Salient Achievements of AICRP Maize 2011

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Maize single cross hybrid in cropping system and its cob

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Maize area, production and productivity trend from 1950-51 to 2010-11

PREFACE

In India, maize (*Zea mays* L.) is the third most important cereal after rice and wheat that provides food, feed, fodder, and serves as a source of raw material for developing hundreds of industrial products *viz*., starch, protein, oil, alcoholic beverages, food sweeteners, pharma, cosmetics, bio-fuel etc.

In India as per the latest report, maize area, production and productivity is 8.55mha, 21.73mt and 2.54t / ha, respectively (2010-11). However, the demand for maize is expected to touch 45mt by 2030 of which 24-25% will be used for human consumption, >60% as poultry and livestock feed and the remaining for industrial raw material. To meet the growing demand of maize All India Coordinated Research Project (AICRP) on maize vested with the responsibility of testing newly developed high yielding hybrids across the country in different agro-climatic conditions. The process of testing is through multidisciplinary (breeding, agronomy, physiology, biochemistry, entomology, pathology and nematology) approach which involves recording observations on various parameters including yield, resistance to pests and diseases. All newly developed varieties will be tested against national checks. National checks are the previously tested high yielding hybrids which have released and notified for cultivation and are presently cultivating in large areas in different agro-climatic conditions of the country. Each new hybrid will be evaluated through AICRP trials for yield and their associated traits apart from their reaction to various major diseases and pests. Based on data of three years of testing the superior hybrids will be identified for release for different agro-climatic conditions.

In coming days profitability of maize cultivation should be encouraged by promoting specialty corn in market in specified area especially in the *peri*-urban areas with good market connectivity. Sweet corn and baby corn had gained importance in last few years. An organized market in specialty corn will help in increasing maize profitability to the maize growers in coming days. With the advent of new generation sequencing technology, it has become possible to unravel the sequence of gene(s) of economic importance and also explore novel alleles present in the germplasm. Bringing such novel alleles into well established cultivars has become possible through transgenics and conventional breeding. Such novel approaches will not only enhanced the *per se* performance of parents involved in hybrids development but also hybrids as well. In this booklet the summary in the form of salient achievements of AICRP during 2011 is presented briefly under different disciplines.

R. Sai Kumar
(Project Director)

April, 2012
New Delhi

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PLANT BREEDING

RESEARCH HIGHLIGHTS

Release of new cultivars during 2011

During 2011, five hybrids *viz*., X7B 401, MCH 38, KMH – 3712, MCH 37 and Mon 29 were released in different maturity groups by Central Sub-Committee on Crop Standard and Notification of varieties for different agro-climatic conditions of the country. The details of these hybrids are given in the Table 1.

Hybrids notified during 2011-12

The following three hybrids (Table 2) from VPKAS, Almora and Pioneer were notified vide S.O. 456(E) dated March 16, 2012.

Registration of Maize Germplasm by NBPGR

The ten promising inbred lines (Table 3) were registered at NBPGR, New Delhi as unique Germplasm. Of these, two are specialty corn lines.

Table 1: List of hybrids released during 54th Annual Maize Workshop, 2011

S.No.	Hybrids	Centre/Organization	Area of Adaptation/Zone	Characteristics
1	X7B 401	Pioneer	Gujarat, Rajasthan, MP. Chhattisgarh (Zone-5) yield-6.5 t / ha	Medium, orange, flint grains, avg.
2	MCH 38	Monsanto	Eastern UP, Bihar, Orissa, Jharkhand, Maharashtra, Tamil Nadu, Karnataka & Andhra Pradesh (Zone-3&4)	Late, Semi-flint, yellow grains, avg. yield-8.6 t / ha
3	KMH – 3712	Kaveri	Punjab, Haryana, Delhi, western UP, East UP, Bihar, Jharkhand, West Bengal, Orissa, Rajasthan, Gujarat, M.P and Chhattisgarh (Zone-2,3&5)	Medium, semi-dent, yellow grains, avg. yield-7.0 t / ha
4	MCH 37	Monsanto	AP, Maharashtra, Karnataka & TN (Zone-4)	Medium, semi-dent, yellow grains, avg. yield-8.1 t / ha
Rabi				
5	Mon 29	Monsanto	Eastern UP, Bihar, Jharkhand & Orissa (Zone-3)	Late, dent, yellow grains, avg. yield-10.0 t / ha

Table 2: List of new hybrids of maize notified during 2011-12

S. No.	Hybrids	Centre/Organization	Area of Adaptation/Zone	Characteristics
1	Vivek 43	VPKAS,Almora	UP,MP and Rajasthan	Early , orange ,flint grains, avg. yield - 5.0t / ha
2	Vivek -39	VPKAS,Almora	UA, HP	Early , orange ,flint grains, avg. yield - 5.0t / ha
3	X7B 401	Pioneer	Gujarat, Rajasthan, M.P, Chhattisgarh (Zone-5)	Medium, orange, flint grains, avg. yield-6.5 t / ha

Table 3: List of maize inbred lines submitted at NBPGR for registration.

S.No.	Inbred Line	INGR#	IC#	Centre	Unique trait/s
1.	DMRE-9	11094	0589141	DMR	Source of resistance to pink borer, attractive orange colour kernels
2.	DMRE-57	11095	0589142	DMR	Source of resistance to pink borer, attractive orange colour kernels
3.	DMR-PFSR-1	11041	0590094	DMR	Source of resistance to PFSR
4.	DMR-PFSR-9	11042	0590095	DMR	Source of resistance to PFSR, stiff, strong and stay green stalk
5.	DPcl-10	11096	0589143	DMR	100% poppiness, good pollinator
6.	DMRHO-57	11090	0589137	DMR	High oil content (6.34%), attractive yellow flint kernels
7.	KDTML-19	11082	0589131	Karimnagar	Drought tolerance, stay green and light orange flint kernels
8.	KDTML-66	11083	0589132	Karimnagar	Drought tolerance,higher no. of kernel rows per cob and high test weight
9.	KDTML-3	11081	0589130	Karimnagar	Drought tolerance, low ASI and orange flint kernels
10.	KML-29	11080	0589129	Karimnagar	Drought tolerance and waterlogging tolerance, stay green foliage

Protection under PPV&FRA

Fifteen hybrids/composites have been identified for grant of certificate under PPV&FRA. Among them, three hybrids under new category namely HQPM-5, HM-9 and Malviya Hybrid 2; five hybrids and seven composites under extant category have been registered. The detailed information of these genotypes has been given in the Table 4.

Evaluation of hybrids and composites in AICRP on maize trials

In *kharif* 2011, total of 238 test entries, which include 135 in IET, 58 in AET-I, 24 in AET-II, 12 in QPM 1-3, 4 in Popcorn and 5 in sweet corn were tested across the country. All the test entries were tested against 27 checks in net trials of 45. Out of 238 entries, 122 and 116 test entries are from 15 public and 34 private sector research and development institutes respectively. The test entries were promoted from IET to AET-I based on the at least 5% (late maturity group) and 10% (medium, early and extra early maturity group) superiority in one or more than one zones. In case of medium, early and extra-early maturity group, days to 50% silking and 75% yellow husk over the best check have also been considered as one of the criteria. The entries which were not

Table 4: List of hybrids/composites submitted for protection under PPV&FRA.

S.No.	Name	Centre	Period of protection (Years)
New category hybrids			
1.	HM-9	CCSHAU Karnal	Dec. 07, 2011 to Dec. 06, 2026
2.	HQPM-5	CCSHAU Karnal	Dec. 07, 2011 to Dec. 06, 2026
3.	Malviya Hybrid Makka-2	BHU Varanasi	Dec. 27, 2011 to Dec. 12, 2026
Extant category hybrids			
4.	Vivek Maize Hybrid-21	VPKAS Almora	March 07, 2011 to Feb. 05, 2022
5.	Vivek Maize Hybrid-23	VPKAS Almora	Sept. 30, 2011 to Feb. 05, 2022
6.	Parkash	PAU, Ludhiana	Sept. 30, 2011 to Sept. 8, 2012
7.	PMH-2	PAU, Ludhiana	Sept. 30, 2011 to April 24, 2021
8.	Buland	PAU, Ludhiana	Oct. 21, 2011 to Aug. 24, 2020
Extant category Composites			
9.	Pratap Makka -3	MPUA&T Udaipur	March 07, 2011 to Feb. 01, 2020
10.	Pratap Makka- 4	MPUA&T Udaipur	March 07, 2011 to April 24, 2021
11.	NAC-6002	UAS Nagenahalli	March 07, 2011 to Sept. 03, 2017
12.	NAC-6004	UAS Nagenahalli	March 07, 2011 to Feb. 01, 2016
13.	Birsa Makai-1	BAU Ranchi	July 20, 2009 to Dec. 31, 2011
14.	Birsa Vikas Makka-2	BAU Ranchi	July 20, 2009 to August 24, 2020
15.	Azad Kamal	CSUA&T Kanpur	Sept. 30, 2011 to Feb. 01, 2020

following the set criteria for medium, early and extra-early maturity group with respect to days to 50% silking and 75% yellow husk were not consider for promotion even though they were better performing for yield over the best checks in that maturity groups. The superior entries are in *Annexure I*. The superior test entries in third or final year of testing will be identified and released during the coming Annual Maize Workshop-2012 based on the three year data.

Breeding for Single Cross Hybrids in different maturity groups

Development of productive inbred lines is one of important mandate of the maize project. A total of 2060 inbred lines belonging to normal, sweet corn and popcorn were evaluated at Delhi during *kharif* 2011. These lines were cleaned and maturity group have been assigned for desirable lines. Besides this, a set of 1665 QPM and 962 normal lines belonging to different maturity groups were maintained during winter season at Hyderabad. A total of 2041 crosses have been attempted during *rabi* 2011, which will be available for evaluation in the coming season. Another set of 319 land races and 170 inbred lines procured from NBPGR was evaluated in the winter nursery, Hyderabad to generate their passport data. A set of 204 inbred lines of different maturity groups has been put in evaluation for drought tolerance at two locations (Delhi and Hyderabad).

Salient achievement of Winter Nursery

1. A total of 8362 genotypes belonging to different centres (Almora, Bajaura, Delhi, Ludhiana, Pantanagar, Udhampur, Srinagar, NBPGR and DMR) were planted and maintained.
2. 5 Single cross hybrids were promoted under coordinated testing: 1 from AET-I to AET-II and 2 from IET to AET-I; besides this, two popcorn hybrids has been evaluated under AET-II which will be available for release during the 55th annual workshop.
3. 319 land races and 170 inbred lines from NBPGR were maintained through controlled pollinations.
4. 1665 QPM and 962 Normal lines were maintained / advanced through controlled pollination.

Breeding for Sweet corn and Popcorn

In total, 699 sister lines of sweet corn (449) and popcorn (250) were evaluated for phenotypic uniformity during *kharif* 2011. The desirable plants within 204 and 111 inbred lines of sweet corn and popcorn respectively, including sister lines were maintained by selfing and are under further evaluation during *rabi* 2011-12 at Maize Winter Nursery, Hyderabad. In addition 54 crosses of sweet corn were evaluated during *kharif* 2011. However, none of the sweet corn crosses were superior over the check hybrid HSC-1. Further, 26 popcorn sister lines were evaluated for popping percentage which was ranging from 45-84%. The results indicated that there is need to improve the popping percentage trait in the popcorn inbred lines.

Breeding for high oil content and baby corn single cross hybrids

Top cross (Elite hybrid x High oil Corn inbred) population have been generated and evaluated for the performance with respect to oil content. Some of the crosses *viz*., VH4 X Temp X Temp x Trop (H0) QPM-B-B-B-60-B-B, VH5 X Temp x Trop (H0) QPM-B-B-B-60-B-B, HQPM5 X Indimyt 345 and HM4 X Indimyt 345 showed the best *per se* performance among top crosses. Ten early hybrids have been evaluated for baby corn traits in high planting density (60x10cm). Among them, HM-4 and VHQPM-9 are found to be good in baby corn traits.

Breeder Seed Production

Indent for maize breeder seed from various states and NSC was received and was also allocated to various centres for the current year 2011-12. The indent for all the varieties is honoured. A total of 240.14 quintal of seed was indented and till date 77.51 quintals is produced and still information is awaited from some of the centres. The details of the breeder seed produced for indented varieties has been mentioned in *Annexure II*.

Genetic divergence among the popular hybrids in India

Genetic diversity was studied between hybrids and their parents (Table 5) by screening 90 SSRs (Table 6) markers. Among total of 90 SSRs markers, nine were found polymorphic and were used for genetic diversity analysis. The SSR dataset was analysed with Power Marker v.3.2 software. A total of 21 alleles were scored with nine SSRs. The Polymorphism Information Content (PIC) value ranged from 0.15 to 0.41

Table 5: Hybrids and their parents selected for genetic divergence study.

S.No.	Hybrids	Pedigree	S.No.	Hybrids	Pedigree
1	HM-4	HKI-1105 x HKI-323	14	PMH-3	LM-17 x LM-14
2	HM-8	HKI-1105 x HKI-161	15	JH-3459	CM-143** x CM-44**
3	HM-11	HKI-1128 x HKI-163	16	Vivek QPM-9	VQL-1** x VQL-2**
4	HQPM-1	HKI-193-1 x HKI-163	17	KNMH-40113	
5	HQPM-5	HKI-163 x HKI-161	18	KNMH-40111	
6	HQPM-7	HKI-193-1 x HKI-161	19	NK-6240	Syngenta
7	DHM-117	BML 6 x BML 7	20	Bio-9637	Bioseeds
8	Prakash	CM-139** x CM-140**	21	Bio-9681	Bioseeds
9	Vivek Hybrid-9	CM-214** x CM-145	22	Seedtech-2324	SeedTech
10	PMH-4	LM 5 x LM 16	23	30V92	Pioneer
11	Buland	LM-11 x LM-12	24	CMH-08-282	Pvt
12	PMH-1	LM-13 x LM-14	25	900MGold	Monsanto
13	PMH-2**	LM-15 x LM-16	26	Syngenta Hybrid	Syngenta

Note: ** Not included in the study

Table 6: List of markers used in the present study

S.No.	Marker	Bin Reaction	Repeat
1	umc1646	5.07	(CTGGA)4
2	phi089	6.08	ATGC
3	umc1355	5.03	(TTTC)4
4	umc1180	4.1	(CATG)5
5	umc1702	4.05	(CAGCCT)4
6	umc1121	8.05	AGAT
7	phi002	1.07	AACG
8	umc1377	8.03	(TAATA)4
9	bnlg1429	1.02	(AG)20

(Table 7). PIC value is a robust diversity parameter which tells about the number of alleles found and their distribution. The lower PIC value indicated the occurrence of less number of alleles and also the low level of polymorphism in study material (inbred and hybrids).

The SSR dataset was analyzed three times. One analysis comprised of all the inbreds and hybrids, one with hybrids alone and the last one with only inbreds. The SSR dataset of nine primers and 44 entries was subjected to allele frequency estimation. The allele frequencies of all the loci in all the entries were subjected to pairwise Roger's distance (1972) estimation. Roger's distance (1972) can be used in (i) investigating the assembly and validation of core collections and the identification of duplicates in seed bank/s and (ii) uncovering pedigree relationships among operational taxonomic units as needed for the detection of essentially derived varieties in plant breeding. Mathematically, Melchinger *et al.*, (1991) derived theoretical results showing that the d_R estimates between two homozygous inbreds are linearly related to the coancestry coefficient (Malecot, 1948). And, d_R is best suited for studying genetic relationship between the inbreds based on allelic informative marker data. The genetic distance between the parents of selected hybrids are presented in Table 8. The table is presented with values which are less than 0.2 and greater than 0.5. The distance between parents of hybrids is relatively

Table 7: Marker wise summery of SSR dataset

Marker	Major Allele Frequency	Gene Diversity	Heterozygosity	PIC
umc1646	0.6860	0.4686	0.2558	0.4108
phi089	0.5814	0.4867	0.0000	0.3683
umc1355	0.8256	0.2880	0.0233	0.2465
umc1180	0.8256	0.3031	0.3023	0.2822
umc1702	0.8788	0.2204	0.1212	0.2090
umc1121	0.6744	0.4392	0.1395	0.3427
phi002	0.9070	0.1687	0.1860	0.1545
umc1377	0.8488	0.2566	0.3023	0.2237
bnlg1429	0.6977	0.4218	0.6047	0.3329
Mean	0.7695	0.3393	0.2150	0.2856

Table 8: Roger's distance between the parents of selected hybrids

OTU	BML6	BML7	CM145	HKI1105	HKI161	HKI163	HKI193-1	HKI323	LM12	LM13	LM14	LM15
HKI1128		0.17		0.56								
HKI163					0.56							
HKI193-1	**0.61**		0.17	0.17								
HKI323			0.17	0.17		0.17						
LM12				0.17								
LM13				**0.61**			0.56		**0.67**			
LM14					0.56				0.06	**0.72**		
LM15			0.17	0.06		0.17		0.11	0.11	**0.56**	0.17	
LM16	0.17				**0.61**	0.17			0.11	**0.56**	0.17	
LM17												0.17
LM5									**0.61**		**0.67**	

more than between non-parents of hybrids. Considerable genetic diversity is observed in the selected inbreds.

Cluster analysis of inbreds alone suggests that the Ludhiana inbreds LM13, LM14, LM15 and LM16 are diverse and are also parents of productive hybrids like PMH1, PMH2, PMH3 and PMH4. SSR dataset for hybrids resulted in a cluster which clearly differentiates the public bred hybrids from private hybrids (Figure 1). A separate cluster of three inbreds (LM12, LM14 and LM16) showed minimum cluster distance Figure 1. But, observed distance was high with other cluster and cluster members.

The genetic dissimilarity between the hybrid data was estimated separately. Low SSR polymorphism was observed in the hybrids panel. Hence, the distances estimated were also of low magnitude. The maximum genetic dissimilarity observed was 0.44 (d_R) between the hybrids. The SSR based pairwise Roger's distance (1972)

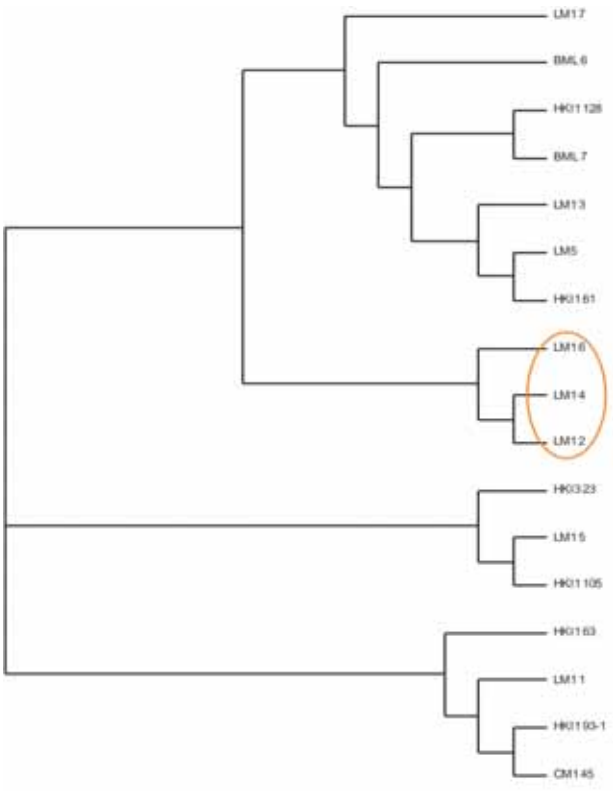


Figure 1: Genetic relationship between inbreds based on Roger's Distance (1972)

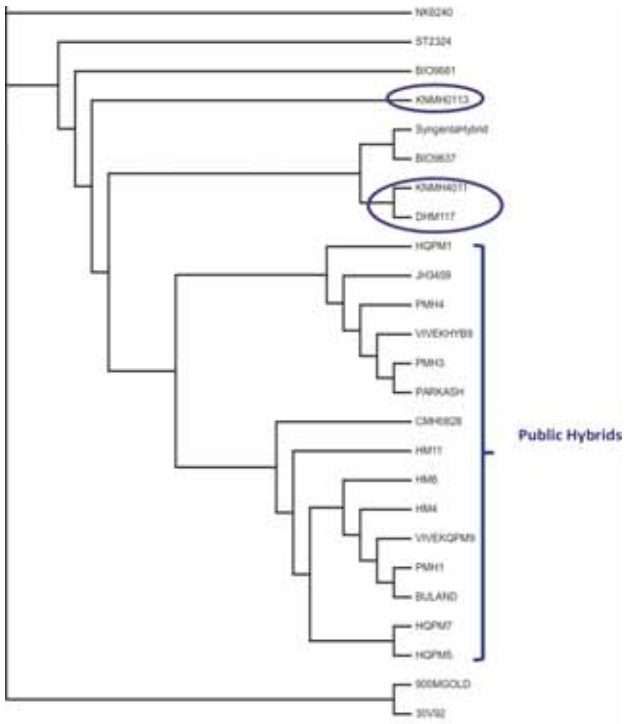


Figure 2: Dendrogram representing the genetic relationship between hybrids based on Roger's Distance (1972)

matrix was subjected to Neighbour Joining method of clustering (Figure 2). The cluster analysis could very well differentiate the public and private bred hybrids. To note the DHM-117 paired away from the public sector hybrids and was also true for KNMH-40111. The mentioned hybrids from Hyderabad and Karimnagar center share one common parent hence, they have clustered together separately. The other public hybrid which is distinctly separate from the public sector hybrids and inbreds is KNMH-40113. The pedigree is not known but the cluster analysis suggests that this hybrid is much diverse among the public bred hybrid. In the final, pooled analysis with inbreds and hybrids was also done. Here, we found distinctly the same pattern observed in above two clusters. The public bred inbreds and hybrids formed a major cluster and the hybrids and inbreds sub-clustered separately in the same cluster. More marker information is required for deducing the parent hybrid relationship, because the markers used in the present report have displayed low level of polymorphism and alleles are too close to distinctly resolve in Metaphor®.

Launch of new ICAR-CIMMYT Collaborative Project

ICAR-CIMMYT collaborative project "Abiotic stress tolerant maize for increasing income and food security among the poor in South and South East Asia" (ATMA) was launched in Project Launch Workshop at University of Hohenheim, Stuttgart, Germany on May 30-June 1, 2011. A workshop was organized by University of Hohenheim Stuttgart, Germany from May 30 to June 1, 2011 during which the water deficit and excess soil moisture situation in South East Asian Countries was deliberated upon. During the presentations, Dr. R. Sai Kumar, Director, DMR highlighted the role of development of a comprehensive package (for the countries) to address these pertinent issues that includes development and dissemination of abiotic stress tolerant maize Single Cross Hybrids with improved agronomic practices. A new project entitled "Abiotic stress tolerant maize for increasing income and food security among the poor in South and South East Asia" (ATMA) was launched with the target of identifying abiotic stress tolerant maize Single Cross Hybrids suitable for cultivation in drought and water logging prone areas of India, Bangladesh, Vietnam and Philippines with the Directorate as leading centre and Dr. Sai Kumar as P.I.

AGRONOMY

In this section the salient achievements of co-ordinated agronomic trials conducted during *rabi* 2010-11 and *kharif* 2011 across the country at different maize AICRP centres are summarized and cited. The major focused areas of the research trials were genotypic response to nutrients, tillage and crop establishment, crop geometry, nutrient management specially site-specific nutrient management (SSNM), bio fertilizers, nitrogen scheduling, development of agro techniques for seed production of female inbred of maize hybrids and their parents, optimization of sowing time, weed management in maize and maize based cropping systems under different agro-ecologies.

1. Genotypic response to nutrients

The genotypes of different maturity groups were evaluated under 3 fertility levels i.e. N: P_2O_5: K_2O 100:50:50, 150:65:65, 200:80:80 kg/ha., in medium, early and extra early maturity, while in late maturity group the fertility levels were 150:65:65, 200:80:80 and 250:95:95 at all the five zones. The differential response of different maturity groups (medium, early and extra early maturity) was observed from different centres in different agro-ecologies. Across the zones, the extra early and early genotypes responded to medium nutrient levels (150:65:65, N: P_2O_5: K_2O) at 3 of the 16 locations and high nutrient levels (200:80:80, N: P_2O_5: K_2O) at 9 locations of the 16 locations (Table 1). The medium maturity genotypes responded to medium nutrient levels at 11 of the 29 locations whereas, the response to high nutrient levels was recorded at 12 out of the 29 locations. The response of late maturity genotypes to medium nutrient levels (200:80:80, N: P_2O_5: K_2O) was recorded at almost all the locations (10 of the 11) and to high nutrient levels (250:95:95, N: P_2O_5: K_2O) at more than 40% locations (5 of the 11). In extra early, early and medium maturity groups of genotypes, the response to medium nutrient level was recorded at 35 of the 45 locations whereas in high nutrient levels, it was recorded at less than 50% locations (21 of the 45 locations). While full maturity group genotypes significantly responded to medium nutrient levels which varied greatly between the zones and maximum response was recorded in Zone- I and III.

Late maturity: Irrespective of the nutrient levels, among the late maturity genotypes, the yield performance of NMH-958 was superior at Bajaura and NMH-920 at Kangra (Zone I), Bhubaneswar and Ranchi (Zone III) respectively. While MCH-40 was found superior at Delhi and Ludhiana (Zone II), Varanasi and Dholi (Zone III) and Ambikapur, Godhra and Jhabua (Zone V) over to best checks of the respective maturity group and centres. While the CMH08-282 genotype was found superior at Ambikapur, Banswara, Chhindwara, Godhra, Jhabua and Udaipur (Zone V).

Table 1: **Response of different maturity genotypes to varying levels of nutrients under various agro-ecologies**

Maturity	Nutrient level-1(150:65:65, $N:P_2O_5:K_2O$)*						Nutrient level-2 (200:80:80 $N:P_2O_5:K_2O$)*					
	Zone I	Zone II	Zone III	Zone IV	Zone V	Across Zone	Zone I	Zone II	Zone III	Zone IV	Zone V	Across Zone
Extra early & Early	6/7	3/3	1/2	2/3	0/1	**12/16**	3/7	3/3	1/2	2/3	0/1	**9/16**
Medium	0/0	2/2	8/9	7/9	6/9	**23/29**	0/0	2/2	3/9	4/9	3/9	**12/29**
Across genotypes	**6/7**	**5/5**	**9/11**	**9/12**	**6/10**	**35/45**	**3/7**	**5/5**	**4/11**	**6/12**	**3/10**	**21/45**
	Nutrient level-1 (200:80:80, $N:P_2O_5:K_2O$)**						**Nutrient level-2 (250:95:95, $N:P_2O_5:K_2O$)****					
Late	3/3	1/1	3/3	0/0	3/4	10/11	2/3	0/1	1/3	0/0	2/4	5/11
Across genotypes	**3/3**	**1/1**	**3/3**	**0/0**	**3/4**	**10/11**	**2/3**	**0/1**	**1/3**	**0/0**	**2/4**	**5/11**

Medium maturity: In medium maturity group, the superior yield performance of X8B691 and KDMH-017 genotypes were found at Delhi, Kanpur, Karnal and Ludhiana (Zone II) over to best standard check. While, MCH 42, was found superior at Bahraich, Ranchi (Zone III), Arabhavi, Karimnagar, Vagarai (Zone IV) and Jhabua (Zone V); JH 31292 at Ranchi, Varanasi (Zone III), Hyderabad, Karimnagar (Zone IV), and Jhabua (Zone V) and NMH-803 and KMH-218 Plus, at Bahraich (Zone III), Arabhavi (Zone IV) and Godhra, Jhabua (Zone V); KMH-3426 and X8B691 at, Bahraich, Ranchi (Zone III), Arabhavi, Kolhapur (Zone IV) and Ambikapur, Banswara, Chhindwara, Godhra , Jhabua (Zone V); KDMH-017 at Bahraich (Zone III), Arbhavi (Zone IV) and Banswara, Godhra , Jhabua (Zone V) and VEH-09-2 at Bahraich (Zone III), Arabhavi (Zone IV) and Godhra (Zone V) and HKH-313 at Bahraich, Dholi (Zone III) and Godhra (Zone V) over the standard best check (BIO 9637) .

Early and extra early: Among the early maturing genotype under different nutrient levels, the yield performance of BIO 605 at Almora, Kangra and Bajaura (zone I), Bahraich, Ranchi (Zone III), Arabhavi, Karimnagar, Vagarai (Zone IV); and FH3506 at Kangra (Zone I); and REH 2003 at Udaipur (Zone V) found superior over to the best check of respective locations. While the extra early maturing genotype, FH 3483 at Delhi (Zone II), Bhubneswar, Ranchi, Dholi (Zone II) and Karimnagar (ZoneIV) was found superior over best checks of the respective centres.

2. Tillage management in maize systems

Different Crop establishment and tillage & residue management trials on tillage x weed control practices and tillage x genotype interactions on maize and in different maize based farming systems were conducted at Udaipur, Dholi and Kashmir centres (Figure 1 and 2). All the genotypes performed superior when planted under conservation agricultural based tillage practices irrespective of the location. Interactions between maize genotypes and tillage & crop establishment techniques was observed at Udaipur and Dholi and the yield performance of different genotypes found significantly higher in permanent beds over to zero till and conventional till. While the interactive effect of tillage and weed control practices was also evaluated at Kashmir and found that weed management in maize by application of Atrazine @1.0 kg a.i. / ha under zero tillage is superior over to other tillage and weed management practices.

3. Nutrient management in maize systems

A. Site-Specific nutrient management (SSNM): The SSNM trial in maize-wheat cropping system was conducted at Bajaura was conducted during *kharif* 2009. The maize yield was significantly higher under SSNM (Figure 3) compared to state recommendations and other nutrient management.

B. Nutrient management through exploring potential of biofertilizers: A trial on nutrient management through exploring potential of biofertilizers on baby corn was conducted at Udhampur and significantly higher green cob yield of baby corn was recorded in cocktail treatment of (Azotobactor +VAM+PSB) over to control.

C. Nitrogen scheduling in maize: N scheduling trial in quality protein maize (QPM) was conducted at Udaipur. Splitting of same dose of nitrogen in 5-

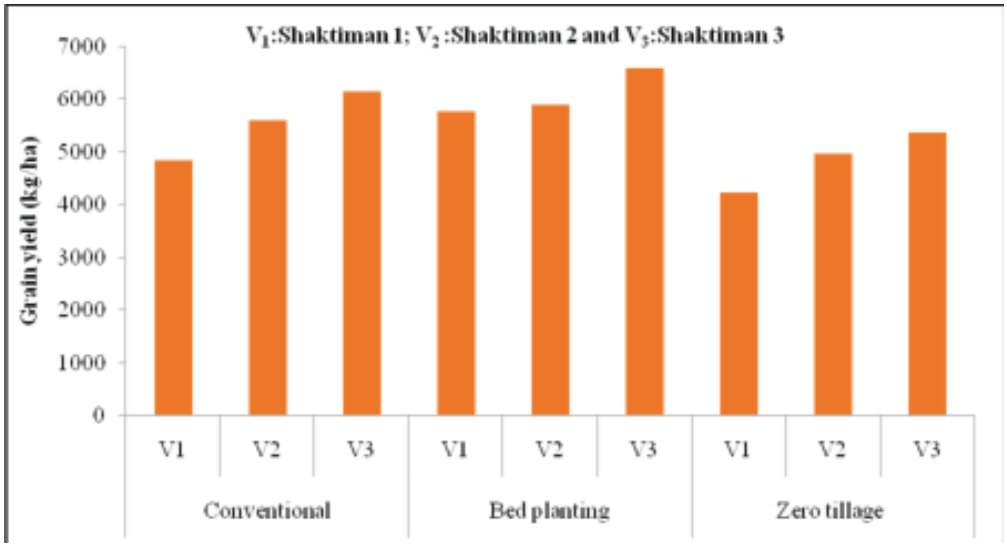


Figure 1: Effect of tillage practices x genotype interaction at Dholi.

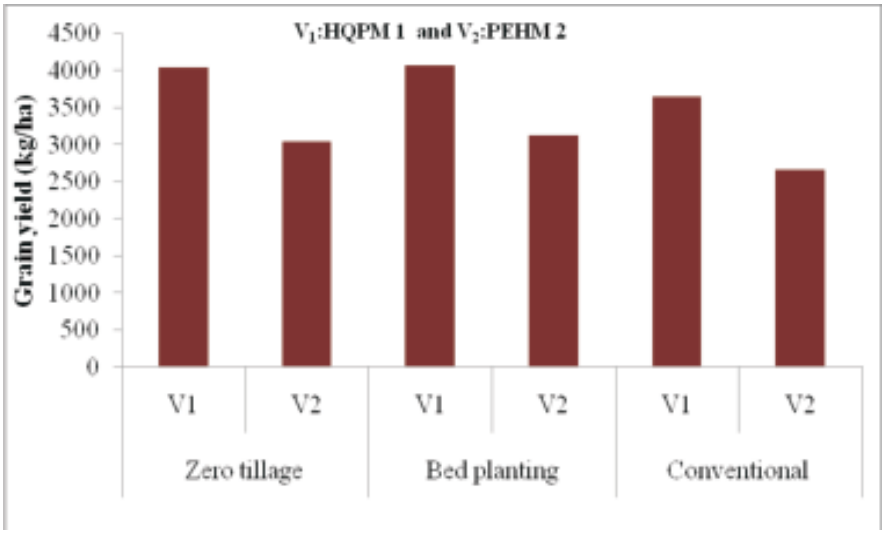


Figure 2: Effect of tillage practices x germplasm interaction at Udaipur

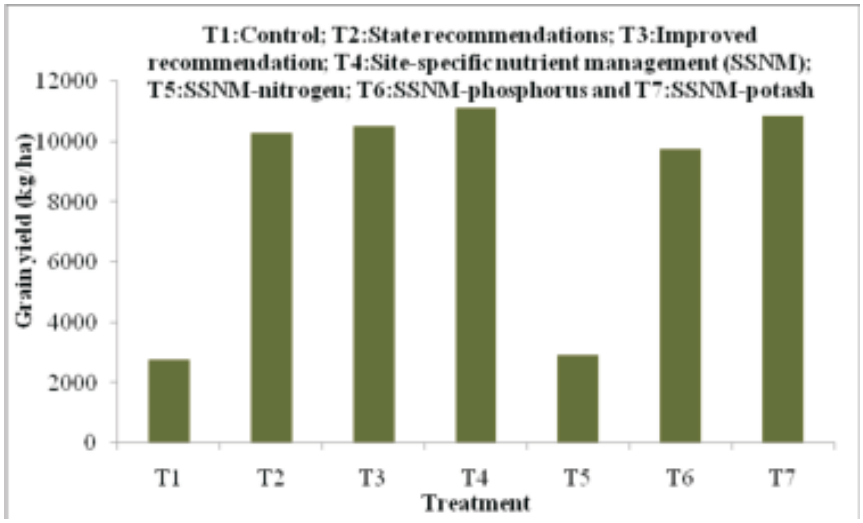


Figure 3: Site specific nutrient management in Maize-Wheat cropping system at Bajaura

doses (10% Basal, 30% at V4, 30% at V8, 20% at VT & 10% at GF) resulted in remarkably higher grain yield over to 3-splits (33% at basal, 33% at V8 and 33% at VT) and other traditional nutrient management practices.

4. Weed management

Studies on weed management trials for diverse weed flora in maize based cropping systems were conducted in different agro-ecologies at various AICRP centres during *kharif* 2011. The result of different weed management practices varied significantly

from location to location. At Kangra, Ludhiana and Arabhavi weed management with oxyflourfen @ 0.15 kg a.i. / ha followed by one hand weeding at 25-30 DAS and at Kashmir, application of oxydiargyl @ 0.09 kg a.i. / ha were found superior to other weed management practices of the respective centres. While at Pantnagar, Udhampur, Ranchi and Udaipur weed free followed by application of metribuzin @ 0.25 a.i. / ha pre-emergence treatment found superior to other weed management practices. At Banswara paired row intercropping of maize + cowpea found best weed management practices over other weed management practices.

5. Plant geometry and nutrient interaction of maize genotypes

Trials on plant geometry and nutrient interaction were conducted at Udaipur, Kashmir, Almora, Bajaura, Kangra, Udhampur, Karnal, Ludhiana, Pantnagar, Ranchi, Arabhavi, Kolhapur, Ambikapur, Banswara, and Chhindwara during *kharif* 2011. At Bajaura, Kangra, Kashmir, Ranchi, Arabhavi, Kolhapur and Udaipur row arrangement of either equal row at 67 / 60 cm or paired row at 84:50 / 80:40 cm does not have significant influence on yield performance of maize genotypes. While residue retention @ 5 ton / ha have significant influence on yield of maize genotypes at all the locations over to clean cultivation. Almost at all the centres the higher yield of maize genotypes was observed due to application of higher doses of nutrients with higher plant population / plant geometry.

6. Performance of maize hybrids to adopt rainfall changes and climatic aberrations

The experiment on Performance of maize hybrids to adopt rainfall changes and climatic aberrations was initiated during last year 2010. It was observed that at most of the locations *viz*., Almora (05.06.11), Bajaura (14.06.11), Kangra, Kashmir, Karnal (15.06.11), Ludhiana, Pantnagar (24.06.11), Gossaingaon (26.05.11), Arabhavi, Hyderabad (05.06.11) and at Udaipur (20.06.11) 10 days early sowing than the normal sowing of all the maturity group hybrids produced significantly higher grain yield over to the late sowing. However, at Udhampur (03.07.11), Kolhapur (04.07.11) and Ambikapur (04.07.11) highest grain yield was obtained at normal sowing time of 1st week of July in all maturity group hybrids. While at Ranchi and Arabhavi, highest grain yield of maize hybrids was obtained when sowing was delayed by 10 days from normal date of sowing.

7. Development of agro-techniques for seed production of single cross hybrids and their parents

Experiments for development of agro-techniques for seed production of single cross hybrid and their parents were conducted at Bajaura, Kangra, Kashmir, Ludhiana, Pantnagar, Ranchi, Arabhavi, Hyderabad, Vagarai, Ambikapur, Chhindwara and Udaipur. These experiments were conducted for promising hybrids of respective agro-ecology. At Ludhiana and Udaipur 1:3 (male:female) ratio and at Pantnagar, Hyderabad, Arabhavi, Chhindwara 1:2 (male:female) ratio while at Ranchi, Vagarai and Ambikapur 1:4 (male:female) ratio was found optimum for the respective centres over to the other male and female ratio.

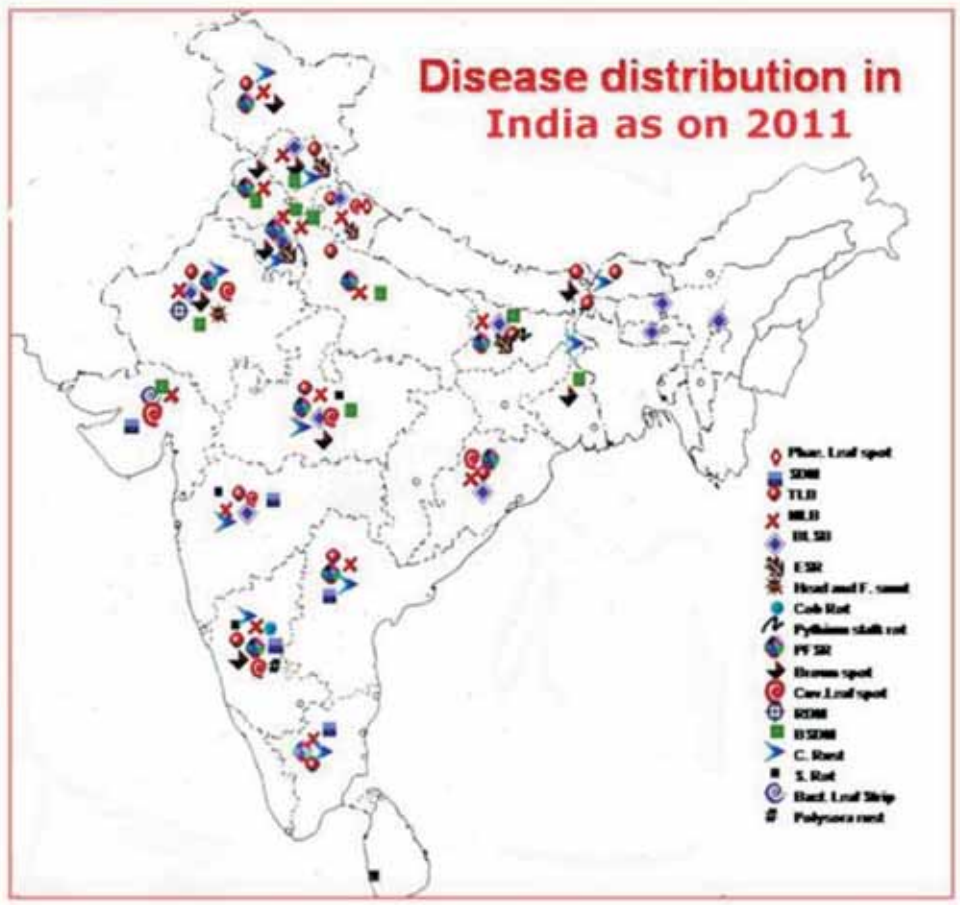
PATHOLOGY

Survey and surveillance

Extensive survey of maize growing areas in different states during the year 2011 revealed that occurrence of Turcicum leaf blight (Karnataka, Himachal Pradesh), Banded leaf and Sheath blight (Rajasthan & Uttarakhand), Brown stripe downy mildew, Erwinia stalk rot, brown spot in Himachal Pradesh were the most common diseases. Disease incidence of curvuleria leaf spot and Rajasthan downy mildew was high. Incidence of ESR was severe in Haldwani. Polysora rust is emerging as a potential threat in Karnataka. Based on the results, the diseases distribution Map of Maize disease was updated.

Coordinated trials

A total of 266 maize genotypes and 30 QPM genotypes in 9 different trials comprising



of various maturity groups were evaluated against different maize diseases *viz.*, Maydis leaf blight (MLB), Turcicum leaf blight (TLB), Banded leaf and sheath blight (BLSB), Sorghum downy mildew (SDM), Brown stripe downy mildew (BSDM), Rajasthan downy mildew (RDM), Post-flowering stalk rots (PFSR), Common rust (C. Rust), Polysora rust (P. Rust) and Erwinia stalk rot (ESR). The screenings of these genotypes were carried out under artificially inoculated conditions in the various hot spots located in different agro climatic zones of the country. The most promising genotypes with combined resistance to various diseases are:

Resistant maize genotypes in IET full season maturity

A total of 45 genotypes were resistant out of 60 genotypes. Promising genotypes with multiple resistance are:

CMH08-381	MLB, BSDM, PFSR
CMH08-381(G)	MLB, BSDM
CMH09-464	MLB, BSDM, PFSR, C. Rust
DMH 7705	MLB, TLB, PFSR
P4546	MLB, TLB, P. Rust, C. Rust
PRO-385	PFSR, ESR, P. Rust

Resistant maize genotypes in IET medium maturity

A total of 39 genotypes showed resistant reaction out of 57 genotypes. Promising genotypes with multiple resistance to various diseases are:

CMH10-474	MLB, BSDM, PFSR
MM1108	MLB, RDM, BSDM, C. Rust
X35A188	MLB, RDM, BSDM, P. Rust, C. Rust
Bisco x 4214	RDM, BSDM, PFSR
DAS-MH-301	PFSR, P. Rust
KNMH 40112	MLB, TLB, RDM, BSDM, PFSR, C. Rust

Resistant maize genotypes in IET early maturity

A total of 15 genotypes showed resistant reaction out of 20 genotypes. Promising genotypes with combined resistance to various diseases are:

CMH10-525	MLB, RDM
CMH10-526	MLB, PFSR
Bisco 2238	RDM, BSDM, ESR
K 21	RDM, BSDM

Resistant maize genotypes in IET extra early maturity

A total of 8 genotypes showed resistant reaction out of 12 genotypes**.** Promising genotypes with multiple resistance are:

FH 3521	RDM, C. rust
FH 3555	MLB, BSDM
FH 3556	MLB, RDM, BSDM

Resistant maize genotypes in AET full season maturity

A total of 30 genotypes were resistant out of 24 genotypes. Promising genotypes with multiple resistance are:

NMH-713	MLB, RDM, BSDM, P.Rust, C.Rust
P3540	RDM, BSDM, P.Rust, C.Rust, PFSR
A 7501	RDM, BSDM, P.Rust, C.Rust, ESR
X8B562	MLB, P.Rust, C.Rust, PFSR
EHQ-16	RDM, PFSR, ESR, C.Rust

Resistant maize genotypes in AET medium maturity

A total of 34 genotypes showed resistant reaction out of 43 genotypes**.** Promising genotypes with multiple resistance to various diseases are:

CMH08-350	MLB, RDM, BSDM, PFSR
CMH08-433	MLB, TLB, RDM, BSDM
JH 31404	MLB, TLB, RDM, BSDM, PFSR
S6217	MLB, RDM, C.Rust
YUVRAJ GOLD	MLB, TLB, P. Rust

Resistant maize genotypes in AET early maturity

A total of 23 showed resistant reaction out of 29 genotypes. Promising genotypes with multiple resistance to various diseases are:

FH 3513	RDM, BSDM, C. Rust
KMH-128	MLB, PFSR, C. Rust, P. Rust
FH 3506	MLB, PFSR, P. Rust

Resistant maize genotypes in AET extra early maturity

A total of 15 genotypes showed resistant reaction out of 21 genotypes**.** Promising genotype with multiple resistance to various diseases is:

FH 3510	MLB, BSDM, C. Rust

Assessment of yield losses due to various diseases of maize using paired plot technique, nine replications under artificial inoculation conditions

Assessment of yield losses experiments conducted in various locations revealed yield losses due to BLSB (29%), PFSR (21-29 %), TLB (12-29 %) SDM (54%) & MLB (14%).

NEMATOLOGY

Two hundred and eighty nine (289) maize entries belonging to different maturity groups were screened against cyst nematode, *Heterodera zeae.* Maize entries *viz.*, P3303, B 161, CMH08-287, M 9977, JH 31467, EH 2116, CMH08-292, CMH10-518, EH-2184, KH-9560 and DH-229 exhibited moderately resistant reaction to *H. zeae.*

Evaluation of inbred lines against PFSR at Delhi, Hyderabad, Ludhiana and Udaipur

1. A total of 51 entries were evaluated and out of them 22 were selected as a resistant to PFSR across the locations with disease score of <5.0 (1-9 rating scale).
2. A total of 10 resistant pools for PFSR are being maintained and inbred lines from these pools are being extracted.

In house projects

* **Studies on variability among the isolates of *M. phaseolina* and *F. moniliforme* in maize and Identification of sources of resistance against Post Flowering Stalk Rots of maize.**

1) Advance maize inbred line developed with resistance against PFSR (Post Flowering Stalk Rots) used to compare these lines with some established elite maize inbred lines to develop a reliable fingerprint for these lines.

2) Eight resistant lines for Post Flowering Stalk Rots from diverse genetic background identified, developed and evaluated at four identified hot spot location (Hyderabad, Delhi, Udaipur and Ludhiana) during 2006 to 2010. Multiplication of seed was done at winter nursery Hyderabad during 2011.

3) Out of eight resistant lines, two inbred lines resistant for PFSR were registered with NBPGR and rest is on pipeline.

a) DMR- PFSR -1 (IC0590094/INGR11041)

b) DMR - PFSR-9 (IC0590095/INGR11042)

* **Post harvest management of losses due to microbial colonization in stored maize grains**

1) Among 26 genotypes, X1280, HQPM 1, Navjot and Prakash exhibited better in storability during nine months storage as the germination percent is maximum (50-70%) as compared with rest of genotypes.

2) These genotypes showed 5-10% increase in germination when treated with Potassium Carbonate @ 4gm/kg and Propionic acid @ 4ml/kg.

DMR- PFSR -1

DMR - PFSR-9

3) In kernel assay experiment, inbred lines LM 13-3, PFSR-R6, AF -04-B-5779-22-3 – 2, CML 321-1-2, CML 3-1-1, Patho. Synthetic and pools PFSR (White), Indimyt-100, Indymit 145 and Indimyt-300-A showed promising results by exhibiting AFB1 conc. <20 ppb when artificially inoculated with highly toxic strain of *Aspergillus*.

4) Quality parameters *viz.*, 100 kernel wt, Specific gravity, Starch%, Oil, Tryptophan and sugar exhibited a decreasing trend while total protein increased during nine months storage.

*** Identification of stable sources of resistance to major diseases of maize**

1) A total of 224 elite lines were evaluated against major diseases of maize under artificial epiphytotic conditions at various hot spot locations (PFSR at Hyderabad, Udaipur, Delhi and Ludhiana, MLB at Ludhiana and Delhi, TLB at Almora, Bajaura and Mandya, P. rust & SDM at Mandya, BLSB at Delhi, Pantnagar and Dhaulakuan, ESR at Ludhiana and Dhaulakuan, BSDM at Dhaulakuan and RDM at Udaipur). The lines having multiple disease resistance are: PFSR – R10, PFSR – S2, CML 117-3-4-1-2-3-1, CM117-3-4-1-2-5-2, KML 3-3, PFSR R3-4, SW-930-313-23-PO-49-54-1-3-1-1-1-2-1-2-1-2-3-1-1-2, CM 117-3-4-1-2-1-1, JCY2-1-2-1-1B-1-2-3-1-1 , JCY3-7-1-2-2-1-3-1-1-2-7-1-1-1, LM13, JCY3-7-1-2-1- 'B-2-1-2-1, JCY2-2-4-1-1-1-3-1-3-1, WSCShrunken X MUS MADHU, WINPOP-1, P390Am / CML c4 F230-B-2-1-2-2-B-B-B, EC 646012, HKI 1040-11-7, CM 117-3-4-1-2-2-1, CM 117-3-2-1-1-1-2-1, PFSR – R9, PFSR – S3, SW-930-313-23-PO-49-54-1-3-1-1-1-2-1-2-3-1-1-2, CML 117-3-4-1-1-4-1, CM 117-3-4-1-2-5-2, CM117-3-4-1-2-2-3, PFSR R3-2, 42050-1-1-2-1-3, CM117-3-4-1-2-5-1, PFSR R3-5, CML117-3-4-1-1-4-1, JCY2-1-2-1-1B-1-2-3-1-1-1, HKI 141, ESM-11-3, HKI 193-1.

ENTOMOLOGY

ACRIP Trials information

1. **Genotypes were evaluated against** *Chilo partellus* **in each maturity group at different Coordinating Center. The least susceptible genotypes were found as (AET stage) given below**

Full Season Maturity: MCH 40, X8B562, CMH08-282, Bio 9681(C), KMH-3670, MCH-40, NMH-731, NMH-920, NMH-958, PMH-1, PMH-3, Seed Tech-2324 (C) , BIO-9681 (C) , HM-11 (C), HM-10 (C).

Medium Maturity: HKH 313, JH31292, KDMH017, KDMH-218plus, KMH-3426, NMH-803, BIO9637(C), HM8(C), MCH-42, VEH-09-2, X-8B691, HM-9(C).

Table 1: Least Susceptible inbred lines

S.No.	Pedigree	Mean LIR
1	SCF	2.94
2	P72	2.96
3	PFSRR9	2.98
4	LM12	2.96
5	CM132	2.92
6	PFSRS-1	3.00
7	E5A	2.94
8	10135	2.82
9	10138	2.80
10	10604	2.91

Early Maturity: KH 9560, REH 2003, JH 3459(C), FH3506, Prakash C, BIO 605, REH 2001.

Extra Early Maturity: FH 3483, JH 3459 (C), FH3478, FH3483, FH3487, Vivek Hybrid 9(C), Vivek QPM 9(C), BIO9637(C), Prakash(C), HM8(C), Seed Tech 2324(C).

2. **Inbred lines screening against stem borer,** *Chilo partellus*

202 inbred lines were evaluated in which 10 were least susceptible, 191 moderately susceptible and one susceptible.

3. **Maize ecosystem manipulation with intercropping for the management of** *Chilo partellus* **under field conditions**
Maize intercropping with cowpea in the ratio of 2:1 has been found to be one of the very potential pest management tactics in maize ecosystem.

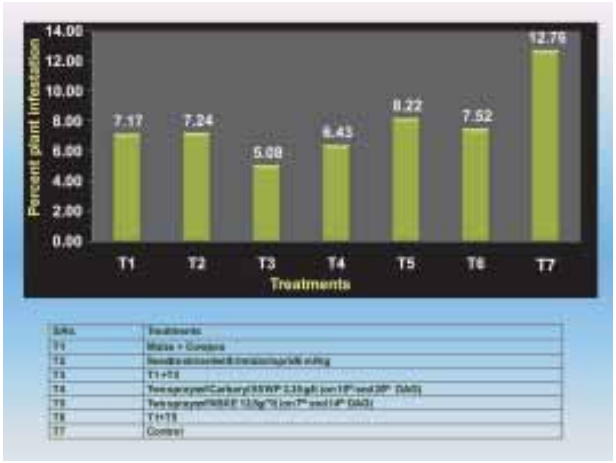


Figure 1: Habitat Manipulation (Result of 8 loc.)

4. Determination of relationship between leaf injury rating and grain yield

A significant yield reduction with increase of LIR was observed. This information can be used for crop loss assessment

Figure 2: Leaf Injury Rating (1-9 scale)

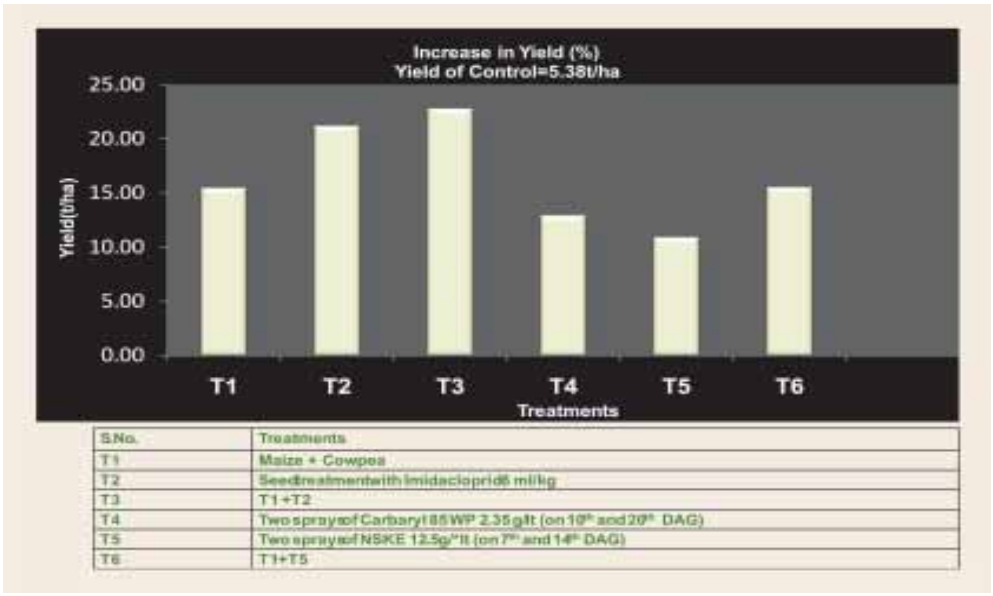


Figure 3: Percent increase in the yield over control in habitat management experiment

Experimental results are based on the mean of observation recorded in 8 locations across the country. Impact was analysed for reduced plant infestation (Figure 1) and its severity (Figure 2) as well increase in yield over the control (Figure 3).

BIOCHEMISTRY

The Biochemistry laboratory of DMR is the pioneer research centre which held a specific position in maize research in India with respect to the development of nutritionally improved maize genotypes. It played a major role in the development of quality protein maize in India. The laboratory functions as a central unit and caters to the needs of various maize centres of the coordinating unit of ICAR and State Agricultural University for biochemical analysis of maize germplasm. The laboratory is well equipped with modern automatic instruments like amino acid analyzer, HPLC, lyfolyser, vacuum concentrator, geltech, automatic solvent extractor system, NIRT, spectrophotometer and many more. The laboratory facilitates the analysis of various parameters of maize quality such as protein quality (protein, tryptophan and lysine), carbohydrate profile (starch, sugar, amylase and amylopectin), oil and carotenoids composition etc.

During the period of 2011–2012 more than 2500 samples received from different sources were analyzed for various quality parameters *viz*., protein, tryptophan, lysine, oil, sugar, carotenoids, β-carotene etc. A total of 554 and 423 lines were analyzed for protein and tryptophan, respectively, 220 for lysine, 59 for total carotenoids and β–carotene, 465 for test weight and specific gravity, 259 for sugar, 259 for starch, 30 for carbohydrate profile and 293 for oil content (Figure 1).

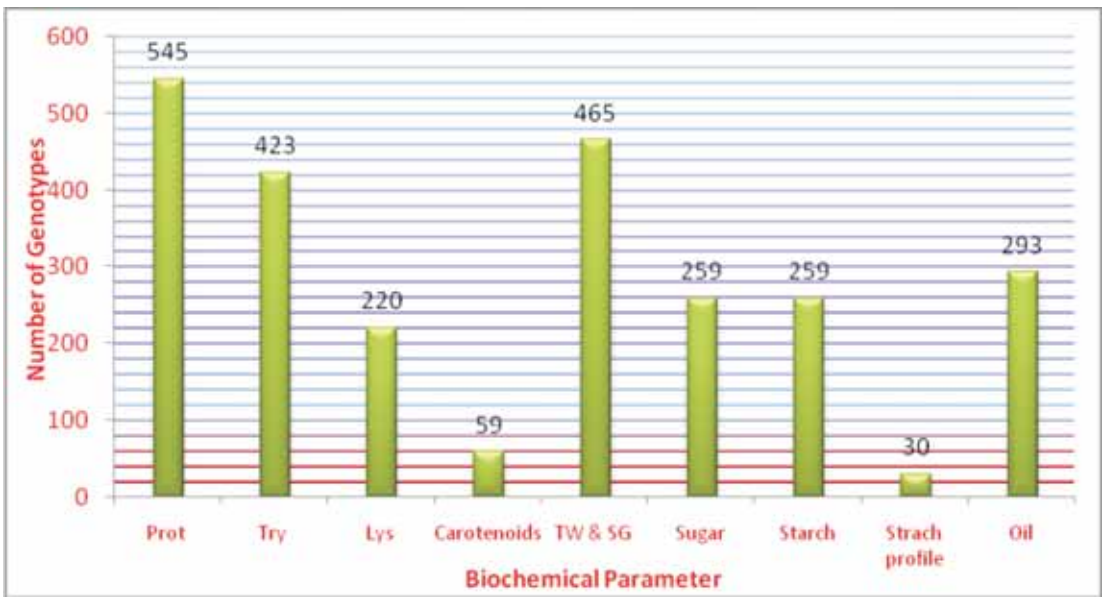


Figure 1: Biochemical analysis of different types of maize germplasm

Protein quality Parameters (Protein, Tryptophan and Lysine)

The protein, tryptophan in protein and lysine in protein parameters were analyzed respectively for 545, 423 and 220 different inbreds as well as hybrids received from various maize centres across India (Table1). The range of protein was 5.91 to 16.86 per cent with lowest and highest values being exhibited by the genotypes C-4 and Madhuri respectively. Tryptophan in protein varied from 0.30 to 0.98 (HKI-164-7-2) per cent. The range of lysine in protein was 1.22 (QPM-7-8) to 4.00 [HKI-170(1+2)] per cent.The distribution of lines for their protein and tryptophan in protein content presented in figure 2 and 3 respectively. Around 67 lines were found to having less than 8 per cent of protein. A large number of lines (185 lines)

Table 1: Most promising lines with better protein quality

S. No	Pedigree	Protein (%)	Tryptophan (%)	Lysine (%)
1.	QPM-5-2XQPM-1-15	9.05	0.61	2.54
2.	QPM-7-4XQPM-6-8	9.10	0.63	2.61
3.	HPQM 5	9.22	0.62	2.60
4.	HKI 170 (1+2)	9.28	0.86	4.00
5.	QPM-10-9XQPM-5-2	9.29	0.84	3.34
6.	QPM 2-18	9.30	0.75	3.06
7.	QPM-7-4XQPM-3-10	9.40	0.62	2.54
8.	HQPM 7	9.55	0.61	2.56
9.	HKI 191-1-2-5	9.56	0.97	3.92
10.	QPM-9-16XQPM-6-8	9.63	0.65	2.70
11.	QPM-9-16XQPM-3-10	9.75	0.75	3.11
12.	QPM-9-2XQPM-1-8	9.77	0.71	2.88
13.	QPM 7-4	9.89	0.96	3.82
14.	QPM 9-2	10.08	0.65	2.72
15.	QPM 1-3	10.09	0.72	2.91
16.	QPM-10-9X1110-7-2	10.09	0.70	2.82
17.	QPM-9-2XQPM-5-2	10.16	0.92	3.74
18.	QPM-9-16XQPM-1-8	10.27	0.65	2.64
19.	QPM-9-2XQPM-3-10	10.35	0.67	2.68
20.	HKI 5072-2BT(1-2)-2	10.40	0.70	3.73
21.	QPM-7-4XQPM-3-7	10.77	0.72	2.94
22.	HPQM-1	10.77	0.60	2.56
23.	QPM-1-15XQPM-3-7	10.83	0.60	2.51
24.	QPM-9-16XQPM-1-14	10.86	0.81	3.26
25.	1110-7-2XQPM-5-2	11.10	0.65	2.72
26.	QPM-916XQPM9-2	11.12	0.72	2.91
27.	QPM-7-4XQPM-9-2	11.34	0.60	2.51

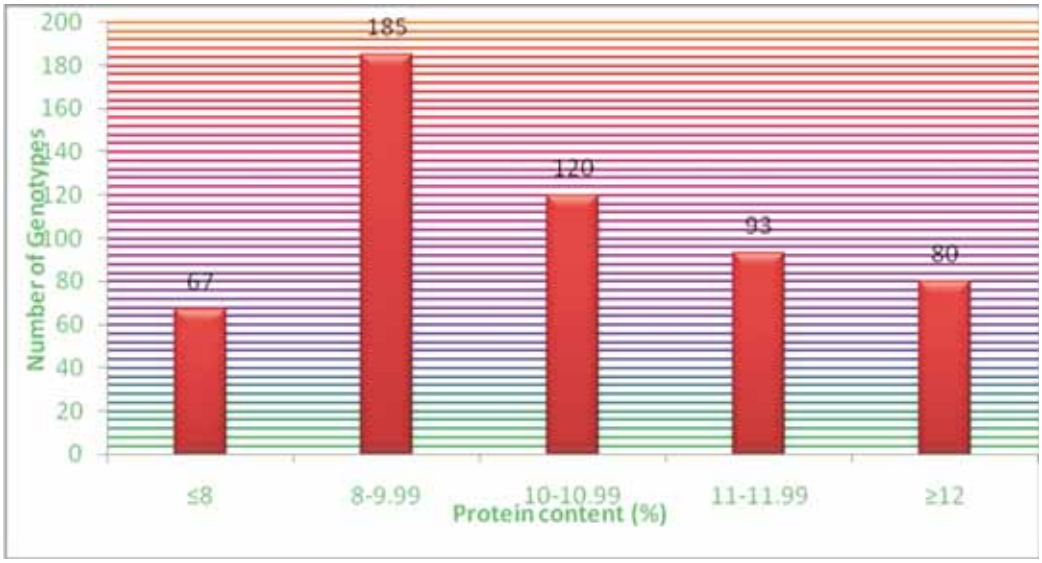


Figure 2: Distribution of lines for protein content

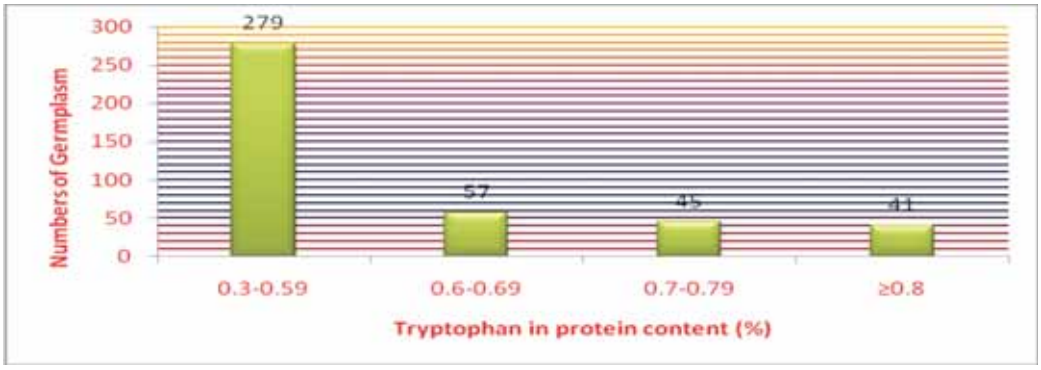


Figure 3: Distribution of lines for tryptophan content in protein

showed between 8-10 per cent protein, 120 lines exhibited 10 to 11 per cent and 93 lines showed protein in the range of 11-12 per cent (figure 2). This year a significant number of lines (80) were found to be having more than 12 per cent of protein. In case of tryptophan a large number of germplasm analyzed was found to be normal as tryptophan content was below 0.6 per cent mark. However, about 57 lines evaluated showed tryptophan in the range 0.6-0.7 % and as many as 45 were placed in the range of 0.7-0.8 per cent. A total of 41 lines showed tryptophan more than 0.8 per cent of their protein. As many as 27 promising line (Table 1) were found to be having more than 9% protein with $\geq$ 0.6% of tryptophan and $\geq$ 2.50% lysine in their protein.

Sugar Content

At maturity, maize kernel contains sugars other than starch in small amounts. Sugars were referred as simple sugars which consist of glucose, fructose and sucrose. In maize, total sugars were present in amounts ranging from 1 to 5 per cent of the kernel weight and

sucrose is the major component, found mostly in the germ. Higher levels of monosaccharides, disaccharides and trisaccharides are present in maturing kernels. As the kernel matures, the sugars decline and starch increases. These relatively high levels of reducing sugars and sucrose are possibly the reason why immature common maize and even more, sweet corn are so well liked by people. A total of 259 samples were received from different sources and analyzed for sugar content. Sugar content varied from 3.00 to 8.35 per cent with lowest and highest values being observed in the genotypes HKI-164-7-7-ER-3 and Madhuri, respectively. Some most promising lines for higher sugar content are given in Table 2.

Table 2: Most promising lines with higher sugar content

S. No.	Pedigree	Sugar (%)
1.	HKI 323	5.00
2.	HKI 295	5.02
3.	HKI 193-2-1	5.03
4.	CML 338	5.06
5.	CML 413	5.08
6.	HKI 139	5.12
7.	HKI P006-178	5.16
8.	SEED TECH 2324	5.20
9.	HKI 323	5.34
10.	HKI L-287	5.35
11.	CML 224	5.39
12.	HQPM 4	5.65
13.	HQPM 1	5.69
14.	HSC 1	6.89
15.	MADHURI	8.35

Starch

The major chemical component of the maize kernel is starch, which provides approximately 70 percent of the kernel weight. Maize is one of the most important multiplier of starch in this earth. Starch is defined as the polymeric carbohydrate consisting of glucose unit joined together through α - D (1- 4) glucoside bonds. Other carbohydrates are simple sugars present as glucose, sucrose and fructose in amounts that vary from 1 to 5 per cent of the kernel. The starch in maize is made up of two glucose polymers: amylose, an essentially linear molecule and amylopectin, a branched form. The composition of maize starch is genetically controlled. In normal maize, amylose makes up 25 to 30% of the starch and amylopectin makes up 70 to 75%. Waxy maize contains a starch that is 100% amylopectin. An endosperm mutant called amylose-extender (ae) induces an increase in the amylose proportion of the starch to 50 per cent and higher.

A total of 259 different QPM and normal maize germplasm received from different sources were analyzed for starch content. The range of starch varied from 51.76 to 74.99 per cent with lowest and highest values being exhibited by the genotypes Madhuri and HKH 317 respectively. One hundred and forty five lines, out of 259 were found to be having more than 70 per cent starch content. Thirteen most promising lines are mentioned in Table 3.

Carbohydrate Profile

In normal maize the ratio of amylose to amylopectin is of 25:75 per cent. Waxy maize possess 100 per cent amylopectin whereas,

Table 3: Most promising lines with higher starch content

S. No.	Pedigree	Starch (%)
1.	HM 11	73.03
2.	JM 12	73.13
3.	HKI 164-4(1-3)	73.33
4.	HM 9	73.59
5.	HKH 414	73.80
6.	HKH 319	73.97
7.	VIVEK MAIZE HYBRID 25	74.04
8.	HKH 322	74.09
9.	JM 8	74.10
10.	HKI 325-17AN	74.20
11.	HKI 325-17ANER-3	74.32
12.	1128*161	74.79
13.	HKH 317	74.99

corn having more than 60% amylose is called high amylose maize. A total of 71 different germplasm were analyzed for starch, amylose in starch and amylopectin in starch. The values of amylose in starch varied from 23.51 to 55.20 per cent with lowest and highest values being observed in the genotypes VIVEK MAIZE HYBRID 33 and VL MAKKA 54, respectively. Amylopectin content in starch ranges from 44.98 (VL MAKKA 54) to 76.49 (VIVEK MAIZE HYBRID 33) per cent. Nine most promising lines selected for amylopectin in starch are mentioned in Table 4.

Table 4: Most promising lines with higher amylopectin in starch

S. No.	Pedigree	Amylopectin in starch (%)
1.	PANCHAGANGA	65.08
2.	PRATAP MAKKA 4 (EC-1108)	66.56
3.	VIVEK MAIZE HYBRID 5	67.98
4.	VIVEK MAIZE HYBRID 27	69.02
5.	PRATAP HYBRID MAIZE 1 (EH-50802)	71.05
6.	VIVEK MAIZE HYBRID 43	71.21
7.	PRATAP MAKKA 5 (EC-3116)	72.90
8.	PRATAP MAKKA CHARI 6 (EC-3135)	75.49
9.	VIVEK MAIZE HYBRID 33	76.49

Oil Content

Oil is an important by-product of maize industry. Due to its better quality and cholesterol lowering benefits, corn oil is highly appreciated by the urban population. The oil content of maize kernel comes mainly from the germ. It has low levels of saturated fatty acid i.e. on an average 11 per cent palmitic and 2 per cent stearic acid. On the other hand it contains high levels of PUFA, mainly linoleic acid with an average value of about 24 per cent. Maize oil is relatively stable since it contains high levels of natural antioxidants. Because of these qualities, oil has become by far the most valuable product of maize industry. Earlier germ containing oil were considered to be a waste product in glucose factories and corn mills, however, nowadays there is a great demand for high oil corn by these industries. Maize oil is highly regarded because of its fatty acid distribution, mainly oleic and linoleic acids. In this respect, populations that consume de-germed maize benefit less in terms of oil and fatty acids than populations that consume whole-kernel products. Therefore, breeding

for higher and better oil corn is an important aspect of maize development program.

A total of 293 samples of maize (QPM, sweet corn and normal maize germplasm) received from different sources, were analyzed for oil content. The oil content varied from 1.94 (HKI 327D) to 11.55 (Madhuri) per cent. Twenty nine lines out of 306 were having more than 5 per cent oil content. Some of the most promising lines for higher oil content are given in Table 5.

Table 5: Most promising lines with higher oil content

S. No.	Pedigree	Oil [Dry wt. basis (%)]
1.	HKI 194-2ER-J	6.22
2.	HKI165	6.28
3.	HKI194-2 ER-4	6.89
4.	MADHURI (SC)	11.55

Carotenoids and β - Carotene

Carotenoids are widely distributed natural pigments responsible for the yellow, orange, and red colors of fruits, roots, flowers etc. They invariably occur in the chloroplasts of higher plants, although in this photosynthetic tissue their color is masked by that of chlorophyll. Carotenoids are hydrophobic, lipophilic substances and are virtually insoluble in water. The importance of carotenoids in foods goes beyond their role as natural pigments. Biological functions and actions have been increasingly attributed to these compounds. Indeed, the provitamin A activity of carotenoids has been known for a long time. Vitamin A is provided in the diet as preformed vitamin A (retinyl ester, retinol, retinal, 3-dehydroretinol and retinoic acid) from foods of animal origin such as liver, milk and milk products, fish and meat or as carotenoids that can be biologically transformed to vitamin A (provitamin A), generally from plant foods.

A total of 59 samples of QPM and normal maize germplasm received from different sources were evaluated for carotenoids and β-carotene. Out of 59, 14 lines were found to possess more than 25 µg / g carotenoid content and only 7 lines were found to be having 2.0 or more than 2.0 µg / g β– carotene content. The carotenoid content ranges from 3.47 (HKI-327 T) to 39.53 (DMH 117-2) µg / g whereas, the range of β– carotene was 0.11 to 2.90 µg / g with lowest values being observed in HKI-170 (1+2) and highest in the genotype African tall. Some of the most promising lines for carotenoid content are presented in Table 6.

Table 6: Most promising lines with higher carotenoid content

S. No.	Pedigree	Carotenoid (µg/g)
1.	PANCHAGANGA	30.44
2.	BMC 7	30.76
3.	GPM 342 (MALE PARANT OF HYBRID KMH-22168)	30.78
4.	DMH 117-2	39.53

Test Weight and Specific gravity

A total of 465 different QPM and normal maize germplasm received from different

sources were evaluated for test weight and specific gravity. Out of the 465, 110 lines were selected for having more than 25 g / 100 grain. The range of test weight was 5.62 to 44.00 g / 100 grain with lowest and highest values being observed in the genotypes 328 x 329 and Seed Tech 2324, respectively. The range of specific gravity was 0.19 (VIVEK MAIZE HYBRID 9) to 1.90 (CML 9). Some of the most promising lines for test weight are given in Table 7.

Table 7: Most promising lines with higher test weight.

S. No	Pedigree	Test weight (g/100 grain)
1.	HKI 119-1-2-5	30.09
2.	QPM-1-14XQPM-3-7	30.19
3.	QPM-9-16XQPM-10-9	30.22
4.	QPM 2-4	30.34
5.	DMR QPM-5(07)-1 X DMR QPM-4(07)-8	30.70
6.	VIVEK 43	30.70
7.	DMR QPM-2(07)-5 X DMR QPM-2(07)-4	31.10
8.	DMH 2	31.29
9.	CI-4*CI-5	31.38
10.	DMR QPM-2(07)-7 X DMR QPM-2(07)-5	31.40
11.	QPM 8-12	31.46
12.	IC 568299	31.55
13.	QPM-7-4XQPM-6-8	31.77
14.	QPM 5-19	31.97
15.	BIO 9637	32.00
16.	QPM-9-16XQPM-1-8	32.13
17.	QPM 1-6	32.28
18.	PMH 2	32.40
19.	CI 4	32.59
20.	VL MAKKA 42	32.65

Apart from this, maize germplasm received from Pathology section, DMR was evaluated for biochemical profiling stored under different regimens. The Biochemical profiling of maize germplasm received from RRS & SPU Begusarai was conducted to identify promising lines suitable for hybrid development programme. Also promising inbreds were evaluated for biochemical profiling received from DMR during *kharif* 2011 and the materials was presented compared to best checks.

PHYSIOLOGY

Research Highlights

During 2011-12 two trials (high temperature and drought) were conducted on abiotic stresses.

1. High Temperature

The trial was conducted during spring 2011. A set of selected 21 maize inbred lines and 5 F_1 hybrids were planted in net-house (Figure1) following all recommended package of practices. High temperature, reduced plant height and inhibited chlorophyll synthesis negatively influenced net photosynthetic rate during vegetative growth. However, the flowering stage was most sensitive to high temperature and resulted in enhanced leaf firing, tassel blasting, increased anthesis-silking interval (ASI) and reduced pollen viability. There was reduction in grain yield up to 90% in inbred lines and 60-80% in F_1 hybrids. The identified promising inbred lines (LM 17, HKI 577, HKI 1532, HKI 170 (1+2), HKI 325 17AN and CA 14514) will be further used in hybrid breeding programme.

2. Drought Stress

A set of 174 inbred lines were evaluated under drought stress (moisture deficit) during *kharif* 2011 under field conditions (Figure 2). The moisture deficit was created by withholding irrigation at the time of flowering. The moisture deficit resulted in increased ASI, induced leaf yellowing, decreased photosynthetic rate, increased root length and reduction in grain yield upto 80% as compared to unstressed control. Based on their performance under moisture deficit, 58 inbred lines showed promising

Figure 1: Screening for heat stress tolerance.

Figure 2: Screening for drought tolerance

results and will be further evaluated under managed stress (rain-out-shelter) conditions for confirmation.

Another set of selected 25 inbred lines was phenotyped for flowering stage drought tolerance.

Out of 25 inbred lines tested, 12 lines exhibited drought adaptive traits like stay green character (measured by SPAD chlorophyll content and LCC score), increased root length, shorter ASI, lesser leaf senescence and non barrenness. These lines (HKI 209, HKI 325 17AN, HKI 335, HKI 577, HKI 1532, CM 139, LM 17, BJIM08-27, BJIM10-36, DTPYC9F119 and CA 14514) showed confirmed source of tolerance to drought and will be used further in hybrid breeding program.

EXTENSION

A. Research output

*Inter-institutional Project: Strengthening and Refinement of Maize AGRI**daksh***

*Maize AGRI**daksh***

Maize AGRI*daksh*, is an expert system of maize crop to disseminate recent advances in Maize to the users. It is based on **AGRI***daksh* which is a tool for developing online expert system.

Progress

I. The information and images of varieties, weeds, diseases, and physical disorder for Maize.

II. Crop were updated and added in the knowledgebase of the system.

III. The maize varieties were validated and the new information received was added to the system.

IV. Decision Tree module was re-examined and modified for adding more questions for variety selection.

V. The duplicated / unwanted varieties were deleted from Maize Expert System

VI. Some issues related to the Farmer's module were solved and static pages updated.

VII. New material was added in the "About us" menu of the System.

VIII. Work started on the Hindi module of the System. Item names appearing on the left hand side of all the web forms are converted from English to Hindi.

IX. Database designing for the development of Multilingual System was completed.

Salient Achievement

* Maize AGRIdaksh has been praised by the farmers at the Demonstrations, Trainings and Kisan Melas and exhibitions.

Institute Project: Accelerating adoption of maize production technologies in India

The Directorate of Maize Research conducted demonstrations in 25 acres of land in Punjab, Haryana, U.P. and Rajasthan using DHM-117 and HQPM-1 hybrids during *kharif* 2011. Average yield of DHM-117 and HQPM-1 in demonstration were 78.34 and 68.0 q / ha respectively. Farmers were very happy with performance and attractive color of DHM-117. They were demanding seed of DHM-117 for next season.

Monitoring of FLD at Garhshankar in Punjab

B. Frontline Demonstrations and Officer Training Programme under ISOPOM

I. Frontline Demonstrations (FLDs)

DMR coordinated approximately eight thousand FLDs during *rabi / spring* 2010-11 and *kharif* 2011 which were organised in more than ten states of India through agencies of public and private sectors. Seed production, Quality Protein Maize, baby corn, green cobs, single cross hybrids, intercropping, etc. were demonstrated in FLDs at farmers field. More than fifty Field Days were organized in different parts of the country to popularize maize technologies.

II. Officers' Training Programme

DMR coordinated more than 12 Officers' Training Programme under ISOPOM in different parts of the country. Thirty or more than thirty participants attended each training programme. Few progressive farmers (men and women) also attended training programme.They gained knowledge and skill about cultivation of *kharif* maize, *rabi* maize, quality protein maize, baby corn, sweet corn, popcorn, intercropping, seed production, value addition, industrial utilization, etc. These trained officials will impart training to the farmers in their respective states and regions and farming community will be benefited.

C. Tribal Sub Plan (TSP) of ICAR

I. Demonstrations

Complete package of cultivation practices, Single cross hybrid, quality protein maize, baby corn, seed production, Integrated Pest Management, resource conservation

Single cross hybrid DHM-117 at Medak in A.P.

Single cross hybrid DHM-117 at tribal farmers' field in Medak in A.P.

technologies, etc. are being demonstrated at tribal farmers' field in more than 100 acres of land in different tribal populated states of India during *rabi* / spring 2011-12. Cost of cultivation in form of inputs is being provided to the demonstrating farmers. Besides this, sprayers, weeders and shellers are also being distributed to the demonstrating farmers.

II. National level training programmes

Five national level training programmes were conducted at DMR, New Delhi during 2011-12. Approximately 50 Tribal farmers from more than 10 states participated in each programmes. Farmers were trained about seed production, production technology and value addition of maize. Seed, sprayers, weeders and shellers were also distributed to the trainee farmers. These trained farmers will impart training to the other farmers in their respective states and regions and farming community will be benefited.

III. Regional training programmes

Regional trainings were imparted in tribal dominated states such as north eastern states (Assam, Meghalaya, Manipur, Sikkim, etc.), Andhra Pradesh, Rajasthan, M.P. etc. during 2011-12. Women tribal farmers also participated in these programmes. They gained knowledge and skill about cultivation of *kharif* maize, *rabi* maize, quality protein maize, baby corn, sweet corn, popcorn, intercropping, seed production, value addition, industrial utilization, etc.

Ex- VC, BAU, Ranchi addressing tribal farmers in training programme

Regional training in East Godavari and Chhindwara district of A.P. respectively

IV. Exhibitions

Different technologies were shown to tribal farmers through samples, specimen, value added products, models etc. on occasions of various Kisan melas and exhibitions.

Tribal farmers showing interest on single cross hybrid maize and value added products

Ms. Ritu Singh imparting training on value addition of Maize

V. Field Visit

Two Field Visits were conducted at experimental field of DMR, baby corn village and sweet corn village during 2011-12. Farmers were very happy to see different maize technologies.

VI. Field Day

More than 10 Field Day were organized in Andhra Pradesh, M.P., North Eastern states, etc. under TSP.

D. Kisan Melas and Exhibitions

Directorate of Maize Research actively participated by putting up stall in the following Kisan Melas and Exhibitions/ occasions:

Tribal farmers field visit

Field Day at Medak in A.P.

Field Day at Banswara(Rajasthan)

Field Day at Kangra (H.P.)

i) 54th Annual Maize Workshop in TNAU, Coimbatore from April 02-04, 2011.

Delegates of 54th Annual Maize Workshop visiting maize exhibition

ii) Vision 2020-University Industry interaction meet organized by Regional Research Station, CCSHAU, Uchani, Karnal (Haryana) on 30.09.2011.

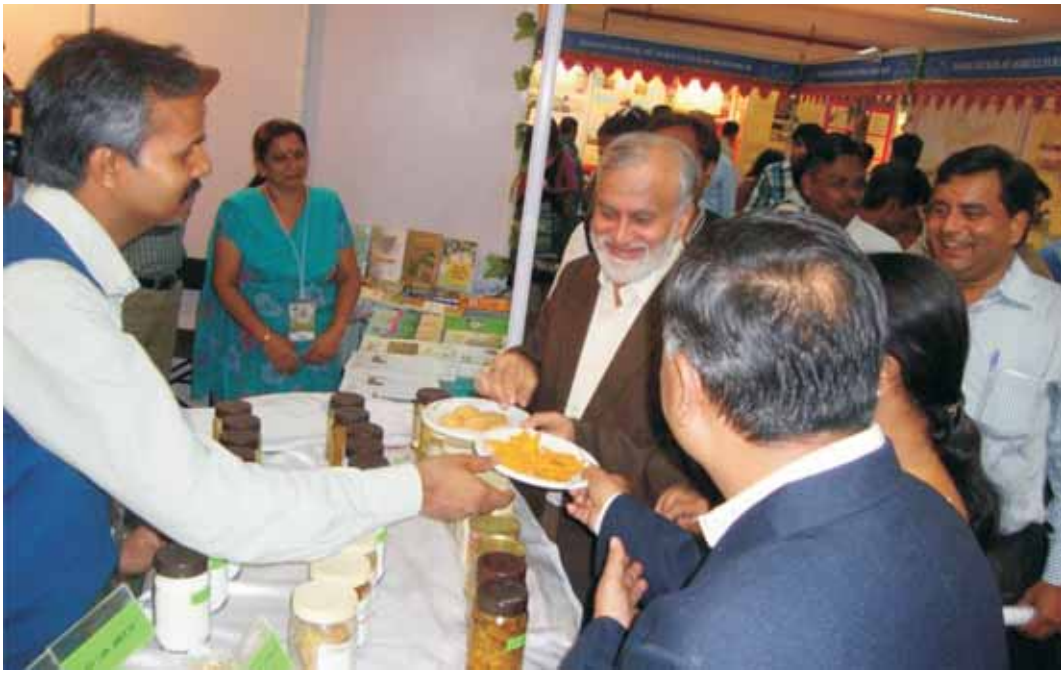
DDG (Crop Science), ICAR and V.C. CCSHAU, Hisar along with other delegates visiting maize stall

iii) Four National level training programmes on "Seed Production, Cultivation and Value Addition of Maize" for tribal farmers under Tribal Sub Plan of ICAR held at DMR, Pusa Campus, New Delhi during 2011-12.

DDG (Agril. Extension) visiting maize exhibition in DMR, New Delhi

Visitors showing interest in seed and value added products of maize

iv) India International Trade Fair (IITF) held in Pragati Maidan, New Delhi from 14th to 27th November 2011.



Secretary, DARE and DG, ICAR praising QPM products in IITF 2012

v) 6th National Conference on KVKs held at JNKVV, Jabalpur, M.P. during 3-5 December 2011.

Visitors interested in value added products of maize in 6th KVK Conference

vi) Pusa Krishi Vigyan Mela held in Mela Ground, IARI, New Delhi from March 01-03, 2012.

PD (Maize) explaining about single cross hybrid maize to lady farmers

vii) Global Conference on Women in Agriculture held in Mela Ground, IARI, New Delhi from 13-15 March, 2012

ZPD, Zone IV, KVK showing keen interest in value added products of maize

ANNEXURES

Annexure I

List of the promoted entries in AICRP-M

List of promoted entries from 61 to 65

S. No.	Z1 GY	R	%	H	S	P	PEDIGREE	Remark
1	8898	1	12.9	103.7	61.8	59.1	Orbit	Promoted
57C	**7879**	**5**		**104.2**	**62.7**	**60.0**	**Seed Tech 2324**	
C.D. (5%)	**833**			**2.67**	**2.03**	**1.86**		
Consideration	**8712**	**5**	**0**	**106.9**	**64.73**	**61.9**		

S. No.	Z2 GY	R	%	H	S	P	PEDIGREE	Remark
1	10017	1	7.1	97.3	59.8	57.8	PRO-385	Promoted
2	9742	2	4.2	98.0	58.3	56.5	CMH08-381	Promoted
56C	**9350**	**12**		**98.5**	**60.9**	**58.1**	**PMH 3**	
C.D. (5%)	**1374**			**2.73**	**2.49**	**2.36**		
Consideration	**10724**	**12**	**0**	**101.2**	**63.39**	**60.5**		

S. No.	Z3 GY	R	%	H	S	P	PEDIGREE	Remark
1	8617	1	20.3	95.5	56.8	54.0	X35A180	Promoted
2	8338	2	16.4	93.8	56.6	53.4	X35A187	Promoted
3	8200	3	14.5	93.7	56.4	53.7	CMH08-381	Promoted
4	7946	4	10.9	96.6	58.3	54.7	MCH 46	Promoted
5	7699	5	7.5	94.2	56.6	54.1	S6668	Promoted
6	7674	6	7.1	94.5	56.3	53.7	DAS-MH-102	Promoted
7	7667	7	7	93.0	56.0	53.1	CMH09-464	Promoted
8	7623	8	6.4	93.9	55.4	52.6	X8B680	Promoted
9	7516	9	4.9	93.9	56.4	53.3	GK 3102	Promoted
10	7494	10	4.6	94.3	56.7	53.5	MCH 45	Promoted
11	7478	11	4.4	95.2	57.8	54.8	CMH10-500	Promoted
12	7469	12	4.3	95.3	57.2	53.9	DMH 7705	Promoted
56C	**7164**	**20**		**93.7**	**57.5**	**54.5**	**PMH 3**	
C.D. (5%)	**1148**			**2.18**	**1.55**	**1.33**		
Consideration	**8312**	**20**	**0**	**95.88**	**59.05**	**55.8**		

S. No.	Z5GY	R	%	H	S	P	PEDIGREE	Remark
1	6301	1	27.7	90.2	54.9	53.8	X35A182	Promoted
2	5840	2	18.3	88.9	57.1	55.6	P4546	Promoted
3	5781	3	17.1	89.0	51.9	52.9	Laxmi 333	Promoted

4	5728	4	16.1	87.8	54.8	52.9	X35A187	Promoted
5	5686	5	15.2	88.0	55.3	53.5	NMH-1247	Promoted
6	5684	6	15.2	89.4	56.1	54.3	S6668	Promoted
7	5646	7	14.4	86.6	54.2	52.5	X35A178	Promoted
8	5601	8	13.5	89.2	55.6	54.0	CMH08-381	Promoted
9	5502	9	11.5	91.4	56.8	54.9	DMH 7705	Promoted
10	5464	10	10.7	89.6	55.4	53.8	B 54	Promoted
55C	**4936**	**17**		**88.9**	**55.2**	**53.4**	**PMH 1**	
C.D. (5%)	**784**			**2.58**	**1.80**	**1.78**		
Consideration	**5720**	**17**	**0**	**91.48**	**57**	**55.2**		

List of promoted entries from 61 to 65

S. No.	Z4GY	R	%	H	S	P	PEDIGREE	Remark
1	10444	1	19.5	98.9	56.5	54.7	PRO-385	Promoted
2	10401	2	19.1	100.8	56.9	55.1	NMH-1247	Promoted
3	10306	3	18	99.7	56.4	54.8	Laxmi 333	Promoted
4	10259	4	17.4	102.3	58.3	56.5	S6668	Promoted
5	10220	5	17	99.7	56.1	54.3	GEO Premium Diamond	Promoted
6	10089	6	15.5	101.0	57.2	54.7	PFMH-97 I 57 (AMAR)	Promoted
7	10072	7	15.3	99.5	57.0	55.3	CMH08-381	Promoted
8	10061	8	15.2	100.9	57.1	54.9	B 54	Promoted
9	9979	9	14.2	100.5	56.8	54.6	GK 3102	Promoted
10	9958	10	14	102.6	59.1	57.2	X35A180	Promoted
11	9867	11	12.9	101.2	56.9	55.0	GK 3103	Promoted
12	9827	12	12.5	99.4	55.7	53.8	PRO-384	Promoted
13	9813	13	12.3	99.4	56.4	54.7	X35A182	Promoted
14	9775	14	11.9	99.2	56.8	55.0	CMH09-464	Promoted
15	9755	15	11.7	100.2	56.3	54.3	X35A187	Promoted
16	9674	16	10.7	101.0	57.8	54.9	MCH 45	Promoted
17	9623	17	10.1	101.7	58.0	56.0	Orbit	Promoted
18	9561	18	9.4	98.9	57.1	55.7	CMH08-381(G)	Promoted
19	9539	19	9.2	99.0	55.6	53.4	X35A178	Promoted
20	9500	20	8.7	100.6	55.8	53.9	X8B680	Promoted
21	9488	21	8.6	98.6	55.5	54.0	Bisco 2324 Plus	Promoted
22	9462	22	8.3	100.9	57.4	54.5	DMH 7705	Promoted
23	9433	23	8	101.6	56.2	54.4	B 161	Promoted
24	9365	24	7.2	102.3	59.1	57.0	HTMH 5402	Promoted
25	9307	25	6.5	101.2	56.7	55.1	HTMH 5106	Promoted
26	9272	26	6.1	99.2	55.4	53.7	Hygreeva	Promoted
27	9234	27	5.7	102.3	59.1	57.2	CMH10-500	Promoted
28	9104	28	4.2	101.5	57.8	56.0	P4546	Promoted
57C	**8736**	**38**		**100.0**	**56.7**	**55.0**	**Seed Tech 2324**	
C.D. (5%)	**1351**			**1.68**	**1.05**	**1.15**		
Consideration	**10087**	**38**	**0**	**101.7**	**57.75**	**56.2**		

List of promoted entries 62 to 66

S. No.	Z1 GY	R	%	H	S	P	PEDIGREE	Remark
1	9466	1	20.3	94.9	56.9	54.0	EHL 161708 (Hyb)	Promoted
2	8884	2	12.9	96.0	56.3	53.6	X35A189	Promoted
3	8790	3	11.8	97.2	56.3	54.2	B 53	Promoted
4	8764	4	11.4	98.4	57.2	55.1	PRO-382	Promoted
5	8624	5	9.6	99.3	58.3	56.6	Proline-777	Promoted
54C	**7865**	**18**		**97.1**	**55.7**	**53.9**	**BIO 9637**	
C.D. (5%)	**1179**			**3.25**	**3.04**	**2.73**		
Consideration	**9044**	**18**	**0**	**100.4**	**58.74**	**56.6**		

S. No.	Z2 GY	R	%	H	S	P	PEDIGREE	Remark
1	9134	1	24.7	95.0	55.7	53.7	Proline-777	Promoted
2	8670	2	18.4	94.9	59.5	56.6	X35A189	Promoted
3	8318	3	13.5	95.7	57.8	55.2	X35A194	Promoted
4	8235	4	12.4	98.3	59.4	56.9	MCH 47	Promoted
57C	**7326**	**22**		**94.4**	**56.8**	**53.9**	**PMH 4**	

List of promoted entries 63 to 67

S.No.	Z1 GY	R	%	H	S	P	PEDIGREE	Remark
1	8209	1	32.2	94.4	57.5	56.1	CMH10-526	*
2	7873	2	26.8	90.7	55.5	53.0	JH 31485	Promoted
3	7869	3	26.8	91.9	54.5	52.7	DAS-MH-501	Promoted
4	7630	4	22.9	89.0	52.7	50.8	Bisco 2238	Promoted
5	7602	5	22.5	90.1	54.4	52.7	K 21	Promoted
6	7343	6	18.3	91.9	54.5	52.7	EH-2170	Promoted
7	7281	7	17.3	94.6	56.2	54.5	CMH10-525	*
8	7236	8	16.6	90.0	53.4	51.9	EH-2101	Promoted
9	7208	9	16.1	88.5	51.9	50.4	EH-2184	Promoted
10	7155	10	15.3	88.8	54.7	53.3	FH 3548	Promoted
11	7147	11	15.1	93.4	57.7	56.5	CMH10-518	*
19C	**6207**	**14**		**88.3**	**52.3**	**50.5**	**JH-3459**	
C.D. (5%)	**906**			**3.45**	**2.59**	**2.43**		
Consideration	**7113**			**91.75**	**54.89**	**52.9**		

S.No.	Z2 GY	R	%	H	S	P	PEDIGREE	Remark
1	7385	1	10.8	90.3	54.4	52.1	K 21	Promoted
20C	**6666**	**8**		**89.3**	**53.4**	**50.8**	**Prakash**	
C.D. (5%)	**909**			**2.39**	**2.42**	**2.31**		
Consideration	**7575**			**91.69**	**55.82**	**53.1**		

S.No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	6547	1	33	86.1	55.7	52.7	CMH10-518	*

2	6233	2	26.6	83.7	52.9	49.8	JH 31485	Promoted
3	5739	3	16.5	82.2	54.0	50.5	Bisco 2238	Promoted
4	5655	4	14.8	83.3	53.8	50.2	EH-2170	Promoted
5	5417	5	10	83.8	54.3	50.4	K 21	Promoted
20C	**4924**	**13**	**-**	**82.6**	**51.1**	**48.1**	**Prakash**	
C.D. (5%)	**1012**			**2.48**	**3.10**	**2.00**		
Consideration	**5936**			**85.08**	**54.2**	**50.1**		
S.No.	**ZN 4 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	9161	1	38.5	92.0	56.5	55.0	CMH10-518	*
2	8433	2	27.5	91.9	56.1	54.4	CMH10-526	*
3	8363	3	26.5	86.9	51.1	48.8	Bisco 2238	Promoted
4	8226	4	24.4	92.9	56.9	55.1	CMH10-519	*
5	7936	5	20	89.4	53.1	51.3	K 21	Promoted
6	7893	6	19.3	91.5	55.5	53.5	CMH10-525	*
7	7823	7	18.3	89.3	53.9	51.6	EH-2170	Promoted
8	7758	8	17.3	88.4	51.2	49.5	EH-2101	Promoted
9	7485	9	13.2	90.1	53.1	51.8	DAS-MH-501	Promoted
20C	**6614**	**15**	**-**	**86.9**	**49.8**	**48.6**	**Prakash**	
C.D. (5%)	**1047**			**1.79**	**1.44**	**1.31**		

List of promoted entries 63 to 67

S.No.	**Z1 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	8209	1	32.2	94.4	57.5	56.1	CMH10-526	*
2	7873	2	26.8	90.7	55.5	53.0	JH 31485	Promoted
3	7869	3	26.8	91.9	54.5	52.7	DAS-MH-501	Promoted
4	7630	4	22.9	89.0	52.7	50.8	Bisco 2238	Promoted
5	7602	5	22.5	90.1	54.4	52.7	K 21	Promoted
6	7343	6	18.3	91.9	54.5	52.7	EH-2170	Promoted
7	7281	7	17.3	94.6	56.2	54.5	CMH10-525	*
8	7236	8	16.6	90.0	53.4	51.9	EH-2101	Promoted
9	7208	9	16.1	88.5	51.9	50.4	EH-2184	Promoted
10	7155	10	15.3	88.8	54.7	53.3	FH 3548	Promoted
11	7147	11	15.1	93.4	57.7	56.5	CMH10-518	*
19C	**6207**	**14**		**88.3**	**52.3**	**50.5**	**JH-3459**	
C.D. (5%)	**906**			**3.45**	**2.59**	**2.43**		
Consideration	**7113**			**91.75**	**54.89**	**52.9**		

S.No.	**Z2 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	7385	1	10.8	90.3	54.4	52.1	K 21	Promoted
20C	**6666**	**8**		**89.3**	**53.4**	**50.8**	**Prakash**	
C.D. (5%)	**909**			**2.39**	**2.42**	**2.31**		
Consideration	**7575**			**91.69**	**55.82**	**53.1**		

S.No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	6547	1	33	86.1	55.7	52.7	CMH10-518	*
2	6233	2	26.6	83.7	52.9	49.8	JH 31485	Promoted
3	5739	3	16.5	82.2	54.0	50.5	Bisco 2238	Promoted
4	5655	4	14.8	83.3	53.8	50.2	EH-2170	Promoted
5	5417	5	10	83.8	54.3	50.4	K 21	Promoted
20C	**4924**	**13**	**-**	**82.6**	**51.1**	**48.1**	**Prakash**	
C.D. (5%)	**1012**			**2.48**	**3.10**	**2.00**		
Consideration	**5936**			**85.08**	**54.2**	**50.1**		

S.No.	ZN 4 GY	R	%	H	S	P	PEDIGREE	Remark
1	9161	1	38.5	92.0	56.5	55.0	CMH10-518	*
2	8433	2	27.5	91.9	56.1	54.4	CMH10-526	*
3	8363	3	26.5	86.9	51.1	48.8	Bisco 2238	Promoted
4	8226	4	24.4	92.9	56.9	55.1	CMH10-519	*
5	7936	5	20	89.4	53.1	51.3	K 21	Promoted
6	7893	6	19.3	91.5	55.5	53.5	CMH10-525	*
7	7823	7	18.3	89.3	53.9	51.6	EH-2170	Promoted
8	7758	8	17.3	88.4	51.2	49.5	EH-2101	Promoted
9	7485	9	13.2	90.1	53.1	51.8	DAS-MH-501	Promoted
20C	**6614**	**15**	**-**	**86.9**	**49.8**	**48.6**	**Prakash**	
C.D. (5%)	**1047**			**1.79**	**1.44**	**1.31**		
Consideration	**7661**			**88.69**	**51.24**	**49.9**		

* the entry has considered for promotion under medium maturity group

List of promoted entries 63 to 67

S.No.	ZN 5 GY	R	%	H	S	P	PEDIGREE	Remark
1	5334	1	21.3	83.6	50.8	48.4	CMH10-525	Promoted
2	4839	2	10	80.8	48.9	46.7	K 21	Promoted
20C	**4399**	**8**	**-**	**81.4**	**47.6**	**45.9**	**Prakash**	
C.D. (5%)	**724**			**3.30**	**1.74**	**2.13**		
Consideration	**5123**			**84.7**	**49.34**	**48**		

List of promoted entries 64 to 68

S.No.	ZN 1 GY	R	%	H	S	P	PEDIGREE	Remarks

1	6229	1	39.9	86.5	52.7	50.5	FH 3556	Promoted
2	6030	2	35.4	85.5	52.3	50.3	FH 3554	Promoted
3	5949	3	33.6	86.4	53.1	51.0	FH 3558	Promoted
4	5585	4	25.4	87.0	52.3	50.1	FH 3555	Promoted
5	5142	5	15.5	86.8	52.5	50.6	K 75	Promoted
6	4951	6	11.2	86.1	51.8	49.7	DH-230	Promoted
12C	**4454**	**9**	**-**	**86.5**	**51.8**	**49.9**	**Vivek Hybrid 9**	
C.D. (5%)	**811**			**1.96**	**1.26**	**1.27**		
Consideration	**5265**			**88.46**	**53.06**	**51.2**		

S.No.	**ZN 2 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	5925	1	17.5	81.8	48.7	46.4	FH 3554	Promoted
2	5626	2	11.5	81.1	48.6	46.3	K 75	Promoted
3	5542	3	9.9	82.8	50.1	47.6	FH 3555	Promoted
12C	**5044**	**6**	**-**	**81.1**	**49.5**	**46.4**	**Vivek Hybrid 9**	
C.D. (5%)	**957**			**1.85**	**1.50**	**1.47**		
Consideration	**6001**			**82.95**	**51**	**47.9**		

S.No.	**ZN 4 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	7501	1	16.2	82.6	49.1	47.1	FH 3555	Promoted
2	7197	2	11.5	83.0	49.2	47.6	FH 3556	Promoted
11C	**6454**	**6**	**-**	**82.0**	**47.3**	**46.0**	**Vivek QPM 9**	
C.D. (5%)	**991**			**0.96**	**0.81**	**0.85**		
Consideration	**7445**			**82.96**	**48.11**	**46.9**		

S.No.	**ZN 5 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	4326	1	17	77.9	47.3	45.7	FH 3554	Promoted
2	4245	2	14.8	78.9	48.2	46.5	FH 3558	Promoted
3	4229	3	14.3	78.2	47.7	45.8	FH 3556	Promoted
12C	**3699**	**6**	**-**	**79.2**	**47.4**	**45.6**	**Vivek Hybrid 9**	
C.D. (5%)	**636**			**1.68**	**1.07**	**1.03**		
Consideration	**4335**			**80.88**	**48.47**	**46.6**		

List of promoted entries from 65 to 69

S.No.	ZN 1 GY	R	%	H	S	P	PEDIGREE	Remarks
1	9269	1	5.3	106.2	60.4	58.6	Bisco New 704	Promoted
13C	**8802**	**3**	**-**	**105.6**	**59.4**	**57.2**	**PMH 3**	
C.D. (5%)	**1003**			**3.10**	**2.76**	**2.85**		
Consideration	**9805**			**108.7**	**62.16**	**60.1**		

S.No.	ZN 2 GY	R	%	H	S	P	PEDIGREE	
1	7761	1	7.1	98.5	59.4	57.3	CMH08-287	Promoted
2	7736	2	6.8	99.3	58.3	55.8	NMH-713	Promoted
13C	**7245**	**7**	**-**	**91.7**	**60.7**	**58.5**	**PMH 3**	
C.D. (5%)	**793**			**5.71**	**1.51**	**1.45**		
Consideration	**8038**			**97.41**	**62.21**	**60**		

S.No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	7524	1	19.2	91.9	57.2	53.9	X35A176	Promoted
2	7382	2	16.9	91.1	55.3	52.5	CMH08-287	Promoted
3	7353	3	16.5	92.3	55.8	53.6	A 7501	Promoted
4	7255	4	14.9	92.5	55.9	53.3	BIO-562	Promoted
5	7162	5	13.4	91.5	55.7	52.7	M 9977	Promoted
6	6839	6	8.3	90.2	55.6	52.9	JH 12157	Promoted
13C	**6313**	**10**	**-**	**91.7**	**57.6**	**54.5**	**PMH 3**	
C.D. (5%)	**971**			**2.09**	**1.75**	**1.77**		
Consideration	**7284**			**93.79**	**59.35**	**56.3**		

S.No.	ZN 4 GY	R	%	H	S	P	PEDIGREE	Remark
1	9074	1	4.6	100.0	57.7	56.0	CMH08-287	Promoted
14C	**8676**	**5**	**-**	**99.9**	**56.5**	**54.6**	**Seed Tech 2324**	
C.D. (5%)	**1065**			**1.63**	**1.05**	**1.03**		
Consideration	**9741**			**101.5**	**57.55**	**55.6**		

S.No.	ZN 5 GY	R	%	H	S	P	PEDIGREE	Remark
1	5335	1	6.5	89.1	55.6	54.2	CMH08-287	Promoted
2	5303	2	5.8	90.2	56.1	54.1	X35A176	Promoted
3	5257	3	4.9	88.9	56.1	54.8	JH 12157	Promoted
12C	**5011**	**7**	**-**	**89.1**	**54.2**	**52.9**	**PMH 1**	
C.D. (5%)	**671**			**3.31**	**1.19**	**1.40**		

List of promoted entries from 66 to 70

S. No.	ZN 1 GY	R	%	H	S	P	PEDIGREE	Remarks
1	8091	1	37.2	100.7	58.1	55.8	BIO 151	Promoted
2	7775	2	31.9	99.2	57.6	55.7	YUVRAJ GOLD	Promoted
3	7570	3	28.4	101.6	58.3	57.0	X35A173	Promoted
4	7569	4	28.4	99.4	57.7	55.7	S6217	Promoted
5	7563	5	28.3	96.6	55.6	53.2	NMH-1242	Promoted
6	7473	6	26.7	99.3	56.9	54.5	B 63	Promoted
7	7426	7	25.9	99.3	57.3	55.2	S6304	Promoted
8	7185	8	21.9	101.0	57.8	55.8	P3396	Promoted
9	6911	9	17.2	97.2	57.8	55.9	CMH08-350	Promoted
10	6870	10	16.5	100.7	57.4	55.7	TITAN	Promoted
11	6825	11	15.8	97.1	54.8	52.4	JKMH-7004	Promoted
12	6814	12	15.6	101.4	58.1	56.4	Bisco 2668	Promoted
13	6786	13	15.1	98.1	55.1	52.8	PFMH-96 N 46	Promoted
14	6715	14	13.9	102.0	59.6	57.2	KDMH 176	Promoted
15	6642	15	12.7	98.6	57.9	55.9	JH 31404	Promoted
16	6642	16	12.6	98.4	55.8	53.9	IMH-666	Promoted
17	6636	17	12.5	98.1	58.2	55.8	BH41009	Promoted
18	6506	18	10.3	100.3	57.1	55.3	BIO-688	Promoted
19	6501	19	10.3	101.2	57.3	55.6	X35A174	Promoted
20	6473	20	9.8	98.2	55.8	53.6	PFMH-96 I 41	Promoted
31C	**5896**	**25**	**-**	**100.4**	**58.1**	**55.9**	**BIO 9637**	
C.D. (5%)	**1027**			**5.22**	**2.94**	**2.95**		
Consideration	**6923**			**105.62**	**61.04**	**58.85**		

S. No.	ZN 2 GY	R	%	H	S	P	PEDIGREE	Remark
1	7969	1	30.5	97.9	58.3	56.2	S6217	Promoted
2	7397	2	21.1	100.3	59.8	57.7	BIO 151	Promoted
3	7117	3	16.5	99.4	59.0	56.8	P3396	Promoted
4	7038	4	15.2	96.7	58.0	55.5	CMH08-350	Promoted
5	6989	5	14.4	99.4	59.6	57.3	B 63	Promoted
6	6960	6	14	97.6	57.4	55.3	S6304	Promoted
7	6955	7	13.9	97.7	58.3	55.7	BIO-688	Promoted
8	6866	8	12.4	96.8	58.4	56.2	YUVRAJ GOLD	Promoted
9	6823	9	11.7	97.9	59.0	56.8	CMH08-292	Promoted
10	6787	10	11.1	100.3	58.8	56.8	X35A174	Promoted
11	6719	11	10	98.2	58.4	56.0	Bisco 2668	Promoted
31C	**6108**	**21**	**-**	**98.3**	**58.0**	**55.9**	**BIO 9637**	
C.D. (5%)	**1036**			**4.03**	**2.64**	**2.56**		
Consideration	**7144**			**102.33**	**60.64**	**58.46**		

List of promoted entries from 66 to 70

S. No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	6831	1	25.3	87.1	53.4	50.5	YUVRAJ GOLD	Promoted
2	6556	2	20.2	91.2	55.1	52.3	X35A173	Promoted
3	6463	3	18.5	88.8	55.6	52.5	KNMH401061	Promoted
4	6461	4	18.5	88.3	54.3	51.2	S6217	Promoted
5	6378	5	17	88.3	55.4	52.5	B 63	Promoted
6	6364	6	16.7	89.9	55.5	52.2	P3396	Promoted
7	6358	7	16.6	85.9	53.6	50.8	CMH08-292	Promoted
8	6332	8	16.1	87.5	54.1	51.3	CMH08-350	Promoted
9	6324	9	16	88.6	55.0	51.9	S6304	Promoted
10	6242	10	14.5	88.9	54.5	51.7	Bisco 2668	Promoted
11	6229	11	14.2	89.0	54.7	51.9	BIO 151	Promoted
12	6176	12	13.2	88.7	53.5	50.2	NMH-1242	Promoted
13	6154	13	12.8	86.4	53.2	50.2	BH41009	Promoted
14	6142	14	12.6	89.4	55.6	52.5	TITAN	Promoted
15	6105	15	11.9	91.5	56.0	53.4	VMH 4106	Promoted
31C	**5453**	**23**	**-**	**88.1**	**54.3**	**51.0**	**BIO 9637**	
C.D. (5%)	**1007**			**2.76**	**2.91**	**1.80**		
Consideration	**6460**			**90.86**	**57.21**	**52.8**		

S. No.	ZN 4 GY	R	%	H	S	P	PEDIGREE	Remark
1	9242	1	24.2	98.0	56.6	54.6	S6217	Promoted
2	9172	2	23.3	97.0	54.8	52.7	NMH-1242	Promoted
3	8829	3	18.7	98.4	56.2	54.4	BIO 151	Promoted
4	8789	4	18.1	97.3	55.9	54.1	YUVRAJ GOLD	Promoted
5	8771	5	17.9	98.0	56.2	54.3	X35A173	Promoted
6	8634	6	16.1	96.4	55.4	53.7	CMH08-292	Promoted
7	8460	7	13.7	97.5	55.5	53.9	B 63	Promoted
8	8416	8	13.1	98.3	55.6	54.0	X35A174	Promoted
9	8347	9	12.2	98.4	57.0	55.7	S6304	Promoted
10	8330	10	12	97.5	56.0	54.5	CMH08-433	Promoted
31C	**7440**		**-**	**96.6**	**55.1**	**53.0**	**BIO 9637**	
C.D. (5%)	**1229**			**1.48**	**1.21**	**1.16**		
Consideration	**8669**			**98.08**	**56.31**	**54.16**		

List of promoted entries from 66 to 70

S. No.	ZN 5 GY	R	%	H	S	P	PEDIGREE	Remark
1	6222	1	46	86.1	51.8	50.0	YUVRAJ GOLD	Promoted
2	6106	2	43.3	86.9	53.0	51.4	BH41009	Promoted
3	6025	3	41.4	86.5	52.9	50.9	S6217	Promoted
4	5584	4	31	85.9	52.6	51.1	CMH08-350	Promoted
5	5575	5	30.8	86.9	54.6	52.8	JH 31404	*
6	5503	6	29.1	87.3	54.4	52.7	KNMH401061	*
7	5438	7	27.6	87.5	53.5	51.6	S6304	*
8	5349	8	25.5	86.9	54.1	52.3	KDMH 176	*
9	5256	9	23.3	86.6	53.3	51.7	BIO 151	Promoted
10	5176	10	21.5	87.0	51.9	50.3	X35A174	Promoted
11	5024	11	17.9	83.7	51.5	49.4	CMH08-292	Promoted
12	5001	12	17.3	87.3	53.7	51.9	X35A173	*
13	4911	13	15.3	85.1	53.2	51.3	CMH08-433	Promoted
14	4903	14	15	86.7	52.7	51.3	B 63	Promoted
15	4887	15	14.7	86.1	52.2	50.3	NMH-1242	Promoted
16	4816	16	13	86.8	53.8	52.1	P3396	*
17	4799	17	12.6	85.2	51.5	49.7	PFMH-96 N 46	Promoted
18	4797	18	12.6	84.2	50.7	48.7	EH-1974	Promoted
19	4727	19	10.9	85.8	51.3	49.3	EC-3161	Promoted
31C	**4261**	**27**	**-**	**84.6**	**51.5**	**49.6**	**BIO 9637**	
C.D. (5%)	**647**			**1.68**	**1.51**	**1.80**		
Consideration	**4908**			**86.28**	**53.01**	**51.4**		

* The entry is tentetively considered for promotin under medium maturity

List of promoted entries from 67 to 71

S.No.	ZN 1 GY	R	%	H	S	P	PEDIGREE	Remarks
1	8654	1	37.2	95.6	56.5	54.4	X8B561	*
2	8594	2	36.3	97.1	57.9	56.4	KDMH 755	*
3	8275	3	31.2	95.5	56.2	54.6	SUN VAAMAN	Promoted
4	7462	4	18.3	96.6	57.0	55.3	31Y45	*
5	7426	5	17.8	96.1	54.8	52.7	HKH-317	Promoted

6	7334	6	16.3	95.0	55.4	53.8	KNMH 4010141	Promoted
7	7195	7	14.1	93.5	55.0	53.2	FH 3513	Promoted
8	7039	8	11.6	96.6	57.1	55.6	REH 2009-12	*
9	6985	9	10.8	93.9	55.9	53.7	EHL 162508 (Hyb)	Promoted
16C	**6306**	**14**	**-**	**91.9**	**54.3**	**52.7**	**JH 3459**	
C.D. (5%)	**919**			**2.96**	**2.01**	**2.07**		
Consideration	**7225**			**94.86**	**56.31**	**54.77**		

* The entry is tentetively considered for promotin under medium maturity

List of promoted entries from 67 to 71

S.No.	ZN 2 GY	R	%	H	S	P	PEDIGREE	Remark
1	7179	1	23.1	88.0	54.2	52.3	31Y45	Promoted
2	6978	2	19.6	86.8	53.8	51.6	X8F984	Promoted
3	6905	3	18.4	89.3	56.3	54.1	X8B561	*
4	6534	4	12	88.5	55.4	53.0	KDMH 755	Promoted
16C	**5833**	**9**	**-**	**87.3**	**53.0**	**51.0**	**JH 3459**	
C.D. (5%)	**829**			**1.68**	**2.05**	**1.96**		
Consideration	**6662**			**88.98**	**55.05**	**52.96**		

S.No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	6305	1	19.5	90.1	55.4	51.9	REH 2009-12	Promoted
2	5972	2	13.2	89.3	54.9	51.7	EHL 162508 (Hyb)	Promoted
3	5935	3	12.5	90.5	56.3	53.3	KDMH 755	*
4	5874	4	11.3	88.9	55.3	52.4	31Y45	Promoted
5	5830	5	10.5	91.1	56.1	52.5	X8B561	*
16C	**5276**	**10**	**-**	**85.6**	**52.3**	**49.7**	**JH 3459**	
C.D. (5%)	**770**			**3.42**	**2.28**	**2.24**		
Consideration	**6046**			**89.02**	**54.58**	**51.94**		

S.No.	ZN 4 GY	R	%	H	S	P	PEDIGREE	Remark
1	7296	1	25.1	89.4	54.0	51.8	EHL 162508 (Hyb)	Promoted
2	7240	2	24.1	88.9	51.6	50.1	KNMH 4010141	Promoted
3	7059	3	21	88.5	51.6	50.0	SUN VAAMAN	Promoted
4	6923	4	18.7	90.4	53.8	52.2	REH 2009-12	*
5	6827	5	17	91.0	54.2	52.6	X8B561	*

6	6822	6	16.9	91.1	55.0	53.5	KDMH 755	*
7	6562	7	12.5	89.1	51.9	50.1	FH 3513	Promoted
8	6459	8	10.7	90.0	53.3	51.7	X8F984	*
15C	**5835**	**14**	**-**	**86.9**	**50.3**	**49.0**	**Prakash**	
C.D. (5%)	**893**			**1.68**	**1.32**	**1.25**		
Consideration	**6728**			**88.58**	**51.62**	**50.25**		

S.No.	**ZN 5 GY**	**R**	**%**	**H**	**S**	**P**	**PEDIGREE**	**Remark**
1	5536	1	23.5	79.9	49.4	47.0	EHL 162508 (Hyb)	Promoted
2	5260	2	17.4	78.8	48.4	46.2	FH 3513	Promoted
3	5126	3	14.4	81.7	50.0	48.3	X8B561	Promoted
4	5003	4	11.6	82.1	50.7	48.4	REH 2009-12	Promoted
5	4987	5	11.3	81.7	49.9	48.7	31Y45	Promoted
16C	**4482**	**11**	**-**	**80.1**	**48.5**	**46.5**	**JH 3459**	
C.D. (5%)	**603**			**1.62**	**1.32**	**1.71**		
Consideration	**5085**			**81.72**	**49.82**	**48.21**		

* The entry is considered for promotion under medium maturity

List of promoted entries from 68 to 72

S.No,	ZN 1 GY	R	%	H	S	P	PEDIGREE	Remarks
1	8240	2	39.6	90.1	52	50	FH 3525	Promoted
2	8124	3	37.6	87.9	50.5	48.8	KH-9888	Promoted
3	7374	5	24.9	87.9	49.5	47.8	FH 3510	Promoted
4C	**5904**	**8**	**-**	**87.2**	**49.3**	**47.1**	**Vivek Hybrid 9**	
C.D. (5%)	**1278**			**4.13**	**2.66**	**2.63**		
Consideration	**7182**			**91.33**	**51.96**	**49.73**		

S.No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	5053	1	42.9	81.2	49.3	46.2	KH-9888	Promoted
2	4428	4	25.3	86.4	48.5	48.3	FH 3525	Promoted
3	4081	6	15.4	83.5	48	44.7	FH 3510	Promoted
4C	**3535**	**7**	**-**	**83.1**	**48.3**	**45.8**	**Vivek Hybrid 9**	
C.D. (5%)	**608**			**2.68**	**3.32**	**2.03**		
Consideration	**4143**			**85.78**	**51.62**	**47.83**		

None of the entries were promoted under QPM trial and No trials were there under baby corn

List of promoted entries from in PC

S.No.	ZN 1 GY	R	%	H	S	P	PEDIGREE	Remarks
1	3929	4	33.4	96.1	56.2	53.9	BPCH6 (POP CORN)	Promoted
2	3763	5	27.8	94.2	54.5	52.9	HKIPCS X WPII	Promoted
3	3680	6	25	94.5	55.1	52.6	BPCH27(POP CORN)	Promoted
5C	**2944**	**8**	**-**	**93.8**	**54.3**	**52.2**	**VL Amber Popcorn**	
C.D. (5%)	**1154**			**3.46**	**2.02**	**2.13**		
Consideration	**4098**			**97.26**	**56.32**	**54.33**		

S.No.	ZN 3 GY	R	%	H	S	P	PEDIGREE	Remark
1	3305	4	21.8	85.3	53.1	49.1	BPCH27(POP CORN)	Promoted
2	3159	5	16.4	85.3	52.0	48.5	HKIPCS X WPII	Promoted
3	3048	6	12.3	86.5	53.4	49.7	BPCH6 (POP CORN)	Promoted
5C	**2714**	**7**	**-**	**83.4**	**50.3**	**46.9**	**VL Amber Popcorn**	
C.D. (5%)	**552**			**2.88**	**2.46**	**2.47**		
Consideration	**3266**			**86.28**	**52.76**	**49.37**		

S.No.	ZN 5 GY	R	%	H	S	P	PEDIGREE	Remark
1	2430	4	15.6	83.4	53.8	51.2	BPCH27(POP CORN)	Promoted
5C	**2102**	**7**	**-**	**81.9**	**52.6**	**49.7**	**VL Amber Popcorn**	
C.D. (5%)	**606**			**2.02**	**1.88**	**1.49**		
Consideration	**2708**			**83.92**	**54.48**	**51.19**		

List of promoted entries from in SC

S.No.	ZN 1 GY	R	%	F	S	P	PEDIGREE	Remarks
1	11123	1	76.75		56.3	54.4	NSCH-12 Sweet corn (Misthi)	Promoted
2	9111	2	44.78		54.8	53.1	BSCH-59	Promoted
3	8040	3	27.76		56.1	53.5	SCST X CUBA 379	Promoted
4	7709	4	22.50		54.7	52.3	BSCH-63	Promoted
6C	**6293**	**5**			**53.1**	**50.8**	**Madhuri**	
C.D. (5%)	**3891**				**2.38**	**1.46**		
Consideration	**10184.37**				**55.48**	**52.26**		

S.No.	ZN 2 GY	R	%	F	S	P	PEDIGREE	Remark
1	14074	1	46.15		57.7	55.6	BSCH-59	Promoted
2	13370	2	38.84		61.9	59.8	NSCH-12 Sweet corn (Misthi)	Promoted
3	11704	3	21.54		62.0	59.2	SCST X CUBA 379	Promoted
6C	**9630**	**4**			**57.9**	**55.6**	**Madhuri**	
C.D. (5%)	**3034**				**2.51**	**2.68**		
Consideration	**12664.47**				**60.41**	**58.28**		

S.No.	ZN 3 GY	R	%	DHOL	FODDER	S	PEDIGREE	Remark
1	11701	1	25.04	6388.9	55.6	52.1	NSCH-12 Sweet corn (Misthi)	Promoted
6C	**9358**	**2**		**3972.2**	**52.3**	**48.7**	**Madhuri**	
C.D. (5%)	**4665**			**1017.56**	**2.18**	**1.75**		
Consideration	**14023.46**				**54.48**	**50.45**		

S.No.	ZN 4 GY	R	%	KOLH	FODDER	S	PEDIGREE	Remark
1	16754	1	40.80	11388.9	55.1	53.7	NSCH-12 Sweet corn (Misthi)	Promoted
2	15359	2	29.08	10833.3	54.1	52.4	BSCH-59	Promoted
3	13597	3	14.27	8333.3	52.4	50.5	BSCH-63	Promoted
6C	**11899**	**4**		**10000.0**	**50.8**	**48.7**	**Madhuri**	
C.D. (5%)	**2691**			**2783.05**	**1.63**	**2.57**		
Consideration	**14590.33**				**52.43**	**51.27**		

S.No.	ZN 5 GY UDAI	R	%	GODH	FODDER	S	PEDIGREE	Remark
1	10833	1	11.62	2083.3	54.4	52.4	BSCH-59	Promoted
2	10642	2	9.65	2777.8	55.3	53.7	NSCH-12 Sweet corn (Misthi)	Promoted
7C	**9705**	**3**		**1388.9**	**52.3**	**50.2**	**Priya**	
C.D. (5%)	**815**			**1369.94**	**1.63**	**1.60**		
Consideration	**10520**				**54**	**52**		

Annexure II

Status of Breeder Seed Production during *kharif* 2011

S.No	Hybrids/ varieties	Centre	Breeder Seed allocated (q)	Breeder Seed produced (q)	Surplus (+) Deficit (-)	Remarks
1	DKC7074R (MCH-35)	Pvt.	0.1			
2	NAH-2049	Mandya	0.42			Information Awaited
3	Pratap kanchan-2	Udaipur	13			May, 2012
4	Pratap Makka Chari-6		5			May, 2012
5	HQPM-7(HKI-161)	Karnal	0.01	0.01		
6	(HKI-193-1)	Karnal	0.01	0.01		
7	Vivek QPM-9 (FQH-4567)	Almora	0.15			
8	Vivek Shankul Makka-31 (VL-103)	Almora	6	6		
9	HM-8 (HKI-1105)	Karnal	0.15	0.15		
10	HQPM-1	Karnal	0.2	0.2		
11	HQPM-5	Karnal	0.2	0.2		
12	Vivek Maize Hybrid-23 (FH-3529)	Almora	0.05	0.02		
13	PMH-2 (JH-3851)	Ludhiana	0.2			Hybrids
14	Pratap Makka-5 (EC-3126)	Udaipur	10			May, 2012
15	Shaktiman-3	Dholi	0.1			Information Awaited
16	Azad kamal (R 9803)	Kanpur	0.2			Information Awaited
17	Buland (JH-6805)	Ludhiana	2			Hybrids
18	Pratap Makka-3	Udaipur	0.8			May, 2012
19	Pratap Makka-3	Udaipur	4			May, 2012
20	Pusa Composite-3	Delhi	3.27	3.5	0.23	
21	Pusa Composite-4	Delhi	0.2	0.2		
22	Jawahar Makka-216	Chhindwara	36.4			Information Awaited
23	Pratap Hybrid Maize-1	Udaipur	3			May, 2012
24	PEEHM-5	Delhi	0.15	0.15		
25	Shaktiman-2	Delhi	0.01	0.01		
26	Gujarat Makai-6	Godhra	0.5	10.5		
27	Jawahar Makai-216	Chhindwara	34.4			Information Awaited
28	NAC-6002	Mandya	0.1	0.5	0.4	

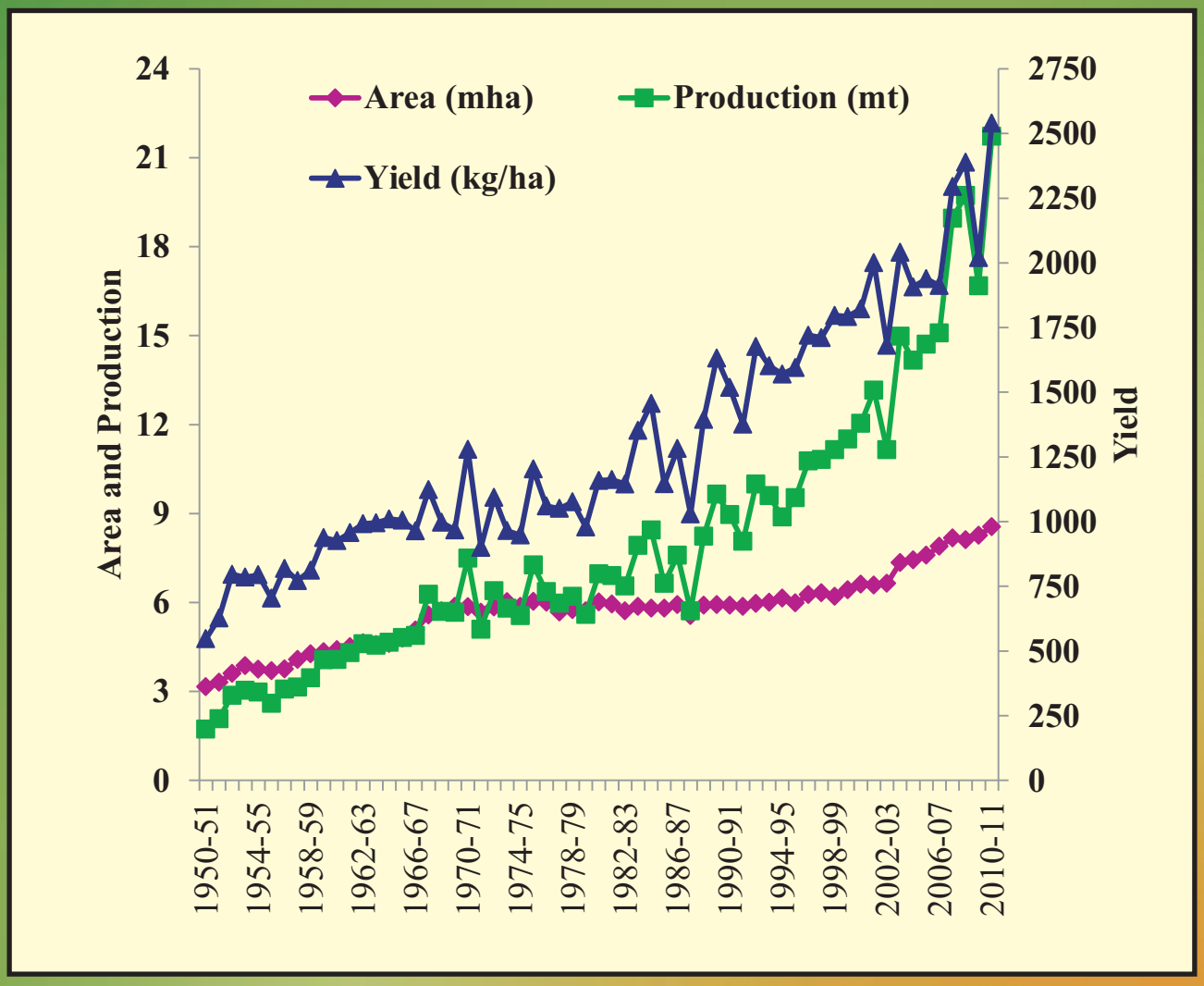
contd ...

29	Narmada Moti	Godhra	0.2	6.6	6.4	
30	Priya Sweetcorn	Hyderabad	0.18			Not produced
31	Amar	Pantnagar	0.7	2	1.3	
32	Aravali Makka-1	Udaipur	6			May, 2012
33	JKMH-175	Pvt.	0.1			
34	Kohinoor	Pvt.	0.1			
35	NAC-6004	Mandya	2.6	2	-0.6	
36	SeedTech-2324	Pvt.	0.1			
37	Shaktiman-1	Dholi	0.25			Information Awaited
38	Vivek Maize Hybrid-9	Almora	0.05	0.5		
39	Gaurav	Pantnagar	3	10	7	
40	Jawahar Composite Makka- 12	Chhindwara	1			Information Awaited
41	Birsa Makkai-2	Ranchi	0.3			June, 2012
42	C-8	Srinagar	3	5	2	
43	Dewaki Composite Makka	Dholi	0.3			Information Awaited
44	Mahi Dhawal	Banswara	0.08			Jun, 2012
45	J-1006	Ludhiana	17.75			Information Awaited
46	Mahi Kanchan	Banswara	0.1			Jun, 2012
47	Azad Uttam	Kanpur	0.5			Information Awaited
48	Trishulata	Hyderabad	0.5			Hybrid
49	Surya	Pantnagar	0.5	0.08	-0.42	
50	Kanchan	Pantnagar	6.5	2.7	-3.8	
51	NLD White		1.2			Information Awaited
52	African Tall	Kolhapur	52.12			Information Awaited
53	Navjot	Ludhiana	1	2	1	
54	Navin	Pantnagar	0.05			Spring 2012
55	Sonari (Shweta)	Pantnagar	0.5			Spring 2012
56	C-6	Srinagar	3	0.5	-2.5	
57	Composite-15	Srinagar	3	5.5	2.5	
58	Vijay Composite Makka	Ludhiana	0.7	2.9	2.2	
59	Early Composite	Bajaura	0.05	2.9	2.85	
60	Ganga Safed-2 CM-400	Pantnagar	0.12			Spring 2012
61	Ganga Safed-2 CM-300	Pantnagar	0.04			Spring 2012
62	Ganga Safed-2 CM-600	Pantnagar	0.04			Spring 2012
63	HM-8 Female	Karnal	0.08	0.08		
64	HM-8 Male	Karnal	0.15	0.15		

contd ...

65	HQPM-1 (Female)	Karnal	0.05	0.05	
66	HQPM-1 (Male)	Karnal	0.15	0.15	
67	HQPM-5 (Female)	Karnal	0.05	0.05	
68	HQPM-5 (Male)	Karnal	0.15	0.15	
69	HQPM-1 (HKI-163R)	Karnal	0.01	3.5	
70	PEHM-2	Delhi	0.2	0.2	
71	PEHM-2 CM-137A	Delhi	2	2	
72	PEHM-2 CM-137B	Delhi	1	1	
73	PEHM-2 CM-138R	Delhi	1	1	
74	Pratap Hybrid Maize-1 Female	Udaipur	2		May, 2012
75	Pratap Hybrid Maize-1 Male	Udaipur	1		May, 2012
76	PEHM-2 Female	Delhi	2.4	2.4	
77	PEHM-2 Male	Delhi	1.5	1.5	
78	PEEHM-5 Female	Delhi	0.15	0.15	
79	PEEHM-5 Male	Delhi	0.05	0.05	
80	Shaktiman-2 CML-186R	Dholi	1.5		Information Awaited
81	Vivek Maize Hybrid-23 Female	Almora	0.05	0.45	
82	Vivek Maize Hybrid-23 Male	Almora	0.1		
83	Vivek-9 CM-212A	Almora	0.1		
84	Vivek-9 CM-212B	Almora	0.05	0.5	
85	Vivek-9 POP-31-C-4HSR	Almora	0.15		
	Total		**240.14**	**77.51**	

NOTE



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