1904 Utilization of introgression lines for simultaneous improvement of yield and fibre quality in upland cotton

Dr. Manjula.S Maralappanavar , University of agricultural sciences dharwad, Dharwad, India
Dr. Vikas Kulkarni , Syngenta, Pune, India
Mrs. Sumangala.S Aratti , University of agricultural sciences, Dharwad, India
Dr. B. M. Khadi , Central Institute for Cotton Research, Nagpur, India
Dr. S.S. Patil , University of Agricultural Sciences, Dharwad, Karnataka (INDIA), Dharwad, India
Mr. Narayanan K , ICAR, Dharwad, India
Dr. I.S. Katageri , Agricultural Research Station, University of Agricultural Sciences, Dharwad-580 007, DHARWAD, India

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Abstract

The Indian textile industry predominantly uses (57%) cotton as its raw material and contributes 24% to industrial production, accounting for 4% of the GDP. Increased mechanization of textile industry requires higher quality fiber and a quota free market regime emphasizes cotton profitability which depends on yield and marketability of fiber quality. Cotton breeding strategies must develop the base germplasm with potential for identifying genotypes that can produce quality cotton at competitive prices. Thirty four stabilized lines, including derivatives of introgression breeding, bred at cotton research stations located in different agro-climatic zones of India were utilized in this study for cultivar development and diversification of base material. Individual plant selections were based on yield and fiber quality in the 35 F_2 populations from the crosses using these lines. One more cycle of selection in F_3 resulted in the identification of 39 segregants which were evaluated in the F_4 in replicated trials during the year 2006-07 along with the cultivar check Sahana. Eight of the F_4 lines were superior to check for yield and all these descended from 8 different crosses involving introgressed derivatives like MSH (Multispecies hybrid), IGM (Introgressed derivative for pest resistance), IS (Introgressed Selection) for stress tolerance. Also segregants for superiority for other triats like boll weight (8), GOT % (5), lint index (9), fibre length (16) and tenacity (16) were identified. The study resulted in the development of diverse base material and producing a few lines with improved yield and fiber quality.

Keywords: Cotton, Fiber quality, Introgression breeding,

India has the distinction of growing all the four cultivated cotton species and also is a major producer and consumer of world cotton. Indian textile industry predominantly uses (57%) cotton as its raw material and contributes 24% to industrial production accounting for 4% of the GDP (Sreenivasan 2004). While the textile industry requires quality cotton, the quota free market regime necessities high productivity. Cotton breeding strategies to develop the base material for identifying productive improved quality genotypes are very crucial for the sustainability of quality cotton production at competitive prices. Cotton, like many crops such as cereals, is experiencing yield stagnation and breeding programs have only made modest increases in yield. Although Bt. technology has helped to harness the yield potential of the commercial genotypes there is an immediate need to initiate programs to increase genetic diversity to enable selection for improved yield and quality. Cultivars of the species

Gossypium hirsutum accounts for at least 90% of cotton production, but the species as a whole is still regarded as relatively low in genetic variation. Introgression of novel genetic variation by breeding with the secondary and tertiary gene pool (of *Gossypium*), though time consuming, is worth pursuing for its possibility of introducing desirable traits into cultivated species (Meyer 1973; Khadi et. al., 2003; Gotmare and Singh, 2004).

Interspecific hybridization involving wild species and cultivated cotton has historically improved cotton yield and other desirable traits. In India introgression programs are being conducted at various cotton research centres. A project under Technology Mission on Cotton in India involving 16 co-operating centers was initiated with the purpose of supporting introgression breeding programs in all cultivated cotton species and to identify superior genotypes for yield and fiber quality.

MATERIALS AND METHODS

A total of 34 stabilized lines bred at different co-operating centers located in different cotton growing zones of India were used for the study. These lines included derivatives from introgression breeding (Table 1). Based on the data of each of these lines a total of 35 crosses were made among selected lines to combine desirable traits. The cultivar Abadhita is a well adapted cultivar at this research station and grown locally by farmers. Therefore this cultivar was most frequently selected as a female parent in crosses. A minimum of 110 F_2 plants of each cross were established during the year 2004-05. The F_2 plants of 35 crosses were sown in 5 rows of 22 plants and individual plants were selected in the field considering the plant type, stress resistance and yield potential in different population based on morphological observations. The yield data was based on the seed cotton yield per plant in grams. The boll size was the average weight of one boll based on weight of twenty completely open bolls. The first selection kept a total of 66 plants which were further tested for fiber quality parameters. The fiber quality was tested at the Regional Quality Evaluation Unit of CIRCOT (ICAR) at Dharwad using HVI. Fifty two plants remained based on the fiber quality report especially 2.5% span length and fiber strength and were advanced to the F_3 generation as plant to progeny rows and also in the F_3 individual plants were selected for yield and fiber quality. During 2006-07 season a total of 39 F_3 plants were advanced to the F_4 generation for replicated trials along with the commercial cultivar Sahana. The trial was conducted in two replications of four lines of each entry in each of the two replications. The average of the yield(in Kilogram) of each genotype in two replications was converted to yield per hectare.

RESULTS AND DISCUSSION

Only 31 of 35 crosses yielded desirable individual plants and sixty-six selected plants (Table 2) were evaluated for quality parameters. Only fifty F_2 plants, from 27 original crosses, were advanced to F_3 generation based on individual plant yield and quality (Table 3). Nine F_2 selections had more than 100 g per plant yield and 24 had tenacity value greater than or equal to 22 g tex^{-1} (Table 3).

The plant in progeny rows in F_3 generation were again subjected to individual plant selections (data not shown) and during the year 2006-07, 39 F_3 selections were evaluated in F_4 replicated trial along with the check cultivar Sahana. Eight of the F_4 lines were superior to check for yield. These eight have descended from 8 different crosses involving introgressed derivatives like MSH (Multispecies hybrid), IGM (Introgressed derivative for pest resistance), IS (Introgressed selection for stress tolerance). Also segregates for superiority for other traits like boll weight (8), GOT % (5), lint index (9), fiber length (16) and tenacity (16) were identified (Fig. 1). The study resulted in the development of diverse base material. Among the 8 genotypes superior for yield potential the segregant from cross LR 5166 x MSH 345 which ranked first (1991 $kgha^{-1}$) also has higher boll weight (4.4 g), 2.5% span length of 28.8 mm and tenacity of 22.9 $gtex^{-1}$. The segregant from IS 376/4/2-19 x RS-2013 IPS 1 (1873 $kgha^{-1}$) had superior fiber length (27.6 mm) and strength (22.4 $gtex^{-1}$). IS 376/4/2-19 is an introgressed line of diploid species with lower thick palisade layer in the leaf confirmed to be tolerant to sucking pest (Ansingkar et. al., 2004). Possibility for the simultaneous improvements in yield and yarn strength was also shown in crosses between PD 3249 and SC-1 (Green and Culp, 1990). Their breeding program historically practiced introgression from several species into *G. hirsutum* germplasm. Also two entries Abadhita x TCH-6 IPS-2 and AH-131 x IGM-4 IPS-2 were superior for quality along with yield while the other 4 superior entries were on par with the check. Thus these entries can be evaluated under multi-location trials for cultivar releases in India. Earlier also cultivars like B-1007, Badnawar-1, Khandwa-2, SRT-1, Arogya in *G.hirsutum* and Vinayak in *G. arboreum* have been developed using introgression stocks (Gotmare and Singh, 2004; Despande 2004). The stabilized segregants for other desirable traits can be further evaluated for specific traits (diseased resistance and pest tolerance) than those identified in this study and used in hybrid development programs.

We also observed that for some traits evaluated for in the three generations F_2 to F_4 there was an increase in values for the trait in question in some of the segregants in F_4 generation relative to that in F_2 generation (data not shown). This increase may be due to breakup of unfavorable linkages for desired trait (Green and Culp 1990). Thus this study resulted in progress towards development of cotton lines with increased yield and quality as well as broadening the germplasm base for development of cotton cultivars.

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Table 1: Genotypes used for the study

Parents	Source	Remarks
MSH-345	Nagpur	Derivative of multispecies hybrid
MSH-SP-G1	Nagpur	Derivative of multispecies hybrid
MSH P-53	Nagpur	Derivative of multispecies hybrid
Rai derivative	Nagpur	*Hirsutum x raimondi* derivative
IV-2	Nagpur	*Hirsutum x raimondi* derivative
AKH-2053	Akola	Stabilized productive lines
AKN-2031	Akola	Stabilized productive lines
AKH-131	Akola	Stabilized productive lines
CWROK-165	Lam(AP)	Entries selected for pest resistance
HD-219/98	Lam(AP)	Entries selected for pest resistance
LK-861	Lam(AP)	Entries selected for pest resistance
L-604	Lam(AP)	Entries selected for pest resistance
IGM-4	Lam(AP)	From introgression breeding
IGM-27	Lam(AP)	From introgression breeding
IGM-100	Lam(AP)	From introgression breeding
IGM-119	Lam(AP)	From introgression breeding
IGM-42	Lam(AP)	From introgression breeding
IGM-102	Lam(AP)	From introgression breeding
TCH-1	Coimbatore	Big boll size and high span length
TCH-2	Coimbatore	Big boll size and high span length
TCH-3	Coimbatore	Big boll size and high span length
TCH-6	Coimbatore	Big boll size and high span length
Surat-3	Surat	productive entries
Surat-4	Surat	productive entries
Surat-5	Surat	productive entries
IS 376/4/2-19	Nanded	introgressed selection for stress tolerance
IS 376/4/2-9	Nanded	introgressed selection for stress tolerance
RS-875	Rajastan	Leaf curl virus resistant genotype
RS-2013	Rajastan	Leaf curl virus resistant genotype
NA-1325	Gujrat	Leaf curl virus resistant genotype
Abadhita	Dharwad	Released Genotype
Anjali	Coimbatore	Released Genotype
LRA-5166	Lam	Released Genotype

Table 2: Screening of F_2 population for effecting Individual Plant Selections (IPS)

Sl. No.	Entry	SCY (g/plot)	Boll wt (g)	No. of IPS
1	Abadhita x MSH 345	6491	4.5	3
2	Abadhita x AKH 2053	5110	3.8	1
3	Abadhita x TCH-6	5015	4.5	2
4	Abadhita x IV-2	4870	3.5	2
5	Abadhita x TCH-2	4601	4.3	1
6	Abadhita x Surat-5	4541	4.3	3
7	Abadhita x IV 3	4485	3.8	-
8	Abadhita x Surat-4	4413	4.4	4
9	Abadhita x TCH-1	4376	4.3	1
10	Abadhita x Surat-3	4177	4.5	1
11	IS 376/4/2-19 X RS-2013	4119	3.4	3
12	Abadhita x AKN 2031	4016	3.7	3
13	AH 131 x IGM-4	3991	3.5	2
14	Abadhita x MSH-SP-G_1	3887	4.0	-
15	IS 376/4/2-9 X RS-875	3842	3.7	3
16	Abadhita x MSHP-53	3821	4.1	2
17	Abadhita x TCH-3	3811	4.6	1
18	Abadhita x Rai	3657	4.4	3
19	IS 376/4/2-19 X RS-875	3460	3.6	4
20	IS 376/4/2-9 X RS-2013	3424	2.7	3
21	IGM 102 x NA 1325	3308	2.8	4
22	IGM 100 x CWROK 165	3126	3.0	2
23	IS 376/2-15 X RS-875	2821	3.7	2
24	IS 376/4/2-19 X RS-875	2738	3.7	1
25	HD-219/98 x RS 875	2624	2.9	3
26	LK 861 x IGM-4	2386	2.8	2
27	IGM 100 x NA 1325	2088	3.3	1
28	RAC 9544 x IGM 119	1882	3.4	3
29	IGM 100 x L 604	1861	3.0	2
30	LK 861 x IGM-4	1739	3.1	3
31	IGM 100 x L 604	1302	3.2	1
32	LRA 5166 x IGM-42	895	2.8	-
33	Anjali x IGM-42	795	3.0	-
34	LRA 5166 x MSH-345	725	4.6	1
35	LRA 5166 x IGM-27	579	3.8	2

Table 3: Yield and fiber quality of Individual Plant Selections (IPS)

Sl. No.	Entry	SCY (g/plant)	2.5%SL (mm)	Micronaire value	Maturity Ratio	Tenacity (g/t)	Elongation %
1	Abadhita x MSH 345 IPS-1	59	22.7	4.8	0.8	19.4	6.8
2	Abadhita x MSH 345 IPS-2	70	28.7	3.7	0.7	23.9	6.4
3	Abadhita x AKH 2053	51	27.2	4.3	0.75	21.3	6.7
4	Abadhita x TCH-6 IPS-1	42	24.7	3.4	0.68	22.4	6.2
5	Abadhita x TCH-6 IPS-2	62	27.8	3.8	0.69	22	6.1
6	Abadhita x IV-2	64	25.9	4.7	0.78	21.3	6.6
7	Abadhita x TCH-2	64	28.8	3.9	0.70	24.1	5.5
8	Abadhita x Surat-5 IPS-1	45	25.1	5.0	0.81	22.1	6.3
9	Abadhita x Surat-5 IPS-2	75	27.0	4.4	0.76	23.4	6.1
10	Abadhita x Surat-4 IPS-1	118	27.6	3.5	0.67	22.9	6.4
11	Abadhita x Surat-4 IPS-2	59	27.6	3.4	0.67	22.0	6.1
12	Abadhita x Surat-4 IPS-3	74	24.9	4.4	0.75	19.4	6.8
13	Abadhita x TCH-1	36	26.8	4.4	0.75	21.4	6.8
14	IS 376/4/2-19 X RS-2013 IPS-1	55	23.2	4.4	0.75	19.4	6.8
15	IS 376/4/2-19 XRS-2013 IPS-2	71	23.2	4.2	0.74	19.6	7.0
16	Abadhita x AKN 2031 IPS-1	47	28.4	3.7	0.69	23.9	6.0
17	Abadhita x AKN 2031 IPS-2	72	26.2	4.0	0.73	22.6	6.4
18	AH 131 x IGM-4 IPS 1	60	25.3	4.2	0.73	20.2	6.6
19	AH 131 x IGM-4 IPS 2	61	26.2	4.5	0.76	21.1	6.4
20	IS 376/4/2-9 X RS-875 IPS-1	83	23.4	3.7	0.69	20.7	6.6
21	IS 376/4/2-9 X RS-875 IPS-2	101	22.5	3.6	0.68	20.9	6.5
22	Abadhita x MSHP-53 IPS-1	68	25.6	4.2	0.74	20.5	6.7
23	Abadhita x MSHP-53 IPS-2	104	27.7	4.5	0.77	22.1	6.4
24	Abadhita x *Rai* derivative IPS-1	56	25.8	4.2	0.73	23.7	5.2
25	Abadhita x *Rai* derivative IPS-2	36	28.2	4.4	0.74	22.9	6.1
26	IS 376/4/2-19 X RS-875 IPS-1	81	24.6	4.1	0.73	21.5	6.1
27	IS 376/4/2-19 X RS-875 IPS-2	69	24.1	4.2	0.76	20.6	6.9
28	IS 376/4/2-9 X RS-2013 IPS-1	72	23.9	4.3	0.75	20.7	6.9
29	IS 376/4/2-9 X RS-2013 IPS-1	87	22.9	4.5	0.77	20.3	6.4
30	IS 376/4/2-9 X RS-2013 IPS-1	62	22.2	3.9	0.72	20.3	6.2
31	IGM 102 x NA 1325 IPS 1	178	23.6	3.7	0.69	20.8	7.0
32	IGM 102 x NA 1325 IPS 2	157	24.8	3.4	0.67	21.1	7.0
33	IGM 102 x NA 1325 IPS 3	102	24.7	3.8	0.69	21.1	6.8
34	IGM 100 x CWROK 165 IPS1	76	27.2	3.7	0.69	22.2	6.5

35	**IGM 100 x CWROK 165 IPS2**	**54**	**24.9**	**4.8**	**0.78**	**20.8**	**6.2**
36	**IS 376/2-15 X RS-875 1**	**58**	**24.8**	**4.3**	**0.76**	**20.4**	**6.8**
37	**IS 376/4/2-19 X RS-875**	**74**	**25.8**	**3.7**	**0.7**	**22.3**	**6.2**
38	**HD-219/98 x PA 304 IPS 1**	**66**	**20.8**	**6.0**	**0.89**	**17.4**	**6.6**
39	**HD-219/98 x PA 304 IPS 2**	**59**	**22.5**	**5.6**	**0.85**	**20.0**	**6.4**
40	**LK 861 x IGM-4 IPS 1**	**75**	**24.1**	**5.7**	**0.89**	**19.3**	**6.5**
41	**LK 861 x IGM-4 IPS 2**	**60**	**22.3**	**5.3**	**0.87**	**18.2**	**6.6**
42	**IGM 100 x NA 1325 IPS-1**	**84**	**25.1**	**4.4**	**0.74**	**20.9**	**6.4**
43	**IGM 100 x NA 1325 IPS-1**	**72**	**26.3**	**4.3**	**0.74**	**23.3**	**6.0**
44	**RAC 9544 x IGM 119 IPS 1**	**104**	**24**	**3.7**	**0.67**	**23.2**	**5.9**
45	**RAC 9544 x IGM 119 IPS 2**	**60**	**24.8**	**4.3**	**0.72**	**21.9**	**6.3**
46	**RAC 9544 x IGM 119 IPS 3**	**86**	**27**	**3.3**	**0.65**	**23.0**	**6.4**
47	**IGM 100 (*Hir* x *rai*) x L 604**	**56**	**26**	**3.5**	**0.68**	**22.2**	**6.8**
48	**LK861 x IGM-4(AKH-2053)**	**61**	**25.6**	**4.3**	**0.72**	**23.4**	**6.3**
49	**IGM 100 x L 604 IPS 1**	**72**	**26.6**	**3.2**	**0.64**	**22.0**	**6.0**
50	**LRA 5166 x MSH-345**	**126**	**28.3**	**3.3**	**0.65**	**24.4**	**6.0**
51	**LRA 5166 x IGM-27 IPS-1**	**103**	**27.2**	**4.5**	**0.75**	**22.9**	**6.2**
52	**LRA 5166 x IGM-27 IPS-2**	**88**	**29.9**	**3.3**	**0.64**	**25.4**	**5.9**
	MEAN	**75**	**25.4**	**4.1**	**0.73**	**21.60**	**6.4**
	RANGE	**36-178**	**20.8-29.9**	**3.2-6**	**0.64-0.89**	**17.4-25.4**	**5.2-7.0**

Table 4: Performance of stabilized segregants (F_4) in replicated trial during 2006-07

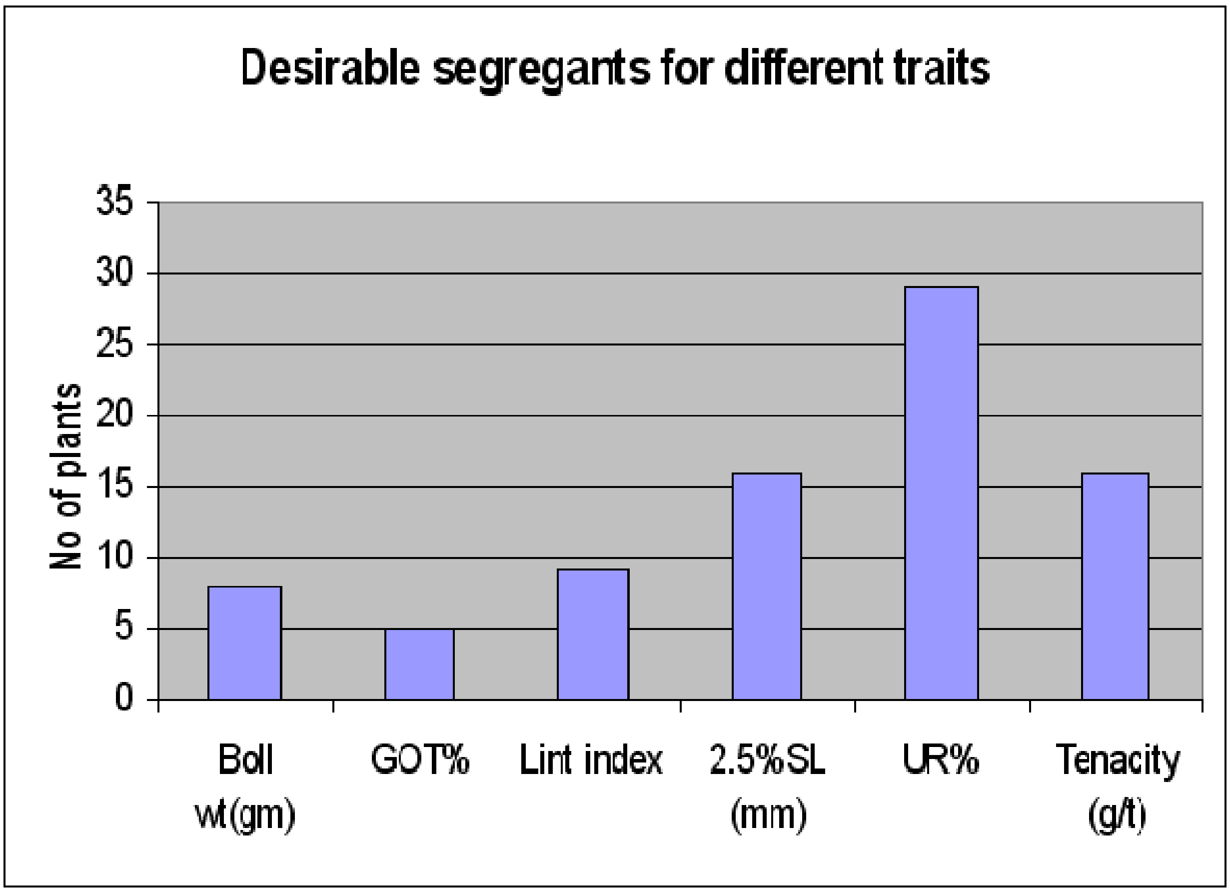
Sl.No.	Entry	SCY (kg/ha)	Boll Wt(g)	seed index	GOT (%)	Lint Index
1	**LRA 5166 x MSH-345**	**1991**	**4.4**	**9**	**35**	**4.91**
2	**Abadhita x TCH-2**	**1948**	**4.7**	**9**	**36**	**5.13**
3	**Abadhita x Surat-5 P2**	**1884**	**4.2**	**9**	**37**	**5.29**
4	**IS 376/4/2-19 X RS-2013 IPS 1**	**1874**	**3.7**	**9**	**38**	**5.52**
5	**AH 131 x IGM-4 IPS 2**	**1845**	**4**	**8**	**39**	**5.18**
6	**Abadhita x TCH-6 IPS2**	**1793**	**3.6**	**8**	**37**	**4.62**
7	**HD-219/98 x RS 875 IPS 1**	**1773**	**3.9**	**8**	**39**	**5.11**
8	**RAC 9544 x IGM 119 IPS 1**	**1765**	**3.6**	**9**	**38**	**5.59**
9	**Sahana ©**	**1722**	**4.1**	**8**	**38**	**5.1**
10	**Abadhita x AKH 2053**	**1656**	**4**	**8**	**37**	**4.76**
11	**Abadhita x IV-2**	**1653**	**3.7**	**8**	**38**	**4.82**
12	**HD-219/98 x RS 875 IPS 2**	**1632**	**4.5**	**10**	**36**	**5.63**
13	**Abadhita x MSH 345 IPS1**	**1625**	**3.8**	**10**	**34**	**5.08**
14	**Abadhita x MSH 345 IPS3**	**1602**	**4.3**	**10**	**36**	**5.63**

15	Abadhita x Rai IPS 1	1601	4	8	38	4.82
16	Abadhita x Surat-4 IPS3	1505	3.7	9	38	5.59
17	Abadhita x Surat-4 IPS2	1486	4.1	9	37	5.29
18	Abadhita x Surat-4 IPS1	1451	3.9	8	39	5.03
19	Abadhita x TCH-1	1432	3.7	9	39	5.66
20	Abadhita x MSN 345 P2	1395	4.8	9	32	4.16
21	Abadhita x TCH-6 IPS1	1391	3.9	9	35	4.78
22	Abadhita x TCH-2	1374	3.8	8	39	5.03
23	LK 861 x IGM-4 IPS 2	1372	3.1	8	36	4.5
24	Abadhita x MSHP-53 IPS 1	1331	4.1	9	40	6
25	Abadhita x MSH 345 IPS2	1217	3.7	9	36	5.13
26	IS 376/4/2-9 X RS-875 IPS 1	1215	3.5	9	35	4.91
27	Abadhita x Surat-4 IPS4	1207	4.2	8	39	5.11
28	IGM 102 x NA 1325 IPS 2	1153	3.7	7	36	3.99
29	Abadhita x MSHP-53 IPS 2	1131	3.4	8	37	4.7
30	Abadhita x TCH 3	1128	3.7	8	35	4.31
31	Abadhita x Rai IPS 2	1102	4.1	8	34	4.18
32	Abadhita x Rai IPS 3	1101	3.9	9	37	5.2
33	Anjali x IGM-42 P2	1050	3.4	8	35	4.25
34	Abadhita x AKH 2031 IPS2	1025	3.3	10	36	5.63
35	Abadhita x Surat-5 IPS 1	1025	3.5	8	34	4.12
36	IS 376/4/2-9 X RS-875 IPS 3	1023	2.9	7	32	3.34
37	IGM 102 x NA 1325 IPS 1	1013	3.1	7	38	4.22
38	LRA 5166 x IGM-27 P2	968	3.9	8	33	3.96
39	LRA 5166 x IGM 42	936	3.2	8	33	3.96
40	LRA 5166 x IGM-27 P1	894	3.2	7	31	3.2
	MEAN	1410	3.8	8	36	4.82
	CV	13.9				
	CD	439.7				

Table 5: Fiber quality of stabilized segregants (F_4) evaluated during 2006-07

Sl. No.	Entry	2.5%SL (mm)	UR%	Micronaire Value	Maturity Ratio	Tenacity (g/t)	Elongation %
1	LRA 5166 x MSH-345	28.8	47	3.9	0.74	22.9	6
2	Abadhita x TCH-2	26.5	49	4.2	0.77	20.6	5.9
3	Abadhita x Surat-5 P2	26.4	50	4.4	0.81	22	6.2
4	IS 376/4/2-19 X RS-2013 IPS 1	27.6	50	4.0	0.74	22.4	5.5
5	AH 131 x IGM-4 IPS 2	26.8	50	4.1	0.78	21.2	5.8
6	Abadhita x TCH-6 IPS2	27.6	47	4.0	0.75	20.8	5.8
7	HD-219/98 x RS 875 IPS 1	25.7	47	4.1	0.77	18.7	5.4

8	**RAC 9544 x IGM 119 IPS 1**	**26.6**	**49**	**4.0**	**0.74**	**20.7**	**5.4**
9	**Sahana ©**	**27.1**	**47**	**4.1**	**0.77**	**20.6**	**5.7**
10	**Abadhita x AKH 2053**	**26.6**	**48**	**4.0**	**0.76**	**21.2**	**5.5**
11	**Abadhita x IV-2**	**24.1**	**49**	**4.5**	**0.79**	**18.4**	**5.4**
12	**HD-219/98 x RS 875 IPS 2**	**27.8**	**47**	**3.9**	**0.77**	**21.3**	**5.6**
13	**Abadhita x MSH 345 IPS1**	**27.4**	**46**	**4.1**	**0.77**	**19.7**	**5.5**
14	**Abadhita x MSH 345 IPS3**	**26.7**	**47**	**4.2**	**0.76**	**20.6**	**5.6**
15	**Abadhita x Rai IPS 1**	**28.1**	**47**	**4.1**	**0.76**	**20.5**	**5.4**
16	**Abadhita x Surat-4 IPS3**	**27.0**	**50**	**3.8**	**0.74**	**21.9**	**5.4**
17	**Abadhita x Surat-4 IPS2**	**27.6**	**48**	**4.1**	**0.77**	**21.6**	**5.9**
18	**Abadhita x Surat-4 IPS1**	**26.1**	**48**	**4.0**	**0.74**	**19.5**	**5.2**
19	**Abadhita x TCH-1**	**27.2**	**48**	**4.0**	**0.75**	**19.3**	**5.3**
20	**Abadhita x MSN 345 P2**	**24.7**	**51**	**4.1**	**0.79**	**23.2**	**5.7**
21	**Abadhita x TCH-6 IPS1**	**26.2**	**47**	**3.6**	**0.73**	**20.8**	**5.2**
22	**Abadhita x TCH-2**	**27.0**	**48**	**3.6**	**0.72**	**19.4**	**5.5**
23	**LK 861 x IGM-4 IPS 2**	**26.1**	**49**	**4.1**	**0.74**	**21.5**	**5.7**
24	**Abadhita x MSHP-53 IPS 1**	**25.0**	**50**	**4.1**	**0.76**	**19.6**	**5.6**
25	**Abadhita x MSH 345 IPS2**	**26.1**	**48**	**4.2**	**0.77**	**20.2**	**5.5**
26	**IS 376/4/2-9 X RS-875 IPS 1**	**25.5**	**49**	**3.4**	**0.70**	**22.5**	**5.6**
27	**Abadhita x Surat-4 IPS4**	**27.7**	**49**	**3.9**	**0.75**	**20.3**	**5.7**
28	**IGM 102 x NA 1325 IPS 2**	**26.6**	**48**	**3.6**	**0.75**	**20.5**	**5.3**
29	**Abadhita x MSHP-53 IPS 2**	**24.4**	**49**	**4.3**	**0.79**	**18.8**	**5.3**
30	**Abadhita x TCH 3**	**28.2**	**48**	**3.7**	**0.71**	**20.6**	**5.6**
31	**Abadhita x Rai IPS 2**	**26.7**	**49**	**4.0**	**0.73**	**21.8**	**6.0**
32	**Abadhita x Rai IPS 3**	**27.2**	**49**	**4.1**	**0.76**	**21.7**	**5.4**
33	**(Anjali x IGM-42) P2**	**27.2**	**48**	**3.5**	**0.74**	**21.5**	**6.7**
34	**Abadhita x AKH 2031 IPS2**	**29.1**	**48**	**4.0**	**0.77**	**23.9**	**5.7**
35	**Abadhita x Surat-5 IPS 1**	**28.2**	**49**	**3.5**	**0.72**	**22.5**	**5.6**
36	**IS 376/4/2-9 X RS-875 IPS 3**	**23.5**	**48**	**3.5**	**0.70**	**19.8**	**5.2**
37	**IGM 102 x NA 1325 IPS 1**	**24.1**	**50**	**3.6**	**0.73**	**20.7**	**5.4**
38	**LRA 5166 x IGM-27 P2**	**27.4**	**47**	**3.7**	**0.74**	**21.7**	**5**
39	**LRA 5166 x IGM 42**	**26.4**	**47**	**3.9**	**0.77**	**19.7**	**5.8**
40	**LRA 5166 x IGM-27 P1**	**27.5**	**48**	**3.4**	**0.72**	**22.1**	**5.8**
	MEAN	**26.6**	**48.3**	**4.0**	**0.8**	**20.9**	**5.6**
	RANGE	**24.1-29.1**	**46-51**	**3-4.5**	**0.7-0.81**	**18.4-23.9**	**5.2-6.7**



Desirable segregants for different traits
No of plants
35
30
25
20
15
10
5
0
Boll wt(gm)
GOT%
Lint index
2.5%SL (mm)
UR%
Tenacity (g/t)

Fig.1

JCS