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Decision Support System for Trait Specific Germplasm Identified Through Multi-location Evaluation

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Abstract

At the national level, National Bureau of Plant Genetic Resources holds a huge collection of germplasm accessions of agri-horticultural crops conserved in the National Gene Bank to cater the needs of breeders and researchers. However, majority of them have not been properly characterized and evaluated yet. Further there is no corresponding increase in the use by the crop improvement scientists, indicating that the collections were not being used to their full potential. Thus, a very large gap exists between availability of germplasm and their actual utilization in crop improvement programme. Substantial knowledge of full genetic potential of the germplasm, their availability with desired traits and proper database with interactive retrieval system was essentially needed for effective utilization of germplasm in crop improvement programmes. Keeping these considerations in view, a programme on multi-location evaluation of germplasm of four major crops namely, rice, wheat, chickpea and pigeonpea was initiated during the X Plan period (2002-07) as Characterization of germplasm of selected crops for specific traits through network approach (Anticipatory Research) to identify stable and region specific germplasm. To fulfill the need, of retrieval system, this decision support system on trait specific Germplasm identified through multi-location evaluation has been developed and installed. The decision support system has Visual Basic IDE as front-end application and SQL Server R2 as back-end with user friendly menus.

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The primary features of this decision support system are data filtering, retrieval, data displaying, data management, data uploading. This system can help to identify superior genotype for their further usage in breeding programme and improved cultivation practices to boost productivity of these crops.

Keywords: Decision Support System, Germplasm, Information System, multilocation, stability analyses, testing

Introduction

Information is one of the important components of today's life. There are fairly large amount of observed evidences that intuitive judgment of human being and capacity of decision making is far from the desired and best decision, and it further become worse even with complexity and stress. To improve quality of decision, disciplines such as economics, statistics and operations research developed various methods for making intellectual choices.

Within the past few years, techniques from information science and artificial intelligence have been implemented in the form of computer programs. Such programs were called as Decision Support System (DSS). In General, DSS is menu-driven interactive computer-based system that helps users in making judgment and choice activities. Decision Support System is a new development in information technology. It allows user to retrieve data according to their choice, which helps them to make quick decision.

National Bureau of Plant Genetic Resources holds a huge collection of germplasm accessions of agri-horticultural crops conserved in the National Gene Bank. However, majority of them have not been properly characterized and evaluated yet. A small portion of the assembled germplasm has only been characterized and evaluated and that too at one location and for a particular season. Further there is no corresponding increase in their use by the crop improvement scientists, indicating that the collections were not being used to their full potential. Thus, a very large gap exists between availability of germplasm and their actual utilization in crop improvement programme. This is because majority of them have not been properly characterized and evaluated to know their actual worth. Furthermore, there is a lack of information on a large number of accessions, particularly for traits of economic importance, which display large genotype × environment interactions and require multilocation and replicated evaluation. Very little information is available on tolerance/resistance to biotic and abiotic stresses in the selected germplasm which are of prime importance particularly under the changing climatic scenario. Substantial knowledge of full

genetic potential of the germplasm, their availability with desired traits and proper database with interactive retrieval system are essentially needed for effective utilization of germplasm in crop improvement programmes. Therefore, proper evaluation of available germplasm for agronomic traits, biotic and abiotic stress tolerance, and quality parameters is an important activity for promotion of germplasm utilization. Keeping these considerations in view, a programme on multi-location evaluation of germplasm of four major crops namely, rice, wheat, chickpea and pigeonpea was initiated during the X Plan period (2002-07) as Characterization of germplasm of selected crops for specific traits through network approach (Anticipatory Research).

Under this programme, large number of accessions of above mentioned crops were received from the National Gene Bank and multiplied for characterization and evaluation for agronomic traits, biotic and abiotic stresses and quality traits in collaboration with Project Directorate/ Project Co-ordinators of these crops and National Active Germplasm Sites (NAGS) associated with them. The locations identified under the All India Coordinated Research Network Project (AICRP) system were utilized for this purpose. Germplasm accessions of rice, wheat, chickpea, pigeon pea were evaluated for agronomic traits, biotic and abiotic stresses, quality traits and protein content during three five years (2004-2009).

All the information analyzed on these crops were into MS excel spreadsheet. It was observed at Bureau that there was need for a DSS through which relevant information can be retrieved and stored for further usage. To fulfill this need, this DSS on trait specific Germplasm identified through multi-location evaluation has been developed and installed. This paper describes about successful operation of new multi optional web based DSS.

Material and Methods

DSS on Trait Specific Germplasm Identified through Multi-location Evaluation is developed using Visual Basic IDE (Randolph *et al*. 2008, Evangelos 2008) as front-end-application and SQL Server R2 (Rankins *et al.* 2010) as back-end with user friendly menus. The database of system is presently having data for 4 crops (rice, wheat, chickpea, pigeopea).

The dataset of these four crops consists of 11 fields *viz.* crop, aspect, characterdata, location, scientist, cultivation_year, sets, accession, range, promising_accessions, bestcheck_value. Fig.1 displays dataset of pigeonpea crop.

Sno	Crop	Aspect	CharacterData	Location	Scientist	Cultivation_year	Sets	Accession	Range	Promising_Accessions	Bestcheck_value
1	Pigeonpea	Agronomic	Days to 50% flowering	MAU, ARS, Badnapur	Dr. S. M.Sudwad	2004	I	375	66.0 -120.0	IC245130, IC245132, IC245131, IC245296,	P33 (103.00)
2	Pigeonpea	Agronomic	Days to 50% flowering	MAU, ARS, Badnapur	Dr. S. M.Sudwad	2004	II	375	71.0 -124.0	IC73954, IC74155, IC73968, IC74043,	P33 (103.00)
3	Pigeonpea	Agronomic	Days to 50% flowering	UAS, Bangalore	Dr. M. Byre	2004	I	375	54.0 -178.0	IC245227, IC245130, IC245131,	UPAS 120 (64.70)
4	Pigeonpea	Agronomic	Days to 50% flowering	UAS, Bangalore	Dr. M. Byre	2005	I	480	70.7 -198.0	None	ICPL-87 (70.67)
5	Pigeonpea	Agronomic	Days to 50% flowering	UAS, Bangalore	Dr. M. Byre	2006	I	453	61.0 -134.0	ICPL-00079, IC244944, P-942-2,	Pusa-992 (76.89)
6	Pigeonpea	Agronomic	Days to 50% flowering	TANU, Coimbatore	Dr. S.	2004	I	375	45.0 - 98.0	IC245136, IC245234, IC245240, IC245266,	UPAS120 (55.00)
7	Pigeonpea	Agronomic	Days to 50% flowering	TANU, Coimbatore	Dr. S.	2004	II	375	45.0 - 89.0	IC74141, IC74146, IC74147, IC74142,	UPAS120 (55.00)
8	Pigeonpea	Agronomic	Days to 50% flowering	TANU, Coimbatore	Dr. N. Nadarajan	2005	I	480	730.0 -175.0	None	P33 (59.4)
9	Pigeonpea	Agronomic	Days to 50% flowering	TANU, Coimbatore	Dr. N. Nadarajan	2006	I	453	60.0 -155.0	Trianx316P12, IC490563, AL-1357-2,	NA
10	Pigeonpea	Agronomic	Days to 50% flowering	IIPR, Kanpur	Dr. I. P. Singh	2004	I	375	59.0 -143.0	IC245229, IC245183, IC245218, IC245221,	P992 (73.38)
11	Pigeonpea	Agronomic	Days to 50% flowering	IIPR, Kanpur	Dr. I. P. Singh	2004	II	375	67.0 -150.0	IC73954 (<66.00)	P992 (73.38)
12	Pigeonpea	Agronomic	Days to 50% flowering	CSAUA & T, Kanpur	Dr. R. P. Singh	2005	I	480	64.0 -155.0	IC015722, IC022555, IC022519, IC022520,	GT-100 (81.67)
13	Pigeonpea	Agronomic	Days to 50% flowering	CSAUA & T, Kanpur	Dr. R. P. Singh	2006	I	453	46.0 -158.0	IC490604, NIC-18870, IC490873,	NA
14	Pigeonpea	Agronomic	Days to 50% flowering	PAU, Ludhiana	Dr. J.S. Sandhu	2004	I	375	68.0 -101.0	IC245183, IC245218, IC245143, IC245178,	NA
15	Pigeonpea	Agronomic	Days to 50% flowering	PAU, Ludhiana	Dr. J.S. Sandhu	2005	I	480	3.02 -152.0	IC022541, IC022543, IC490598, IC015711-	G-101 (132)
16	Pigeonpea	Agronomic	Days to 50% flowering	PAU, Ludhiana	Dr. J.S. Sandhu	2006	I	453	77.0 - 150.0	IC033715, IC490619, IC490873, ICPL-	Pusa-991 (77.00)
17	Pigeonpea	Agronomic	Days to 50% flowering	MPKV, Rahuri	Dr. B. M.	2004	I	375	67.0 -152.0	IC245543, IC245517, IC245518, IC245550,	UPAS120 (68.33)
18	Pigeonpea	Agronomic	Days to 50% flowering	MPKV, Rahuri	Dr. B. M.	2005	I	480	78.0 -198.0	IC022551, IC033521, IC015708, IC015717,	GT-100 (109)
19	Pigeonpea	Agronomic	Days to 50% flowering	BHU, Varanasi	Dr. U.P. Singh	2004	I	375	46.0 -140.0	IC245183, IC245131, IC245221, IC245220,	P992 (74.4 0)
20	Pigeonpea	Agronomic	Days to 50% flowering	BHU, Varanasi	Dr. U.P. Singh	2004	II	375	63.0 -142.0	ICP6221 (<64.00)	P992 (74.40)
21	Pigeonpea	Agronomic	Days to 50% flowering	BHU, Varanasi	Dr. M.N. Singh	2005	I	480	67.0 -181.0	IC016208-2, IC016208-1 (<75.00)	ICPL-87 (76.67)
22	Pigeonpea	Agronomic	Days to 50% flowering	BHU, Varanasi	Dr. M.N. Singh	2005	II	459	63.0 -158.0	IC244985 (<64.00)	GT-100 (83.33)
23	Pigeonpea	Agronomic	Days to 50% flowering	BHU, Varanasi	Dr. M.N. Singh	2006	I	453	60.0 - 152.0	IC490722, IC490619, IC245173, IC490594,	Pusa-991 (71.00)
24	Pigeonpea	Agronomic	Days to 50% flowering	UAS, ARS, Gulbarga	D. P. S. Dharamraj	2005	II	459	72.0 -135.0	IC245316, IC245302, IC245310, IC245363	ICPL-87 (79.33)
25	Pigeonpea	Agronomic	Days to 50% flowering	AGRAU, ARS, Warangal	Dr. S. Vanisree	2005	II	459	72.0 -178.0	IC245551, Panta-110, IC245323,	ICPL-87 (92.29)
26	Pigeonpea	Agronomic	Days to 50% flowering	RAS, Durgapur	Dr. S.J. Singh	2006	I	453	70.0 - 93.0	IC490801, IC490631, IC490257, IC490841,	Pusa-991 (75.18)
27	Pigeonpea	Agronomic	Days to 50% flowering	CCS, HAU, Hisar	Dr. B. P. S. Malik	2006	I	453	77.0 - 150.0	IC033715, IC490619, ICPL-00079,	Pusa-991 (77.00)
28	Pigeonpea	Agronomic	Days to 50% flowering	Pooled over locations	NA	2004	I	375	64.3-126.3	IC245518, IC245183, IC245218, IC245541,	UPAS120 74.00)

Fig.1 Dataset of Pigeonpea

The data of rice consists of 329 records having information about five aspects (agronomic, diseases, insects/pests, Multiple disease, Multiple pest resistance) of four years 2004-2008 from 19 locations across India. It consists of 28 character data on various aspects. The data of wheat consists of 390 records having information about four aspects (agronomic, quality, Multiple disease and abiotic) of five years 2004-05 to 2008-09 of 14 locations. It consists of 21 character data on various aspects. The data of chickpea consists of 538 records having information about four aspects (agronomic, biotic stresses, abiotic stresses and quality) of five years 2004-05 to 2008-09 of 20 locations. It consists of 20 character data on various aspects. The data of pigeonpea consists of 325 records having information about three aspects (agronomic, biotic stress and quality) of three years 2004-06 of 16 locations. It consists of 11 character data on various aspects. Fig.2 shows startup screen of this system.

Fig. 2 Homepage of trait specific germplasm identified through multi-location evaluation (decision support system)

The Query web-page of this system is developed to retrieve information. Attributes for this DSS are Crop, Year, Locations, Accessions, Scientists, and Characters. In this web form, user is prompted to make choices on these attributes through dropdown boxes. Click on the submit button displays filtered data according to the choice, into datagrid appearing in new window screen. Fig. 3 Shows the query web-page.

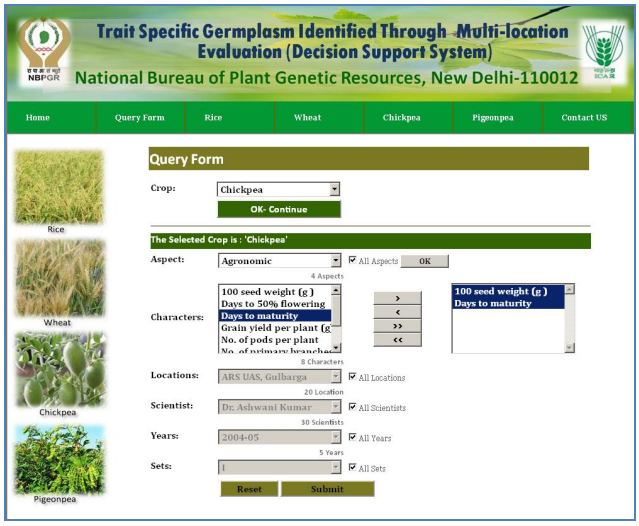

Fig. 3 Query web-form

In the query web-page, user is prompted to select crop from dropdown box and click button. As soon as user makes his choice, the dropdown boxes of aspects is populated. Again, user is prompted to select an aspect from dropdown box and click "OK" button. It results in populating characters, locations, scientists, years and sets dropdown boxes. Now User can make his choice on all of these options and click submit button to see in datagrid. Fig. 4 Shows filtered data according to choice made by user.

Sno	Crop	Aspect	CharacterData	Location	Scientist	Cultivation_year	Sets
301	Chickpea	Agronomic	Days to maturity	IGKV, Raipur	Dr. P.L. Johnson	2004-05	II
303	Chickpea	Agronomic	Days to maturity	IGKV, Raipur	Dr. P.L. Johnson	2005-06	II
305	Chickpea	Agronomic	Days to maturity	IGKV, Raipur	Dr. P.L. Johnson	2006-07	II
307	Chickpea	Agronomic	Days to maturity	IGKV, Raipur	Dr. P.L. Johnson	2008-09	I

Fig. 4 Filtered data on the basis of desired choice

Results and Discussion

The trait specific germplasm are grown in many parts of the country in large areas. Yet, no authentic information is available on the area and distribution. This has become a major constraint in developing these germplasms. It is important to fill this gap in order to improve the availability of information. Since long, the need based

selection and domestication of trait specific germplasm by mankind has helped in evolution of several useful plant species.

The DSS described in this paper will help scientists, researchers and policy planners to do need based selection of germplasm at a single interface. It is helpful in finding plant species which can be useful for diversification of agriculture. With the help of this DSS farmers also can be benefited to get information of improved varieties of plants species which can improve their yield.

This DSS offers immense opportunity for identification of trait specific germplasm suited to different agro-climatic niches. It can be used to help in analysing characters of different aspects, which can standardize package of practice information. Primary features of this DSS are data filtering, retrieval, data displaying, data management, data uploading through MS Excel worksheet. The Information on all these crops will be useful to germplasm curators, breeders, researchers and students to select material for their further use in studies and crop improvement programme and promote utilization of plant genetic resources.

References

[1] Cohen, Marc-David. Kelly, Charles. Medaglia, Andrés. (March-April 2001). Decision Support with Web-Enabled Software. SAS Institute. Vol. 31, No. 2, , pp. 109-129
[2] Decision Support System http://www.pitt.edu/~druzdzel/psfiles/dss.pdf.
[3] Nick Randolph, David Gardner. 2008. *Professional Visual Studio 2008*. Reprint by Wiley India Pvt. Ltd., New Delhi
[4] Nick Randolph, David Gardner. 2008. *Professional Visual Studio 2008*. Reprint by Wiley India Pvt. Ltd., New Delhi
[5] Petroutsos Evangels 2008. *Mastering Microsoft Visual Basic 2008*. Reprint by Wiley India Pvt. Ltd., New Delhi
[6] Ray Rankins, Paul Bertucci, Chris Gallelli, Alex T Silverstein. 2010. *Microsoft SQL Server 2008 R2 Unleashed*. Sams