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Research Article

Evaluation of Physical Properties of Bt Cotton Fibre and their Non-Bt Counterparts at Different Growth stages

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ABSTRACT

A comparative study on fibre properties of MECH-162 and MECH-12 Bt cottons and their counterpart non-Bt, were carried out. Physical properties of fibres such as 2.5% span length, micronaire, tenacity (strength), maturity ratio and immature fiber content (IFC %) were assessed by standard procedures. Data suggested that the 2.5% span length and tenacity (g tex^{-1}) of Bt cottons and their non-Bt counterparts did not change significantly as the days of fibre development progressed. Micronaire (fineness) of Bt cottons and their non-Bt counter parts was less by 87.4% on 25th day of fibre development in comparison to final fibre development stage after 45 days. Maturity ratio improved with fibre development and greater by 18 and 13.3% for MECH-162 and MECH-12 respectively on the 45th day compared to 25th day of development. Maturity ratio was stabilized on 45th day. No significant change was recorded between the maturity of Bt cottons and their non-Bt counterparts. Immature fibre contents for both Bt and their non Bt counter parts were greater by 122.2% at the initial stage. This stabilized at the final stage of fibre development (45th day). No difference was observed in the IFC% content between Bt and non-Bt cottons at the final stage. It appears that the fibre traits of Bt and non-Bt cottons were categorically the same at final stage of the fibre development.

Key words: Bt cotton, Micronaire, Tenacity, Maturity, Immature fibre content

Introduction

Cotton is a globally important crop and is produced in tropical and subtropical countries worldwide. India has largest area under cotton production in the world (12.8 m ha) (Textile Commissioner Report, 2015). Nearly 92% of total cotton crop area is under *Bt* (Kranti KR, 2012). Despite largest cotton growing area in the world, India has lesser production due to lower yield (The cotton Corporation of India Ltd, 2015). Major cotton growing area (60%) is in the central zone of India, but there is a wide variation in yield under rainfed condition, due to a wide range of rainfall (<400 to > 900 mm).

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Bacillus thuringiensis (or Bt) cotton is the outcome of the genetically engineered form of the natural cotton. The bacterium is inserted into the natural cotton which produces a protein, endotoxin in nature, causing stomach poison in the caterpillars (Barwale *et al*., 2004). The beginning of 21st century saw many investigations on Bt cottons. The present study has been carried out to know various aspects of Bt cottons fibre traits, which can be useful to the textile industry.

Materials and Methods

Samples of MECH-12 and MECH-162 Bt cottons and their non-Bt counterparts (MECH-162

and MECH-12) were grown at Athawa Agricultural Research Farm, Navsari Agricultural University, Surat (Gujarat) during the *kharif* season of 2004-05 & 2005-06. The cotton fibers were collected at the fibre development on 25, 30, 30, 35, 40 and 45 days. Planting was done in 18 rows with 60 dibbles for Bt and 18 rows with 15 dibbles for non-Bt at the border lines, and necessary gap filling were done. Physical parameters of fibres viz. 2.5% span length, micromere (micro gm inch^{-1}), maturity (%), tenacity (gm tex^{-1}) and immature fibre content (IFC) were assessed by the standard procedures. For determination of the physical parameters, a High Volume Instrument (HVI) was used. This instrument works on the principle of Constant Rate of Extension (CRE). The Advanced Fibre Information system (AFIS) was employed to determine the maturity and immature fiber content (IFC) percentage of Bt and non-Bt cottons (Sundaram *et al*., 2004). AFIS provides physical properties of a single fiber as well as fibre distribution. In the AFIS the clean fibers are carry- forwarded by the pneumatic channels where fibres are interrupted by a beam of light. Optoelectronic sensors located at appropriate positions generate the voltages proportional to change in intensity of light beam. With the help of advanced electronics and computation technologies, these voltage could be converted into the measurement traits. AFIS consists with length and maturity Module. In all assessments the data of 2004-05 and 2005-06 have been reported.

Results and Discussion

Cellulose synthesis in cotton fibre is paramount important and it influences the fiber morphological and structural properties, which in turn influences the physical and mechanical characteristics of cotton fibers and their by-products like yarns and fabrics. Data summed in the Table 1 and 2 for the physical parameters of Bt cottons and their non -Bt counter parts (MECH-162 and MECH-12) revealed that micronaire of cotton fibres at various development growth stages was low in initial days of development but at latter stages, it increased. Micronaire of MECH- 162 was higher by 87.4% at 45th day compared to 25th day of fibre development. Similarly the micronaire of MECH-12 was greater by 85.1% at the maturity stage compared to initial day of fibre development. But at the maturity, the micronaire value of BtMECH-12 and BtMECH-162 and their non-Bt counterparts did not have any difference (F=0.0871; P=2.41) (Tables 1 & 2). It might be due to cross sectional deposition of cellulose molecules on the cell wall of fibres with time. Similar type of results was obtained by earlier researchers (Mayee *et al*., 2004).

Among various parameters which determine the quality of cotton, fiber length occupies an important position as it influences the spin ability of cotton to a large extent. Hence, this characteristic of cotton has assumed great importance in commercial transactions and price of cotton. Non-significant difference (F= 0.087;

Table 1. Span length, micronaire and tenacity of MECH-12 Bt and non-Bt counterpart

Category	Day	2.5% span length (mm)			Micronaire (mg in^{-1})			Tenacity (g tex^{-1})		
		2004-05	2005-06	Mean	2004-05	2005-06	Mean	2004-05	2005-06	Mean
Bt	5	27.8	24.4	26.1	2.3	2.6	2.45	22.0	19.5	19.7
Non-Bt		27.8	26.4	27.1	2.3	2.9	2.6	21.7	21.2	21.4
Bt	3	28.4	25.7	27.05	3.9	3.7	3.8	21.6	18.7	20.1
Non-Bt	0	27.4	25.7	26.55	3.7	3.9	3.8	22.1	20.1	21.1
Bt	3	28.5	27.1	27.8	4.2	4.3	4.2	21.9	20.2	21.1
Non-Bt	5	28.5	26.5	27.5	4.5	4.3	4.4	20.2	19.8	20.0
Bt	4	27.8	26.8	27.3	4.5	4.9	4.7	21.1	19.1	20.1
Non-Bt	0	27.8	26.4	27.1	4.3	4.4	4.3	21.9	19.5	21.4
Bt	4	28.0	28.2	28.1	4.4	4.6	4.5	23.5	20.1	21.8
Non-Bt	5	27.4	26.9	27.15	4.5	4.7	4.6	22.8	20.8	21.8

Table 2. Span length, micronaire and tenacity of MECH-12 and its non-Bt counterpart 2004 -05 & 2005-06

Category	Day	2.5% span length (mm)			Micronaire (mg in^{-1})			Tenacity (g tex^{-1})		
		2004-05	2005-06	Mean	2004-05	2005-06	Mean	2004-05	2005-06	Mean
Bt	5	27.4	27.7	27.5	2.3	2.3	2.3	30.3	20.4	25.3
Non-Bt		26.4	30.1	28.2	2.2	2.1	2.1	22.5	22.3	22.4
Bt	30	31.9	28.3	30.1	3.1	2.9	3.0	22.5	21.1	21.8
Non-Bt		31.1	28.8	29.8	3.3	3.4	3.4	22.4	22.2	22.3
Bt	35	31.2	28.4	30.7	4.2	4.0	4.1	22.4	20.2	21.3
Non-Bt		31.6	29.8	29.7	3.8	4.4	4.1	22.2	20.9	21.5
Bt	40	30.0	29.5	30.5	4.8	4.4	4.6	22.3	20.0	21.1
Non-Bt		31.0	30.1	20.5	4.7	4.8	4.7	22.6	20.0	21.3
Bt	45	32.1	28.9	30.5	4.9	4.6	4.7	23.0	23.7	23.3
Non-Bt		32.0	29.4	30.7	4.8	4.6	4.7	23.8	24.3	24.0

P=3.45) were recorded between the fibre length of Bt cotton and their non-Bt counterparts (Tables 1 & 2) at any stage of fibre development. It may be due the development of fibre elongation till 25th day of fibre development (Flint, 1950). This finding is similar to other workers (Yadav *et al.*, 2012). In addition to fibre length, fineness and fiber tenacity (gram tex^{-1}) are major factors which influences the strength of yarn spun from staple cotton. In case of conventional ring spinning, the influence of fiber tenacity becomes more significant. Non-significant changes (F= 0.023; P= 4.51) were recorded in the tenacity (strength) of Bt cottons at any stage of development. It may be attributed to the orientation and uniform deposition of cellulose molecules along the fibre length. Reports suggest that the tenacity of Bt and non–Bt does not differ significantly (Maharana *et al.*, 2011). The maturity is increased as days of the growth increased without any definite trend and it became almost the same at the final stage of fibre development for both the cropping seasons 2004-05 and 2005-06 (Fig. 1 & 2). It could be due to uniform development of thickness of cell wall. Similarly, the immature fibre content decreased by 122.3 and 124% for MECH-12 and MECH-162 respectively at 45th day of development. No significant difference was recorded in IFC between MECH-162, MECH-12 cottons and their non- Bt counterparts at the final stage of growth (Fig. 3 & 4). This finding is similar to the earlier workers (Sankaranarayanan *et al*. 2011, Rekha. 2007).

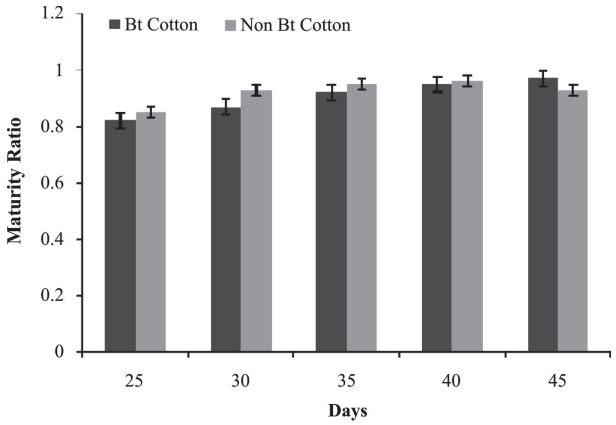

Fig. 1. Mean values of two years of maturity ratio and days of growth of cotton fibres of MECH- 162 Btcotton and its non-Bt counterpart

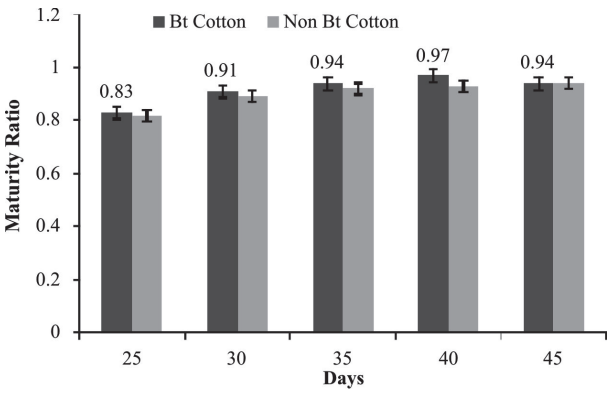

Fig. 2. Mean values of two years of maturity ratio and days of growth of cotton fibres of MECH- 12 Bt cotton and its non-Bt counterpart.

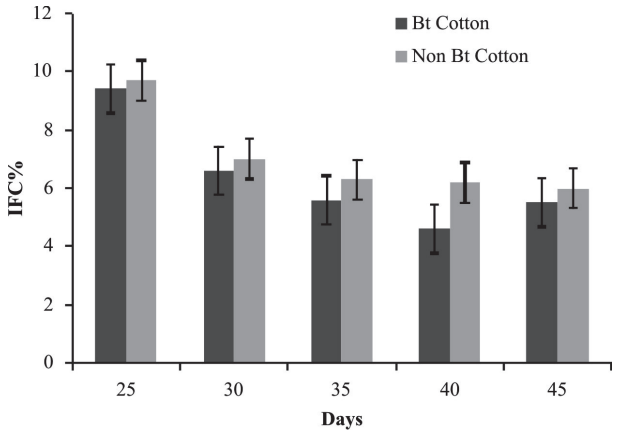

Fig. 3. Mean values of two years of immature fibre content (IFC %) and days of growth of cotton fibres of MECH- 162 Bt cotton and its non-Bt counterpart

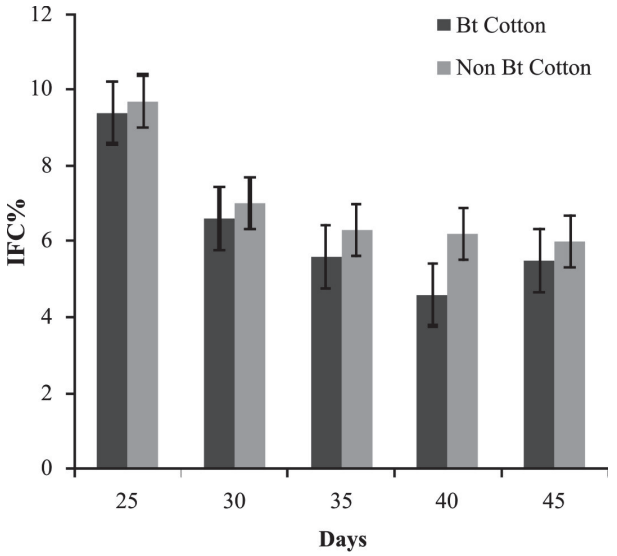

Fig. 4. Mean values of two years of immature fibre content (IFC %) and days of growth of cotton fibres of MECH- 12 Bt cotton and its non-Bt counterpart

Conclusions

In general, MECH-162 and MECH-12 Bt cottons and their non-Bt counterpart's had similar fiber length. Microniare value goes on increasing and stabilized at the final stage of fiber development. Tenacity also showed similar trend. It can be categorically stated that there was no difference in fibre traits of Bt cottons MECH-12 and MECH-162 and their non- Bt counter parts at various stages of growth of the crop.

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