Information System for Fieldpea Germplasm

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SUMMARY

Information System for Fieldpea Germplasm provides a user friendly interface for generating data entry, queries/reports, keep up integrated database for analyzing and interpreting data. The system has been developed on three-tier Client-server architecture using ASP.NET with C# and SQL server 2005. Presently, the system contains information on 480 evaluated for 21 valuable descriptors (12 qualitative traits and 9 quantitative traits) for each attainment for climatic conditions for agriculture in India. Analysis of the data was done on the estimator *viz.,* Mean, Range, Variance, Standard Deviation, Skewness and Kurtosis. System contains two operational sub-systems (*viz.*, Data Management and Report Generation sub-systems).

Keywords: Germplasm, Information system, Accessions, Mysql, Descriptors, Client-Server Architecture.

1. INTRODUCTION

Fieldpea is an important rabi pulse crop grown for food, feed and vegetables in North and central parts of the country. In India, crop occupies about 0.82 million hectare area and producing 0.99 million tonnes of grain. The main fieldpea are produced by Uttar Pradesh, Madhya Pradesh, Bihar, Assam, and Odisha. Fieldpea has great promise for diversification of rice-wheat system in north India. However, its present level of productivity is not attracting the growers to substitute wheat (Katiyar and Dixit, 2009). Narrow genetic base (ambiguous germplasm identification, difficulty in tracing different features, assessment and data usage) has been recognized as one of the major constraint to break the yield plateau in fieldpea. Indicating the genetic variability is a Huge/big task for plant genetic resource person to provide the client with easily available and assessable data on which they are working (Miliar *et al.,* 1982; Mundankar and Karibasappa, 2008; Kumar *et al.*, 2013).

Plant genetic resources are the building block for the development of improved cultivars either through conventional breeding or through modern techniques of plant genetic manipulation (Chen and Huang, 2007). Recognizing this fact, ICAR-Indian Institute of Pulses Research, Kanpur involves for collection characterization, evaluation, multiplication and conservation of crop germplasm. These are being maintained without proper electronic data management system. The crop breeders are also having difference of opinions in germplasm data collection, evaluation and conservation. Data evaluation and validation are the major issues. An adaptive approach is required to acquire most recent information on each germplasm accession to make it more effective. The utility of germplasm collection and utilization are enhanced if the unique traits of each accession are identified, described, and stored in the form of a database which leads to efficient management of data for easy access and quick retrieval. Therefore, there is a need to develop an information system for fieldpea germplasm

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for crop breeders to allow interactive search and access information of required traits of the germplasm. A variety of databases and information systems (Chen and Huang, 2007; Devraj *et al.*, 2014; Kumar *et al.*, 2013; Miliar *et al.*, 1982; Mundankar and Karibasappa, 2008; Ravisankar *et al.*, 2009; Sarkar and Naik, 1996) have been developed for germplasm in agricultural crops. It indicates that information system applications for crop germplasm are modern IT approach for crop breeders and scientists and these are meant to be used directly by the progressive farmers and extension specialists. The germplasm information system for fieldpea not only have the basic information's on collected germplasm accessions but also have information such as physiological characteristics, morphological characteristics and agronomical characteristics. The present system have additional advantages for getting the statistical summary(*i.e.*, Mean, Range, Variance, Standard Deviation, Skewness and Kurtosis) in tabular as well as graphical form for each evaluation descriptor and its various descriptor states. At present, the information regarding 480 attainments which are evaluated for 21 descriptor (12 qualitative and 9 quantitative traits) are available in database. Information system has been designed and developed with the user-friendly data management and report generation system. Different data entry forms and reports (qualitative, quantitative, query-based and thorough reports) are designed to retrieve correct information on fieldpea germplasm. The database provides safe data storage that can be secured and shared over the Local Area Network (LAN) at Institute level and will be linked with the Institute's/ICAR website and the KRISHI Portal for access by the crop breeders.

2. MATERIALS AND METHODS

A database for fieldpea germplasm is developed on the basis of data gathered by exploration, evaluation, multiplication, characterization and conservation at ICAR-Indian Institute of Pulses Research, Kanpur (Katiyar and Dixit, 2009). The database contains information of each accession. A total 12 qualitative traits were included in the database. The descriptors and its different states are described in Table 1. The database also contains data of nine quantitative traits (i.e. Days to 50% flowering, Plant height, Flower opening, Pod length, No. of primary branches, No. of pods per plant, No. of seeds per pod, 100-Seed weight

and Yield per plant). Description about all these data for fieldpea germplasm are presented in Table 2.

Table 1. Descriptors (qualitative data) and descriptor stats selected for fieldpea accessions

Descriptors	Descriptor States
Early plant vigour (EPV)	Good Medium Poor
Anthocyanin colour (AC)	Absent Present
Leaf size (LS)	Small Medium Large
Foliage colour (FC)	Light green Green Dark green
Leaf axil colour (LAC)	Green Purple
Standard petal colour of flower (SPCF)	White Purple
Pod number/Axil (PNA)	Single Double Multiple
Pod curvature (PC)	Absent Weak Medium Strong
Pod beak (PB)	Pointed Blunt
Intensity of green colour pod (IGCP)	Light green Green Dark green
Seed shape (SSh)	Spherical Cylindrical Dimpled
Seed colour (SC)	White Green Brown

Table 2. Descriptors (quantitative data) for fieldpea attainment

Descriptor	Description
Days to 50% flowering (DF)	Number of days when 50% plants had flowers
Plant height (PH)	Length considered from the ground level to the tip of the plant (in cm.)
Flower opening (FO)	Number of days when first flower opens
Number of primary branches (NPB)	Branches coming out from main shoot are summed up
Number of pods per plant (NPP)	Filled pods counted at the time of harvesting
Pod length (PL)	Length of pre matured pods measured in cm.
Number of seeds per pod (NSP)	seeds per pod counted and average calculated
100 seed weight (SW)	100 seeds were weighed in gm.
Yield per plant (YP)	Yield per plant was recorded (gm)

The system architecture consist of three-tier architecture *viz.*, Client side interface layer, Server side application layer and Database layer (Sharma *et al.* 2006; Devraj *et al.* 2014) (Fig. 1). The client side interface layer is developed using the technologies: HTML and JavaScript that contains the browser based platform to access the desired information from the database using input entry forms and reports. The server side application layer is implemented using ASP. net with C#. It helps to impart the interface between the client and database. The queries are implemented in this layer for inserting, modifying and retrieving data. The access rights are also specified in this layer. The IIS (Internet Information Server) has been used to support web-based applications that access the databases. Last, the database layer accumulate all the information about fieldpea germplasm. The rational database structure was used with the implementation done using SQL Server 2005. It is used for designing the tables and relationship among the tables. Total 16 tables were designed using name of accession as primary key and qualitative traits/quantitative traits are used as secondary key. All the tables have proper interaction via primary key-foreign key relationship. The system operates on windows 2008 server. C# language for server side scripting and JavaScript for client side scripting is utilized for expanding the germplasm information system for fieldpea.

For accessing the system worldwide, it has been developed in "English" language for utilizing by the various users *viz.*, crop breeders, researchers, genetic resource specialists, planners, extension specialists and progressive farmers. The present database may be used for developing mobile-based apps in different local languages for the farmers of the country.
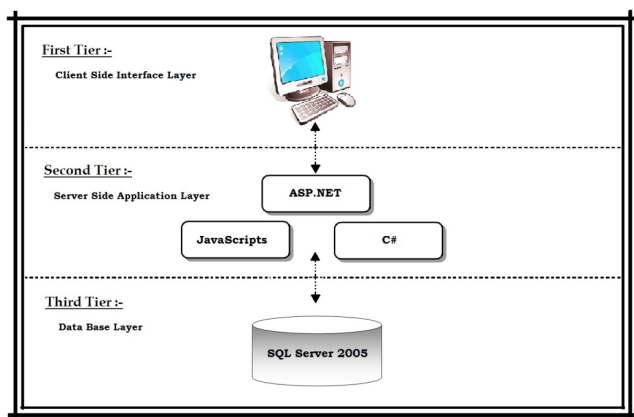
3. RESULTS AND DISCUSSION

Germplasm information system is a user-friendly system to facilitate the end-user via user-id and password. It allows user to add, view and delete information and perform searching efficiently (Stafne *et al.,* 2001). There are normally three types of users *viz.*, System Administrator, Nodal Officer/Head and User/Crop breeder. Each type of user having own authentication through valid user name and password. System Administrator is the user who manages the overall system operations and has the right to add, update and delete any part of the information entered in the database. Data analysis and report generation is also done by the System Administrator. Nodal Officer/Head is the user who approve/disapprove the information entered by the concerned crop breeder. The Users/Crop breeders are the persons who can enter information regarding the fieldpea germplasm. They are only the users responsible for data entry, updation and its submission for approval. Complete system has three subsystems viz., User Section, Germplasm Data Management and Germplasm Reports (Fig. 2). User Section contains all the information related to users and their rights given for using the system and other facilities (add, modify, delete options). Germplasm Data Management subsystem is developed for collecting, processing and storing the data. A sample screen short provides data entry interface of the system (Fig. 3). This can be activated through authentication rights given by system administrator. Germplasm Reports subsystem has been designed to access the desired information based on the queries and generate reports in PDF format. This is done by end user without any authentication. Under this subsystem different reports *viz.*, Qualitative, Quantitative, Query-based and Detailed reports are generated.

Fig. 1. Three Tier Architecture of the System

Fig. 2. Subsystems of germplasm information system

Fig. 3. Data entry screen for fieldpea germplasm

Qualitative reports are used to generates summary of statistics on qualitative data in table along with frequency distribution for all the distinct characters in graphical form (Pie Chart). For generating fieldpea qualitative report, select the desired qualitative character (for example, Early Plant Vigour (EPV)) for drop-down menu and click "Show report" option (Fig. 4). The system generates report for the selected character (Fig. 5). System also generates qualitative reports for the characters by selecting "All Qualitative Report" option.

Report on quantitative character shows the summary of statistics (Number of accessories, Minimum value, Maximum value, Mean, Variance, Standard Deviation, Skewness and Kurtosis) in tabular form alongwith frequency distribution in graphical representation (Bar Chart) (Fig.6).

Fig. 4. Screen showing selection of qualitative character

A Query-based report contains single query or multiple queries reports based on selected parameter (descriptor name, descriptor state and value) (Fig. 7). An output of information are retrieved on the screen (Fig. 8). Detail report shows the complete information for all the acquired data on fieldpea germplasm. Reports can be generated in PDF formats afterwards (Fig. 9).
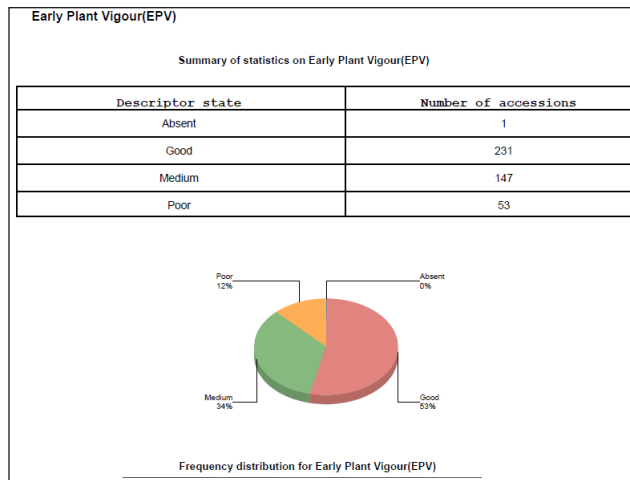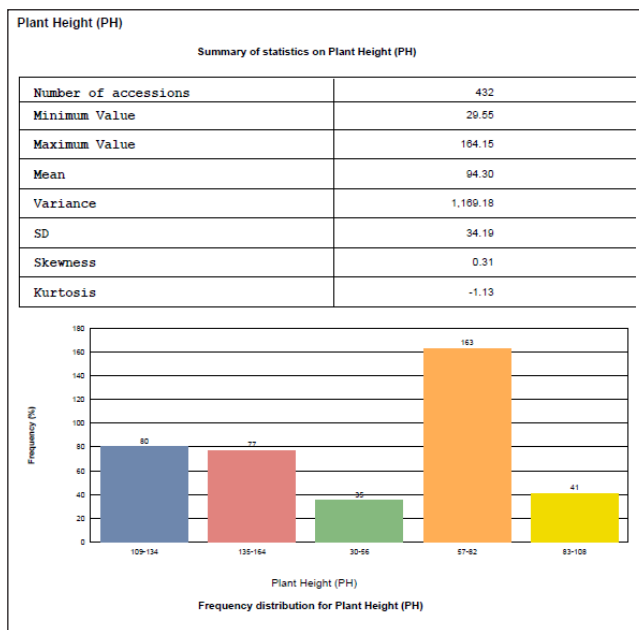

Fig. 5. Report on qualitative character

Fig. 6. Report on quantitative character
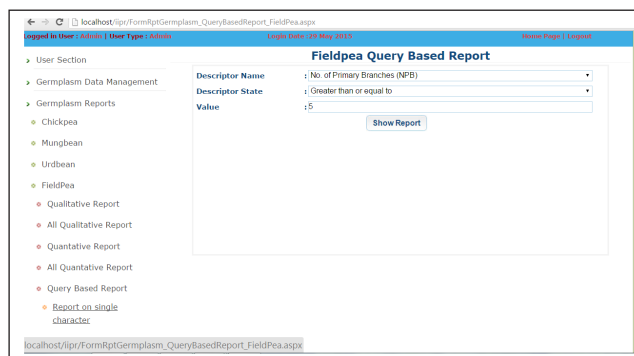

Fig. 7. Screen showing selection of multiple characters

Retrieval of Information

FieldPea accessions having Plant Height (PH) <50, No. of Pods Per Plant (NPP) >64

Total No. of Accessions : 2

Serial No.	Accession
1	P 1297-2-2
2	P 544-4

Fig. 8. Query-based report

4. CONCLUSIONS

Germplasm information system for fieldpea is a web-based system which can be utilized by various users *viz.*, Crop breeders, Researchers, Genetic resource specialists, Planners, Extension specialists and Progressive farmers. Only authenticated clients having proper permissions can update the database. The user needs web browser and internet connectivity to access the system. The system contains the information on 480 fieldpea accessories, including 12 qualitative traits and 9 quantitative traits. System will help the user in fetching data for a single feature or multiple features related to particular trait. The system provides statistical analysis for each evaluation descriptor and its descriptor states. The present system is expected to be of great significance to the end users and will help them in identification and selection of desired genotypes/ traits. This system is capable to have the features to extend for other food legumes as well using open source technology. In future, the present database may be used for developing mobile-based apps in different local languages for farmers. In short, an adaptive system is required to acquire most recent information on fieldpea germplasm to make it more effective.

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Listing of Evaluation Data (Fieldpea)

S.No.	Accession	EPV	DF	PH	NPB	NPP	SW	YP	LS	FC	LAC	SPFC	PC	IGCP
1	P 1541-33	G	56	123	3	61	23	34	M	LG	G	D	M	G
2	P 544-4	M	60	46	3	67	25	21	M	DG	G	D	M	LG
3	P 1545-5-1	G	59	56	4	47	22	29	M	G	G	D	M	G
4	P 1545-2	G	59	139	4	59	24	31	M	G	G	D	M	G
5	P 1456-A-3	G	57	146	5	65	23	16	M	G	G	D	W	G
6	P 1457-7-1	G	57	50	2	69	22	42	S	G	G	S	M	LG
7	P 1547-2	M	65	67	3	60	23	26	M	DG	G	D	M	G
8	P 1547-4	M	63	161	3	51	24	12	M	DG	G	D	M	LG
9	P 1547-5	G	57	75	3	67	25	13	M	G	G	D	M	G
10	P 1545-7-18	G	58	126	5	62	27	40	M	G	G	D	W	LG
11	P 1548-A-2	G	57	155	3	73	25	17	M	G	G	D	M	LG
12	P 1573	G	60	73	3	73	24	36	L	G	G	D	M	G
13	P 1575	P	63	111	4	58	25	46	M	G	G	D	M	G
14	P 1579	M	59	79	5	71	22	22	M	LG	G	D	M	DG
15	P 1582	M	61	126	4	57	20	48	M	G	P	S	M	LG
16	P 1585	M	56	69	3	57	15	29	L	G	G	D	M	G

Fig. 9. Detail report of fieldpea germplasm

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