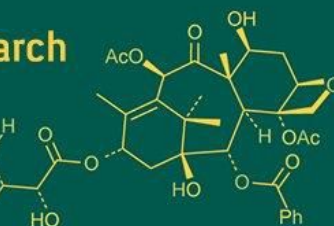
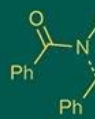
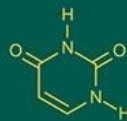
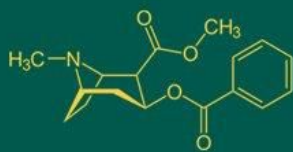


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Growth rates of *Bt* cotton (*Gossypium hirsutum* L.) hybrid RCH-659 as influenced by mulching and fertigation schedules

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Abstract

A field experiment was conducted to evaluate the effect of fertigation schedules and mulching on growth rates of *Bt* Cotton (*Gossypium hirsutum* L.) at Research Farm, Department of Agronomy, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif*, 2020-21. Split plot design with three replications was used to set up the experiment. The experiment comprised of sixteen treatment combinations, including four fertigation schedule treatments in the main plot and four mulching treatments in the sub plot. The gross and net plots measured 40.50 and 21.60 square meters, respectively. Each replication included a random distribution of the treatments. Increased fertilizer levels with fertigation scheduling caused the Absolute Growth Rate of plant height and dry matter to rise. Fertigation scheduling of 140:70:70 NPK kg ha⁻¹ resulted in increased AGR of plant height and dry matter at all stages. AGR for plant height was at its highest in silver polyethylene mulch (M₄) during all stages except at 91-120 DAS and 121-150 DAS whereas AGR for dry matter was found to be highest in silver polyethylene mulch (M₄) followed by application of black polyethylene mulch (M₃). The values of Relative Growth rate, Crop Growth Rate, Leaf Area Duration and Leaf Area Index were found maximum with fertigation scheduling of 140:70:70 NPK kg ha⁻¹ and application of silver polyethylene mulch (M₄).

Keywords: *Bt* cotton, fertigation, mulching, growth rates

Introduction

One of India's most significant cash crops and sources of fiber is cotton. It is crucial to the nation's industrial and agricultural economies. Since the beginning of the 21st century, Asian countries have experienced a faster increase in cotton production and processing than the rest of the world. In the inevitable future, too, the tendency is anticipated to continue. This crop is grown in around 80 different nations, although only six of them; China, India, The United States, Pakistan, Brazil, and Uzbekistan contribute to 85% of the world's supply. It is grown on 32.19 M ha worldwide, of which 12.95 M ha, or roughly 40% of the total, are in India (AICRP on Cotton, 2021) ^[1] during the 2020-21 growing season. India produces 371 lakh bales of cotton lint compared to the 1451 lakh bales produced globally. It is one of the few commodity crops that have a significant chance of bringing farmers, traders, and entire countries long-term success. The crop directly supports the lives of 6 million farmers nationwide. About 85% of the country's textile industry's raw materials come from there, and it also employs 70 million people (Khadi, 2009) ^[6]. Cotton export generates 760 billion in foreign currency, or one-third of the nation's overall foreign exchange revenues (Kranthi *et al.*, 2009) ^[7]. Cotton seed contains about 20% oil that is used as culinary oil and for soap making. Indian cotton production is barely 487 kg ha⁻¹, compared to a global average of 766 kg ha⁻¹. India's poor yields are primarily due to the 66 % of its land being used for cotton cultivation under rainfed conditions. The main states that grow cotton on a substantial scale are Maharashtra, Gujarat, and Telangana (68 per cent of the national area and 64 per cent production). With an area of 39.36 lakh hectares, or almost one third of the country's cotton area in 2021-22, Maharashtra state contributes to the largest area in the nation. Only 71.66 % (388 kg ha⁻¹) of the nation's productivity comes from the state's production, which amounts to 89.86 lakh bales (AICRP on Cotton, 2022) ^[2]. The Marathwada region has 12.85 lakh ha of cotton land and produced 19.64 lakh bales in the 2021-22 season with a meagre output

of 245 kg ha⁻¹.

In India, cotton production and productivity have considerably increased during the last few decades. India is the world's largest producer of cotton and second-largest exporter of the fiber. The largest cotton user worldwide is India. Major pests and diseases were the main obstacle to the growth in cotton production. The cotton boll worm is one of the most significant pests. In the current condition of cotton production, *Bt* cotton not only provided resistance to bollworms but also increased productivity, farmer income, ecological gain through reduced pesticide usage, and human benefit through low residual impacts on biological entities. The country's yield and productivity of *Bt* cotton are rapidly declining, primarily as a result of late sowing, unbalanced fertilizer use, and improper irrigation water management. The commercial distribution of *Bt* cotton hybrids signaled the start of the nation's transgenic era. This was made feasible by the introduction of the *Bt* gene in the *hirsutum* species of cotton to control bollworms, which was well-liked by farmers.

Bt cotton has significantly increased cotton productivity over the past ten years, mainly in irrigated areas. Drip irrigation can assist farmers in bringing more land under cotton irrigation while significantly increasing crop yields because *Bt* cotton performs better under irrigation than non-*Bt* cotton (Manjunatha *et al.*, 2010) [8].

Water and fertilizer are important factors in boosting *Bt* cotton yield. However, as fertilizer and water management have a significant impact on the profitability of cotton cultivation, farmers are becoming increasingly concerned about the growing prices for inputs such as fertilizers. The various agronomic approaches are just as crucial to increase cotton output as high yielding cultivars. Therefore, careful planning is required for the timing, amount, and application technique of both water and fertilizer. Using irrigation water as the transporter and distributor of plant nutrients, drip fertigation is an effective way to administer fertilizers that ensures precise and uniform distribution of nutrients close to the active root zone. Regarding farmers' adoption of fertilizer application methods, drip irrigation has grown significantly in popularity. This is because, in comparison to traditional irrigation and fertilizer application methods, a significant amount of irrigation water and nutrients are saved. However, it has been discovered that fertigation using liquid fertilizer or 100% water soluble fertilizer not only reduces the quantity of fertilizers applied, but also increases the efficacy of fertilizer application.

As a result, the cost of production is decreased, and ground water contamination is minimized, eliminating ecological disruptions and health hazards brought on by nitrate leaching and accumulation in deeper layers. Thus, fertigation could be a boon to Indian agriculture by enabling the effective use of expensive and limited fertilizers. In light of this, the current study was carried out to compare the growth rates of *Bt* cotton grown with water soluble fertilizers applied using drip fertigation. It's crucial to contrast various mulching techniques with fertigation as well. We compare it in order to provide farmers with a strong recommendation to conserve water while using fertilizers effectively to control production cost.

2. Materials and methods

A field experiment was conducted during *kharif*, 2020-21 at Research Farm, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani to evaluate the effect of fertigation schedules and mulching on growth rates

of *Bt* Cotton (*Gossypium hirsutum* L.). The soil of the experimental plot was clayey in texture, a slightly alkaline reaction, along with low levels of organic carbon, low levels of nitrogen that is readily available, medium levels of phosphorus, high levels of potassium that are readily available.

In all, sixteen treatment combinations, consisting of four fertigation schedules (80:40:40 NPK kg ha⁻¹, 100:50:50 NPK kg ha⁻¹, 120:60:60 NPK kg ha⁻¹ and 140:70:70 NPK kg ha⁻¹) and four mulching treatments (no mulch, organic mulch, black polyethylene mulch and silver polyethylene mulch) were evaluated in split plot design with three replications. Before the experiment, pigeon pea was grown in the field and harvested in January and kept fallow prior to cotton sowing. The raised beds of 1.2 m width were formed with the help of tractor. The lateral lines of drip system were spread before application of polyethylene mulch. A silver/black polyethylene mulch of 25 μ thickness having width of 120 cm was spread over the raised bed keeping silver /black color upside as per the treatment. Two sides of mulch were buried under the sloping sides of bed. The sowing line were marked on the polythene sheets using a rope for making holes at 30 cm distance. Holes are made using a 2 inch GI pipe on the polyethylene mulch at 30 cm distance. After making holes cotton seeds were dibbled in the holes. In the present study, the polyethylene mulch of 25 μ thickness silver/black color, keeping silver/black color up as per the treatments, was used for each row of cotton. And for Organic mulch treatment, it was applied to the experimental plots @ 5 t ha⁻¹ at 30 DAS. The mulch was applied to each plot as per the treatment. The cotton hybrid RCH-659 was sown on 04.07.2020. A row to row distance of 150 cm and plant to plant distance of 30 cm was maintained to obtain a plant population of 22,222 plants per hectare. Sowing was done manually by dibbling maintaining plant to plant spacing of 30 cm. The well-decomposed FYM was applied uniformly to respective plots before sowing as per the treatments. The fertilizers were applied to each plot according to the treatments. Urea, 19:19:19 NPK fertilizer, mono potassium phosphate (0:52:34) and potassium nitrate (13:0:45) were used as water soluble fertilizer for N, P and K, respectively. The data on different growth rates were recorded at an interval of 30 days from the date of sowing up to harvesting. Different growth rates were calculated by using the formulae given below.

2.1 Absolute growth rate (AGR)

The rate of in a growth variable *i.e.* height (H) or dry weight (W) by a plant at a specific time interval (t) is called as absolute growth rate. It is expressed as cm per day in case of plant height and g per day in case in case of dry matter accumulation per plant. The AGR of two growth variables *viz.*, plant height and total dry matter per plant were computed by the formula given by Richards (1969) [10].

$$\text{AGR (Height) (cm day}^{-1}\text{)} = \frac{H_2 - H_1}{t_2 - t_1}$$

$$\text{AGR (Dry matter) (g day}^{-1}\text{)} = \frac{W_2 - W_1}{t_2 - t_1}$$

Where

H₂ and H₁ are plant heights, while W₂ and W₁ are dry matter weights per plant at t₂ and t₁ times, respectively.

2.2 Crop growth rate (CGR)

The crop growth rate is commonly used for the determination of production efficiency of plant stand. CGR represents total dry matter productivity of the community per unit land area over a certain time span. CGR enables comparison to be made between stand communities of different types in different habitat (Hunt, 1978) [5]. This is determined by using the following formula.

$$\text{CGR (g day}^{-1} \text{ m}^{-2}) = \frac{W_2 - W_1}{t_2 - t_1} \times \text{number of plants m}^{-2}$$

Where,

W_2 = dry weight of plant at time t_2 (g plant⁻¹)

W_1 = dry weight of plant at time t_1 (g plant⁻¹)

2.3. Relative growth rate (RGR)

Blackman (1919) [3] pointed out that the increase in dry matter of plant is a process of continuous compound interest wherein the increment in any interval adds to the capital for the subsequent crop growth. This rate of increment is known as relative growth rate (RGR), which was worked out by the formula given by Fisher (1921) [4].

$$\text{RGR (g g}^{-1} \text{ day}^{-1}) = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{t_2 - t_1}$$

Where,

W_1 and W_2 are the weights of dry matter in g per plant at times t_1 and t_2 , respectively and $t_2 - t_1$ is the time interval in days.

Log_e = natural logarithm to the base „e“ = 2.3026.

2.4. Leaf area duration (LAD)

Watson (1947) [11] integrated with time and termed the result leaf area duration in order to connect dry matter production with the leaf area index. LAD takes into account the length and size of the crop canopy's photosynthetic tissue. Days are used to express the LAD.

$$\text{LA} = \frac{L_1 + L_2}{2} \times (t_2 - t_1)$$

Where,

L_1 = LAI at first stage

L_2 = LAI at second stage

$t_2 - t_1$ = time interval between second and first stage

2.5 Leaf area index (LAI)

Leaf area ratio is the ratio of surface leaf area (one side only) to the ground area occupied by the crop plant. Crop yield in general is assessed based on per unit of ground area instead of per plant. The leaf area index was determined by using the formula given by Watson (1952) [12].

$$\text{LAI} = \frac{\text{Leaf area per plant (dm}^2\text{)}}{\text{Ground area per plant (dm}^2\text{)}}$$

3. Results

The results of the present study have been summarized under following heads.

3.1 Absolute growth rate (AGR) for plant height (cm day⁻¹ plant⁻¹)

Fertigation schedules influenced the Absolute Growth Rate (AGR) for plant height (cm day⁻¹ plant⁻¹) of *Bt* cotton during 2020-21. Increased fertilizer levels with fertigation scheduling caused the AGR of plant height to rise. With the exception of 91-120 DAS, fertigation scheduling of 140:70:70 NPK kg ha⁻¹ resulted in increased AGR of plant height at all stages. The AGR of plant height has increased as a result of an increase in plant height with increasing fertilizer levels of fertigation scheduling. At all stages, with the exception of 91-120 DAS and 121-150 DAS during 2020-2021, the Absolute Growth Rate (AGR) for plant height (cm day⁻¹ plant⁻¹) was higher in all mulching treatments than in no mulch. With the exception of 91-120 DAS and 121-150 DAS during 2020-21, AGR for plant height was at its highest in silver polyethylene mulch (M_4) during all stages.

The aforementioned findings could be explained by the varied vegetative development behavior of cotton. In comparison to non-mulch treatments, the application of polyethylene mulch showed increased vegetative growth. Vegetative growth increased in mulch treatments (M_2 , M_3 and M_4) with increasing crop duration compared to no mulch (M_1).

3.2 Absolute Growth Rate (AGR) for dry matter (g day⁻¹ plant⁻¹)

According to data on fertigation schedules, (S_4) application of 140:70:70 NPK kg ha⁻¹ reported the highest values of Absolute Growth Rate (AGR) for dry matter (4.0083 g day⁻¹ plant⁻¹), followed by (S_3) application of 120:60:60 NPK kg ha⁻¹ (3.9040 g day⁻¹ plant⁻¹) and (S_2) application of 100:50:50 NPK kg ha⁻¹ (3.7923 g day⁻¹ plant⁻¹) between 61-90 DAS during year 2020-2021. Due to the application of 80:40:40 NPK kg ha⁻¹ in (S_1) controlling vegetative growth during the course of study, the lowest Absolute Growth Rate (AGR) for dry matter was recorded. Similar trends were seen between 0-30, 31-60, 91-120 and 121-150 DAS.

Mulching was applied and this had an impact on the Absolute Growth Rate (AGR) for dry matter (g day⁻¹ plant⁻¹) of *Bt* cotton. With regard to mulching treatments, the application of silver polyethylene mulch (M_4) produced the highest Absolute Growth Rate (AGR) for dry matter, followed by the application of black polyethylene mulch (M_3) at 61-90 DAS during 2020-2021. The application of silver polyethylene mulch (M_4) between 61 and 90 DAS resulted in the highest Absolute Growth Rate (AGR) for dry matter (3.9723 g day⁻¹ plant⁻¹), which was followed by the application of black polyethylene mulch (M_3) at square formation and flowering stage (3.8687 g day⁻¹ plant⁻¹), during 2020-2021. The Absolute Growth Rate (AGR) for dry matter was initially slow between 0 and 30 DAS, increased between 31 and 60 DAS and 61 to 90 DAS, and subsequently decreased as the crop gets matured. Other stages of crop growth showed a similar tendency. While polythene mulch has an impact on plant height, Sympodial branches, and other characteristics including vegetative growth, it has positive influence on AGR values. Similar result reported by Nalayini (2007) [9].

3.3 Crop growth rate (CGR) for dry matter (g day⁻¹ m⁻²)

Table No. 2 indicates that Crop Growth Rate (CGR) for dry matter (g day⁻¹ m⁻²) of *Bt* cotton as influenced by fertigation

schedules and mulching at various crop growth stages. It was discovered that the Crop Growth Rate (CGR) of dry matter for *Bt* cotton was initially very slow between 0-30 DAS and reached its peak between 61-90 DAS before gradually declining till 150 DAS. The highest average Crop Growth Rate (CGR) for dry matter was found between 61-90 DAS ($8.5123 \text{ g day}^{-1} \text{ m}^{-2}$).

Fertigation schedules had an impact on the analysis of data pertaining to Crop Growth Rate (CGR) for dry matter ($\text{g day}^{-1} \text{ m}^{-2}$) of *Bt* cotton. In terms of fertigation schedules, (S_4) application of 140:70:70 NPK kg ha^{-1} was shown to have the highest Crop Growth Rate (CGR) for dry matter, followed by (S_3) application of 120:60:60 NPK kg ha^{-1} and (S_2) application of 100:50:50 NPK kg ha^{-1} . When compared to other treatments, application of 80:40:40 NPK kg ha^{-1} in (S_1) produced the lowest Crop Growth Rate (CGR) for dry matter. The Crop Growth Rate (CGR) for dry matter fluctuated between 61 and 90 DAS on a regular basis; the highest Crop Growth Rate (CGR) for dry matter was recorded with the application of 140:70:70 NPK kg ha^{-1} ($8.8183 \text{ g day}^{-1} \text{ m}^{-2}$), followed by (S_3) application of 120:60:60 NPK kg ha^{-1} ($8.5888 \text{ g day}^{-1} \text{ m}^{-2}$) and 100:50:50 NPK kg ha^{-1} (S_2) ($8.3431 \text{ g day}^{-1} \text{ m}^{-2}$) in the years 2020-2021. Over the course of study, a similar pattern was seen at all phases of growth.

Mulching was applied, and the results showed that (M_4) the application of silver polyethylene mulch obtained the highest Crop Growth Rate (CGR) for dry matter, followed by (M_3) the application of black polyethylene mulch at square formation and at flowering during 2020-2021. Between 61 and 90 DAS, the M_4 application of silver polyethylene mulch ($8.7391 \text{ g day}^{-1} \text{ m}^{-2}$) produced the highest Crop Growth Rate (CGR) for dry matter, followed by the M_3 application of black polyethylene mulch ($8.5111 \text{ g day}^{-1} \text{ m}^{-2}$), the M_2 application of organic mulch ($8.4370 \text{ g day}^{-1} \text{ m}^{-2}$), and the M_1 application of no mulch ($8.3622 \text{ g day}^{-1} \text{ m}^{-2}$). The application of silver polyethylene mulch (M_4) at square formation resulted in the highest Crop Growth Rate (CGR) for dry matter among other treatments.

3.4 Relative growth rate (RGR) for dry matter ($\text{g g}^{-1} \text{ day}^{-1}$)

Higher Relative Growth Rate (RGR) was observed for dry matter with (S_4) application of 140:70:70 NPK kg ha^{-1} , followed by (S_3) application of 120:60:60 NPK kg ha^{-1} and (S_2) application of 100:50:50 NPK kg ha^{-1} at 0-30 DAS and 121-150 DAS. With (S_4) application of 140:70:70 NPK kg ha^{-1} , among different fertigation schedules, the Relative Growth Rate (RGR) for dry matter was highest and application of (S_1) 80:40:40 NPK kg ha^{-1} was observed to have the lowest Relative Growth Rate (RGR) for dry matter. The maximum Relative Growth Rate (RGR) for dry matter was seen between 61 and 90 DAS with (S_1) treatment of 80:40:40 NPK kg ha^{-1} , followed by (S_2) application of 100:50:50 NPK kg ha^{-1} , and (S_3) application of 120:60:60 NPK kg ha^{-1} over the year 2020-2021. During study period, the Relative Growth Rate (RGR) for dry matter increased initially between 0 and 30 DAS and subsequently decreased as the crop neared maturity.

The application of mulches had an impact on the Relative Growth Rate (RGR) for dry matter ($\text{g g}^{-1} \text{ day}^{-1}$) of *Bt* cotton. Data on the application of mulches showed that, at 0-30 DAS (M_4) silver polyethylene mulch and (M_3) black

polyethylene mulch gave the highest values of Relative Growth Rates (RGR) for dry matter during 2020-2021.

3.5 Leaf area duration (LAD) (day)

The fertigation schedules had an impact on the Leaf Area Duration (LAD) of *Bt* cotton. Increased fertilizer levels with fertigation scheduling during the two years of the study led to longer leaf area duration than lower levels at all stages. The fertigation schedule (S_4) application of 140:70:70 NPK kg ha^{-1} at all times throughout 2020-21 produced the highest Leaf Area Duration (LAD) value. It was followed by the application of 120:60:60 NPK kg ha^{-1} under fertigation schedule (S_3) and 100:50:50 NPK kg ha^{-1} under fertigation schedule (S_2). Lowest values for leaf duration were found when applying 80:40:40 NPK kg ha^{-1} according to the fertigation schedule (S_1). Fertigation scheduling with increased fertilizer levels have increased leaf area, which has led to better leaf area duration values at fertigation scheduling with higher fertilizer levels than at lower fertilizer levels.

Mulching treatment had an impact on *Bt* cotton's Leaf Area Duration (LAD) data. The highest Leaf Area Duration (LAD) among the mulching treatments was achieved by (M_4) application of silver polyethylene mulch (128.36) at 91-120 DAS, followed by (M_3) application of black polyethylene mulch (124.67) during 2020-21.

3.6 Leaf area index (LAI)

During the study year, fertigation schedules had an impact on the Leaf Area Index (LAI) of *Bt* cotton. Every degree of fertilizer addition with fertigation scheduling was accompanied by an increase in the leaf area index. As a result of better light absorption and increased leaf area at fertigation scheduling with higher fertilizer levels, the leaf area index has increased. Thus, during years of the experimentation, the highest level of fertigation schedule, 140:70:70 NPK kg ha^{-1} (S_4), reported increased Leaf Area Index (LAI) at all growth stages.

Mulching was applied, and the results show that it had an impact on the Leaf Area Index (LAI) of *Bt* cotton. The highest Leaf Area Index (LAI) was attained throughout year of the experimentation with (M_4) application of silver polyethylene mulch from the 0-30 DAS period up to the 121-150 DAS stage period, and then in (M_3) application of black polyethylene mulch after that.

4. Discussion

The improved soil nutrition under fertigation scheduling along with mulching, which resulted in favourable soil environment and it enhanced the root proliferation subsequently providing better water and nutrient uptake resulting in increased plant growth. The fertigation scheduling also have helped in precise application of required nutrients at required growth stage in sufficient quantity, thus resulting in higher water and nutrient uptake by the crop resulting in healthy growth of the plant. The increase in plant height, number of monopodial and sympodial branches, number of functional leaves and leaf area contributed to increased plant dry matter accumulation. Thus increase in plant height as well as dry matter accumulation resulted in higher growth rates. Higher growth rates under fertigation schedule (S_4) application of 140:70:70 NPK kg ha^{-1} along with application of polyethylene mulch was attributed to higher nutrient supply

which enhanced the plant growth by participating in cell division and cell elongation in plants. Liquid fertilizers integrated with mulch application prolonged the release of nutrients besides improving the soil physical properties *i.e.* soil aeration, water holding capacity and bulk density of soil. It was correlated with the increase in various crop

growth attributes *viz.*, plant height, number of monopodial and sympodial braches, number of functional leaves, leaf area and dry matter accumulation. Thus higher plant height as well as dry matter accumulation, the growth rates were higher.

Table 1: Mean Absolute Growth Rate (AGR) for plant height (cm day⁻¹ plant⁻¹) and for dry matter (g day⁻¹ plant⁻¹) of *Bt* cotton hybrid as influenced by different treatments at various crop growth period

Treatments	AGR (cm day ⁻¹ plant ⁻¹)					AGR (g day ⁻¹ plant ⁻¹)				
	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121-150 DAS	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121-150 DAS
Main plot: Fertigation scheduling (S)										
S ₁ : 80:40:40 NPK kg ha ⁻¹	1.4083	2.9250	1.5707	0.8407	0.1727	0.5393	1.772	3.7723	2.7583	1.0667
S ₂ : 100:50:50 NPK kg ha ⁻¹	1.4667	3.0667	1.6007	0.8313	0.1680	0.5617	1.774	3.7923	2.8258	1.1333
S ₃ : 120:60:60 NPK kg ha ⁻¹	1.4917	3.3417	1.6023	0.6410	0.4323	0.5760	1.844	3.9040	2.9661	1.2027
S ₄ : 140:70:70 NPK kg ha ⁻¹	1.5293	3.5500	1.6507	0.6543	0.4357	0.5790	1.893	4.0083	3.059	1.2667
Sub plot: Mulching (M)										
M ₁ : No mulch	1.4083	2.9750	1.5033	0.7947	0.2973	0.5477	1.805	3.8010	2.6667	1.1667
M ₂ : Organic mulch	1.4500	3.1583	1.5133	0.7277	0.3563	0.5467	1.819	3.8350	2.7333	1.1667
M ₃ : Black polyethylene mulch	1.5083	3.3333	1.6060	0.7270	0.2830	0.5693	1.833	3.8687	2.8000	1.1693
M ₄ : Silver polyethylene mulch	1.5293	3.4167	1.6010	0.7183	0.2723	0.5927	1.826	3.9723	2.8333	1.1667
GM	1.4591	3.1694	1.5402	0.7483	0.3104	0.5584	1.818	3.8522	2.7389	1.1671

Table 2: Mean Crop Growth Rate (CGR) (g day⁻¹ m⁻²) and mean Relative Growth Rate (RGR) (g g⁻¹ day⁻¹) of *Bt* cotton hybrid as influenced by different treatments at various crop growth period

Treatments	CGR (g day ⁻¹ m ⁻²)					RGR (g g ⁻¹ day ⁻¹)				
	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121-150 DAS	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121-150 DAS
Main plot: Fertigation scheduling (S)										
S ₁ : 80:40:40 NPK kg ha ⁻¹	1.1865	3.8984	8.2991	6.0683	2.3467	0.0928	0.0485	0.0373	0.0110	0.0034
S ₂ : 100:50:50 NPK kg ha ⁻¹	1.2357	3.9028	8.3431	6.2168	2.4933	0.0941	0.0475	0.0372	0.0109	0.0036
S ₃ : 120:60:60 NPK kg ha ⁻¹	1.2672	4.0568	8.5888	6.5254	2.6459	0.0950	0.0478	0.0369	0.0107	0.0038
S ₄ : 140:70:70 NPK kg ha ⁻¹	1.2738	4.1646	8.8183	6.7298	2.7867	0.0952	0.0484	0.0369	0.0105	0.0039
Sub plot: Mulching (M)										
M ₁ : No mulch	1.2049	3.9710	8.3622	5.8667	2.5667	0.0933	0.0486	0.0371	0.0106	0.0037
M ₂ : Organic mulch	1.2027	4.0018	8.4370	6.0133	2.5667	0.0932	0.0488	0.0371	0.0107	0.0037
M ₃ : Black polyethylene mulch	1.2525	4.0326	8.5111	6.1600	2.5725	0.0946	0.0480	0.0369	0.0109	0.0037
M ₄ : Silver polyethylene mulch	1.3039	4.0172	8.7391	6.2333	2.5667	0.0959	0.0469	0.0372	0.0108	0.0036
GM	1.2409	4.0057	8.5123	6.2267	2.5682	0.0939	0.0483	0.0371	0.0107	0.0037

Table 3: Mean Leaf Area Duration (LAD) (Days) and Mean Leaf Area Index (LAI) of *Bt* cotton hybrid as influenced by different treatments at various crop growth period

Treatments	LAD (days)					LAI				
	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121-150 DAS	0-30 DAS	31-60 DAS	61-90 DAS	91-120 DAS	121-150 DAS
Main plot: Fertigation scheduling (S)										
S ₁ : 80:40:40 NPK kg ha ⁻¹	4.92	45.34	96.33	118.11	90.83	0.3281	2.6944	3.7278	4.1463	1.9093
S ₂ : 100:50:50 NPK kg ha ⁻¹	5.16	46.80	98.89	120.64	93.64	0.3438	2.7759	3.8167	4.2259	2.0167
S ₃ : 120:60:60 NPK kg ha ⁻¹	5.51	48.42	101.75	124.00	97.00	0.3671	2.8611	3.9222	4.3444	2.1222
S ₄ : 140:70:70 NPK kg ha ⁻¹	5.91	49.58	103.83	126.81	99.95	0.3943	2.9111	4.0111	4.4426	2.2204
Sub plot: Mulching (M)										
M ₁ : No mulch	5.06	45.48	95.64	116.36	88.72	0.3374	2.6944	3.6815	4.0759	1.8389
M ₂ : Organic mulch	5.24	45.96	97.64	120.17	93.17	0.3493	2.7148	3.7944	4.2167	1.9944
M ₃ : Black polyethylene mulch	5.51	49.10	102.75	124.67	97.67	0.3676	2.9056	3.9444	4.3667	2.1444
M ₄ : Silver polyethylene mulch	5.68	49.60	104.78	128.36	101.86	0.3789	2.9278	4.0574	4.5000	2.2907
GM	5.37	47.53	100.20	122.39	95.35	0.3583	2.8106	3.8694	4.2898	2.0671

Conclusion

Fertigation schedule *i.e.* application of 140:70:70 NPK kg ha⁻¹ along with application of polyethylene mulch resulted in maximum value of AGR for plant height (cm day⁻¹ plant⁻¹)

¹) and dry matter (g day⁻¹ plant⁻¹), Crop Growth Rate (CGR), Relative Growth Rate (RGR), Leaf Area Duration (LAD) and Leaf Area Index (LAI).

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