AATCC Review

03 February 2023: Received
05 June 2023: Revised
10 August 2023: Accepted
13 October 2023: Available Online

www.aatcc.peerjournals.net

Research Article Open Access

Effect of Mepiquat Chloride and Nitrogen levels on yield and economics of Bt (*Bacillus thuringiensis*) cotton

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ABSTRACT

A field experiment was conducted in *Bt* cotton during the kharif season 2018 at the National Seed Production Area of Choudhary Charan Singh Haryana Agricultural University, Hisar. As cotton has indeterminate growth habit, so to control plant height and encourages the translocation of photosynthesis towards reproductive sinks (growing cotton bolls), which lead to higher yields this experiment was conducted in factorial R.B.D with three replications comprising three levels of Nitrogen (N_1: 100% RDF, N_2: 125%RDF, N_3: 150%RDF) and three different doses of growth retardant (G_1: Control, G_2: Mepiquat chloride application 20g *a.i.*/ha. at 60 DAS, G_3: Mepiquat chloride application 20g *a.i.*/ha at 60 DAS and 75 DAS). The results indicated that several bolls/m^2, boll weight (g), and seed cotton yield (kg/ha) was higher at 150% and 125% RDF than 100% RDF. However, seed index is significantly high with 100% RDF. A number of bolls/m^2, boll weight (g) and seed cotton yield (kg/ha) was significantly higher with twice the spray of mepiquat chloride at 60 and 75 DAS compared to the control. Similarly highest gross and net return was recorded with 150% RDF level of nitrogen followed by 125% RDF and 100% RDF. Among spraying of mepiquat chloride higher gross returns and net returns was recorded with two sprays of mepiquat chloride (Rs.1,87,138/ha& 95,850/ha) followed by single spray (Rs 1,82,457/ha & Rs 92,473/ha) and control (Rs 1,66,902/ha &Rs 88,364/ha).

Keywords: *Bt* cotton, Mepiquat chloride, seed index, seed cotton, yield, net returns, RDF

INTRODUCTION

Approximately 14% of industrial production and 4% of the GDP are contributed by the textile industry, which uses cotton as a raw material. This industry provides direct employment for about 35 million people. Around 12.50% of raw cotton is consumed by the hand loom industry, and around 62.70% by the power loom industry. Nearly 3.40% and 21.40% of all raw cotton is used by mills and the hosiery industry, respectively. Also, it is the source of huge quantities of biomass, including dried cotton stalks used as fuel, cotton seed oil cake, linters, and edible oil. Its high lint yield and long staple length are crucial characteristics. The most significant commercial product is lint, which gives the textile sector a source of high-quality fiber. Cotton seeds, which are the main byproduct of lint production, are a significant source of oil for human consumption and are also used as animal feed.

The split application of N in which 25% at sowing + 25% at first irrigation + 50% at flowering with one hoeing at 3 weeks and earthing up at 6 weeks treatment gave maximum number of sympodial branches/plant and bolls/plant to a significant level compared to other treatments [1]. A field experiment conducted by [2] shows that the application of nitrogen @ 160 kg N/ha significantly increased seed cotton yield of cotton. Kasap and Killi (2004) observed that application of 150 to 250 kg N/ha gave the highest number of sympodial branches and bolls/plant in cotton crop [3].

Growth inhibitors like mepiquat chloride (MC) are known to decrease inter nodal length, which in turn lowers plant height and encourages the translocation of photosynthesis towards reproductive sinks (growing cotton bolls), all of which lead to higher yields. By improving the retention of photosynthates in growing bolls, plant growth regulators (PGRs) increase yield. In industrialized countries, PGRs are frequently employed to increase cotton production by modifying plant growth, as well as to enhance lint yield and fiber quality. Global cotton production uses mepiquat chloride (MC) to regulate plant development, increase yield, and improve quality. Application of MC at the squaring stage or at both squaring and flowering stages significantly improved cotton quality parameters like fiber length (1.7%) and fiber strength (2.8%) without significant loss of yields [4]. Considering the above points, the following study was carried out to find the effect of Mepiquat chloride and nitrogen levels on the yield & economics of *Bt* cotton.

MATERIALS AND METHODS

The study was conducted at the the National Seed Production Area of Choudhary Charan Singh Haryana Agricultural University, Hisar, during *kharif* season 2018 by using the RCH

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DOI: https://doi.org/10.58321/AATCCReview.2023.11.04.183

650 genotype of Bt cotton. An experiment was carried out in Factorial Randomized block design, where one factor was different nitrogen levels (N_1: 100% RDF, N_2: 125%RDF, N_3: 150%RDF) and other one was different doses of growth retardant (G_1: Control, G_2: Mepiquat chloride application 20g *a.i.*/ha. at 60 DAS, G3: Mepiquat chloride application 20g *a.i.*/ha at 60 DAS and 75 DAS). This treatment was replicated three times. To calculate the seed index, the weight of 100 cotton seeds was randomly taken after ginning from each plot and expressed in grams. Total seed cotton harvested from all the picking (two) per plot and seed cotton yield in kg/ha was computed based on net seed cotton yield per plot. The total no. of bolls harvested per m^2 was calculated in each plot from five tagged plants by adding the mean number of good and bad opened bolls harvested per m^2. Five fully opened bolls from tagged plants in each plot were picked randomly and weighed and recorded as average boll weight per plant in grams.

The expenditure incurred on individual treatment was worked out from the detailed assessment of the fixed and variable costs involved such as land preparation, seed, plant protection, chemicals, and labor engaged in different operations. Gross income for all treatments was calculated separately taking into consideration the grain and seed yield of individual crop. Thereafter, net returns were calculated after subtracting the expenditure incurred on the individual treatment from the gross expenditure of the same treatment.

The benefit: cost ratio was calculated as follows.

$$B:C = \frac{\text{Gross return (Rs.ha}^{-1})}{\text{Cost of cultivation (Rs.ha}^{-1})}$$

RESULT AND DISCUSSION

YIELD ATTRIBUTES AND YIELD

Number of bolls/m^2 was high at 150% and 125% RDF than 100% RDF. This is due to preventing the abscission of squares and bolls [5]. A number of bolls/m^2 was significantly higher with spraying mepiquat chloride twice at 60 and 75 DAS compared to control. This was due to reduction in the abscission of buds and bolls. Mepiquat chloride completely counteracts the effect of abscisic acid and thus reduces the shedding of reproductive structures over control. Similar results were observed by Joseph and Johnson [6].

Higher boll weights were recorded with 150% and 125% RDF. It might be due to increased nitrogen fertilizer rate and increased leaf photosynthetic rate which might have resulted from a higher accumulation of metabolites thus impacting boll weight [7]. There was no difference observed in the weight of the boll due to mepiquat chloride application.

Higher seed cotton yields (3450 kg/ha) were obtained with the application of nitrogen at 150% RDF. The substantial increase in seed cotton yield due to the application of higher levels of nitrogen might be due to the favorable effect of nitrogen on growth attributes like increased number of bolls per plant, dry matter accumulation per plant and its subsequent translocation towards sink improved the seed cotton yield [8], [9]. Seed cotton yield was significantly higher (3531kg/ha) with two sprays of mepiquat chloride at 60 and 75 DAS when compared to a single spray 60 DAS (3442 kg/ha) and control (3338 kg/ha). The seed cotton yield depends on the accumulation and partitioning of photo assimilates in reproductive parts of the plant [10], [11].

Seed index is significantly high with 100% RDF. The increase in seed index may be due to enhanced photosynthetic activity, as N is an essential component of chlorophyll [12]. The application of MC significantly increased the seed index compared with the control. It has been reported that bolls on cotton treated with MC have larger photosynthetically supplied sinks for carbohydrates and other metabolites than untreated bolls.

ECONOMICS

The highest gross and net return was recorded with 150% RDF level of nitrogen followed by 125% RDF and 100% RDF. It is mainly due to higher seed cotton yield and seed index. Higher returns due to increased yield levels at higher application of nitrogen [13].

Among spraying of mepiquat chloride higher gross returns and net returns were recorded with two sprays of mepiquat chloride (Rs.1,87,138/ha& 95,850/ha) followed by single spray (Rs 1,82,457/ha&Rs 92,473/ha) and control (Rs 1,66,902/ha &Rs 88,364/ha). This was mainly because of higher seed cotton yield with the growth regulator application. The B:C was greater with growth regulator compared to the control.

Table-1 Effect of different nitrogen levels and mepiquat chloride dose on yield and yield attributes of Bt cotton hybrid.

Treatment	Seed cotton Yield(kg/ha)	No of bolls/m^2	Boll wt (g)	Seed index (g)
Nitrogen levels				
N_1 (100% RDF)	3421	56	4.49	11.4
N_2 (125% RDF)	3440	57	4.51	10.38
N_3 (150% RDF)	3450	57	4.63	10.42
SEm±	25	3	0.1	0.04
CD at 5%	NS	NS	NS	0.11
Mepiquat chloride dose				
G_1 (Control)	3338	50.9	4.52	9.4
G_2 (MC@ 20g a.i./ha at 60 DAS)	3442	58.6	4.61	11
G_3 (MC@ 20g a.i./ha at 60 and 75 DAS)	3531	61.1	4.5	11.8
SEm±	25	3	0.1	0.04
CD at 5%	75.57	7.8	NS	0.11

Table- 2 Effect of different nitrogen levels and mepiquat chloride dose on the economics of Bt cotton hybrid.

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C
Nitrogen levels				
N_1 (100% RDF)	79108	144318	65210	1.8
N_2 (125% RDF)	88475	190320	101845	2.1

N_3 (150% RDF)	91217	199850	108663	2.2
Mepiquat chloride				
G_1 (Control)	88538	166902	88364	1.8
G_2 (MC@ 20g a.i./ha at 60 DAS)	89964	182437	92473	2.1
G_3 (MC@ 20g a.i./ha at 60 and 75 DAS)	91298	187138	95850	2.1

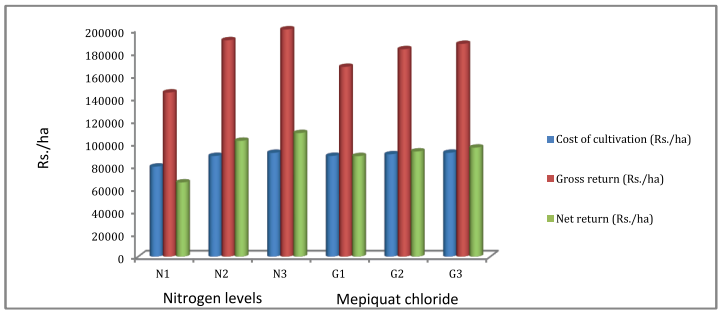

Fig-1 Effect of different nitrogen levels and mepiquat chloride dose on the economics of Bt cotton hybrid.

CONCLUSION

Based on the above data it may be concluded that seed cotton yield (kg/ha), no. of bolls/m^2 and boll weight (g) were significantly at par with all levels of nitrogen. The seed index was significantly higher with 100% RDF. Twice spray of mepiquat chloride (20g *a.i./*ha) at 60 and 75 DAS recorded maximum boll weight which enhanced the seed cotton yield.

ACKNOWLEDGMENTS: This research received no specific grant from any funding agency or the commercial or not-for-profit sectors. We thank Dr. Karmal Singh and Priyanka Devi for their helpful involvement in this work.

CONFLICT OF INTEREST: The authors declare no competing interests.

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