

University of Agricultural Sciences, Dharwad



Use of Male sterility in Cotton and Molecular Markers for fertility Restoration in CGMS of *G.hirsutum* Cotton

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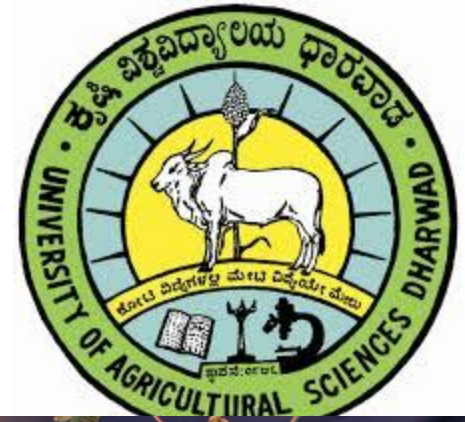
Why hybrids?



- Seed cotton yield superiority (25-100%) than better parents and commercial checks
- Blending of Traits : Interspecific hybrids-yield, fibre quality, pest tolerance, abiotic stress tolerance
- Seed industry- about Rs. 4000crores (Of the Rs 10,000 crore Indian seed market, almost 40 per cent is dominated by Bt cotton)
- 100% seed replacement
- Picked up area in India : 95% (Bt cotton....)



DHH 1062 Hybrid



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DHB 1071 Cotton hybrid



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G.Hirsutum Sahana *G.arboreum DLSa17/* *G.herbaceum DDhC11*



Defoliation due to grey mildew





Yield : 9-10 q/ha
Fibre length : 23-24 mm
GOT (%) : 31
Mic. Value : 5.0
Fibre strength : 17-18 g/tex
Counts : 20s-24s



Dharwad Desi Colour Cotton



Hybrids - History makers



- Hybrid development : 1890s..1930 (India)....1940 (commercial scale, H4,C.T. Patel)
- Varalaxmi (1970) and Jaylaxmi (1980) –B. H Katagraki



DCH32



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Cotton Hybrid seed production



- Doak method of emasculation, Hand Pollination
- Labor shortage, cost increase ..
- Rs. 200 (US\$ 3) per kilogram seed: available to farmers @350
- Almost double now (Rs. 400)-Major labor, available@950





Possibilities of Reduction of labor cost



- GMS/ CGMS application
- Cytoplasmic genetic male sterility system(Meyer 1973)
- CMS line of *G. harkensii* cytoplasm- highly **stable** and **fertility restoration** is possible
- **Suguna** was the first hybrid - genetic male sterility (Gregg male sterile) in public sector and MECH 4 in private sector.



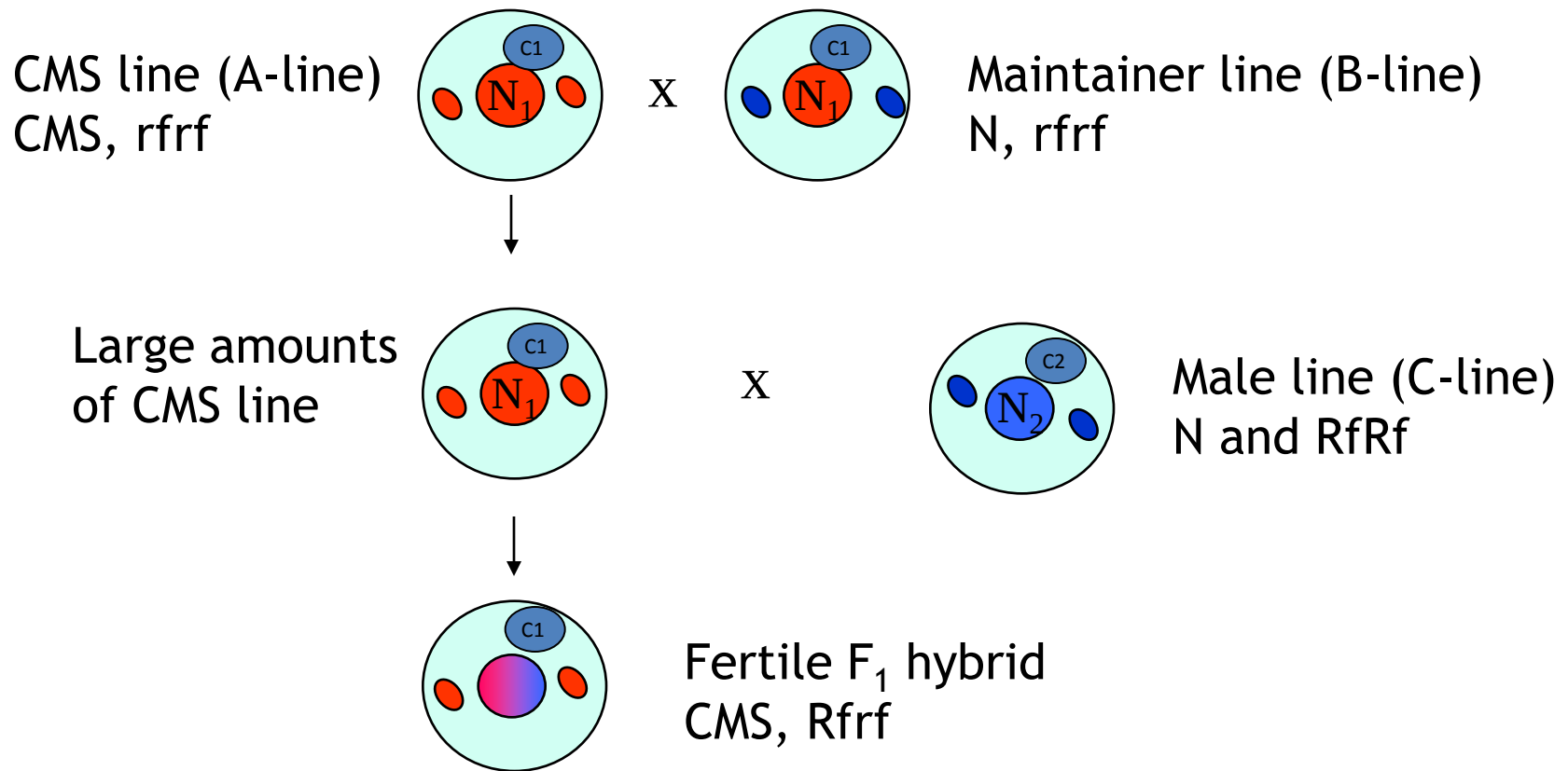
Why not picked up?



- Ill effect of sterile cytoplasm-boll size
- Restorer-maintenance, diversification
- Necessity of hand pollination
- In diversification-Molecular markers enhance breeding



CMS and Restoration





What is possible through Molecular Markers ?



- Their tight association with trait of interest
- Possible to convert diverse lines into restorers
- Maintenance of fertility restorer trait

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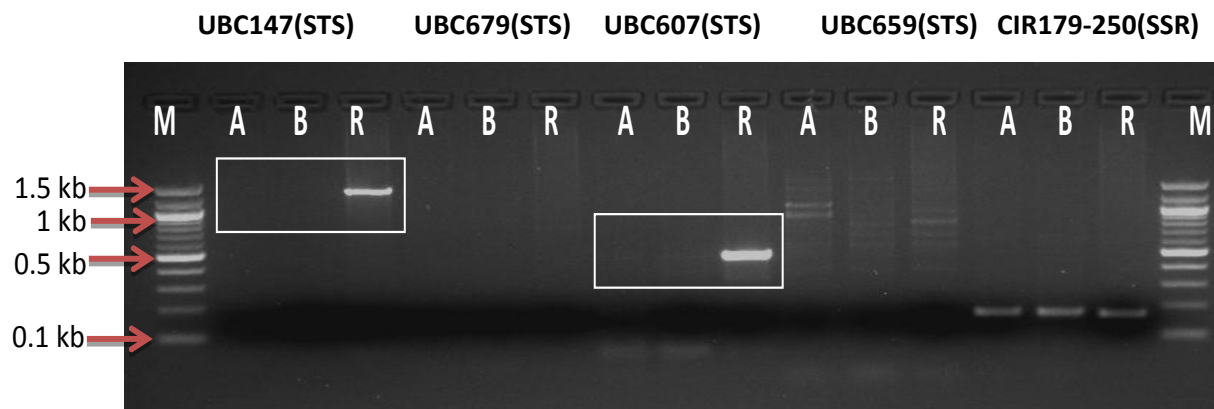
What is to report here?



- Chosen Known Markers : 10 RAPD, 7SSR, 6STS
- A ,B and R lines for confirmation
- Diverse *G.hirsutum* , *G.barbadense*,
G.herbaceum, *G.arboreum* lines, wild species
and F2 of A X R: For Validation
- Jinfa Zhang and James McD. Stewart, Identification of Molecular Markers Linked to the Fertility Restorer Genes for CMS-D8 in Cotton, *Crop sci*2004.1209 Vol. 44 No. 4, p. 1209-1217
- Chen et al Molecular mapping of genic male-sterile genes ms_{15} , ms_5 and ms_6 in tetraploid cotton Plant Breeding [Volume 128, Issue 2](#), pages 193–198, April 2009
- Feng et al STS markers linked to the Rf_1 fertility restorer gene of cotton, [Theoretical and Applied Genetics](#) January 2005, Volume 110, Issue 2, pp 237-243

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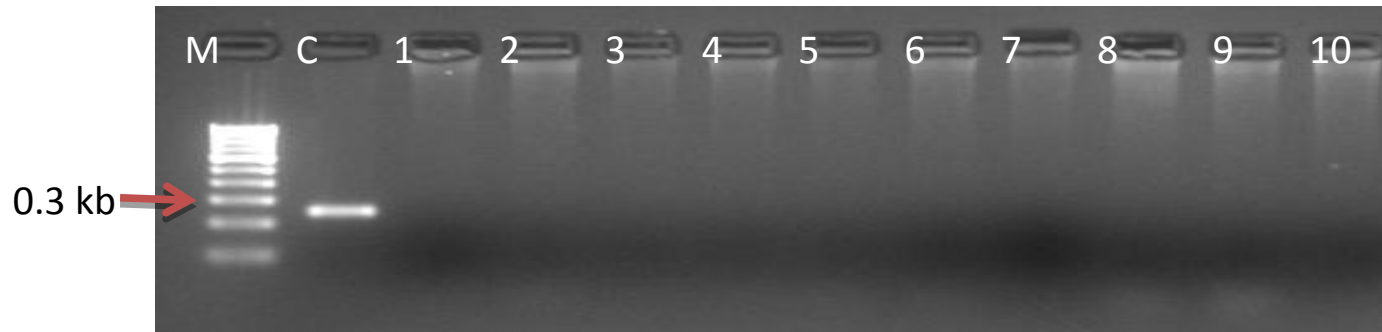
DS-28A, DS-28B and DR-7



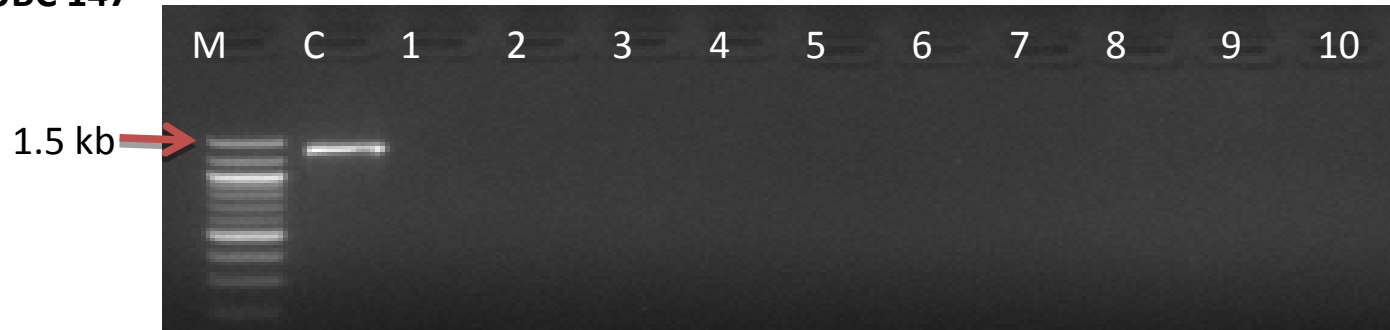
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A-lines

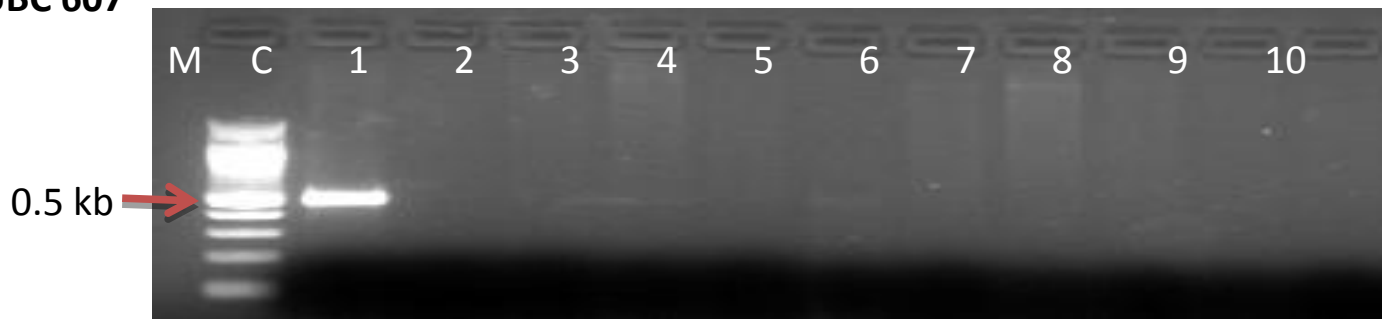
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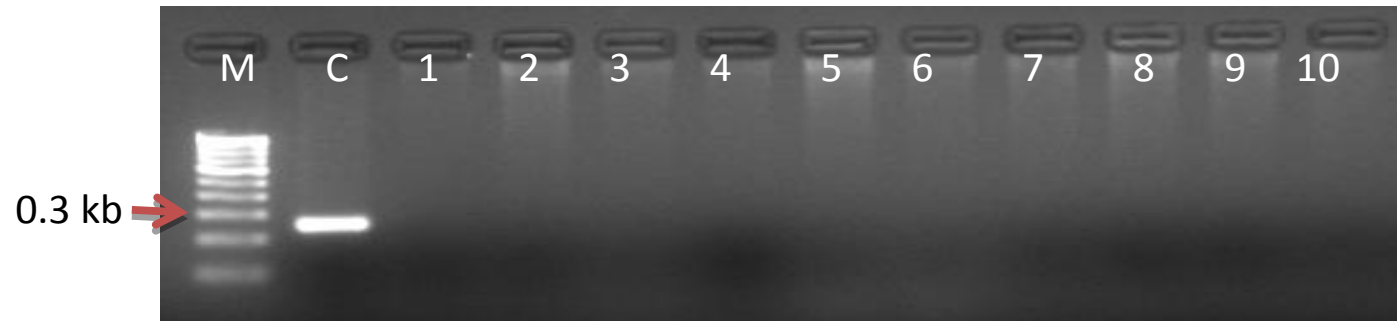


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B-lines

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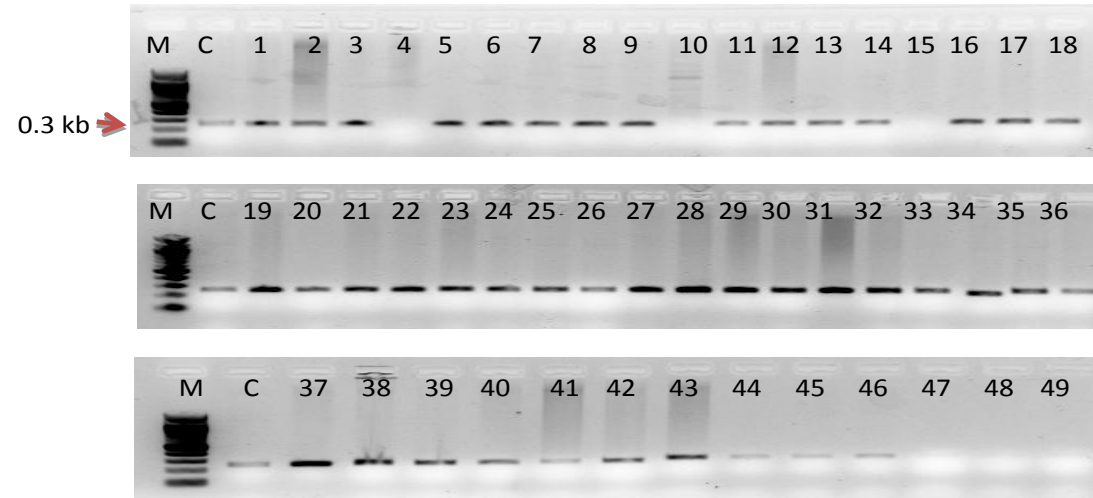


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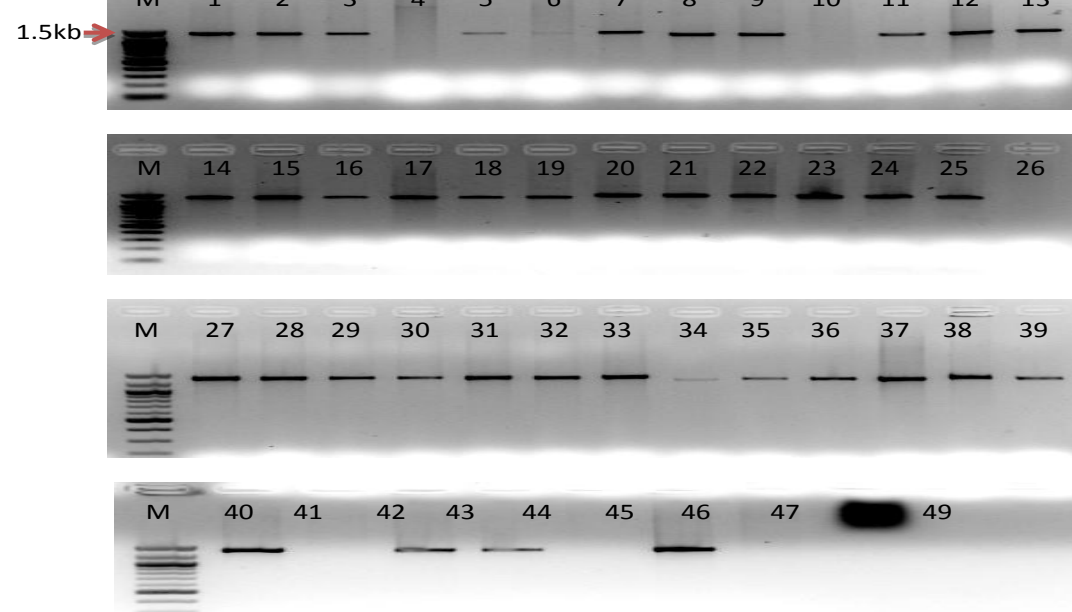


R-line

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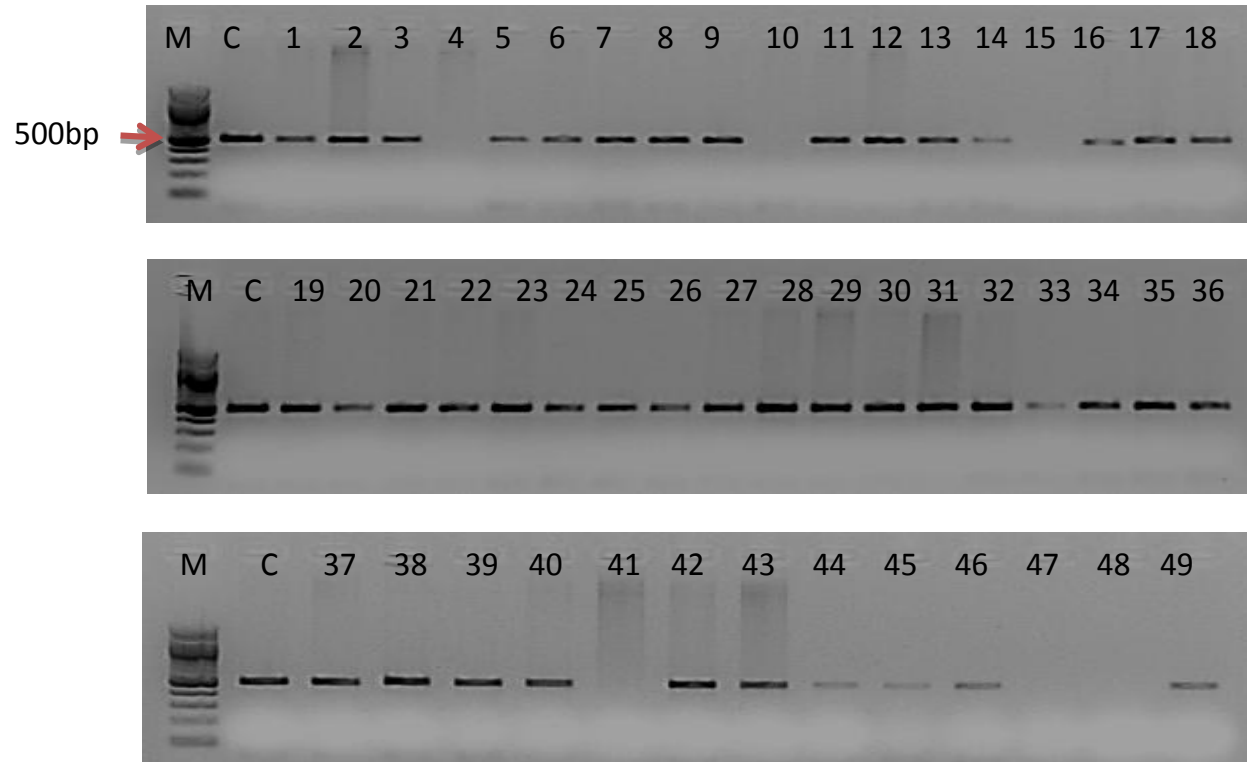


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Contd..

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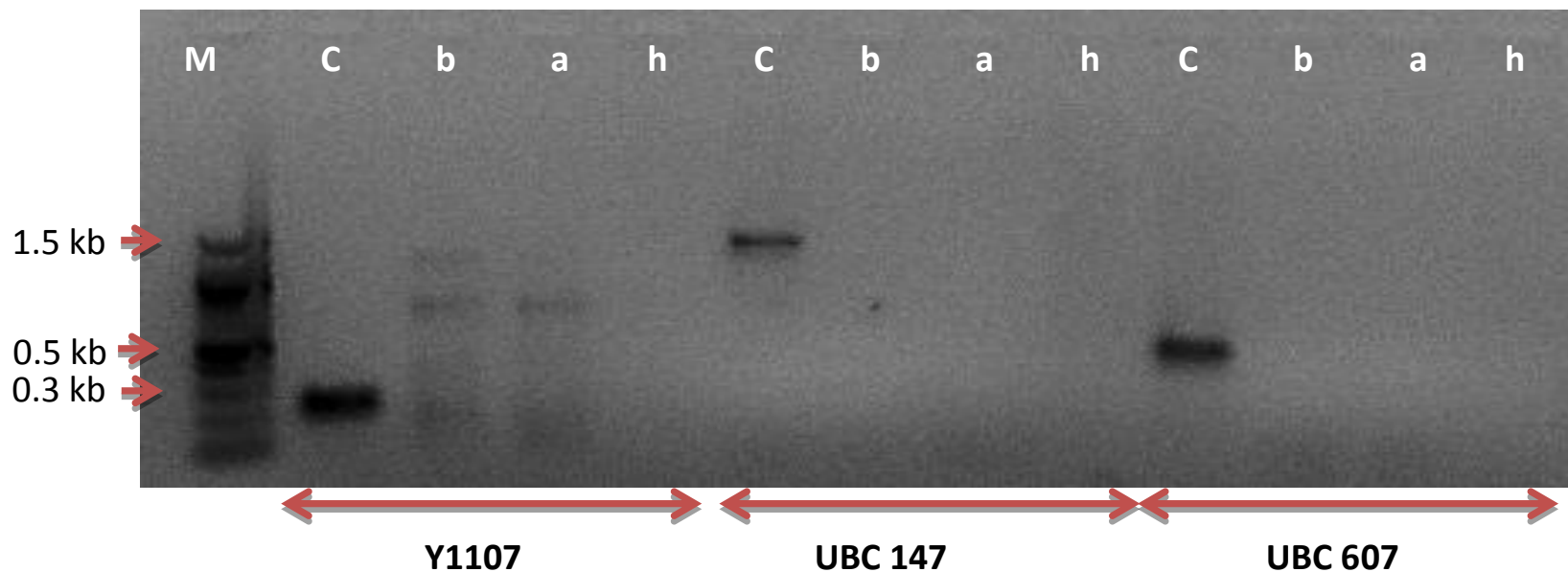


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Sl. No.	R-line	Amplification	Sl. No.	R-line	Amplification	Sl. No.	R-line	Amplification
1	DR-7-1	+	42	DR-7-42	+	83	DR-7-83	-
2	DR-7-2	+	43	DR-7-43	+	84	DR-7-84	-
3	DR-7-3	+	44	DR-7-44	+	85	DR-7-85	-
4	DR-7-4	-	45	DR-7-45	+	86	DR-7-86	-
5	DR-7-5	+	46	DR-7-46	+	87	DR-7-87	-
6	DR-7-6	+	47	DR-7-47	+	88	DR-7-88	-
7	DR-7-7	+	48	DR-7-48	+	89	DR-7-89	-
8	DR-7-8	+	49	DR-7-49	-	90	DR-7-90	-
9	DR-7-9	+	50	DR-7-50	-	91	DR-7-91	-
10	DR-7-10	-	51	DR-7-51	-	92	DR-7-92	-
11	DR-7-11	+	52	DR-7-52	-	93	DR-7-93	-
12	DR-7-12	+	53	DR-7-53	-	94	DR-7-94	-
13	DR-7-13	+	54	DR-7-54	-	95	DR-7-95	-
14	DR-7-14	-	55	DR-7-55	-	96	DR-7-96	-
15	DR-7-15	+	56	DR-7-56	-	97	DR-7-97	-
16	DR-7-16	+	57	DR-7-57	-	98	DR-7-98	-
17	DR-7-17	+	58	DR-7-58	-	99	DR-7-99	-
18	DR-7-18	+	59	DR-7-59	-	100	DR-7-100	-
19	DR-7-19	+	60	DR-7-60	-	101	DR-7-101	-
20	DR-7-20	+	61	DR-7-61	-	102	DR-7-102	-
21	DR-7-21	+	62	DR-7-62	-	103	DR-7-103	-
22	DR-7-22	+	63	DR-7-63	-	104	DR-7-104	-
23	DR-7-23	+	64	DR-7-64	-	105	DR-7-105	-
24	DR-7-24	+	65	DR-7-65	-	106	DR-7-106	-
25	DR-7-25	+	66	DR-7-66	-	107	DR-7-107	-
26	DR-7-26	+	67	DR-7-67	-	108	DR-7-108	-
27	DR-7-27	+	68	DR-7-68	-	109	DR-7-109	-
28	DR-7-28	+	69	DR-7-69	-	110	DR-7-110	-
29	DR-7-29	+	70	DR-7-70	-	111	DR-7-111	-
30	DR-7-30	+	71	DR-7-71	-	112	DR-7-112	-
31	DR-7-31	+	72	DR-7-72	-	113	DR-7-113	-
32	DR-7-32	+	73	DR-7-73	-	114	DR-7-114	-
33	DR-7-33	-	74	DR-7-74	-	115	DR-7-115	-
34	DR-7-34	-	75	DR-7-75	-	116	DR-7-116	-
35	DR-7-35	+	76	DR-7-76	+	117	DR-7-117	-
36	DR-7-36	+	77	DR-7-77	-	118	DR-7-118	-
37	DR-7-37	+	78	DR-7-78	-	119	DR-7-119	-
38	DR-7-38	+	79	DR-7-79	-	120	DR-7-120	-
39	DR-7-39	+	80	DR-7-80	-	121	DR-7-121	-
40	DR-7-40	+	81	DR-7-81	-	122	DR-7-122	-
41	DR-7-41	+	82	DR-7-82	-	123	DR-7-123	-
						124	DR-7-124	-

Cultivars of other species

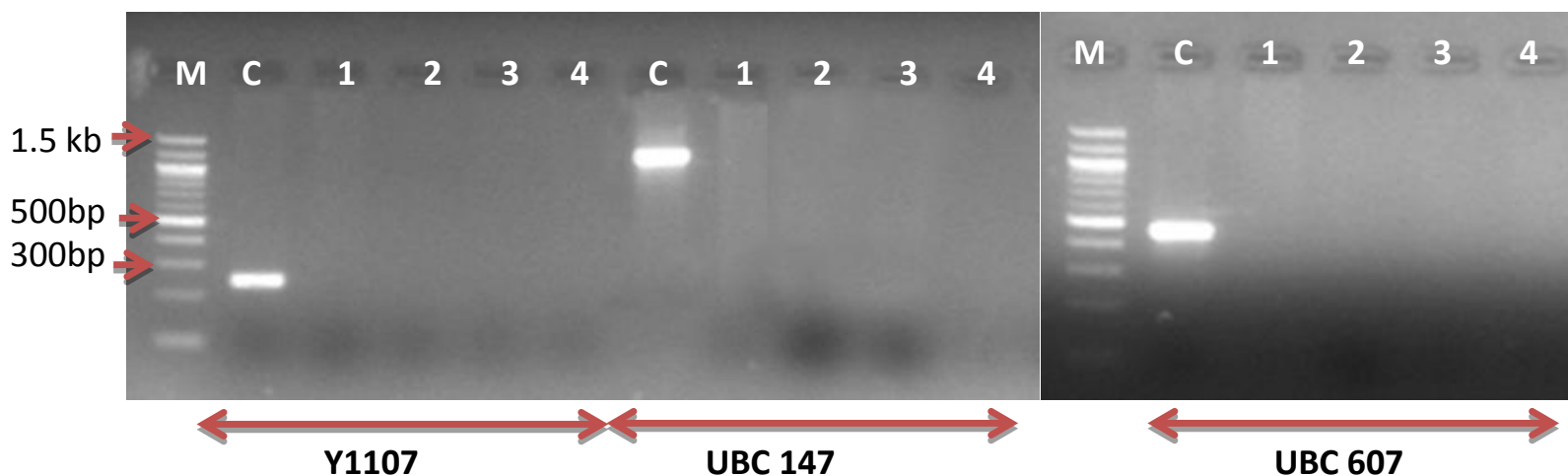
Sl no	Species	Amplification status
2	<i>Gossypium barbadense</i> , cv. SBYF 425	-
3	<i>Gossypium arboreum</i> , cv. DLSa 17	-
4	<i>Gossypium herbaceum</i> , cv. Jayadhar	-



c = control, b = *G. barbadense*, a = *G. arboreum*, h = *G. herbaceum*

Wild and crosses with wild species

Sl no	Species	Amplification
1	<i>G. herbaceum</i> L. x <i>G. anomalum</i> L.	-
2	<i>G. hirsutum</i> L. x <i>G. australe</i> F. Muell.	-
3	<i>G. raimondii</i> Ulbr.	-
4	D genome	-

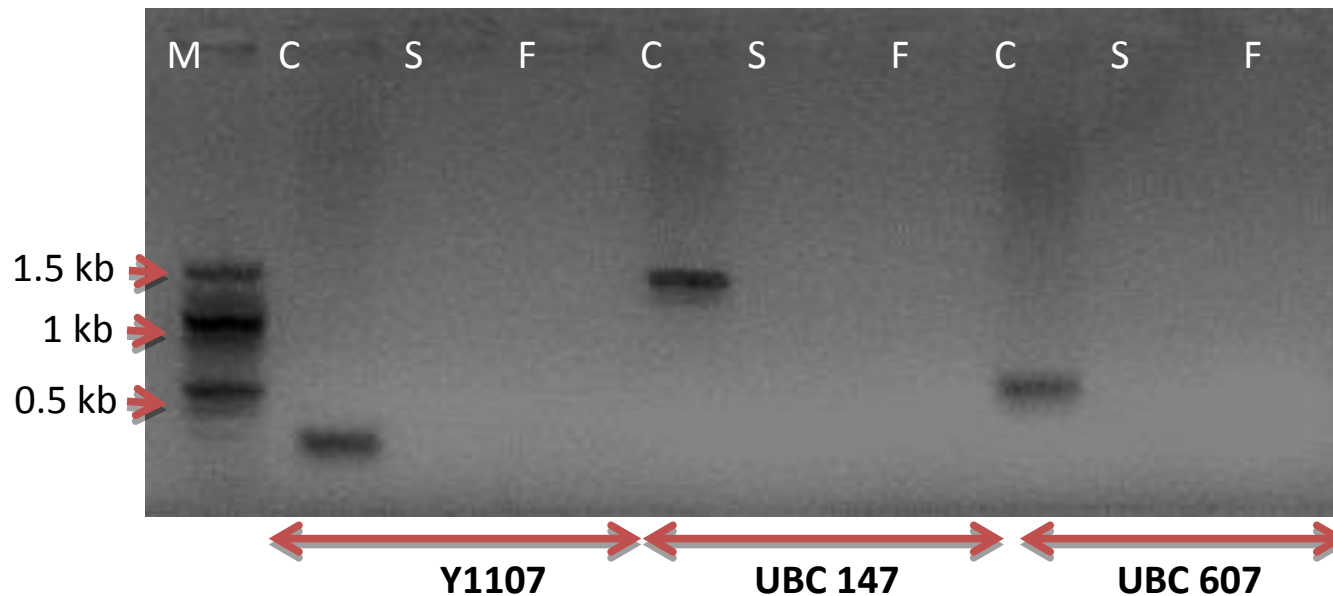


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GMS line

G. hirsutum, c v. Abadhita GMS

Sl No.	Plants	Amplification
1	Sterile plant	-
2	Fertile plant	-

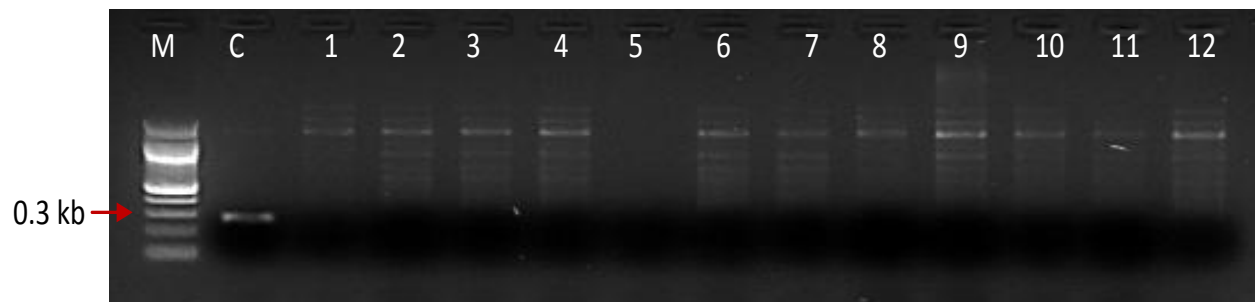


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G. hirsutum germplasm

RST-9/SGNR	CCH-1831
CPD-1011	EC560379
BN	128333 Acala 44
LH-2256	SEC-4
MCU-5	CAK-023A
HAG-1055	NO-15
141725	CPD-423
GJHV-440	EC560422
ABR-08-4/15	HS-289
HBS-110	HSB-148
CSHH-243M	20075WIR7178
CPD-429	CPD-819

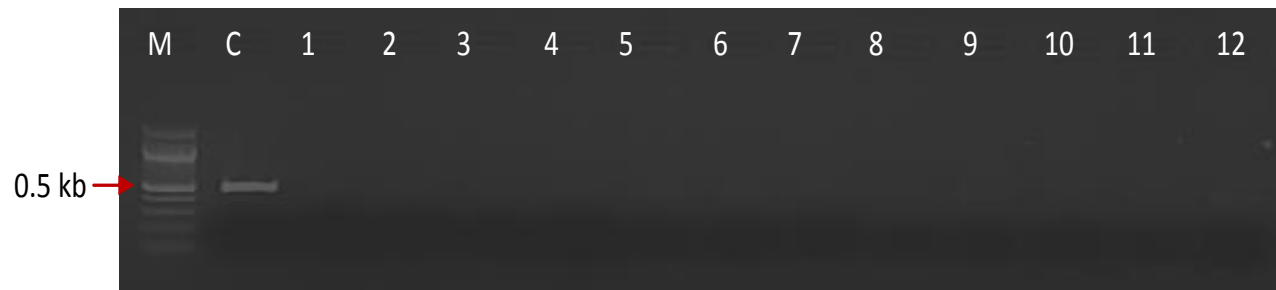
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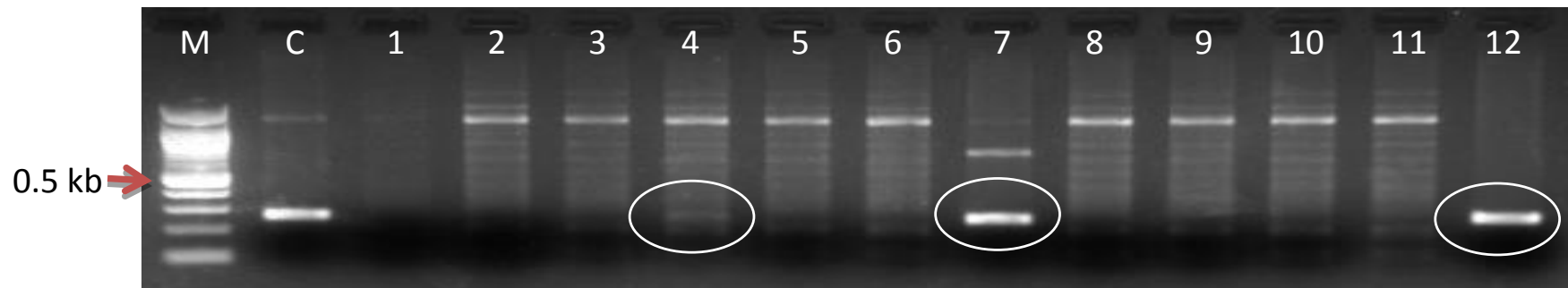
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RILs

Sl. No.	RILs	Amplification status	Sl. No.	RILs	Amplification status
1	RILs 1	-	41	RILs 48	-
2	RILs 2	-	42	RILs 49	-
3	RILs 3	-	43	RILs 50	-
4	RILs 4	-	44	RILs 51	+ ←
5	RILs 6	-	45	RILs 52	-
6	RILs 7	-	46	RILs 53	-
7	RILs 8	-	47	RILs 54	-
8	RILs 9	-	48	RILs 55	-
9	RILs 10	-	49	RILs 56	-
10	RILs 11	-	50	RILs 57	-
11	RILs 13	-	51	RILs 58	+ ←
12	RILs 15	-	52	RILs 59	-
13	RILs 16	-	53	RILs 60	-
14	RILs 18	-	54	RILs 61	-
15	RILs 19	-	55	RILs 62	-
16	RILs 20	+ ←	56	RILs 63	-
17	RILs 21	-	57	RILs 64	-
18	RILs 22	-	58	RILs 65	-
19	RILs 23	+ ←	59	RILs 66	-
20	RILs 24	-	60	RILs 67	-
21	RILs 25	-	61	RILs 68	-
22	RILs 26	-	62	RILs 69	-
23	RILs 28	-	63	RILs 70	-
24	RILs 29	+ ←	64	RILs 71	-
25	RILs 30	-	65	RILs 72	-
26	RILs 31	-	66	RILs 73	-
27	RILs 32	-	67	RILs 74	-
28	RILs 33	-	68	RILs 75	-
29	RILs 34	-	69	RILs 76	-
30	RILs 35	+ ←	70	RILs 77	-
31	RILs 37	-	71	RILs 78	-
32	RILs 38	-	72	RILs 79	-
33	RILs 39	-	73	RILs 80	-
34	RILs 40	-	74	RILs 81	-
35	RILs 41	-	75	RILs 82	-
36	RILs 42	-	76	RILs 83	-
37	RILs 43	-	77	RILs 84	-
38	RILs 45	-	78	RILs 86	-
39	RILs 46	-	79	RILs 87	-
40	RILs 47	-	80	RILs 88	-

RILs

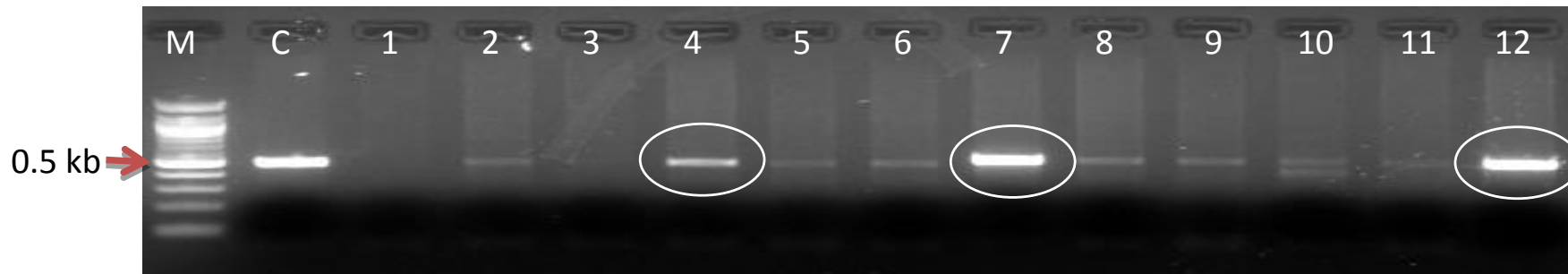
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UBC 147

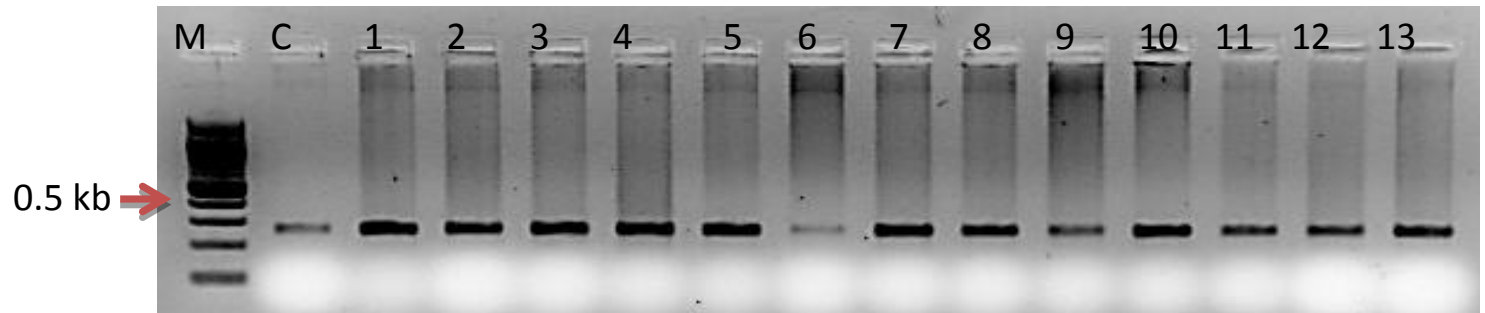


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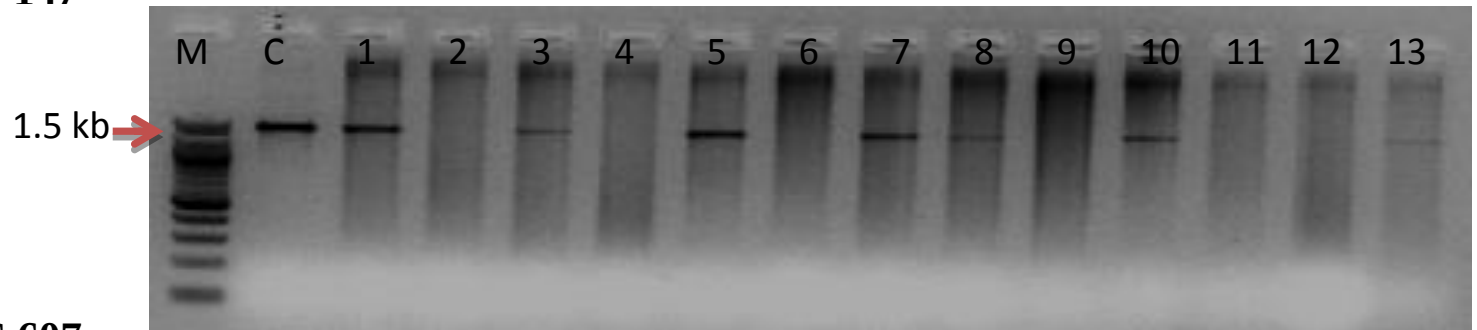


A X R

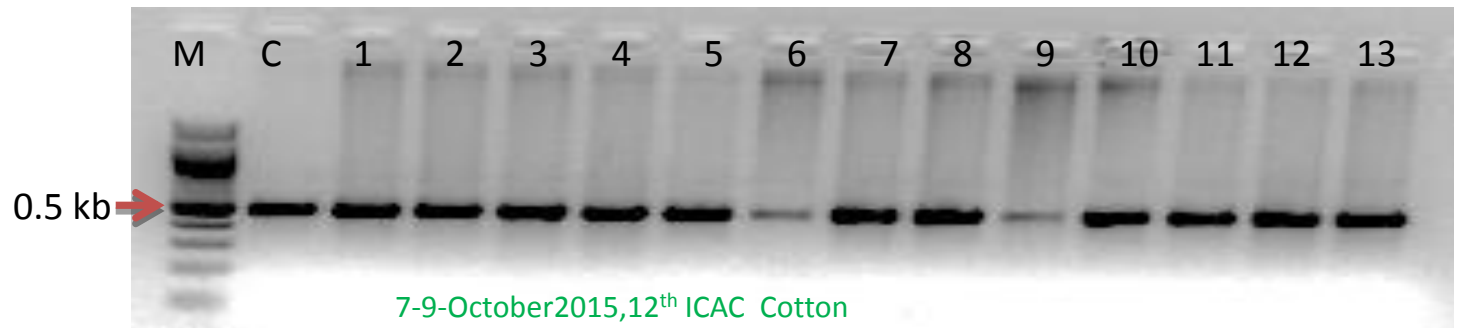
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UBC 147



UBC 607



Sl. No.	F ₁ plants	Amplification status						
		Y1107, UBC 147, UBC 607	Y1107, UBC 147	UBC 147, UBC 607	Y1107, UBC 607	Y1107	UBC 147	UBC 607
1	DRF1-7-1	+	+	+	+	+	+	+
2	DRF1-7-2	-	-	-	+	+	-	+
3	DRF1-7-3	+	+	+	+	+	+	+
4	DRF1-7-4	-	-	-	+	+	-	+
5	DRF1-7-5	+	+	+	+	+	+	+
6	DRF1-7-6	-	-	-	+	+	-	+
7	DRF1-7-7	+	+	+	+	+	+	+
8	DRF1-7-8	+	+	+	+	+	+	+
9	DRF1-7-9	-	-	-	+	+	-	+
10	DRF1-7-10	+	+	+	+	+	+	+
11	DRF1-7-11	-	-	-	+	+	-	+
12	DRF1-7-12	-	-	-	+	+	-	+
13	DRF1-7-13	+	+	+	+	+	+	+

Pollen viability in A x R

Sl. No.	F ₁ plant	No. of Fertile pollen	No. of Sterile pollen	Viability percentage
1	DRF1-7-1	254	0	100.00
2	DRF1-7-2	198	3	98.50
3	DRF1-7-3	352	3	99.15
4	DRF1-7-4	286	1	99.65
5	DRF1-7-5	311	0	100.00
6	DRF1-7-7	379	0	100.00
7	DRF1-7-8	218	1	99.54
8	DRF1-7-9	263	0	100.00
9	DRF1-7-10	223	2	99.11
10	DRF1-7-11	395	0	100.00
11	DRF1-7-12	309	1	99.67
12	DRF1-7-13	174	0	100.00

Acknowledgements

- My university for funding
- Students
- Dr.Rafiq Choudhary
- Dr.Mohamed Negm and all others

From Excellence in Plant Sciences to Value for Society



Thanks

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