyptium and Digitaria sanguinalis. If the user selects any one of these weeds, its scientific name, Family, weed description and Control gets displayed (Figure 6).



Installation

1. Type URL 'play.google.com' in web browser
2. Type 'CTRI – FCV TOBACCO' in search button
3. In 'Apps' category 'CTRI' logo with 'CTRI – FCV TOBACCO' as title will be displayed.
4. Click on 'CTRI – FCV TOBACCO', a new screen with description of the app, snapshots along with 'Install' option gets displayed.
5. Click 'Install' option to execute the App in your mobile.

It is concluded that in agriculture, vast number of mobile apps are developed and in use by the researchers and farmers for the purpose. All the apps have different usage as per its functionalities. Many apps are being utilized for different kind of functionality regarding the farming activities like cropping information, pesticides, fertilizer, seed, selling of crop, irrigation information, estimation of crop production, weather information and information regarding the best practices of farming. The mobile developed on tobacco is an icon based user-friendly menu driven application for easy and instant accessing of complete information on FCV tobacco in English and Telugu languages. Quick and instant mobile accessing will assist the tobacco farmers in semantic management of crop for achieving higher yields with desired quality. It also helps in transferring the latest technology instantaneously by which the Institute visibility is improved. This app is first of its kind developed for the benefit of tobacco farmers. It was hosted in google play store with url: 'https://play.google.com/store/apps/details?id=com.icar.ctri' and installed in 1000+ devices.

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