International Journal of Environment and Climate Change

Volume 13, Issue 10, Page 2252-2260, 2023; Article no.IJECC.105790
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Different Doses and Scheduling Time of Plant Growth Regulators and Defoliants on Growth and Yield of Cotton (*Gossypium hirsutum* L.) under High Density Planting System

M. Priyadarshini [a++*], G. Santhosh kumar [b#], U. Nagabhushanam [c†] and K. Pavan Chandra Reddy [d‡]

[a] Department of Agronomy, College of Agriculture, Rajendranagar, PJTSAU-500030, India.
[b] Agricultural College, Warangal, PJTSAU-506006, India.
[c] Rice Section, RARS Warangal, PJTSAU- 506006, India.
[d] Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, PJTSAU-500030, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i102888

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/105790

Original Research Article

Received: 20/06/2023
Accepted: 26/08/2023
Published: 05/09/2023

[++] P.G Scholar;
[#] Assistant professor;
[†] Principal Scientist;
[‡] Associate professor;
**Corresponding author: E-mail: priyadarshinimarka621@gmail.com;*

ABSTRACT

A field trial to determine the effect of different dosages, Scheduling time of plant growth regulators and defoliators on growth and yield of cotton under high density planting system was conducted at Regional Agricultural Research Station, Warangal during kharif-2022. The experiment consisted of eleven treatments laid out in Randomized Block Design with three replications. The treatment details were T_1: Application of Mepiquat chloride (M.C) 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 40 % boll burst, T_2: M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst, T_3: M.C 20, 30 g a.i ha^{-1} @ 40, 55 DAE respectively + Ethereal 2000 ppm @ 40% boll burst T_4: M.C 20, 30 g a.i ha^{-1} @ 40, 55 DAE respectively + Ethereal 2000 ppm @ 60% boll burst T_5: M.C 20 g a.i ha^{-1} @ 40,55 & 75 DAE+ Ethereal 2000ppm @ 40 % boll burst, T_6: M.C 20 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst, T_7: M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 40 % boll burst, T_8: M.C 25 g a.i ha^{-1} @ 40, 55 & 75 DAE+ Ethereal 2000ppm @ 60% boll burst, T_9: M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 and 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst, T_{10}: M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 and 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst and T_{11}: Control .(Water spray at 40, 55 and 70 DAE). Results revealed that foliar application of M.C @ 20 g a.i ha^{-1} @ 40, 55 & 70 DAE in conjunction with Ethereal 2000 ppm @ 60% boll burst recorded higher seed cotton yield. Plant growth, dry matter accumulation and stalk yield were recorded highest in control plot and lowest with spraying of M.C 20, 25 and 30 g a.i ha^{-1} @ 40, 55 and 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst. Among similar doses of Mepiquat chloride, all the agronomic traits of cotton crop are positively influenced with application of 2000 ppm Ethereal @ 60% boll burst. The spraying of M.C @ 20 g a.i ha^{-1} at 40, 55 and 70 DAE + Ethereal 2000 ppm @ 60% boll burst would be economically ideal to the farming community.

Keywords: Active ingredient; defoliators; drymatter production; ethereal; Gossypium hirsutum; harvest index; mepiquat chloride; plant growth regulators.

ABBREVATIONS

AI : Active ingredient
MC : Mepiquat Chloride
HI : Harvest index
ha^{-1} : per Hectare
ha : Hectare
HDPS : High density planting system

1. INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important cash crop of the world. Because of its great contribution to Indian agriculture in terms of employment generation, industrial development and national economy it is reffered as "King of fibres" [1]. According to 2021-22 data global area under cotton is 32.7 million ha with production of 121.6 million bales, where each bale weighs 217.72 kgs [2]. During 2021-22 in India the cotton area, production and productivity projected as 12,371 thousand ha, 31,117 thousand bales of each 170 kgs, 428 kg ha^{-1} [3] In Telangana, in 2021-22 it was recorded that area under cotton is 18.89 Lakh ha, production of cotton is 48.78 Lakh bales and Productivity of 439 kg ha^{-1} [4]. In Telangana, Nalgonda is leading district with area of 294074.18 ha under cotton cultivation.

Cotton progress depends on environment and seasonal practices, impacting growth, development, and yield. Maximizing cotton yield involves adjusting plant density per unit area, but it varies with cultivars used. Optimal plant spacing plays a pivotal role in adjusting plant density to enhance cotton productivity, particularly under irrigated conditions [5]. High density planting system (HDPS) of cotton is a method of cultivation, where the space between the rows and plants in a row is decreased in order to increase number of plants per unit area, which will result in more number of bolls per unit area and subsequent increase in yield. But the problem with HDPS is over crowding of plants causing excessively taller height, more vegetative growth; mutual shading which may intern leads to reduction in yield [6]. Thus plant growth regulators have to be applied to HDPS cotton which will reduce the plant height of cotton and helps in increasing productivity and profitability of the HDPS cotton. Mepiquat chloride (1,1-dimethyl-piperidinium chloride), a common plant growth regulator, is extensively employed to control cotton growth structure, modulate plant growth, and expedite maturation in conditions of high planting densities [7]. The application of growth regulators led to dose-dependent reductions in plant height, decreased height to node ratio, increased boll weight, and delayed maturity. Mepiquat chloride enhanced compactness and reduced nodes [8]. Environmental factors, notably temperature impact mepiquat chloride's influence on cotton potentially causing varied outcomes among different locations [9].

Plant defoliants are the chemicals which will promote the development of abscission layers in the leaf petioles, leading to the premature desiccation and shedding of foliage compared to its natural occurrence. They will reduce the trash content in the lint and enhance the lint quality. Defoliants are chemicals that modify plant metabolism, inducing leaf shedding. In agriculture, they clear crop leaves to ease harvesting. Ethylene-based agents promote leaf drop, synchronous boll opening, and sunlight exposure, readying cotton for mechanical harvest. Timely and precise defoliation is vital for a successful harvest [10]. Various defoliants including Dropp ultra, Ethereal, Nacl, Paraquat and Urea are employed in cotton at varying rates depending on environmental conditions and cultivar used. The experiement aimed to determine the effect of different dosages, Scheduling time of plant growth regulators and defoliators on growth and yield of cotton under high density planting system.

2. METHODS AND MATERIALS

Field experiment was conducted at RARS, Warangal during *kharif* - 2022 season. The experimental site is geographically located at 18^{o}10' N Latitude and 79^{o}59' E Longitude and at an altitude of 1200 mts above mean sea level, categorized under Central Agro Climatic Zone of Telangana.The soil of experimental site is clay loam in texture with nearly neutral pH in reaction(7.2), E.C (0.53 dsm^{-1}), low in organic carbon (0.43%), Low in available Nitrogen (209 kg ha^{-1}), Medium in available phosphorous (28 kg ha^{-1}) and potassium (334 kg ha^{-1}).

The experiment was laid out in a Randomized Block Design with eleven treatments. The treatment details are T_1: Application of Mepiquat chloride (M.C) 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 40 % boll burst, T_2: M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst, T_3: M.C 20, 30 g a.i ha^{-1} @ 40, 55 DAE respectively + Ethereal 2000 ppm @ 40% boll burst T_4: M.C 20, 30 g a.i ha^{-1} @ 40, 55 DAE respectively + Ethereal 2000 ppm @ 60% boll burst T_5: M.C 20 g a.i ha^{-1} @ 40,55 & 75 DAE+ Ethereal 2000ppm @ 40 % boll burst, T_6: M.C 20 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst, T_7: M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 40 % boll burst, T_8: M.C 25 g a.i ha^{-1} @ 40, 55 & 75 DAE+ Ethereal 2000ppm @ 60% boll burst, T_9: M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 and 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst, T_{10}: M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 and 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst and T_{11}: Control .(Water spray at 40, 55 and 70 DAE). The treatments were sown at a spacing of 80×20 cm on 25/06/2022. Recommended dose of fertilizers was 120-60-60 NPK kg ha^{-1} through urea, di ammonium phosphate, muriate of potash. Adequate plant protection measures were taken as per requirement. Randomly 5 plants were selected in net plot and tagged them to record biometric observations (non-destructive sampling). Plant height of those 5 plants was recorded at 30, 60, 90, 120 and at Harvest stage and were averaged. 3 plants from gross plot, were selected and removed for recording drymatter accumulation and were averaged (destructive sampling).

During crop growing season most of the rainfall occurred during the months of June (102.6 mm), July (444.8 mm), August (397.3 mm), September (184.8 mm) and October (93.6 mm) in 4, 21, 16, 9 and 7 rainy days, respectively. The rainfall of 1223 mm was received during 57 rainy days during the entire crop growth period. The mean maximum temperature and minimum temperature recorded was 30.6^{o}C and 21.7^{o}C, respectively.

Similarly, stalk yield and seed cotton yield were taken for m^2 area, and was calculated to kg ha^{-1}. The harvest index was calculated as the ratio of economic yield to biological yield, following the method proposed by Donald in 1962. The formula for calculating the harvest index is as follows:

$$\text{Harvest index} = \frac{\text{Economic yield}^*}{\text{Biological yield}^{**}} \times 100$$

*Seed cotton yield
**Seed cotton yield + Stalk yield.

All the growth parameters and yield recorded in the study were conducted statistical analysis by using OPSTAT for randomised block design. Where all the parameters were tested (F-test) at five percent probability level. Treatments showing no significant differences were denoted as "NS" (non-significant). In cases where significant difference observed, critical difference values were mentioned in the table. Statistical analysis was done according to Gomez and Gomez [11].

3. RESULTS AND DISCUSSION

3.1 Effect of Mepiquat chloride and Ethereal on Initial and final plant population (No. ha^{-1})

Results relating to initial and final plant population as influenced by different doses and scheduling time of Mepiqaut chloride (M.C) and Ethereal under HDPS was represented in the Table 1**.** Plant population was not significantly differed among treatments. However, final plant population was found to be reduced in all the treatments over initial plant population due to heavy rainfall during early crop growth stages, plants lost during intercultural operations and dry matter collection.

3.2 Effect of Mepiquat Chloride and Ethereal on Growth Parameters

Plant height has importance as it shapes node and internode structure enabling the growth of essential sympodial branches that impact productivity. Table 2 displays plant height data across growth stages i.e., 30, 60, 90, 120 days after sowing (DAS) and at harvest. At 30 DAS, plant height was not significantly differed among treatments. However from 60 DAS to harvesting stage there was a significant effect of Mepiquat chloride and Ethereal on plant height. As application of plant growth regulators stopped at 75 DAE, a consistent pattern of change in plant height was observed from 90 DAS to until harvest. At harvest control treatment showed highest plant height (121.73 cm), while lowest plant height was recorded with (T_{10}) M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst (95.3cm). Similar results were observed by Priyanka et al. [12], Khetre et al. [13] and Collins et al. [14].

Mepiquat chloride is a growth regulator used in cotton, which hinders the biosynthesis of gibberellic acid within the plant. Gibberellic acid is a key regulator of cell elongation and division, primarily responsible for stem elongation. Inhibition of gibberellic acid counters the elongation effect, resulting in shorter stems and overall reduced plant height [15] and Rademacher [16]. Among similar Mepiquat chloride treatments application of 2000ppm Ethereal at 40% boll burst resulted in lowest plant height compared to application of 2000ppm Ethereal at 60% boll burst. This might be due to the reason that use of defoliants at early stages, potentially promoted the accelerated shedding of leaves, leading to a decrease in the absorption of photosynthates and ultimately causing a reduction in the height of the plants. Similar results were observed by Sravanthi. [10], Kulvir and Pankaj [17], Singh et al. [18] and Mrunalini et al. [19].

Drymatter production serves as the foundation for plant growth, development and yield. The use of plant growth regulators impacted the accumulation of dry matter and its accumulation was influenced by various dosages and time of application of Mepiquat chloride and various stages of application of Ethereal (Table 3). However dry matter accumulation followed same trend as plant height from 90 DAS to till harvest of the crop. At harvest control treatment was superior (5988 kg ha^{-1}) out performed other treatments in drymatter accumulation and lowest figure was recorded with the application of M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 40% boll burst (T_9) (4220 kg ha^{-1}). Similar findings were noted by Priyanka et al. [12], Kaul et al. [20] and Paslawar et al. [21]. The decrease in the accumulation of drymatter production could be because of both the observed decline in plant height and the disruption in the source sink relationship resulting from the application of Mepiquat chloride Priyanka et al. [12].

Significant enhancement in drymatter was observed when defoliants were applied at a later stage compared to their early application. Delaying the defoliation process enabled increased carbon assimilation and the allocation of photosynthates towards the growth of cotton bolls and greater biomass accumulation. These findings align with the outcomes as reported by Kulvir et al. [17], Mrunalini et al. [19] and Sravanthi et al. [10]. The decrease in the drymatter accumulation over control as effected by different Mepiquat chloride and Ethereal treatments was depicted in the Fig. 1 where reduction in plant dry matter ranged from 11.82% with Spraying of M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst, T_3: M.C 20 g a.i ha^{-1} @ 40 DAE (T_2) to 29.5% in

Spraying of M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst (T_9).

3.3 Effect of Mepiquat Chloride and Ethereal on Yield

Results in Table 3 showed highest seed cotton yield with spritzing of M.C 20 g a.i ha^{-1} @ 40, 55 & 75 DAE + Ethereal 2000 ppm @ 60% boll burst (T_6) (3264 Kg ha^{-1}) and lowest in the control treatment (T_{11}) (2262 Kg ha^{-1}). According to Patel et al. [22], Brar et al. [23].). Application of higher doses of M.C at higher no of doses resulted in higher seed cotton yield. In contrary to them here application 20 g of a.i ha^{-1} at 3 stages resulted in higher economic yield, this might be due to higher level of hindrance to gibberellin synthesis at higher doses of M.C, which inturn resulted in very low vegetative growth, which is necessary to support reproductive growth.

This could be due to the better partitioning of photosynthates to reproductive plant parts. In cotton excessive vegetative growth occurs at the cost of economic yield, application of Mepiquat chloride regulates the excessive vegetative growth and resulted in more number of yield components and highest seed cotton yield Uma et al*.* [1]. Application of M.C 20 g a.i ha^{-1} resulted in higher yields, this might be due higher level of hindrance to Gibberelin synthesis at high doses of M.C.

Among the different stages of spraying of 2000ppm of Ethereal at 60% boll burst resulted in higher seed cotton yield compared to Ethereal application at 40% boll burst stage. This could be due to early leaf defoliation that adversely affect all agronomic characteristics of crop, on contrary application of defoliators at correct time preferably not before 60% boll burst allowed the crop to adequately partition the carbohydrates which ultimately resulted in higher yields. Similar results were observed with Sravanthi et al*.*, [10], Raghavedra and Rama (2020) and Singh et al [18].

Results in Table 4 showed highest stalk yield in control (T_{11}) treatment (6673.33 Kg ha^{-1}) and lowest in (T_{10}) M.C application of 20,25 and 30 g a.i ha^{-1} @ 40,55 and 60 DAE + Ethereal 2000ppm @ 60% boll burst due to the reduction in plant height accompanied by diminished accumulation of dry matter. Similar outcomes were noticed by Priyanka et al*.* [12] and Patel et al*.* [22]. Stalk yield varied with stage of application of Ethereal, among both stages i.e., 40% , 60% boll burst stages such that application of Ethereal at 60% boll burst resulted in higher stalk yield in all of M.C applied treatments [24-26].

Delayed defoliation would facilitate time for more carbon accumulation and better partitioning of photo assimilates to all the plant parts and similar results were observed by Sravanthi et al*.* [10] and Mrunalini et al*.* [19]. Higher Harvest index was observed with with T_6 (M.C 20 g a.i ha^{-1} @40,55 & 75 DAE application + Ethereal 2000ppm spraying @40% boll burst) (36.89) and lowest recorded with control (25.28). Priyanka et al., [12] found similar outcome [27-30].

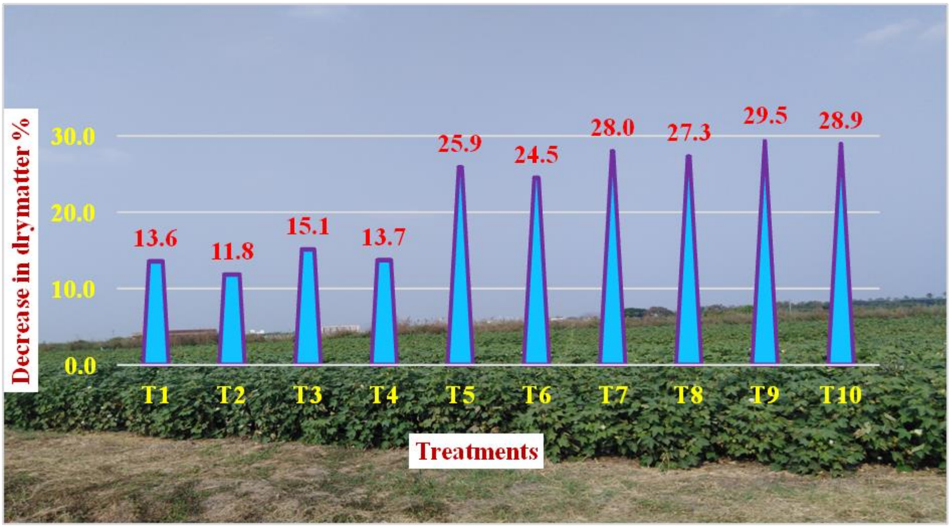

Fig. 1. Change in dry matter of cotton as influenced by different doses and Scheduling time of Mepiqaut chloride and Ethereal under HDPS

Table 1. Initial and Final population (No. ha^{-1}) of cotton as influenced by different doses and Scheduling time of Mepiqaut chloride and Ethereal under HDPS

S. No	Treatments	Initial	Final
T_1	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 40 % boll burst	61771	59271
T_2	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst	61354	59271
T_3	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 40 % boll burst	61458	59375
T_4	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 60 % boll burst	61354	58854
T_5	M.C 20 g a.i ha^{-1} @ 40, 55 &70 DAE + Ethereal 2000 ppm @ 40 % boll burst	61563	59201
T_6	M.C 20 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst	61458	59375
T_7	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 40 % boll burst	61979	59757
T_8	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst	61250	58750
T_9	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst	61563	59479
T_{10}	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst	61458	59375
T_{11}	Control (Water spray @ 40, 55 & 70 DAE)	61667	59167
SEm ±		316	350
C.D (P=0.05)		NS	NS

NS- Non significant; C.D -Critical difference; SEm – Standard error of mean

Table 2. Plant height (cm) of cotton as influenced by different doses and Scheduling time of Mepiqaut chloride and Ethereal under HDPS

S. No	Treatments	Plant height (cm)				
		30 DAS	**60 DAS**	**90 DAS**	**120 DAS**	**at Harvest**
T_1	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 40 % boll burst	11.11	19.18	58.00	99.27	110.20
T_2	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst	11.40	19.17	59.23	100.07	110.37
T_3	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 40 % boll burst	10.83	21.26	56.40	97.73	109.97
T_4	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 60 % boll burst	11.79	21.90	57.73	98.23	109.30
T_5	M.C 20 g a.i ha^{-1} @ 40, 55 &70 DAE + Ethereal 2000 ppm @ 40 % boll burst	11.59	21.24	52.60	87.20	99.07
T_6	M.C 20 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst	11.76	21.19	53.07	88.00	98.83
T_7	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 40 % boll burst	11.23	19.39	50.77	86.20	97.20
T_8	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst	10.62	19.37	51.90	87.53	96.90
T_9	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst	11.60	20.77	48.50	84.00	95.87
T_{10}	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst	11.14	20.64	49.77	85.07	96.23
T_{11}	Control (Water spray @ 40, 55 & 70 DAE)	10.93	27.31	66.43	112.70	121.73
SEm ±		**0.30**	**0.85**	**0.94**	**4.05**	**3.70**
C.D (p=0.05)		**NS**	**2.50**	**2.8**	**11.95**	**10.93**

Table 3. Drymatter production (kg ha^{-1}) of *Bt* cotton as influenced by different doses and Scheduling time of Mepiqaut chloride and Ethereal under HDPS.

S. No	Treatments	Drymatter production				
		30 DAS	60 DAS	90 DAS	120 DAS	at Harvest
T_1	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 40 % boll burst.	116	1931	3480	4220	5176
T_2	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst.	121	1932	3516	4300	5280
T_3	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 40 % boll burst.	119	2176	3294	4069	5082
T_4	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55DAE + Ethereal 2000 ppm @ 60 % boll burst.	122	2196	3360	4184	5167
T_5	M.C 20 g a.i ha^{-1} @ 40, 55 &70 DAE + Ethereal 2000 ppm @ 40 % boll burst.	120	2168	2804	3558	4438
T_6	M.C 20 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst.	109	2162	2851	3605	4522
T_7	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 40 % boll burst.	115	1946	2688	3399	4312
T_8	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst.	116	1955	2735	3494	4354
T_9	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst.	119	2149	2599	3310	4220
T_{10}	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst.	123	2137	2638	3363	4256
T_{11}	Control (Water spray @ 40, 55 & 70 DAE)	125	2554	4232	5012	5988
SEm ±		**5**	**79**	**220**	**235**	**238**
C.D (p=0.05)		**NS**	**223**	**650**	**692**	**701**

Table 4. Yield of cotton as influenced by different doses and scheduling time of Mepiqaut chloride and Ethereal under HDPS

S. No	Treatments	Seed Cotton Yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest Index (%)
T_1	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 40 % boll burst	2857	6028	31.87
T_2	M.C 25 g a.i ha^{-1} @ 40 & 55 DAE + Ethereal 2000 ppm @ 60 % boll burst	2883	6071	32.23
T_3	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 40 % boll burst	2713	5923	31.24
T_4	M.C 20 g a.i ha^{-1} @ 40 DAE and 30 g a.i ha^{-1} at 55 DAE + Ethereal 2000 ppm @ 60 % boll burst	2744	5982	31.24
T_5	M.C 20 g a.i ha^{-1} @ 40, 55 &70 DAE + Ethereal 2000 ppm @ 40 % boll burst	3230	5421	37.32
T_6	M.C 20 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst	3264	5408	37.62
T_7	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 40 % boll burst	3114	5362	36.67
T_8	M.C 25 g a.i ha^{-1} @ 40, 55 & 70 DAE + Ethereal 2000 ppm @ 60 % boll burst	3141	5352	36.86
T_9	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 40 % boll burst	3022	5306	36.08
T_{10}	M.C 20, 25, 30 g a.i ha^{-1} @ 40, 55 & 70 DAE respectively + Ethereal 2000 ppm @ 60 % boll burst	3043	5317	36.24
T_{11}	Control (Water spray @ 40, 55 & 70 DAE)	2262	6673	25.28
SEm ±		**113**	**203**	**1.07**
C.D (p=0.05)		**334**	**599**	**3.16**

4. CONCLUSION

Applying higher doses of Mepiquat chloride at 3 stages resulted in lowest plant height, drymatter production and stalk yield. However, higher economic yield was recorded with spraying of Mepiquat chloride @ 20 g a.i ha^{-1} at 40, 55 and 70 DAE + Ethereal 2000 ppm @ 60 % boll burst. Spraying of Ethereal 2000 ppm at 60 % boll burst resulted in superior agronomic characteristics and yield.

ACKNOWLEDGEMENT

I would like to express my gratitude to Mrs. B. Madhavi for the invaluable assistance provided in data collection, data analysis, and manuscript writing. I wish to extend my sincere thanks to RARS, Warangal for providing fund during entire experimental period.

COMPETING INTERESTS

Authors have declared that no competing interests exists.

REFERENCES

1. Uma Maheswari, Murali M, Krishnasamy S. Effect of crop geometries and plant growth retardants on physiological growth parameters in machine sown cotton. Journal of Pharmacognosy and Phytochemistry. 2019;8(2):541-545.
2. Available: www.pjtsau.edu.in cotton outlook January-2022
3. Available: www.indiastat.com
4. Available: Aicrp on cotton- 2022; www.aiccip.cicr.org.in
5. Zaman I, Ali M, Shahzad K, Tahir MS, Matloob A, Ahmad W, Alamri S, Khurshid MR, Qureshi MM, Wasaya A, Baig KS. Effect of plant spacings on growth, physiology, yield and fiber quality attributes of cotton genotypes under nitrogen fertilization. Agronomy. 2021;11(12):2589.
6. Priyanka, K, Rekha MS, Lakshman K, Rao CS. Influence of plant growth regulators in cotton under HDPS. The Pharma Innovation Journal. 2021;10(7):329-331.
7. Stuart et al. Cited but not listed; 1984.
8. Reddy DN, Baker, Hodges HF. Temperature and mepiquat chloride effects on cotton canopy architecture. Agronomy Journal. 1990;82:190-195.
9. Rosolem CA, Oosterhuis DM, Souza FSD. Cotton response to mepiquat chloride and temperature. Scientia Agricola. 2013;70: 82-87.
10. Sravanthi S, Rekha MS, Venkateswarlu B, Rao CS, Jayalalitha K. Effect of defoliants on percent defoliation and yield of American cotton (*Gossypium hirsutum*). Research on Crops. 2022;23(2):458-465.
11. Gomez KA, Gomez AA. Statistical Procedures for Agriculture Research, 2nd Ed. John Willey and Sons, New York.1984: 680.
12. Priyanka et al Cited but not listed; 2022.
13. Khetre OS, Shinde VS, Asewar BV, Mirza, IAB. Response of growth and yield of Bt cotton to planting densities as influenced by growth regulators. International Journal of Chemical Studies. 2018;*6*(4):485-488.
14. Collins GD, Edmisten KL, Wells R, Whitaker JR. The effects of mepiquat chloride applied to cotton at early bloom and physiological cutout. Journal of Cotton Science. 2017;21(3):183-189.
15. Suttle JC. Involvement of ethylene in the action of the cotton defoliant thidiazuron. Plant Physiology. 1985;78: 272–276.
16. Rademacher Cited but not listed; 2000.
17. Kulvir S, Pankaj R, Singh K. Dose and time dependent efficacy alteration of different defoliants on seed cotton yield. Journal of Environmental Biology. 2015; 36:891-895.
18. Singh K, Singh HP, Rathore P, Singh K, Mishra SK. Manipulations of source sink relationships through mepiquat chloride for enhancing cotton productivity and monetary returns in north western India. J. Cotton Res. Dev. 2017;31(1):62-68.
19. Mrunalini K. Sree Rekha, Murthy M, V.R.K, Jayalalitha K. Impact of harvest-aid defoliants on yield and economics of high-density cotton. Indian Journal of Agricultural Research. 2019;53(1):116-119.
20. Kaul A, Deol JS, Brar AS. Response of different Bt cotton (*Gossypium hirsutum L.*) hybrids to canopy modification practices. Journal of Applied and Natural Science. 2016;*8*(3):1188-1197.
21. Paslawar AN, Meena AK, Deotalu AS, Bhale VM, Ingole PG, Rathod TH. Foliar application of mepiquat chloride under high density planting system on different species of cotton. National Symposium on Future Technologies: Indian cotton in the

next decades at Acharya Nagarjuna University, Guntur 2015;17-19.

22. Patel BR, Chaudhary PP, Chaudhary MM, Reddy TV. Effect of mepiquat chloride on yield attributes, yield and economics of Bt cotton under high density planting system; 2021.
23. Brar HS, Kumar D, Singh P. Dataset of source-sink manipulation through growth retardant for enhancing productivity and profitability of cotton in north west, India. Data in brief. 2020;31:105914.
24. Kadiyam Priyanka. Performance of Cotton (*Gossypium hirsutum* L.) under HDPS to various plant growth regulators, Msc (Agri) Thesis, ANGRAU, Guntur, Andhra Pradesh; 2021.
25. Kataria GK, Khanpara MD. Effect of cycocel and mepiquat chloride on physiology, growth and yield of irrigated Bt cotton (*Gossypium hirsutum L.*). International Journal of Scientific Research. 2012;1(1):90-91.
26. Nawalkar DP, Ban YG, Kumar V. Influence of ethylene and maleic hydrazide on morpho- phonological events and yield in cotton hybrids. Research in Environment and Life Sciences. 2015;8(4): 697-700.
27. Raghavendra T, Reddy YR. Efficacy of defoliants on yield and fibre quality of American cotton in semi-arid conditions. Indian Journal of Agricultural Research. 2020;54(3):404-407.
28. Snipes CE, Baskin CC. Influence of early defoliation on cotton yield, seed quality, and fibre properties. Field Crop Research. 1994;37:137- 143.
29. Sravanthi. Studies on defoliants in High density planting cotton- green gram sequence, PhD thesis, ANGRAU, Guntur, Andhra Pradesh; 2020.
30. Subbiah BV, Asija GL. A rapid procedure for the determination of available nitrogen in soil. Current Science. 1956;25:259-260.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/105790