Indian maize cultivar database (IMCDB): a tool for breeders

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Abstract

An attempt has been made to present information on maize cultivars that have been developed and notified for cultivation in India. These cultivars emanated from public as well as private breeding programmes in the country. The Indian maize cultivar database (IMCDB) is a central repository for hybrids and open pollinated varieties (OPVs) notified for cultivation since the initiation of organized research on maize in India in 1957. The database summarizes vital information on various key traits including adaptability of cultivars, their average yield and resistance to diseases and insect-pests along with pedigree. It also carries image gallery showcasing photographs of cobs/ standing crop of the public-bred cultivars released after 1993. A perusal of IMCDB revealed that the public sector invested in both hybrids and OPVs while the private sector targeted hybrids alone. The study further showed diverse varietal portfolio of public sector with Quality protein maize (QPM) and specialty corns standing out. However, both the sectors emphasized yellow maize and addressed the requirements of rainy seasons. The IMCDB provides contact information on developers of the cultivars thereby facilitating interactions among the members of maize community. The information contained within maize database can be accessed at on-line expert system called maize AGRIdaksh www.iimr.res.in/maizeexpertsystem / www.agridaksh.iasri.res.in/maize.

Key words

Maize cultivars, hybrids, open pollinated varieties, database, public sector, private sector

Introduction

Maize, *Zea mays* L. is the third most important cereal after rice and wheat in India that provides food, feed, fodder, and serves as a source of basic raw material for the number of industrial products such as starch, protein, oil, alcoholic beverages, food sweeteners, cosmetics, etc. Its unprecedented growth has been attributed to its increasing use in poultry as feed, increasing interest of the consumers in nutri-rich products and above all availability of high yielding hybrids (Pingali & Pandey, 2001; Kumar et al 2013; Yadav et al 2016). Currently, Indian maize programme is completely focused on the development and deployment of single cross hybrids (SCHs) in various production ecologies in the country.

Maize breeding in India

The systematic breeding efforts in maize began with the launch of All India Coordinated Maize Improvement Project (AICMIP) later re-christened as All India Coordinated Research Project on maize (AICRP on maize) – a first of its kind in 1957 at Pusa Campus, New Delhi. The project facilitated planning, implementing and monitoring of research activities and aided in generation of data on the performance and stability of experimental materials i.e. hybrids and OPVs across production ecologies (Dhillon & Malhi 2006). In 1961 the project resulted in development of 4 double cross hybrids (DCHs) and since 1967 OPVs were also developed for cultivation on farmers' fields. Since then, 239 cultivars comprising 122 OPVs and 117 hybrids (81 single cross hybrids {SCHs} and 36 multi-parent crosses{MPCs}) have been developed, released and notified for cultivation in different production ecologies of the

country. In 1978, the first proprietary hybrid was released and notified for cultivation. The private sector, since then has been actively engaged in hybrid breeding and till date 109 hybrids including 41 SCHs have been developed and notified.

IMCDB

The importance of databases can hardly be overstated. Maize database on released cultivars can act as a powerful tool in catering to the needs of rapidly expanding maize community. Among many things, it can throw light on cultivar development scenario enabling us to view patterns in operations, facilitate retrospective analysis and guide in trait-prioritization for future breeding strategies. More importantly, such a database would augment efforts on documentation, conservation and effective utilization of crop genetic resources. Accordingly a database called IMCDB has been developed (Kaul et al 2017). Its varietal component features general information on hybrids and OPVs, viz. denomination, pedigree, notification number/year and nature of cultivar i.e. whether it is a single cross hybrid, double cross hybrid, three-way cross or an OPV. The area of adaptation of each hybrid / OPV has been given in terms of Agro-Climatic Zone (ACZ) followed by the names of states covered under each zone. The database also gives addresses of the organizations / AICRP centres that have developed the cultivars. Besides, information on key traits namely average yield, maturity, kernel texture and kernel colour is also given. Information on resistance / tolerance to biotic and abiotic stresses has also been compiled. The database also carries information on Quality Protein Maize (QPM), sweet corn, baby corn, pop corn, high starch and fodder cultivars. The data on biochemical parameters like protein (%), tryptophan (%), total soluble solutes TSS (%) are recorded wherever applicable. This component also presents information on production ecology i.e. cropping season of each notified cultivar.

Table 1 summarizes the detailed information on notified cultivars of maize in India. The varietal component currently contains information about 348 notified cultivars including 226 hybrids and 122 OPVs that were released for cultivation in different parts of the country. Of these, 239 cultivars (117 hybrids and 122 OPVs) emanated from public sector. Likewise, 109 notified hybrids were proprietary that were developed by private breeding programmes but released after AICRP testing of three years. The database records also display information on 11 QPM cultivars comprising 10 hybrids and one OPV besides three each of *opaque 2* and fodder varieties, respectively. In case of sweet corn, information on nine cultivars that included five public-bred (two hybrids and three OPVs) and four proprietary hybrids has been given. The database also contains information about four pop corn OPVs, five baby corn cultivars (two hybrids and three OPVs) and one high starch hybrid that emanated from public breeding programmes.

The study of IMCDB displayed diverse varietal portfolio of public sector: grain maize, yellow and white; fodder maize; QPM to augment nutrition-agriculture linkage; specialty corns like sweet corn, pop corn and baby corn to cater to the needs of peri-urban agriculture; etc. The private sector, on the other hand emphasized overwhelmingly yellow grain maize. A preponderance of cultivars for rainy season could be ascertained which is expected given that the crop is pre-dominantly grown in rainy seasons. The cultivar profile highlighted that both the sectors developed hybrids but public sector emphasized OPVs as well in their breeding programmes.

The search for materials possessing higher yielding potential across the diverse maize-growing environments has shaped the evolution of the breeding programmes in India. The database is therefore an efficient tool to reflect upon the cultivar development scenarios which in turn may pave way for identifying breeding priorities and refine future crop improvement programmes.

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Table 1: Information about notified cultivars summarized within IMCDB at a glance (1961-2017)

IMCDB	Public sector	Private sector	Total
Total notified cultivars	239	109	348
Cultivar category			
OPVs	122	-	122
SCHs	81	41	122
MPCs	36	61	97
Unspecified*	-	7	7
Kernel colour			
Yellow	191	96	287
White	48	4	52
Unspecified*	-	9	9
QPM	11	-	11
Opaque-2	3	-	3
Specialty corns			
Sweet corn	5	4	9
Pop corn	4	-	4
Baby corn	5	-	5
High starch	1	-	1
Fodder maize	3	-	3
Production ecology (season)			
Rainy (Kharif)	218	95	313
Post-rainy (Rabi)	10	11	21
Summer	1	-	1
Rainy and post-rainy	10	3	13

*No information exists on these proprietary hybrids