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# Effect of plant growth regulators and micro-nutrients on fibre quality of high density planted Bt cotton (*Gossypium hirsutum* L.)

**Shaikh Wasim Chand, PN Karanjikar, SY Dhale, Mirza IAB and KS Baig**

**Abstract**
A field experiment was conducted during *kharif* seasons of 2018-19 and 2019-20 on clayey soil at Research Farm, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was laid out in split plot design with three replications consists of twelve treatment combinations comprising of three plant growth regulator treatments in main plot and four micro-nutrient treatments in sub plot. It was resulted that among application of plant growth regulators, Brassinosteroids @ 0.01% improved fibre quality parameters like, upper half mean length (UHML) (mm), Micronaire (µg inch$^{-1}$), bundle strength (g tex$^{-1}$), minimum maturity (%) and minimum breaking elongation (%) during year 2018-19 and 2019-20 as compare with other plant growth regulators. Fibre quality data was improved with Brassinosteroids @ 0.01% followed by Mepiquat Chloride and NATCA during both the years of study. Among application of micro-nutrient treatments, fibre quality data was improved with Foliar spray at square formation and at flowering of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B ($M_3$) which was followed by foliar spray of Grade II micro-nutrient at square formation and at flowering ($M_4$) during year 2018-19 and 2019-20. Fibre quality data found non-significant with application of plant growth regulators and micro-nutrients during both the years of study.

**Keywords:** Fibre quality, plant growth regulators, micro-nutrients, Bt cotton, clayey soil, high density planting, HVI

## Introduction
Cotton (*Gossypium hirsutum* L.), the 'king of fibres' or 'white gold' is an important cash crop and it supplies a major share of raw materials to the textile industry and playing a key role in the economic and social affairs of the world. As per the estimates, 47.5 million bales of lint are required to meet the domestic and export requirements by 2020 AD in India. Cotton is an important raw material for the Indian textile industry contributing about 65 per cent of its requirements. One could argue that developing countries like India with very low crop yields offer the greatest opportunity for increasing global production. In this situation, the high yielding Bt cotton under sustained agricultural practices would result in better increase in yield and quality. The high density planting system is now being conceived as an alternate production system having a potential for improving productivity and profitability, increasing efficiency, reducing input costs and minimizing risks associated with India's cotton production system. Plant growth regulators are known to modify the source to sink relationship and increase the translocation and photosynthetic efficiency resulting in increased square and boll retention and boll set per cent (Kirankumar, 2001) [7].

Plant growth regulators (PGR) are used to control excessive vegetative growth and promote higher seed cotton yield as well as improves fibre quality. In cotton, flowering is a continuous process. However, all flower produced are not retained and harvested. About 40 to 50 per cent of flowers and bolls will shed due to bollworm attack or nutritional or moisture stress. Hence, there is a need to supplement cotton crop with proper micro and macronutrients in balanced way for higher flower production and retention for obtaining higher yield. Plant growth regulators like, N-acetyl–thiazolidine-4-carboxylic acid (NATCA), Brassinosteroids (BRs) and Mepiquat chloride (MC) improves growth, yield and quality of Bt cotton. NATCA is a bio-stimulant and triggers plants to synthesize amino acids and hormones that are essential for normal functioning, growth and development of plants. Brassinosteroids (BRs) are a group of naturally-occurring steroidal phytohormones playing fundamental roles during normal plant growth and development. Mepiquat chloride, is a water soluble organic molecule which is absorbed by the green parts and redistributed throughout the plant.

In the recent years, growth regulators considered as new generation agrochemicals after fertilizers and pesticides.

Nutritional deficiencies affect the vegetative as well as reproductive growth that ultimately lower down the seed cotton yields as well as fibre quality. Foliar feeding with plant nutrients gives quick benefits and economizes nutrient element as compared to soil application (Verma, 1973) [15]. Foliar feeding is often effective when roots are unable to absorb sufficient nutrients from the soil due to high degree of fixation, losses from leaching, low soil temperature and lack of soil moisture (Singh *et al.*, 1970) [13].

Certain micro-nutrients may help to secure uniform emergence, rapid seedling growth and healthy plant stand. Magnesium is a constituent of the chlorophyll molecule, with each molecule containing 6.7 per cent magnesium, which is the driving force of photosynthesis. Zinc is an essential mineral nutrient and a co-factor of over 300 enzymes and proteins involved in cell division, nucleic acid metabolism and protein synthesis (Marschner and Cakmak, 1986) [8]. Boron is an essential element that cotton needs during all stages of growth and fruiting. Researches indicated that boron has been universally recognized as the most important micro-nutrient for cotton production and cotton (*Gossypium hirsutum* L.) is sensitive to B deficiency because of its high B requirement (Shorrocks, 1992) [12]. Iron plays an important role in the synthesis of chlorophyll and also helps in the absorption of other nutrients. These micro-nutrients play vital role in the physiology of cotton crop and being a part as catalyst in enzymatic reactions.

## Materials and Method

A field experiment was carried out at Research Farm, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* seasons of 2018-19 and 2019-20 on clayey soil. The experiment was laid out in split plot design with three replications. It consists of twelve treatment combinations comprising of three plant growth regulator treatments in main plot ($G_1$- NATCA @ 5%, $G_2$- Brassinosteroids @ 0.01% and $G_3$- Mepiquat chloride @ 50 g a.i. $ha^{-1}$) and four micro-nutrients treatments in sub plot ($M_1$- Soil application of $ZnSO_4$ @ 20 kg + $MgSO_4$ @ 20 kg + $FeSO_4$ @ 20 kg + B @ 10 kg $ha^{-1}$, $M_2$- Foliar spray at square formation of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B and $M_3$- Foliar spray at square formation and at flowering of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B and $M_4$- Foliar spray of Grade II micro-nutrient at square formation and at flowering). Recommended dose of fertilizers 120:60:60 NPK kg $ha^{-1}$ were applied during both years of experimentation. The soil was clayey in texture and slightly alkaline in reaction having low organic carbon, low in available nitrogen, medium in available phosphorus, high in available potassium and medium in available magnesium. Among micro-nutrients soil was deficient in available zinc and medium in available iron and boron. Fibre quality parameters like, upper half mean length (UHML) (mm), micronaire (µg $inch^{-1}$), bundle strength (g $tex^{-1}$), minimum maturity (%) and minimum breaking elongation (%) recorded during both the years of study. The fibre quality studies were undertaken with the help of High Volume Instrument (HVI) at Cotton Research Station, Nanded. High volume instrument systems are based on the fibre bundle testing *i.e.* many fibres are checked at the same time and their average values determined. In HVI, the bundle testing method is automated.

## Results and Discussion

Effect of plant growth regulators and micro-nutrients on quality like, upper half mean length (UHML) (mm), micronaire (µg $inch^{-1}$), bundle strength (g $tex^{-1}$), minimum maturity (%) and minimum breaking elongation (%) recorded during both the years of study of Bt cotton was presented in Table 1 and it was noted that application of Brassinosteroids @ 0.01% improves all the fibre quality parameters followed by application of mepiquat chloride @ 50 g a.i $ha^{-1}$ and NATCA @ 5% during year 2018-19 and 2019-20. Kasukabe *et al.*, (1999) filed a patent on the production of cotton fibres with improved fibre characteristics by treatment with brassinosteroids. The variations in fibre quality parameters with application of plant growth regulators might be due to fibre properties which are primarily governed by genetic makeup of hybrid cotton coupled with soil and climatic interaction, which modify the ultimate expression of fibre properties. Fibre quality parameters *viz.*, upper half mean length (UHML) (mm), micronaire (µg/inch), bundle strength (g/tex), minimum maturity (%) and minimum breaking elongation (%) were not influenced significantly with application of plant growth regulators during both the years (2018-19 and 2019-20). The present results corroborate with the findings of Ashcraft (1996) [2], Sun *et al.*, (2004) [14], Yang *et al.*, (2014) [16] and Ahmed *et al.*, (2017) [16].

Among application of micro-nutrients, fibre quality parameters did not differed significantly with application of micro-nutrient treatments during both the years of study. Foliar spray at square formation and at flowering of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B improved fibre quality followed by Foliar spray of Grade II micro-nutrient at square formation and at flowering during both the years of study. It might be due to foliar application of micro-nutrients required to support the processes of growth and development of cotton fibres in the boll. Positive effects of micro-nutrients on quality parameters were also supported by Chhabra *et al.*, (2004) [3], Gormus (2005) [1], Devraj *et al.*, (2007) [4], Ratnakumari and Hema, (2009) [11], Raju *et al.*, (2011) [11] and Raju and Thakare (2012) [10].

**Table 1:** Effect of plant growth regulators and micro-nutrients on upper half mean length (UHML) (mm), micronaire (µg $inch^{-1}$), bundle strength (g $tex^{-1}$), minimum maturity (%) and minimum breaking elongation (%) of high density planted Bt cotton during year 2018-19 and 2019-20.

| Treatments | UHML (mm) | | Micronaire (µg $inch^{-1}$) | | Bundle strength (g $tex^{-1}$) | | Minimum maturity (%) | | Minimum breaking elongation (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2018-19 | 2019-20 | 2018-19 | 2019-20 | 2018-19 | 2019-20 | 2018-19 | 2019-20 | 2018-19 | 2019-20 |
| **Plant growth regulators (G)** | | | | | | | | | | |
| $G_1$ - NATCA @ 5% | 31.69 | 31.80 | 3.68 | 3.83 | 26.61 | 26.78 | 82.71 | 83.13 | 6.14 | 6.30 |
| $G_2$ - Brassinosteroids @ 0.01% | 32.01 | 32.17 | 3.34 | 3.43 | 27.14 | 27.30 | 83.31 | 83.75 | 6.34 | 6.49 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $G_3$ - Mepiquat chloride @ 50 g a.i $ha^{-1}$ | 31.84 | 31.93 | 3.53 | 3.65 | 26.83 | 27.02 | 83.08 | 83.35 | 6.23 | 6.39 |
| S.E.(m)+ | 0.32 | 0.43 | 0.26 | 0.21 | 0.48 | 0.47 | 0.34 | 0.43 | 0.06 | 0.13 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **Micro-nutrients (M)** | | | | | | | | | | |
| $M_1$- Soil application of $ZnSO_4$ @ 20 kg + $MgSO_4$ @ 20 kg + $FeSO_4$ @ 20 kg + B @ 10 kg $ha^{-1}$ | 31.54 | 31.66 | 3.66 | 3.80 | 26.45 | 26.61 | 82.53 | 82.89 | 6.08 | 6.22 |
| $M_2$- Foliar spray at square formation of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B | 31.66 | 31.75 | 3.57 | 3.67 | 26.53 | 26.70 | 82.64 | 83.00 | 6.12 | 6.25 |
| $M_3$- Foliar spray at square formation and at flowering of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B | 32.20 | 32.36 | 3.39 | 3.50 | 27.33 | 27.58 | 83.73 | 84.13 | 6.47 | 6.65 |
| $M_4$- Foliar spray of Grade II micro-nutrient at square formation and at flowering. | 31.98 | 32.09 | 3.45 | 3.58 | 27.12 | 27.25 | 83.22 | 83.61 | 6.28 | 6.45 |
| S.E.(m)+ | 0.30 | 0.36 | 0.18 | 0.15 | 0.45 | 0.59 | 0.39 | 0.67 | 0.12 | 0.20 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **Interaction (G x M)** | | | | | | | | | | |
| S.E.(m)+ | 0.52 | 0.61 | 0.30 | 0.26 | 0.78 | 1.02 | 0.66 | 1.16 | 0.21 | 0.34 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| GM | 31.85 | 31.97 | 3.52 | 3.64 | 26.86 | 27.03 | 83.03 | 83.41 | 6.24 | 6.39 |

## Conclusion

On the basis of two years experimental data, it can be concluded that application of plant growth regulators and micro-nutrients on fibre quality of Bt cotton did not influenced significantly during year 2018-19 and 2019-20. Application of Brassinosteroids @ 0.01% improved fibre quality parameters followed by application of mepiquat chloride @ 50 g a.i $ha^{-1}$ and NATCA @ 5% during year 2018-19 and 2019-20. Among application of micro-nutrients, Foliar spray at square formation and at flowering of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B improved fibre quality followed by Foliar spray of Grade II micro-nutrient at square formation and at flowering treatment during both the years of study. Application of Brassinosteroids @ 0.01% + Foliar spray at square formation and at flowering of 0.5% $ZnSO_4$ + 0.5% $MgSO_4$ + 0.5% $FeSO_4$ + 0.2% B achieved higher fibre quality parameters under high density planted Bt cotton during both the years of study.

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