Research and Development Efforts on Hybrids of Diploid Cotton in Mahyco, India

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ABSTRACT

India is an important cotton growing country with the largest area under cotton in the world. India is also considered the birth place of the two diploid cotton species G. arboreum and G. herbaceum, known as Desi cottons. Since these species are highly resistant to pests and diseases, tolerant to drought, fit for rainfed cultivation in low rainfall and poor soil areas and possess high structural uniformity of the fiber, the advantage of exploiting the diploid inter and intra specific heterosis was considered .The present paper deals with the R & D efforts carried out in Mahyco to augment the yields in diploid cottons coupled with improvement in fiber properties and production technology.

Introduction

Maharashtra Hybrid Seeds Company Ltd, ("MAHYCO") was one of the few organizations that ushered the Green Revolution in India, 34 years ago. Mahyco has a research centre recognized by the Department of Science and Technology, Govt of India. Today Mahyco is involved in Research, Production and Marketing about 300 products covering 35 different crops. The reason for commencing research in genetics was that in view of the colossal population, there was need for efficient use of India's limited resources of cultivable land and water and also man made fertilizers and pesticides.

India is the only country to grow hybrid cotton on a commercial scale since the seventies. With 65 percent of cotton grown under rainfed condition and diploid cottons withstand moisture stress better, efforts were made to develop hybrids between two diploid species, *G. arboreum* and *G. herbaceum*

New World cotton hybrids proved to be high yielding but very susceptible to diseases and pests. Most of the hybrids in cotton so far have been tetraploids, paving the way for the development of a large pesticide industry. Tetraploid cotton hybrids got patronage largely from above average cultivators. Since diploid cottons occupy about 35 percent of India's cotton area and have a high degree of resistance to diseases, insects and drought with wider adaptability, the development of diploid hybrids would be valuable if heterosis in yield is coupled with fiber quality. Diploid cotton hybrids have a high yield, medium fiber quality and low care requirement.

Some of the cotton hybrids identified in the study were also tested in All India Co-ordinated Cotton Improvement Project.

Achievements

Efforts on the development of diploid cotton hybrids began in 1986. Both, inter as well as intraspecies diploid cotton hybrids were tested for yield, fiber characters and reaction to major pests and diseases of cotton. A major breakthrough was achieved when the first diploid cotton hybrid MDCH-201 was identified and subsequently released by Central Seeds Release Committee in the year 1992 for cultivation in the states of Maharashtra, Madhya Pradesh, Gujrat and Rajasthan. This was the first diploid cotton hybrid to be released by a Private Seed Organization in India. Some of its salient features are:

- MDCH-201 is a conventional interspecific (*G.herbaceum* and *G. arboreum*) hybrid.
- Four years AICCIP trial data indicate superiority of MDCH-201 over check hybrids DH-9 by 31.03%
- Higher ginning outturn (34.1%) resulted in 48.3% more lint yield/ha.
- MDCH-201 is highly resistant to Bacterial blight, *Alternaria* leaf spot, moderately resistant to grey mildew and tolerant to *Fusarium* wilt and root rot
- Performs well under water stress conditions.

Seed Production

The area under diploid hybrids has not spread to the expected extent, despite the fact that diploid hybrids need low care and less inputs. Delicate flower biology and poor boll setting are impediments to seed production. Experience suggest that flower buds of old world cotton suffer more damage from emasculation than new world cotton, leading to a low retention rate of crossed flowers and low availability but high cost of seed. Research into male sterility systems has intensified to eliminate the labour intensive emasculation and pollination processes.

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Acceptance for commercial cultivation and spread of hybrids requires efficient hybrid seed production technology. Efforts in the breeding programme were concentrated on developing efficient seed production technology. A genetic male sterility system was developed and transferred in both *G. arboreum* and *G. herbaceum* backgrounds. This has helped in resolving production problems to great extent but seed producing farmers had to rogue out 50% of the plant population after bud formation. MDCH-212 was the first diploid cotton hybrid based on male sterility that can be easily produced by farmers.

With the launching of MDCH-212, the seed production technology improved as it eliminated tedious emasculation process and made it profitable by reducing the labour costs down in seed production although boll size remained a limitation (below 2 gms cotton per boll). This was overcome by incorporating big boll size (around 4 gms) parents in back-crossing programme, leading to a big bolled female parent.

MDCH-222 was the first diploid cotton hybrid based on genetic male sterility with a boll size of 3.2 gms. It was tested for two years in All India Co-ordinated Cotton Improvement Project Trials and the data is summarized as table 4. It has great potential for yield with wide adaptability and gave an encouraging performance in these trials.

Future

Diploid cotton hybrids are of comparative recent origin. Extensive training of seed producing farmers is necessary in order to achieve optimum yields. Fiber properties in general and fiber length and fineness in particular need much improvement.

Biotechnological approaches to identify genotypes at an early stage of plant growth will help in organizing research programmes.

Table 1. Performance of MDCH-201 in AICCIP trials.

Year of Testing		No of Trials	Mean yield (Q/ha)			
			MDCH-201	Check I DH-7	Check II DH-9	Check III Local Variety
First	1988-89	7	17.22	15.87	14.76	9.80
Second	1989-90	8	19.39	14.68	16.03	13.68
Third	1990-91	8	14.64	8.83	9.93	7.58
Fourth	1991-92	8	17.34	-	11.63	-
Mean			17.14		13.08	
			Percentage Increase or decrease over the checks			
First	1988-89	-	-	8.50	16.66	75.71
Second	1989-90	-	-	32.08	20.96	41.73
Third	1990-91	-	-	65.79	47.43	93.13
Fourth	1991-92	-	-	-	49.09	-
Mean		-	-	30.64	31.03	65.60

Table 2. Lint yield/ha of MDCH-201 in all India cotton improvement project trials.

Year	MDCH-201	DH-7	DH-9	Local Variety
1988-89	603	540	443	363
1989-90	696	527	494	482
1990-91	432	290	278	256
1991-92	615	-	368	-
Mean	586	452	395	367
Year	% Increase over MDHC 201			
		DH-7	DH-9	Local Variety
1988-89		11.66	36.11	66.11
1989-90		32.06	40.89	44.39
1990-91		48.96	55.39	68.75
1991-92		-	67.11	
Mean		29.64	48.35	59.67

Table 3. Quality characteristics.

Quality Characteristics	Years	MDCH-201	Check-1 DH-7	Check-2 DH-9	Check-3 Local variety
Ginning outturn					
	1988-89	35.6	34.7	30.7	37.6
	1989-90	35.9	35.9	30.8	35.2
	1990-91	29.5	32.8	28.0	33.7
	1991-92	35.5	-	31.7	-
	Mean	34.1	34.4	30.3	35.5
Mean Fiber Length (mm)					
	1988-89	22.0	22.4	26.6	22.6
	1989-90	21.1	22.0	27.5	21.7
	1990-91	21.4	21.6	26.9	22.9
	Mean	21.5	22.0	27.0	22.4
Fiber- micronaire					
	1988-89	5.6	6.5	4.7	4.7
	1989-90	5.4	5.7	4.7	-
	1990-91	4.9	6.1	4.3	4.4
	Mean	5.3	6.1	4.5	4.5
Fiber Strength (g/tex)					
	1988-89	48.2	51.8	48.7	52.6
	1989-90	51.9	50.7	51.5	-
	1990-91	48.8	47.9	51.5	46.1
	Mean	49.6	50.1	50.5	49.3
L.U.R					
	1988-89	49	50	48	51
	1989-90	49	50	47	-
	1990-91	52	52	49	51
	Mean	50	51	48	51
Maturity Coefficient					
	1988-89	.80	-	.81	.81
	1989-90	.80	.78	.80	-
	1990-91	.80	.81	.80	.74
	Mean	.80	.79	.80	.77

Table 4. Summary of MDCH-222 AICCIP.

Line	Mean S/C yield (kg/ha)				Fiber length	GOT	Lint yield
	1996-97	1997-98	Mean	% Inc	(mm)	%	kg/ha
MDCH-222	1188	1466	1327	37.9	24.1	35.0	464
AKA-8401	886	1039	962		26.5	34.9	362