Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6301

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 1052-1058 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

NHH 250: A New High Yielding Sucking Pest Tolerant American Cotton Hybrid for Central Zone of India

Baig K. S.[1*], Deosarkar D. B.[2], Gaikwad A. R.[3] and Pandagale A. D.[4]

Cotton Research Station, Nanded 431 604, Maharashtra State, India

(Under Vasantrao Naik Marathwada Agricultural University Parbhani-431 402 (M.S)

*Corresponding Author E-mail: khizerbaig123@gmail.com

Received: 3.03.2018 | Revised: 10.04.2018 | Accepted: 16.04.2018

ABSTRACT

Cotton hybrid NHH 250 was developed by crossing female parent NH 111 with PH 1009 as a male. Newly developed hybrid, NHH 250 has given consistent performance in central zone comprising of four states viz., Maharashtra, Madhya Pradesh, Orissa and Gujarat for seed cotton yield under rainfed conditions. On an average of 07 trials conducted across Marathwada region for four years, NHH 250 recorded 74.94 and 12.54 % higher seed cotton yield over checks NHH 44 and Bunny, respectively. On an average of 10 State Multi-location hybrid trials conducted in Maharashtra state during 2008 to 2014, the hybrid NHH 250 recorded 37.44, 34.10, 50.00, 28.84 and 12.81 per cent increased seed cotton yield over checks viz., NHH 44, Bunny, PKV HY 4, PKV HY 5 and Phule 492, respectively. On an average of 17 trials conducted under AICCIP during 2010 to 2012 in central zone, the Hybrid NHH 250 recorded 23.93 and 13.33 per cent increased seed cotton yield over zonal check, Ankur 651 and Local checks, respectively. It is found tolerant against Bacterial blight, Alternaria leaf spot and Grey mildew. This hybrid is also found tolerant for sucking pests. The hybrid NHH 250 has recorded mean fibre length of 27.7 mm, fibre strength of 20.8 g/tex and micronaire of 4.1 µg / inch. The mean seed oil content of NHH 250 is 17.87 per cent. Hence, it is recommended for general cultivation under rainfed conditions of central zone.

Key words: *Cotton, NHH 250, Standard Heterosis, Seed cotton yield, Sucking pests tolerant*

INTRODUCTION

Cotton is one of the most important fibre yielding crop at global level cultivated in more than seventy countries under tropical and subtropical regions. In India, it is grown on 105 lakh hectares area with average lint productivity of 568 kg/ha[3]. Though the area under cultivation is largest, the National cotton productivity is still low as compared to the world's average. Dependence on rain by 65 per cent area, poor quality of seeds, high incidence of pests and diseases, fragmented land holdings coming in the way of application of modern production technologies for increasing average productivity of cotton in the country[12]. India is the only country in the world where all the four cultivated species (*Gossypium hirsutum, G. barbadense, G. arboreum and G. herbaceum*) and their hybrid combinations are commercially grown.

Cite this article: Baig, K.S., Deosarkar, D.B., Gaikwad, A.R. and Pandagale, A.D., NHH 250: A New High Yielding Sucking Pest Tolerant American Cotton hybrid for Central Zone of India, *Int. J. Pure App. Biosci.* **6(2):** 1052-1058 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6301

India is the pioneer country for commercial cultivation of hybrid cotton. The first *intrahirsutum* cotton hybrid, H 4 was released in India during 1971, since then area under hybrid cotton is increased gradually and at present, hybrid cotton occupies more than 95 per cent area of the total area under cotton. The genus *Gossypium* includes 50 species, four of which are cultivated, 44 are wild diploids and two are wild tetraploid[6]. In India, Exploitation of heterosis is documented very well in cotton. On an average, the interspecific hybrids (*G. hirsutum* x *G. barbadense*) have reported heterosis to the tune of 7 to 50 per cent as against 10 to 138 per cent in *intrahirsutum* hybrids, where as in case of diploid cotton, heterosis has been reported to the extent of 220 per cent (*G. herbaceum* x *G. arboreum*)[8].

In India, at present more than 500 *intrahirsutum* hybrids mostly of transgenic cotton are under cultivation, however most of them are susceptible to sucking pests and diseases. Thus, there is urgent need to have an additional *intrahirsutum* cotton hybrid having high yield coupled with tolerance to pests and diseases for rainfed tracts of central zone

MATERIAL AND METHODS

The hybrid NHH 250 (NH 111 x PH 1009) was develop by crossing NH 111 as a female and PH 1009 as male parent at Cotton Research Station, Nanded, Maharashtra, India during 2005-2007. Both the parental lines *viz*., NH 111 and PH 1009 are inbred lines developed and maintained at this centre. After preliminary testing, the F_1 seeds of NHH 250 along with parental lines were multiplied and further evaluated on seven locations (Nanded, Parbhani and Badnapur) for four years during 2006 to 2009 under rainfed condition as station / university trials along with popular hybrid checks *viz*., Bunny and NHH 44. Simultaneously, the hybrid NHH 250 was also tested in State Multi-Location Hybrid trials on 10 locations (Nanded (5), Amrawati (2) and Rahuri (3)) during 2008-2009 to 2014-2015 along with five checks *viz*., NHH 44, Bunny, Phule 492, PKV HY4 and PKV HY5.

Similarly, the hybrid NHH 250 was also evaluated under AICCIP for three years (2010-2012) at National level on seventeen locations *viz*., Khandwa (1), Indore (3), Nanded (3), Akola (3), Bharuch (3), Jalna (3) and Bhawani Patna (1) along with local checks from respective centres and zonal check, Ankur 651. The Experiment was conducted in Randomized block design with three replications at all the locations. The analysis of variance was performed as suggested by Panse and Sukhatme[11]. The recommended Package of practices was followed during each year and each location for raising good crop. Observations were recorded on seed cotton yield (kg/ha), ginning outturn (%), lint yield (kg/ha) and morphological characteristics based on DUS guidelines[2]. The lint samples were subjected to fibre quality analysis at the laboratory of Cotton Research Station, Nanded and data were recorded on 2.5% span length (mm), micronaire value (*u*g/inch) and tenacity (g/tex).

Distinguishing morphological characteristics of NHH 250 along with parental lines

The hybrid NHH 250 is semi-spreading hybrid with medium height (91-120 cm).The leaf colour is green with medium hairiness. Gossypol and leaf nectary glands are present on leaves and bolls in hybrid as well as both of the parental lines along with leaf petiole pigmentation. Anther pollen colour is buff in case of hybrid, where as it cream and yellow colour in female and male parent, respectively.(Table 1).

Evaluation at Station / University level

The hybrid NHH 250 was tested during *Kharif* seasons under rainfed conditions on seven locations over a period of four years (2006 to 2009). On an average of seven locations, the hybrid NHH 250 recorded 1509 kg/ha seed cotton yield with 12.54 to 74.94 per cent increase over hybrid checks Bunny (1341 kg / ha) and NHH (74.94 kg / ha), respectively. (Table 2)

Evaluations at State level

The hybrid NHH 250 was tested over ten locations for five years (2008, 2010, 2012,

2013 and 2014) under rainfed conditions. On an average of 10 locations, the hybrid NHH 250 recorded 1215 kg/ha seed cotton yield with 37.44, 12.81, 50.00 and 28.84 per cent increased seed cotton yield over hybrid checks *viz*., NHH 44, Phule 492, PKV HY4 and PKV HY5, respectively (Table 3).

Evaluations at National level under All India Coordinated Research Project on Cotton

On an average of 17 trials conducted over three years (2010-12) on different locations in central zone (Maharashtra, Madhya Pradesh, Gujrat and Orissa states), the hybrid NHH 250 recorded 13.33 and 23.93 per cent enhanced seed cotton yield over local checks at respective centres and zonal check, Ankur 651, respectively (Table 4).

Overall performance of NHH 250 in University/State/ National trials

On an average of 34 trials conducted over nine years (2006 to 2014), the hybrid NHH 250 recorded 1390 kg/ha seed cotton yield with 23.77, 59.22, 71.60, 47.40, 29.06, 9.01 and 19.21 per cent increase seed cotton yield over hybrid checks *viz*., Bunny, NHH 44, PKV HY 4, PKV HY 5, Phule 492, local checks of respective centres (National trials) and zonal check, Ankur 651, respectively (Table 5) .

Newly developed cotton hybrid NHH 250 expressed standard heterosis to the tune of 12.54, 74.94 over popular hybrid Bunny and NHH 44, respectively in university trials, 12.81 to 50.0 per cent over Phule 492 and PKV HY 4, respectively in state multi-location hybrid trials and 13.33 to 23.93 per cent over local checks and zonal check, Ankur 651, respectively in AICCIP trials. The findings in the present investigation on standard heterosis over local/zonal checks are in accordance with Bhatade and Rajeswar[4], Neelam Dheva *et al.*[10] and Khadi *et al*[9].

Mean performance of NHH 250 for ginning outturn (%), oil content (%) and fibre quality parameters (2010 to 2012)

On an average of 17 locations, the hybrid NHH 250 recorded 35.4 per cent ginning outturn which is superior than local checks (33.6%) and at par with zonal check, Ankur 651 (35.2%). This hybrid also recorded high oil content (17.87 %) compared to local checks (14.57 %) and zonal check, Ankur 651 (17.10 %). On an average of eleven locations, hybrid NHH 250 recorded better 2.5% span length (27.5 mm) which is at par with local checks (27.3%) and zonal check, Ankur 651 (29.1%). It had also recorded acceptable micronaire value 4.4 (μg / inch) and good bundle strength (22.3 g / tex) which is at par with local check (22.1 g/tex) and zonal check, Ankur 651(22.7 g / tex). Similarly, on an average of seventeen locations, the hybrid NHH 250 recorded 508 kg/ha lint with 25.75 per cent increase over zonal check, Ankur 651 (404 kg / ha) (Table.6).

Performance of NHH 250 against major diseases and pests

Heavy infestation due to bollworms particularly in non-Bt cotton and sucking pest complex are the two major bottlenecks in cotton cultivation[1]. Grover and Pental[5], reported that Jassids and Whitefly are the pests next to bollworm, which destabilize cotton productivity. Therefore, development of high yielding cotton hybrid having tolerance to sucking pest is needed to combat losses caused by these biotic stresses. The hybrid NHH 250 recorded tolerant reaction against Whitefly and Jassids consistently for three years in AICCIP trials conducted under natural conditions at Nanded and Khandwa station during 2010-2012. Similar observations were recorded for Boll damage (%) and Locule damage (%) in comparison with local checks and zonal check, Ankur 651 (Table 7).

Cotton diseases cause considerable yield losses at times of high disease intensity and under favourable weather conditions in specific locations. Cultivation of disease resistant varieties is often the most economical and permanent solution for disease management and also have immense scope for minimising yield losses with least disturbance to the environment[7]. The newly released hybrid NHH 250 is found tolerant against major cotton diseases *viz*., Bacterial blight (*Xanthomonas axonopodas* pv.*malvacearum*), Alternaria Leaf Spot (*Alternaria macrospora)*

and Grey mildew *(Ramularia areola)* at all the three locations *viz*., Nanded, Akola and Khandwa in screening trials conducted under natural conditions for three years (2010-2012) in AICCIP trials (Table 8).

Overall, the hybrid NHH 250 is found most desirable for the cultivators of central zone comprising of four states *viz*., Maharashtra, Gujarat, Madhya Pradesh and Orissa particularly under rainfed situation. NHH 250 possessed high seed cotton yield (14-16 qtls per hectare), good ginning out turn (36.0 %) and tolerance to sucking pests and diseases. In India, inspite of achieving record production during the past years, the textile industry still faces shortage of medium staple cotton. The hybrid, NHH 250 has superior medium long staple (27.7 mm) with better fibre strength (20.8 g/tex) and fine Micronaire (4.1 μg / inch) and will meet the requirement of the textile industry. Central Varietal Release and Identification Committee, New Delhi notified NHH 250 vide notification no. S.O 2805(E) dated 25th August, 2017. Release of such a high yielding stable hybrid may play important role in stabilizing yields under rainfed situation besides meeting the requirements of textile industry of medium staple and improving income of cotton cultivators of the central zone.

Table 1: Distinguishing morphological characteristics hybrid NHH 250 along with parental lines

Sr. No.	Characters	Description		
		NHH 250 (Hybrid)	**NH 111 (Female)**	**PH 1009 (Male)**
1.	Plant growth habit	Semi spreading	Semi spreading	Semi spreading
2.	Plant height	91-120 cm	100-140 cm	91-120 cm
3.	Branching (No. of monopodia)	0-2	0-4	0-2
4.	Leaf lobe	3	3	3
5.	Leaf colour	green	Green	Green
6.	Leaf hairyness	medium	Medium	Medium
7.	Leaf appearance	flat	Flat	Flat
8.	Leaf gossypol Glands	Present	Present	Present
9.	Boll gossypol Glands	Present	Present	Present
10.	Leaf nectary Glands	Present	Present	Present
11.	Leaf petiole pigmentation	Present	Present	Present
12.	Leaf Shape	(Normal) Palmate	Palmate Normal	Palmate Normal
13.	Plant stem hairyness	medium	Medium	Medium
14.	Plant stem pigmentation	Present	Present	Present
15.	Bract type	Normal	Normal	Normal
16.	Petal colour	Cream	Cream	Yellow
17.	Petal spot	Absent	Absent	Absent
18.	Flower stigma	Exerted	Exerted	Exerted
19.	Anther filament colour	Absent	Absent	Absent
20.	Anther/pollen colour	Buff	Cream	Yellow
21.	Boll bearing habit	Solitary	Solitary	Solitary
22.	Boll colour	green	Green	Green
23.	Boll shape (longitudinal section)	Elliptical	Elliptical	Elliptical
24.	Boll surface	smooth	Smooth	Smooth
25.	Boll tip	present	Pointed	Pointed
26.	Boll opening	open	Open	Open
27.	Boll weight (g)	3.6	3.8	3.55
28.	Seed fuzz	Sparse	Sparse	Sparse
29.	Seed fuzz colour	Greenish Gray	Gray	Gray
30.	Fibre colour	White	White	White
31.	100 seed wt (g)	7.3	9.1	8.2
32.	Fibre : colour	White	26.4	27.5
33.	Fibre length (2.5 % span length) (mm)	27.47	20.60	21.35
34.	Fibre : Strength (g/tex)	22.33	4.6	4.3
35.	Fibre : fineness	4.4	Semi spreading	Semi spreading
36.	Seed oil content (%)	17.87	--	--
37.	Biomass (t/ha)	2.57	--	--

Table 2: Performance of hybrid NHH 250 in station trials/ university trials during 2006 to 2009 under rainfed condition

Year	Location	Seed Cotton Yield (kg/ha)			CD @ 5%	CV %
		NHH 250	Bunny	NHH 44		
2006	Nanded	1806	1858	--	394	12.5
2007	Nanded	2031	1898	--	382	12.27
2008	Nanded	1198	1221	752	186	9.78
	Parbhani	1560	1388	833	439	16
2009	Nanded	1441	1389	874	208	11.04
	Parbhani	1255	808	796	202	11.44
	Badnapur	1270	822	1057	168	9.9
	No. of locations	7	7	5		
	Mean	**1509**	**1341**	**862**		
	% increase over checks		**12.54**	**74.94**		

Table 3: Performance of hybrid NHH 250 in state multilocation trials during 2008 to 2014-for seed cotton yield (kg/ha) under *rainfed* condition

Year	Location	Checks					CD @ 5%	CV %
		NHH 250	NHH 44	Phule 492	PKV HY 4	PKV HY 5		
2008-09	Nanded	943	639	318	385	318	127	12.99
2010-11	Nanded	608	564	318	--	434	115.7	12.77
	Amrawati	1308	1400	1169	--	1435	148.23	11.59
2012-13	Nanded	995	--	478	358	313	135	19
	Rahuri	1036	--	1401	1093	1191	235.95	12.66
	Amrawati	1591	--	2083	1114	1568	168.63	9.99
2013-14	Nanded	1411	--	991	785	704	157.78	10.67
	Rahuri	1931	--	1848	1094	1713	399.41	12.91
2014-15	Nanded	884	569	571	441	519	170.39	17.29
	Rahuri	1446	1252	1597	1214	1235	261.91	11.48
No. of locations		10	5	10	08	10		
Mean		1215	884	1077	810	943		
% increase over checks			**37.44**	**12.81**	**50.00**	**28.84**		

Table 4: Performance of NHH 250 in AICCIP trials under rainfed conditions for seed cotton yield (2010 to 2012)

Year of testing	Trial Location	NHH 250	Local check	Zonal check (Ankur 651)	CD at 5%	Local Checks
2010-11 (7 locations)	Khandwa	542	…	280	100	JKHY 1
	Indore	959	156	844	146	JKHY 1
	Nanded	702	756	471	197	NHH 44
	Akola	1549	1241	1014	153	PKVHY 2
	Bharuch	1075	1078	819	160	H 12
	Jalna	1991	1744	1806	268	NHH 44
	Bhawanipatna	1705	1391	1955	124	BUNNY
2011-12 (5 locations)	Nanded	1244	417	828	269	PKVHY 1
	Akola	1425	1005	932	258	PKVHY 2
	Indore	1219	1122	1180	135	BUNNY
	Jalna	2600	2466	2285	180	PKVHY 2
	Bharuch	1585	1806	1305	302	G. Cot Hy. 12
2012-13 (5 locations)	Nanded	1023	605	389	269	NHH 44
	Akola	1120	1123	1037	258	PKVHY 2
	Indore	1477	1093	981	135	JK HY 2
	Jalna	1866	1704	1739	180	PKV HY 2
	Bharuch	2477	2686	1953	302	G. Cot Hy. 12
Weighted Mean (kg/ha)		**1445**	**1275**	**1166**		
Percentage increase over the check			**13.33**	**23.93**		

Table 5: Summary of performance of hybrid NHH 250 under rainfed condition during 2006-07 to 2012-13

Trial Name	Year	No. of Locations	Checks							
			NHH 250	Bunny	NHH 44	PKV HY 4	PKV HY 5	Phule 492	Local checks (AICCIP trials)	Ankur 651 (Zonal check)
Station trials	2006 to 2009	7	1509	1341	862	--	--		--	--
SMHT trials	2008 to 2014	10	1215	906	884	810	943	1077	--	--
AICCIP trials	2010 to 2012	17	1445	--	-	--	--		1275	1166
	Total Mean	**34**	**1390**	**1123**	**873**	**810**	**943**	**1077**	**1275**	**1166**
Percent increase over the checks (%)				**23.77**	**59.22**	**71.60**	**47.40**	**29.06**	**9.01**	**19.21**

Table 6: Mean Performance of NHH 250 for Ginning outturn (%), oil content (%) and fibre quality parameters in National trials conducted under rainfed conditions (2010 to 2012)

Name of hybrid	Ginning outturn (%) (mean of 17 trials)	Oil content (%) (mean of 3 trials)	2.5% span length (mm) (mean of 11 trials)	Micronaire (µg / inch) (mean of 11 trials)	Bundle Strength (g / tex) (mean of 11 trials)	Lint yield (kg/ha) (mean of 17 trials)	% increase over
NHH 250	35.4	17.87	27.50	4.40	22.30	508	--
Local Check	33.6	14.57	27.30	3.90	22.10	426	19.25
Ankur 651 (Zonal Check)	35.2	17.10	29.10	3.90	22.70	404	25.75

Table 7: Reaction to major diseases of NHH 250 in AICCIP Trials conducted under natural conditions during 2010 to 2012

Item	Year	NHH 250			Local check			Ankur 651 (zonal check)		
		Nanded	Akola	Khandwa	Nanded	Akola	Khandwa	Nanded	Akola	Khandwa
Bacterial	2010-11	...	...	2	...	...	1	...	...	3
Blight	2011-12	0	2	...	0	2	...	1	2	...
(Grade)	2012-13	2	2	...	0	1	...	0	3	...
Alternaria	2010-11	...	...	2	...	...	2	...	...	2
Leaf Spot	2011-12	2	…	...	2	…	...	2	…	...
(Grade)	2012-13	2	…	...	2	…	...	2	…	...
Grey	2010-11	…	…	1	…	…	2	…	…	1
Mildew.	2011-12	1	…	...	0	…	...	0	…	...
(Grade)	2012-13	0	…	...	0	…	...	0	…	...

Table 8: Reaction to insect pests of NHH 250 in AICCIP trials conducted under natural conditions during 2010 to 2012

Insect pest	Year	NHH 250		Local check		Ankur 651 (zonal check)	
		Nanded	Khandwa	Nanded	Khandwa	Nanded	Khandwa
Jassids / 3 leaves	**2010-11**	…	3.7 (2.1)	…	3.5 (2.0)	…	3.6 (2.0)
	2011-12	6.70 (2.68)	2.05	8.50 (3.00)	1.91	10.60 (3.33)	2.25
	2012-13	5.90 (2.53)	…	7.40 (2.81)	…	6.10(2.56)	…
Whitefly / 3 leaves	**2010-11**	…	3.1 (1.9)	…	4.7 (2.3)	…	3.9 (2.1)
	2011-12	6.70 (2.68)	1.82	14.00 (3.80)	1.79	10.10 (3.25)	2.1
	2012-13	13.40 (3.72)	…	9.00 (3.06)	…	12.40 (3.59)	…
Boll damage (%)	**2010-11**	…	9.7 (18.2)	…	12.4 (20.6)	…	12.1 (20.3)
	2011-12	0.05 (1.27)	17.95	0.68 (4.69)	16.92	0.52 (4.08)	18.34
	2012-13	12.90 (21.04)	…	15.10 (22.85)	…	12.15 (20.39)	…
Locule damage (%)	**2010-11**	…	7.5 (15.8)	…	10.9 (19.3)	…	9.2 (17.7)
	2011-12	0.23 (2.51)	18.25	0.39 (2.55)	16.14	0.24 (2.76)	18.4
	2012-13	3.15 (10.21)	…	4.65 (12.39)	…	4.50 (12.24)	…

(Figures in parenthesis for Jassids and Whitefly are √ x+0.5 transformed values and figures for boll damage and locule damage are angular transformed values)

REFERENCES

1. Ansingkar, A.S., Khadke, P.P., Borikar, S.T. and Bhosle, S.S. and Altering, G., *hirsutum* cotton at cellular level to impart multiple sucking pest resistance through interspecific hybridization. Proc. International Symposium on "Strategies for Sustainable Cotton Production – A Global vision" Crop improvement, 23 to 25 November, 2004, University of Agriculture Sciencesr, Dharwad, Karnataka (India).pp 101-103 (2004).
2. Anonymous, Bulletin of Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA), Published by Registrar, PPV & FR Authority, New Delhi - 110012 , Government of India (2007).
3. Anonymous, Annual report of Cotton Research Station, Nanded., Vasantrao Naik Marathwada Krishi Vidyapeeeth, Parbhani, Maharashtra, India.pp vi-vii (2017).
4. Bhatade, S.S. and Rajeswar, S.R., Heterobeltiosis and standard heterosis for yield and quality characters in some *Gossypium hirsutum* L. crosses. *Madras Agril. J*., **81:** 34-35 (1994).
5. Grover Anil and Deepak Pental, Important pests causing economic damages to various crops. *Curr. Sci*. **84 (3):** 310-320 (2003).
6. Gotmare, V. and Phundan Singh, Introgressive hybridization for improvement of fibre quality trait. Proc. National Seminar on Improvement of fibre quality traits in cotton.15th February, *Central Institute for Cotton Research, Nagpur. pp*. 1-8 (2005).
7. Gururajan, K.N, Sundar, S., Kannan, A. and Chidambaram, P., Disease management through resistance breeding for increasing cotton production. Proc. International Symposium on "Strategies for Sustainable Cotton Production – A Global vision" vol.1 Crop improvement, 23 to 25 November, 2004, University of Agriculture Sciences, Dharwad, Karnataka (India). pp 104-106 (2004).
8. Khadi, B.M., Kulkarni, V.N., Katageri, I.S. and Mahantashivayogayya, K., Development of cotton hybrids in India and their role in increasing cotton production. Proc. National Symposium on "Changing World Order-Cotton Research, Development and Policy in Context", 10-12 August, 2004. Acharya N.G. Ranga Agricultural University, Hyderabad (India) pp 40-48 (2004).
9. Khadi, B.M., Patil, B.R., Pattanashetti, S.K., Katageri, I.S. and Mogali, S.C., Heterosis studies in long staple *intrahirsutum* hybrids of cotton. Proc. International Symposium on "Strategies for Sustainable Cotton Production – A Global vision" vol.1 Crop improvement, 23 to 25 November, 2004, University of Agriculture Sciences, Dharwad, Karnataka (India).pp 233-235 (2004).
10. Neelam Dheva, Potdukhe, N.R and Patil, V.T., Heterosis for seed cotton yield and other morphological charecters in G. *hirsutum* L., *J. Cotton Res. Dev*. **16 (2):** 165-167 (2002).
11. Panse, V.G. and Sukhatme, P.V., Statistical methods for Agriculture workers 2nd Edition I.C.A.R. New Delhi. (1985).
12. Sreenivasan, S., On the competitiveness of Indian Cottons are quality front in the free market area. Proc. International Symposium on "Strategies for Sustainable Cotton Production – A Global vision" Crop improvement, 23 to 25 November, 2004, University of Agriculture Sciences, Dharwad, Karnataka (India).pp 5-8 (2004).