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Effects of nutrients and plant growth regulators on yield and quality characters of cotton

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Abstract
India is one of the leading cotton producer and consumer in the world. Cotton 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. The objective of this field experiment was to study the effects of nutrients combination with growth regulators on yield and quality characters of cotton. The treatments consisted of plant growth regulators G_0 -Control (Water spray), G_1 – NAA @ 40 ppm (45th and 60th DAS) and G_2 – Mepiquat chloride @ 100 ppm (70th and 90th DAS) were assigned with sulphur, zinc and boron (N_0 – Control, N_1 – 30 kg S ha^{-1} as gypsum + 5 kg Zn ha^{-1} as zinc sulphate + 0.5 kg B ha^{-1} as borax, N_2 – 45 kg S ha^{-1} as gypsum + 5 kg Zn ha^{-1} as zinc sulphate + 0.5 kg B ha^{-1} as borax and N_3 – 60 kg S ha^{-1} as gypsum + 5 kg Zn ha^{-1} as zinc sulphate + 0.5 kg B ha^{-1} as borax). The application of 1-napthalene acetic acid (NAA) @ 40 ppm recorded higher seed cotton yield and application of 60 kg sulphur (S) + 5 kg zinc (Zn) + 0.5 kg boron (B) ha^{-1} had a remarkable influence on the yield and quality characters of cotton.

Keywords: Cotton, NAA, Mepiquat chloride, Sulphur, Zinc and Boron

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. In India, it plays a predominant role in the textile industry and economy of the country. The demand of textile market depends upon the quality of cotton fibre and governs by compound functions of mean fibre length, fibre fineness, fibre maturity and fibre strength. Nutritional deficiencies affect the vegetative as well as reproductive growth that ultimately lower down the seed cotton yields as well as fibre quality. Productivity of cotton can considerably be improved by judicious agronomic management. Fulfillment of nutritional requirements of the crop is essential for obtaining the higher yields and fibre quality (Kalaichelvi, 2009 and Kumar *et al.*, 2011) [8, 9].

Sulphur deficiencies have increasingly occurred in crops due to declined use of sulphur containing fertilizers and greater removal of sulphur by crops. The application of 30 kg S ha^{-1} resulted in increased fibre length (Sharma *et al.*, 2000) [19]. Quality characters *viz.*, fibre length, uniformity and fibre strength increased with increase in gypsum level from 0 to 200 kg ha^{-1}, compared to the untreated control (Makhdum *et al.*, 2001) [12]. Application of sulphur significantly improved the fibre quality *viz.*, ginning percentage, lint index, seed index, fibre length and fibre strength (Vaiyapuri *et al.*, 2010) [20]. Sulphur and zinc application significantly increased the fibre fineness (Xinhua Yin *et al.*, 2011) [21]. Crop yields are often limited by low soil levels of mineral micronutrients such as zinc (Cakmak, 2000) [3].

Zinc is an essential micronutrient and a co-factor of over 300 enzymes and proteins involved in cell division, nucleic acid metabolism and protein synthesis (Marschner 1986) [14]. Combined application of sulphur, iron and zinc recorded maximum ginning percentage and seed index (Mamatha, 2007) [13]. Ahmed *et al.* (2011) [1] observed that Zn is needed to optimize irrigated cotton productivity. Foliar application of 0.5 per cent $ZnSO_4$ combined with 1 per cent $MgSO_4$ at 45 and 60 DAS recorded significantly higher lint index (45.3) and ginning percentage (37.1) (Sankaranarayanan *et al.*, 2010) [18]. Boron is one of the most important micronutrient that cotton requires throughout crop growth, particularly during reproductive growth. Christos (2006) [5] opined that boron application significantly increased the yield and yield components of cotton. Fibre length and fibre fineness was significantly influenced by boron application (Majid Rashidi *et al.*, 2011) [10]. Majid Rashidi and Mohsen Seilsepour (2011) [11] reported that application of boron recorded maximum fibre length (31.7 mm). Plant growth regulators (PGR) are used to control excessive vegetative growth and promote higher seed cotton yield. In the recent years, growth regulators considered as new generation agrochemicals after fertilizers and pesticides.

Bynum *et al*. (2007) [2] reported that plant growth regulators increased the number of bolls, boll weight and seed cotton yield. Plant growth regulators such as Pix and Turbopamuk increased seed cotton yield, but did not affect fibre quality (Gencsoylu, 2009) [6]. Pix and nitrogen application increased the seed cotton yield when compared to control (Yasari and Vahedi, 2012) [22].

Materials and Methods

The field experiments were conducted at Experimental Farm (11°24' N, 79° 44' E, +5.79 m MSL), Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram, Tamil Nadu, India. The Climate of study area is sub-tropical, with a mean annual temperature between 23.2 °C and 33.2 °C, the mean hours of bright sunshine per day was 9.5 and an average annual rainfall of 1500 mm. The experiments were laid out in factorial randomized block design with three replications and plot size of 20 m^2. The treatments consisted of plant growth regulators G_0 -Control (Water spray), G_1 – NAA @ 40 ppm (45th and 60th DAS) and G_2 – Mepiquat chloride @ 100 ppm (70th and 90th DAS) were assigned with sulphur, zinc and boron (N_0 – Control, N_1 – 30 kg S ha^{-1} as gypsum + 5 kg Zn ha^{-1} as zinc sulphate + 0.5 kg B ha^{-1} as borax, N_2 – 45 kg S ha^{-1} as gypsum + 5 kg Zn ha^{-1} as zinc sulphate + 0.5 kg B ha^{-1} as borax and N_3 – 60 kg S ha^{-1} as gypsum + 5 kg Zn ha^{-1} as zinc sulphate + 0.5 kg B ha^{-1} as borax). Thinning and gap filling were done 10 days after sowing. The recommended dose of chemical fertilizer 80:40:40 kg nitrogen, phosphorus, potassium (NPK) ha^{-1} was applied uniformly to all the plots through urea, di-ammonium phosphate (DAP) and muriate of potash (MOP), respectively. The soil of the experimental fields were clay loam in texture, low in available nitrogen, medium in available phosphorus, high in available potassium and deficient in sulphur, zinc and boron.

Results and Discussion

Application of plant growth regulators significantly influenced the seed cotton yield. Among the different treatments, application of NAA @ 40 ppm excelled other treatments by registering the maximum seed cotton yield. The reason for the increased yield might be due to the increased photosynthetic efficiency through stabilization of chlorophyll, higher production of photosynthesis, which resulted in increased translocation of organic material from source to sink. Thus partitioning of photosynthates move towards the development of reproductive parts than to the vegetative growth and would have resulted in higher seed cotton yield. These results are in close agreement with the finding obtained in cotton by Rajagowthaman (2007) [17].

Among the various treatments imposed in the study, application of sulphur, zinc and boron significantly influenced the seed cotton yield. Application of micronutrients significantly increased the yield attributing characters and seed cotton yield. Similar results were recorded by Chhabra *et al.* (2004) [4] in cotton. Supply of sulphur in addition to recommended NPK might be the lifting factor behind the increased seed cotton yield. These results are in accordance with the observation of Gobi *et al.* (2006) [7].

Application of plant growth regulators did not significantly affect the fibre quality. Application of sulphur, zinc and boron significantly influenced the quality characters *viz.*, ginning percentage, fibre length and fibre bundle strength. This might be due to favorable effect of sulphur, which played greater role in making the nutrients available to crops there by contributing significantly for better fibre quality. Similar findings were reported by Prasad (2000) [16]. Micronutrient application significantly influenced the quality characters. This might be due to application of these nutrients that could have increased the rate of photosynthesis along with active absorption of various nutrients and translocation of photosynthates to the site of storage organ. This present finding is in consonance with that of Pawar *et al.* (2005) [15].

Table 1: Effect of nutrients and plant growth regulators on yield and quality characters of cotton

Treatments	Seed cotton yield (q ha^{-1})		Ginning percentage		Fibre length (mm)		Fibre bundle strength (g tex^{-1})	
	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop
Growth regulators								
G_0	19.24	19.03	36.03	35.99	28.98	28.86	27.54	27.51
G_1	21.71	21.49	36.04	36.03	28.97	28.90	27.49	27.49
G_2	20.77	20.70	36.04	36.01	29.98	28.89	27.48	27.48
S.Ed.	0.33	0.30	0.07	0.06	0.10	0.09	0.11	0.10
CD (P=0.05)	0.66	0.62	NS	NS	NS	NS	NS	NS
Nutrients								
N_0	16.02	15.93	34.09	34.02	27.19	27.10	25.14	25.11
N_1	20.81	20.58	36.36	36.35	28.88	28.71	27.30	27.32
N_2	22.70	22.52	36.83	36.81	29.87	29.82	28.74	28.73
N_3	22.76	22.58	36.85	36.84	29.96	29.91	28.83	28.81
S.Ed.	0.39	0.36	0.10	0.09	0.15	0.13	0.17	0.15
CD (P=0.05)	0.79	0.74	0.20	0.19	0.30	0.27	0.35	0.31

Conclusion

The application of 1-napthalene acetic acid (NAA) @ 40 ppm was highly impressive which had a remarkable effect on the seed cotton yield and application of 60 kg sulphur (S) + 5 kg zinc (Zn) + 0.5 kg boron (B) ha^{-1} significantly influenced the seed cotton yield and quality characters.

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