Indian Journal of Agricultural Sciences **88** (6): 841–4, June 2018/Article

Web-enabled data extraction system for cotton pests

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Received: 29 December 2016; Accepted: 23 March 2018

ABSTRACT

Under Online Pest Monitoring and Advisory Services (OPMAS) program, huge information/data on cotton pest along with weather were collected in three intensive cotton growing zones, viz. the North Zone (Punjab, Haryana and Rajasthan), the Central Zone (Maharashtra, Madhya Pradesh and Gujarat), and the Southern Zone (Andhra Pradesh, Telangana, Karnataka and Tamil Nadu), in India. Based on pest monitoring weekly advisory services were issued to extension agencies and farmers for control measures of pests in the cotton crop. Under the project extraction system was developed which was based on three tier architecture, i.e. presentation, application and data tier to reduce the effort for searching a huge set of data for desired information on real time points. In the system, the central value of pest (mean, maximum and minimum) and spread of the pest in terms of variance and standard deviation may be obtained. These results can provide the epidemic status of the pest based on the threshold values which can be utilized to issue advisories to farmers about the pest control. In future the data extracted from this system can be used for pattern development using pest population as a character under study and time variable as an independent/ explanatory variable.

Key words: Cotton pests, Extraction system, OPMAS, Three-tier architecture, Web-enabled

In India, there are ten major cotton growing states which fall under three zones, viz. the North Zone (Punjab, Haryana and Rajasthan), the Central Zone (Maharashtra, Madhya Pradesh and Gujarat), and the Southern Zone (Andhra Pradesh, Telangana, Karnataka and Tamil Nadu). The cotton provides the livelihood for about 60 million people directly and indirectly through its production, processing, marketing and trade. India has emerged as the second largest producer of cotton in the world and occupies the first position in terms of total area under crop production at over 9.44 million ha (http://eands.dacnet.nic.in/Agricultural_Statistics_At_Glance-2015%20E-book/book.swf). However, the productivity level is still below the world average. Pests and diseases are one of the major constraints for reduction in cotton yield as well as quality of produces. These losses can be minimized, if data or information on various aspects of crop growth as well as pests incidences on a regular basis (daily/weekly) is available so the proper monitoring can be done for issuing an advisory for control measures on the priority basis to the farmers. ICT based e-pest surveillance and advisory, a program on National Information System for Pest Management (NISPM) for Bt-cotton was launched in 2008 by Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers Welfare with the ICAR-National Research Centre for Integrated Pest Management as a lead centre and ICAR Institutes/State Agricultural Universities (SAUs)/Krishi Vigyan Kendras (KVKs) as a collaborative centres to monitor the pest across the country and issue the pest advisories to extension agency and the farmers, for disseminating the information of the emerging pest in cotton as well as the Integrated Pest Management (IPM) intervention across the country. During 2014-15 this programme was modified and continued as Online Pest Monitoring and Advisory Services (OPMAS) till 2015-16. This program was implemented in 10 states through sixteen centers (including two specialized centers) located at Faridkot (Punjab), Sirsa (Haryana), Banswara (Rajasthan), Anand (Gujarat), Khandwa (Madhya Pradesh), Akola (Maharashtra), Jalna (Maharashtra), Ahmednagar (Maharashtra), Karimnagar (Telangana), Guntur (Andhra Pradesh), Mysore (Karnataka), Perambalur (Tamil Nadu) and Belgaum (Karnataka) representing SAUs, ICAR and KVKs. This program was funded by Department of Agricultural Corporation and Farmers Welfare (DAC), Ministry of Agriculture and Farmers Welfare. The objective of this program was to develop and implement web based pest monitoring and advisory services for emerging insects, pest- and diseases and any other significant problem in cotton crop. The survey and surveillance are carried out by 13 field centers on cotton for collection of data on insects, pests, diseases and natural enemy along with the collection of real time weather data. Before the crop season baseline

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informations were collected from each village from the cotton growing farmers to know the resources and the level of the crop productivity. Under the project observation on insect pests, diseases and beneficial were collected from 234 villages covering 26 districts. In each village, two fixed and two random fields were selected for recording the pest activities on weekly basis. A roving survey was conducted for pest infestation in a village different from that of selected by field assistant. At every fortnight these pest information were communicated to State Agricultural Department (SADs) for further action. Based on prevailing pest scenario in the area, location specific advisories were issued by each center to registered farmers through SMSs on weekly basis. Under NISPM and OPMAS, data were generated on regular (daily/weekly) basis from different locations as mentioned above. Manually extracting a huge amount of data from books and literature is very time consuming and all the relevant data present in one place is also a rare thing to happen. In this study an attempt has been taken to develop web-enabled extraction system based on the data collected for pest monitoring and advisory services for extension agencies and farmers for effective dissemination of information to end user. Weekly pest data of different places and year are kept in same database, so that user can extract the relevant information timely. The extraction system is reliable in future as well. The administrator just need to add the information of pests into the existing database.

MATERIALS AND METHODS

For development of this web-enabled extraction system, three tier architecture system which consists of presentation, application and data tier (Kumar *et al*. 2012, Kandal *et al*. 2006, Berners-Lee 1990*,* Kumar *et al*. 2016 a*, Kumar et al.* 2016 b is shown in Fig 1.

The presentation tier consists of the user interface which allows user to select the options provided in the web pages to have the required information. The submitted options by the user was taken to database via application tier in the form of SQL (Structured Query Language). In the application there are various methods/functions used to retrieve data from the database. In extraction system, presentation layer is implemented using CSS (Cascading Style Sheet) and HTML (Hyper Text Markup Language) which interacts with the application tier in two way communication. The application tier is composed of scripts running on web server which communicate between the user interface and the database. The script consists of Active Server Pages (ASP) and Hyper Text Markup Language (HTML) (Berners-Lee, 1990) along with Cascading Style Sheet (CSS) (https://www.w3schools.com/css/) to make the web pages more interactive and dynamic. Java programming was used to generate codes on Java Scripting Programming (JSP) and also to connect database tier with web-enabled system. Postgres SQL was used to create the database for the extraction system. It is powerful, open access and secure data base management system. The web-enabled system was implemented through NetBeans 8.0.2 IDE (Integrated Development Environment) (https://netbeans.org/) which is a data editor. Glass fish server was used to test the system on local host. Postgres SQL was used to create the database for the extraction system. It is powerful, free and reliable database management system and facilitates the administrator of the database to import the excel sheet directly into the database of the extraction system.

RESULTS AND DISCUSSION

The developed system is platform independent and enrich in various functionalities which makes the system executable on any operating system, thus user need not to do any setup prior to use the system. This web-based extraction system (http://14.139.56.66/opmas/presentable_1/index.html) involves two modes of knowledge access, first is extracting the data and then performing analysis on it. Fig 2 shows the homepage of the extraction system which provides other links to navigate from one page to another page. It is developed using PostgreSQL for the implementation of database and NetBeans IDE 8.0.2 for scripting the java codes. NetBeans editor is free and open source Integrated Development Environment (IDE) which has dynamic language support, i.e. the codes can be scripted in PHP, JavaScript, Groovy etc. It provides end-to-end solutions for all java development platforms. It provides plugins for database connections, in this extraction system, the connection to Postgres database is established through java scripting. Postgres database is available for all the platforms, i.e. Windows, Linux, Unix etc, the

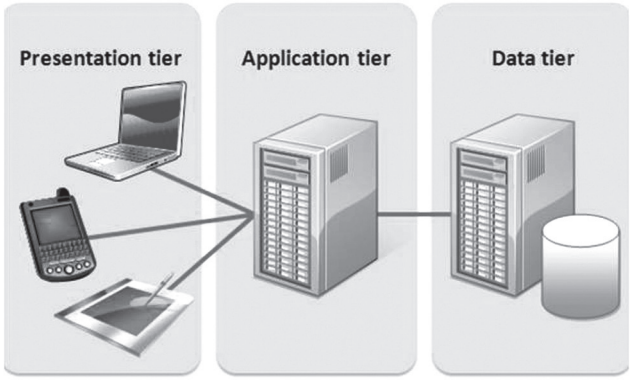

Fig 1 Three tier architecture

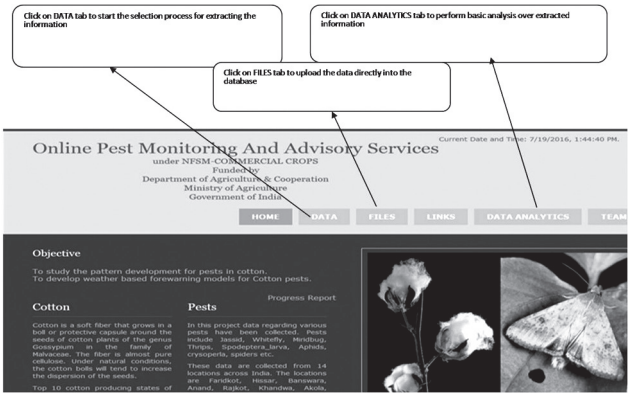

Fig 2 Home page of the Extraction System

major advantage for choosing PostgreSQL in this system is extremely responsive in high volume environments. The platform provides analysis of spatial data by installing postgres GIS plugins, which can be used to monitor the pest infestation at spatial scale in the future.

The first tab after the homepage is the data tab, from which the user select various options for extracting the information. It provides the list of locations available in this system. The system is developed in such a way that user can select a location (in Fig 3) with multiple pests to view the extracted information. The whole process of extraction system is presented in the form of flow chart in Fig 4. As per the flow chart, the system provides checkbox for selection of location followed by year to know the pest status (counts for a pest and percentage for diseases) at monthly or weekly interval. In the next stage user can select multiple pests. Based on the selections made by user, the result is displayed consisting of location, year, monthly/weekly, pests and its value extracted from the database in fraction of minutes as shown in Fig 5. If user is satisfied with their selection terms, they can download the result by clicking on download CSV as shown in Fig 5. If user wants to change the selection terms, they can again navigate to data tab. Based on the extracted data, a prototype system was developed to get the desired information about the cotton pest related to central values of the pests (mean, maximum and minimum values) and spread of the data (variance and standard deviation) which is presented in Fig 6. If the maximum value of pests or disease is more than the threshold value which is already prescribed in the literature then that year may be considered as epidemic year. Economic threshold level (ETL) is the level at which control measures are to be implemented to prevent the economic damage. Based on the experimental trail conducted by ICAR-CICR, ETL for different insect pests has been determined and is fixed as 1-2 jassids/leaf for jassids, 8-10 adults or 20 nymphs/leaf for whitefly, 10 thrips/leaf for thrips (Ref.: Integrated Pest Management Package for Cotton 2014) by creating artificial infestation. For recording the pest population in cotton five randomly spots are selected in one acre field and at each spot observation are made on four randomly selected plants. Total number of nymphs or adults of each insect pest on three leaves (one each from top, middle and lower parts) are recorded on each plant. Overall average of populations

Fig 3 Selection of a location.

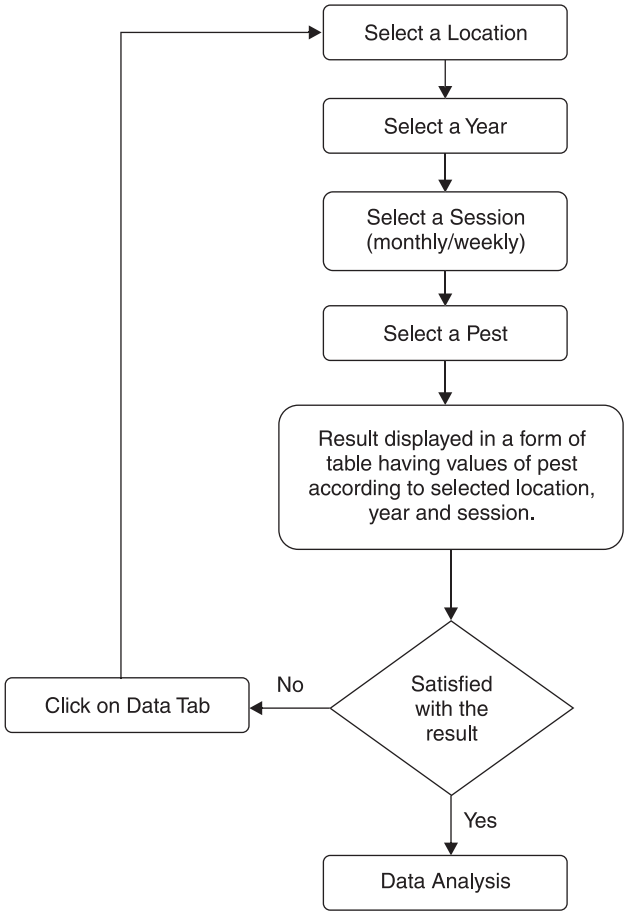

Fig 4 Flow chart of extraction system.

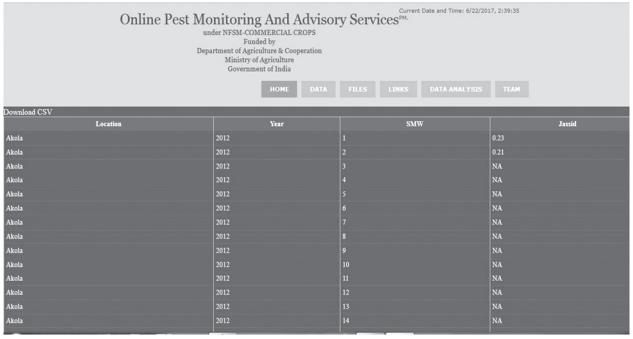

Fig 5 Sample result displayed.

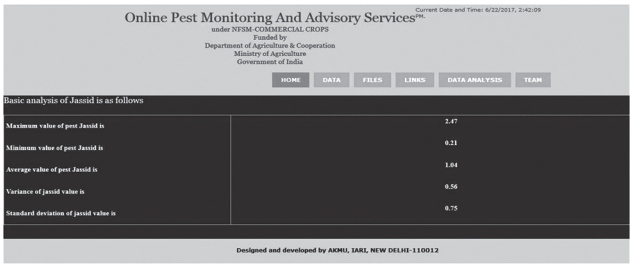

Fig 6 Information about the basis statistics of pest.

of each insect (No./leaf) on 20 plants are calculated and is compared with fixed ETL. Further the extracted data can be used by the end user for the pattern development using pest population as a character under study and a time variable

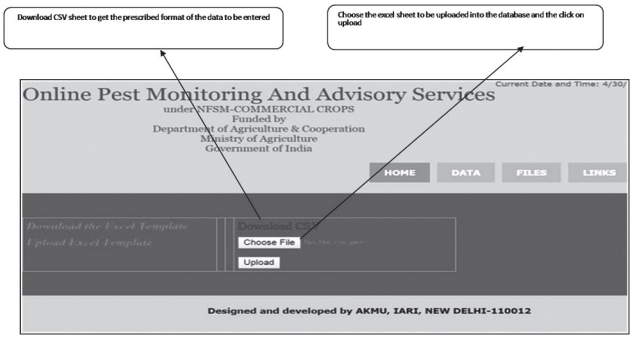

Fig 7 Uploading data into database

as an independent/explanatory variable.

In this extraction system a facility for data import was also provided to end user on File tab which navigates to another webpage (Fig 7) where user can download the prescribed format for data entry. The prescribed format is given to user so that every user feeds the data into same format and the database thus developed can be normaliased and non-redundant. The authenticity for uploading this data entries can be provided to specific user only. The specified user can upload the data into the database directly using the options provided in the extraction system.

Conclusion

In this study the extraction system is developed to reduce the effort of searching huge set of complex data. The system facilitates users to select the pest for a target location and year and thus, obtaining the pest value based on weekly data through statistical operations. If the maximum value of particular insect, pest or disease is more than the threshold value which is already prescribed in the literature then that year may be considered as epidemic year therefore controlled measures should be applied on the farmers field to save the crop. This web-enabled extraction system provides the pest monitoring for extension agency and farmers for effective dissemination of information to end user on the real time basis. User can also import the data directly into the database by using import facility of the extraction system and these data can be used for pattern development using pest population as a character under study and time variable as an independent/ explanatory variable.

ACKNOWLEDGMENT

Online Pest Monitoring and Advisory services (OPMAS) is funded by National Food Security Mission (NFSM) - Commercial Crop (Cotton), Department of Agriculture and Cooperation, Ministry of Agriculture Farmers Welfare, India.

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