**Evaluating the Efficacy of Mepiquat Chloride Application on Morpho-Physiological and Quality Traits of cotton (*Gossypium hirsutum* L.) Under Varying Plant Spacings**

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**Evaluating the Efficacy of Mepiquat Chloride Application on Morpho-Physiological and Quality Traits of cotton (*Gossypium hirsutum* L.) Under Varying Plant Spacings**

**ABSTRACT**

Cotton (*Gossipium hirsutum* L.) is essential fiber containing commercial crop of the world. It also plays pivotal role in the economy of Pakistan and growth of textile industry. Morphological and physiological characters of cotton are affected by the growth patterns and cultivation methods. Excessive vegetative growth of its plant leads to low yield through suppression of reproductive growth. A plant growth regulator, Mepiquat chloride regulates the vegetative progression of cotton and enhances the reproductive growth. Similarly, wise plant spacing improves planting density and performance of physiological attributes of plants. The proposed field trial was laid out at research area of Department of Agronomy, University of Agriculture Faisalabad during 2019. The research trial was conducted in Randomized Complete Block Design (RCBD) under split plot arrangement with three replications. Sowing was done on May 25, 2019. Treatments comprised of two factors, levels of mepiquat chloride (0, 30, 60, 90, 120 g ha-1) and plant spacing (23 cm and 30 cm). Growth, yield and lint in cotton were positively affected by plant spacing. Mepiquat chloride helped the plant to achieve desirable plant height thus reducing the negative impacts linked with excessive vegetative growth. Level of 120 g ha-1 proved best for the growth of plant. Among physiological characters nitrogen contents (%), chlorophyll a and b contents (mg g-1) and relative water contents (%) were increased by increasing levels of MC regardless of plant spacing. Benefit cost ratio (BCR) of 3.25 at 120 g ha-1 under plant spacing of 30 cm showed higher economic impact over other treatments.

**Key words:** Cotton, *Gossipium hirsutum* L., Mepiquat chloride

**Introduction**

Cotton (*Gossypium hirsutum* L.) is a miraculous fiber crop and no other crop has competition ability with it even after 8000 years. Due to its versatile uses, cotton provides thousands of beneficial goods and also a big source of many jobs from field to industry. Many cultivars are now available to farmers and they can choose from different varieties of cotton according to their environment and cultural conditions. However the cotton production is being declined since last decade due to unfavorable conditions, uncontrolled insects and pests, low water availability and excessive vegetative growth. Because of these reasons farmers depend on plant regulators that induces growth for example mepiquat-chloride especially to contest in extensive growth of vegetative parts. Mepiquat-chloride (1, 1-dimethylpiperidinium chloride), a regulator for plants growth that suppress the growth of vegetative parts of cotton and modifies the configuration of assimilate segregating towards reproductive parts, nutrient uptake and their translocation (Gwathmey and Clement, 2010). It modifies plant structural design by decreasing the leaf area, length of internodes, increases the penetration of light and use efficacy and promotes setting of bolls at inferior sympodial twigs results increased yield of cotton (Mao *et al.,* 2014).

Mepiquat-chloride improves the uptake of nutrients and segregating to reproductive parts by increasing the growth of cotton roots due to greater lateral roots and promotes size of sink (Sawan, 2013). It also increase the seed and fiber quality by enhancing the retention of 1st bolls set. On the other hand, the betterment in quality of fiber has been found to be varying depending upon the dose and timing of the mepiquat-chloride (Ren *et al.,* 2013). Many strategies have been developed to apply mepiquat chloride for controlling the vegetative growth of cotton plant. Furthermore, MC increases transpiration, CO2 fixation, CO2 exchange of leaf, chlorophyll content and stomatal conductance (Zhao and Oosterhuis, 2000).

Establishing suitable cotton plant population is vital to get higher yield from cotton plant (Ali *et al.,* 2009). It is reported that by decreasing the plant spacing or increasing the density of planting increases the earliness by decreasing the days to flowering and squaring (Munir *et al.,* 2015). The planting density disturbs growth and development of plant, fiber quality and lint yield (Awan *et al.,* 2011). Additionally, fruit formation, structure of canopy, light interception and dry matter segregating to fruit changes with modifications in planting density (Wang *et al.,* 2011). Though, numerous studies have been described inconsistent outcomes refer to seed yield.

Planting technique is key factor that disturbs crop development and growth and lastly the yield of crop. Suitable plant density rely on cultivar type, planting time and environment. At very high planting density the retention of bolls reduced by covering of inferior plant canopy subsequently from higher index of leaf area (Jost *et al.,* 2006) whereas fiber quality characters are perpetually affected by the plant population and spacing (Awan *et al.,* 2011). Enhancement in quality and seed yield may happen at higher planting density but it needs better nutrient management and well canopy (Siebert *et al.,* 2006). Density of plant directly impacts the interception of radiation, availability of moisture, humidity and movement of wind that in response disturb the canopy-height, pattern of branching, yield, fruiting behavior and maturity of crop (Jahedi *et al.,* 2013).

The condition of field which yields plants with short stature can usually bear high plant density deprived of suffering significant reduction in yield (Hake *et al.,* 1991). Numbers of fruiting bodies (bolls, blooms and squares) and their position on plant can changed with density of plant (Kerby *et al.,* 1990). An optimistic connection between the plant height and plant density was described but opposite relation was detected between main stem nodes/plant and plant density, days after establishing to high bloom and retention of bolls (Siebert *et al*., 2006). In thick population of plant, improved interception of light is offset by capability of leaves of lower dence canopy to greater efficiently consume sun-light resultant in weak efficiency of use of radiations (Brodrick *et al.,* 2013). Improving earliness without the scarification of yield has been the objective in most of the cotton breeding agendas.

Though, early maturity of crop can be operated by the variety of managing factors comprising, nitrogen, cultivar, date of sowing, plant density, irrigation, growth regulators and insect control (Shah *et al.,* 2005). Early time maturity aids to fit the crop in dual patterns of cropping as in cotton growing territories of Pakistan, facilitates cotton crop to grow during the stages of greater satisfactory dampness circumstances, escape loss from insects injuries during the late season, minimizes the usage of pesticides and with many other inputs like fertilizer and water irrigation. Though, the prose on retort of local *Gossipium hirsutum* L. cultivars to diverse managing methods with objective to bring earliness is infrequent. The essence of *Gossipium hirsutum* L. crop administration is to have balance among reproductive growth and vegetative.

**MATERIALS AND METHODS**

The field work to check the effect of plant spacing in cotton under mepiquat application was conducted during 2019 at Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan. The design was Randomized Complete Blocked Design with Split plot arrangement. The treatments consist of two factors (Factor A: Plant spacing (PS) as main plot factor; Factor B: Mepiquat chloride (MC) as subplot factor) with three replications. Plot size was 15 m2 each with three rows being 75 cm wide. Seeds of variety FH-326 were sown at 23 cm and 30 cm apart as per treatment during May 2019. Standardized production measures were practiced all through the growing period. All the data was collected from 10 randomly nominated plants of individual plot.

The recommended amounts of nitrogen (N) 198 kg/ha, phosphorus 87 kg/haand potash 45 kg/ha were applies in Urea form, DAP and MOP correspondingly. Full dose of phosphorus and potash along with half Nitrogen was applied as basal dose whereas residual half Nitrogen were given after 30 days after sowing. Mepiquat chloride was foliar practiced three time with 5 leaf intervals from 6th leaf stage (at flowering, peak bloom and boll setting) in five different stages i.e. 0, 30, 60, 90 and 120 g/ha (Tung *et al*., 2019; Tung *et al*., 2018a, b).

At 60% of bolls opening the first harvest was done and the final harvesting was done at 90% of harvestable boll opening. For determination of yield component 100 g seed cotton was taken and 100 cotton seeds were also ginned. The observed parameters were plant height, no. of bolls/plant, bolls weight, seeds cotton yield/plant, seed index, lint index ginning out turn (GOT), total nitrogen contents (%), Chlorophyll a and Chlorophyll b. The data was collected as follows and their average values were calculated.

**Plant height (cm)**

Height of plant is basic architectural trait in the cotton that holds the canopy. It is linked with both the reproductive and vegetative characters of the plant so it is considered a key observation for estimation of plant growth and yield. The plant height was observed from ten randomly nominated plants, directly prior to 1st harvesting.

**Average boll weight (g)**

The weight of Boll is important yielding constituent and there is a positive correlation among boll weight and total seed cotton yield (Kaynak, 1995). The average boll weight was calculated in (g) by dividing the total seed cotton yield/plant over the number of opened bolls.

**Number of sympodial branches**

Number of sympodial branches/plant were observed by calculating the sympodial branches from the nominated plants of individual plot and average was taken.

**Seed cotton yield (g) per plant**

Seed cotton yield/plant is vital agronomic trait to be an initiative for economic analysis of the crop. Seed cotton was handpicked from selected plants of the plots and weighed by E-balance to determine the seed cottony yield/plant. Then the average values were taken.

**Ginning Out Turn (GOT) %**

Ginning out turn was recorded after ginning 10 g samples of seed lint from selected plants of each plot and ginning out turn was calculated by using the formula of (Singh, 2004).

**Chlorophyll a and b (mg g-1)**

Chlorophyll a is the reaction center’s pigment for photosynthesis in plants and converts solar energy into electrical energy for the photolysis of water molecules. Chlorophyll b play an important character in blue violet light absorbance that very crucial for the photosynthetic machinery in plant cells. It is very important for the light trapping ability of the plant (Wang *et al.,* 2011). Chlorophyll contents were analyzed spectro-photometrically (Zhao and Oosterhuis, 1998).

**Relative water content (%)**

Fresh leaf samples were collected from each plot at physiological cutout stage (terminal was 5 nodes upstairs to the topmost 1st position flower) and took their fresh weight using digital weight balance. Dipped the leaves in distilled water for 15-18 hours and then took their turgid weight. Sundried the leaf samples for 24 hours and placed them in oven for 24 hours at 72°C and took their dry weight. Finally, the total water content was measured using the following formula given by Barrs and Weatherly (1962).

**Total Nitrogen contents (%) of leaf with petiole**

Nitrogen is very essential nutrient in for crops like cotton because it is very important for certain metabolic processes occurring in the plant cells, photosynthetic activity especially, and for the transport of photosynthate towards the sink (Borowski, 2001). At physiological cutout phase the petiole and leaf samples were wash away using distilled H2O, dried in sunlight and after that dried by using oven having 70°C temperature till constant load and crushed by using electrical grinder and filtered through < 2mm filter. The 0.5 gram of sample was obtained processed through digestion, distillation and titration for determination of nitrogen concentration following the Kjeldhal method (Bremner, 1964).

**Quality parameters**

After seed cotton ginning from each of the nominated plants, ten gram lint sample from each of the nominated plants were obtained and kept for conditioning for 6 h with 65 to 68 percent relative humidity at 20°C in laboratory of Fiber Technology Department, University of Agriculture Faisalabad. After that quality parameters i.e. fiber length (mm), strength (g/tex), fineness (µg inch-1), elongation (%) and uniformity (%) were observed by using high volume instrument (HVI). Module-920 of HVI-900A provided the data to the CPU (Central Processing Unit of PC computer) for interpretation.

**Data analysis**

All the collected data was subjected to Fisher’s ANOVA (Statistics 8.1) and means were compared by Tukey’s HSD 0.05 probability. Percentage change (decrease or increase) were observed by comparison with control (without MC) plants.

**RESULTS AND DICUSSION**

Final plant height as significantly reduced by applied mepiquat chloride (Table 1.1). Minimum plant height was observed from plots with 120 g ha-1 MC and plots without MC were the tallest. Plant spacing didn’t affect plant height significantly but wide plant spacing caused compaction in plant structure that lead MC to significantly affect the plant height (Craig and Gwathmey, 2005). It was observed that maximum reduction in plant height under plant growth regulator was given by the most compact plants. This reduction was due to reduced height to node ratio. About 14-17% shorter plants were observed with MC as compared to those without PGR and similarly 11% reduction was observed by Cook and Kennedy (2000), 9% by Pettigrew and Johnson (2005) and 10.0-14.6% by Siebert and Stewart (2006).

Average boll weight was increased by increasing plant spacing (Table 1.1). The increment in harvestable bolls by MC and plant spacing affect the average weight of boll (Mao *et al.,* 2015). The rise in average weight of boll with increasing MC levels was suggested to be due to increase in reproductive growth pattern by MC (Zhao *et al.,* 2000) and improvement of spatial pattern due to difference in plant density by plant spacing (Negash *et al.,* 2015). No. of sympodial branches/plant was maximum (23.50) at MC5 (120 g ha-1) and minimum (16.17) in control (MC0) condition. Whereas plant spacing had no effect on it and their relations was also non-significant (Table 1.1). MC inhibits the endogenous gibberelic acid biosynthesis that results in inhibition of cell elongation through reducing cell wall plasticity (Yang *et al.,* 2014).

Table 1.2 showed significant effect of MC and plant spacing on seed cotton yield/plant and ginning out turn and the maximum values were 50.01 g ha-1 and 39.69% respectively observed by use of 120 g ha-1 MC under 30 cm plant spacing. These results were ascribed to the reason that MC reduced the abscisic acid and the hormone ethylene which in turn causes increase in boll retention and hence more heavy opened bolls. The results were accordingly observed by Ahmed *et al*. (2014) and El-Shahawy (1999). Karthikeyan and Jayakumar (2001) gave the similar results for cotton yield. It was suggested that the relocation of integrates between reproductive and vegetative patterns might be a reason that contributed to yield. Furthermore, change in maturity and fruit sharing pattern due to mepiquat chloride could also be the reason for increased yield (Biles and Cothren, 2001).

However the interactive effect of both the factors (MC×PS) showed inconsistent result as it was significant for ginning out turn but was not significant for seed cotton yield per plant. Plant spacing and the interaction of both (MC and plant spacing) was significant for ginning out turn (GOT) %. The highest (38.34 %) GOT was observed at MC4 (120g ha-1) with higher plant spacing i.e. 30 cm. The results were contradictory to the finding of Ali *et al.* (2009) who found insignificant effect of PS on GOT of cotton but had similar results as reported by Wilson *et al.* (2007) who observed increase in GOT with increasing levels of MC at higher plant spacing.

Among physiological characters, chlorophyll a (Table 1.2) and chlorophyll b (Table 1.3) content were increased by increasing MC doses but plant spacing had no effect on any of these characters and neither the interaction was significant. The results were same as reported by Zhao and Oosteruis (2000) and Tung *et al.* (2018) for chlorophyll contents. Water status of plant is very impotent for the stability of plant and for all the biosynthetic processes in plant. Relative water content holds the fresh weight of plant and keeps the water and solute as well as solvent potential balanced at all levels of plant organization. Data analysis showed that the relative water content was significantly affected by both MC and PS but the interaction was insignificant (Table 1.3). When Mathur *et al*. (2005) checked the similar results of plant growth inhibitor on Japanese Mint. Increased water contents might be due the increased water retention in fresh weight of plant and better root adsorption for water uptake till physiological cutout stage. Mepiquat chloride (MC) also had significant effect on total nitrogen contents of leaf with petiole but the plant spacing (PS) and interactive effect of MC and PS was found to be not significant for nitrogen contents (Table 1.3). Same results were reported by Mehasen et al. (2012) and Mahdi (2016) for MC but the exception exists for the results of plant spacing because Mahdi (2016) observed significant effect of wide plant spacing on nitrogen contents and chlorophyll contents. Zhao and Oosterhuis (2000) suggested that this increase could be due to high specific leaf weight because MC application regulates up the chlorophyll contents.

Quality parameters are very important character regarding fiber quality in cotton and are very useful for the textile industry. The outcomes revealed that the influence of MC on fiber length was significant but plant spacing and interaction was found non-significant (Table 1.4). Mean value for fiber length was found highest (28.90mm) at MC4 (120g ha-1).The results were similar to that of fiber length observed by Hussain *et al.* (2000) but there was exception for plant spacing as he observed significance effect of spacing for the fiber length. The strength of Fiber reveals the force in grams, needed to halt a bundle of fibers by one text unit in size, fastened in 2 sets of jaws (1/8 inch apart). Strength percentages are remunerated for readings above 29.4, whereas discounts are incurred for readings below 25.5. Sturdier threads provide stronger tales which increase productivity by increasing processing speed with less end breakages. Both the factor i.e. MC and plant spacing were insignificant for fiber strength (Table 1.4) and the results were contrary with the finding of Clawson *et al.* (2006) who found inconsistent effect of MC and PS on fiber strength.

Fiber fineness is the indirect measure of fiber maturity and fineness. Statistical values showed that the fiber fineness was significantly affected by both MC and PS but their interaction was not significant for it (Table 1.4) and the results were according to the findings of Sawan, (2013) for MC treated plant. Fiber elongation i.e. the length to strength ratio in cotton fiber was increased by 4% with increasing the level of MC from 0 to 120 g ha-1 (Table 1.5). Similar results were observed by Sawan *et al.* (2006). However, increase in fiber elongation is quite unpredictable under different levels of MC because it shows inconsistent results towards it (Stuart, 2005). Fiber uniformity is the percentage (ratio) between the 50% and 2.5% span length of fiber length. The studies revealed that the fiber uniformity was affected neither by mepiquat chloride (MC) and nor by plant spacing (PS) and even the interactive effect of MC and PS was not significant as found by Wilson *et al.* (2007) (Table 1.5).

***Table 1.1.*** Comparison of means for the effect of levels of mepiquat chloride on plant height (cm), average boll weight (g) and number of sympodial branches

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Plant height (cm) | | Average boll weight (g) | | Number of sympodial branches | |
| **Treatment** | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm |
| MC0 = 0 g ha-1 Mepiquat chloride | 123.76 ± 1.9 a | 118.72 ± 2.6 a | 2.61 ± 0.09 e | 2.67 ± 0.09 d | 16.3 ± 0.88 e | 16.0± 0.57 e |
| MC1 = 30 g ha-1 Mepiquat chloride | 120.26 ± 2.4 ab | 115.47± 2.4 b | 2.67 ± 0.10 d | 2.73 ± 0.11 c | 18.7 ± 0.88 cd | 17.3 ± 0.88 de |
| MC2= 60 g ha-1 Mepiquat chloride | 118.00 ± 2.3 c | 113.17 ± 2.4 c | 2.92 ± 0.04 c | 2.98 ± 0.05 bc | 20.0 ± 0.57 c | 19.3 ± 0.88 cd |
| MC3= 90 g ha-1 Mepiquat chloride | 109.33 ± 0.8 d | 108.17± 1.5 d | 3.12 ± 0.02 ab | 3.21 ± 0.02 a | 22.6 ± 0.88 ab | 21.0 ± 0.58 bc |
| MC4= 120 g ha-1 Mepiquat chloride | 105.33 ± 0.9 e | 105.00± 0.6 de | 3.20 ± 0.03 a | 3.28 ± 0.01 a | 23.0 ± 0.57 ab | 24.0 ± 0.57 a |
| HSD (0.05) Mepiquat chloride | 1.7331 | \*\* | 0.0617 | \*\* | 1.3145 | \*\* |
| HSD (0.05) Plant Spacing | 12.489 | Ns | 0.1357 | \* | 1.6497 | Ns |
| HSD (0.05) Interaction  Mepiquat chloride \* Plant Spacing | 2.3341 | Ns | 0.1798 | Ns | 2.3825 | Ns |

Means followed by the same letter were not significantly different by Honestly significant difference (HSD) test (*P*≤ 0.05 and *P* < 0.01)

***Table 1.2.*** Comparison of means for the effect of levels of mepiquat chloride on Seed cotton yield per plant, ginning out turn and Chlorophyll a

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Seed cotton yield per plant (g) | | Ginning out turn (%) | | Chlorophyll a (mg g-1) | |
| **Treatment** | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm |
| MC0 = 0 g ha-1 Mepiquat chloride | 20.0 ± 0.57 i | 24.0 ± 0.57 h | 30.000±0.5774 h | 33.00 ± 0.5774 g | 0.79 ± 0.09 h | 0.90 ± 0.25 f |
| MC1 = 30 g ha-1 Mepiquat chloride | 27.0 ± 0.57 g | 30.0 ± 0.57 f | 34.000 ± 0.5774 g | 36.000 ± 0.5774 f | 0.87± 0.13 g | 1.25 ± 0.13 e |
| MC2 = 60 g ha-1 Mepiquat chloride | 32.0 ± 0.57 e | 35.0 ± 0.57 d | 38.000 ± 0.5774 e | 40.00 ± 0.5774 d | 1.30 ± 0.07 d | 1.29 ± 0.17 d |
| MC3= 90 g ha-1 Mepiquat chloride | 36.0 ± 0.57 d | 40.0 ± 0.57 c | 40.000 ± 0.5774 d | 42.500 ± 0.5000 c | 1.42 ± 0.06 c | 1.75 ± 0.05 b |
| MC4 = 120 g ha-1 Mepiquat chloride | 43.0 ± 0.57 b | 50.0 ± 0.57 a | 46.000 ± 0.5774 b | 48.500 ± 0.50 a | 1.76 ± 0.27 b | 1.87 ± 0.21 a |
| HSD (0.05) Mepiquat chloride | 1.3145 | \*\* | 0.8605 | \*\* | 0.7253 | \*\* |
| HSD (0.05) Plant Spacing | 1.2690 | \*\* | 1.2982 | \*\* | 0.2984 | Ns |
| HSD (0.05) Interaction  Mepiquat chloride \* Plant Spacing | 1.9804 | \* | 1.8051 | \*\* | 0.7728 | Ns |

Means followed by the same letter were not significantly different by Honestly significant difference (HSD) test (*P*≤ 0.05 and *P* < 0.01)

***Table 1.3.*** Comparison of means for the effect of levels of mepiquat chloride on chlorophyll b, relative water content and total nitrogen content of leaf with petiole

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Chlorophyll b (mg g-1) | | Relative water content (%) | | Total nitrogen content of leaf with petiole (%) | |
| **Treatment** | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm |
| MC0 = 0 g ha-1 Mepiquat chloride | 1.38 ± 0.28 i | 0.92 ± 0.22 j | 61.71 ± 2.35 f | 67.95± 7.22 ef | 1.86 ± 0.28 d | 2.20 ± 0.40 cd |
| MC1 = 30 g ha-1 Mepiquat chloride | 1.62 ± 0.09 f | 1.43 ± 0.11 h | 68.54 ± 1.29 ef | 73.91 ± 1.40 cde | 2.43 ± 0.06 cd | 2.73 ± 0.66 bcd |
| MC2 = 60 g ha-1 Mepiquat chloride | 1.74 ± 0.17 e | 1.49 ± 0.16 g | 70.61 ± 0.72 de | 79.11 ± 1.82 bcd | 3.23 ± 0.43 bcd | 2.83 ± 0.20 bc |
| MC3= 90 g ha-1 Mepiquat chloride | 2.55 ± 0.11 b | 1.98 ± 0.03 d | 72.23 ± 1.01 cde | 84.15 ± 3.85 ab | 3.06 ± 0.66 bc | 4.15 ± 0.05 ab |
| MC4 = 120 g ha-1 Mepiquat chloride | 2.75 ± 0.22 a | 2.35 ± 0.02 c | 80.57 ± 3.54 abc | 88.85 ± 5.55 a | 3.90 ± 0.23 ab | 4.85 ± 0.15 a |
| HSD (0.05) Mepiquat chloride | 0.9050 | \*\* | 5.5523 | \*\* | 1.0186 | \*\* |
| HSD (0.05) Plant Spacing | 0.3456 | Ns | 6.2868 | \* | 0.7895 | Ns |
| HSD (0.05) Interaction  Mepiquat chloride \* Plant Spacing | 0.9523 | Ns | 9.3259 | Ns | 1.3497 | Ns |

Means followed by the same letter were not significantly different by Honestly significant difference (HSD) test (*P*≤ 0.05 and *P* < 0.01)

***Table 1.4.*** Comparison of means for the effect of levels of mepiquat chloride on fiber length, fiber strength and fiber fineness

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Fiber Length (mm) | | Fiber Strength (g/tex) | | Fiber Fineness (micronaire) | |
| **Treatment** | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm | Plant spacing 23cm | Plant spacing 30cm |
| MC0 = 0 g ha-1 Mepiquat chloride | 26.36 ± 0.08 cd | 26.56 ± 0.97 cd | 18.80 ± 0.45 a | 18.93 ± 1.38 a | 3.30 ± 0.05 e | 3.60 ± 0.05 efg |
| MC1 = 30 g ha-1 Mepiquat chloride | 27.40 ± 0.11 bcd | 27.80 ± 0.35 bc | 20.76 ± 1.26 a | 20.90 ± 1.78 a | 3.50 ± 0.05 fg | 3.86 ± 0.03 de |
| MC2 = 60 g ha-1 Mepiquat chloride | 27.80 ± 0.05 bc | 28.00 ± 0.10 bc | 22.03 ± 0.88 a | 22.00 ± 1.70 a | 3.80 ± 0.05 def | 4.03 ± 0.03 cd |
| MC3= 90 g ha-1 Mepiquat chloride | 28.33 ± 0.40 ab | 28.00 ± 0.10 b | 22.13 ± 2.03 a | 27.55 ± 0.05 a | 4.26 ± 0.08 bc | 4.35 ± 0.05 bc |
| MC4 = 120 g ha-1 Mepiquat chloride | 28.80 ± 0.51 a | 28.65 ± 0.55 ab | 22.90 ± 2.65 a | 24.85 ± 3.65 a | 4.56 ± 0.17 b | 5.35 ± 0.05 a |
| HSD (0.05) Mepiquat chloride | 2.3007 | \*\* | 4.9758 | Ns | 0.1250 | \*\* |
| HSD (0.05) Plant Spacing | 0.7995 | Ns | 4.6094 | Ns | 0.2303 | \*\* |
| HSD (0.05) Interaction  Mepiquat chloride \* Plant Spacing | 2.3900 | Ns | 7.3034 | Ns | 0.3109 | Ns |

Means followed by the same letter were not significantly different by Honestly significant difference (HSD) test (*P*≤ 0.05 and *P* < 0.01)

***Table 1.5.*** Comparison of means for the effect of levels of mepiquat chloride on fiber elongation and fiber uniformity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Fiber elongation (%) | | Fiber uniformity (%) | |
| **Treatment** | Plant spacing  23cm | Plant spacing  30cm | Plant spacing  23cm | Plant spacing  30cm |
| MC0 = 0 g ha-1 Mepiquat chloride | 7.96 ± 0.34 f | 8.33 ± 0.16 ef | 81.70 ± 1.90 a | 85.36 ± 0.34 a |
| MC1 = 30 g ha-1 Mepiquat chloride | 9.06 ± 0.08 def | 9.00 ± 0.05 def | 83.70 ± 1.55 a | 83.73 ± 1.26 a |
| MC2 = 60 g ha-1 Mepiquat chloride | 9.50 ± 0.20 cde | 9.70 ± 0.06 cd | 84.53 ± 0.53 a | 83.16 ± 0.96 a |
| MC3= 90 g ha-1 Mepiquat chloride | 10.10 ± 0.23 cd | 10.85 ± 0.15 bc | 84.56 ± 0.80 a | 83.55 ± 2.45 a |
| MC4 = 120 g ha-1 Mepiquat chloride | 11.53 ± 0.54 ab | 13.45 ± 1.35 a | 84.50 ± 0.30 a | 84.50 ± 1.10 a |
| HSD (0.05) Mepiquat chloride | 0.8318 | \*\* | 5.1519 | Ns |
| HSD (0.05) Plant Spacing | 0.9463 | Ns | 2.2089 | Ns |
| HSD (0.05) Interaction  Mepiquat chloride \* Plant Spacing | 1.4019 | Ns | 5.5324 | Ns |

Means followed by the same letter were not significantly different by Honestly significant difference (HSD) test (*P*≤ 0.05 and *P* < 0.01)

**CONCLUSION**

Growth, yield and lint in cotton were positively affected by plant spacing. Foliar applied mepiquat chloride helped in ameliorating the negative impacts of excessive vegetative growth and 120 g ha-1 of mepiquat chloride proved best in this regard.

**ACKNOWLEDGEMENT**

The research was supported by Department of Agronomy, University of Agriculture Faisalabad, Pakistan.

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