Scientific Papers. Series B, Horticulture. Vol. LXVII, No. 2, 2023
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

STUDY REGARDING THE INFLUENCE OF SOME CLIMATIC PARAMETERS FROM THE GREENHOUSE ON THE TOMATO PRODUCTION AND FRUITS QUALITY

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Abstract

Greenhouses provide a controlled environment where temperature, humidity, and light can be optimized for tomato growth. The present study was carried out to estimate the growth, biochemical, and physiological responses of cherry tomatoes to some environmental conditions. Data was collected on different dates during the period extending from December 2022 to March 2023. Based on collected data, the potential growth rate of plants has been predicted: plant height, 2.43 cm/day to 2.98 cm/day; leaf growth, 0017 cm/day; three leaves per week. Plants with a high day length were high in height and produced more leaves. A significant relationship found between the inflorescence and the data collected for total mass/inflorescence, average size of fruits/inflorescence, diameter of fruit/inflorescence, and fruit height/inflorescence. A non-significant interaction found between the fruit keeping quality, fruit size, and inflorescence number. Regarding their biochemical responses, every inflorescence differs significantly from the others. A non-significant relationship was also found between fruit acidity and inflorescence order. The current study confirms a direct relationship between biochemical, growth, and productivity indicator under greenhouse conditions. An analysis of variance was used to statistically assess the collected data at a confidence level of p 0.05.

Key words: *tomatoes, greenhouse, productivity, growth rate, biochemical attributes.*

INTRODUCTION

The tomato (*Lycopersicon esculentum* Mill.), a south American-originating species, is the most widely cultivated vegetable in the world (Ohashi et al., 2022). Along with all types of peppers, potatoes, eggplant, and ground cherries, it is a major crop in the family Solanaceae. It is a well-known vegetable or fruit due to its nutritional and medicinal attributes, as it contains different types of minerals, vitamins, and antioxidants (Knapp and Peralta, 2016; Fatima et al., 2009). In view of its industrial importance, the tomato industry has been declared the most developed, geographically connected, and inventive horticulture industry (Costa and Heuvelink, 2007). It has been reported that 186.821 million metric tons of tomatoes were produced in the world during the year 2020 on 5,051,983 hectares, yielding an average of 37.1 metric tons per hectare (Branthôme, 2020).

Today, the world has been facing a constant threat of food scarcity and malnutrition, with the number of hungry people rising to 828 million in 2021, an increase of around 46 million since 2020 and 150 million since 1990 (WHO, 2015). It has now become the need of the hour for the scientific community to introduce innovative, time-consuming, and reliable methods of food production. Greenhouse is a Optimistic and sustainable method for the production of vegetables, especially tomatoes at large scale (Ofori et al., 2022). It has been widely adopted as an arbitrary and yield-oriented configuration in which growers can set desired environmental conditions (Taki and Yildizhan, 2018). People all over the world are replacing manual and traditional methods with advanced technology-based methods, and greenhouse technology could be a reliable alternative to land (Ohashi et al., 2022). There are plenty of studies that explain the behavior of greenhouses (Shimizu, 2007).

Previously, different crops were grown to observe the response of various variables, and a significant relationship between greenhouse conditions and plant morphological, biochemical, and growth parameters has been reported (Chang et al., 2013; Chan et al., 2022; Arshad, 2021).

A research report ranked the tomato as the second-most important vegetable crop in the world and reported it as an important component of the Mediterranean diet both quantitatively and qualitatively (Viuda-Martos et al., 2014). Plants adapt morphologically or functionally in response to their environment (Koning, 2000). To evaluate the response of tomatoes to different greenhouse conditions, different experiments were performed in the past (Draghici et al., 2021). Alsadon et al. (2018) found a direct relationship between greenhouse conditions and tomato plant growth and productivity. A greenhouse setup is a flexible solution for the cultivation of tomatoes, as it can provide optimally manageable growth conditions. Several growth phases and light conditions influenced the optimal microclimate conditions for the productive greenhouse cultivation of tomatoes. Garca et al. (2011) classified tomato growth into five phases: the initial leaf period, vegetative growth, flowering, early fruiting, and the mature fruiting period. The duration of time that each growing phase will last depends on the understudied tomato variety and growth control parameters: temperature, light, substrate, and nutrients. All the nutritional, structural, mechanical, and climate-based aspects of a greenhouse are crucial for plant growth, fruit quality, and production. (Shamshiri et al., 2018). According to a study, the growing periods of tomatoes grown under two greenhouse setups were 133 days and 126 days, respectively (Garcia et al., 2011). In a comparative study, De Gelder et al. (2002) reported a 9 percent increase in production, an 8-10 percent increase in dry matter, and high transpiration in a CO_2- and air-circulated closed greenhouse compared to a normal, heated conventional greenhouse (Opdam et al., 2004). The influence of temperature on all aspects of tomato plant growth is significant. Plants grown under suboptimal temperature conditions produced thicker leaves and showed less growth. On the other hand, truss and leaf initiation are also directly influenced by temperature (Van Der Ploeg and Heuvelink, 2005). The optimal temperatures of 22-25°C for the development of leaves and trusses and 22-26°C and 22-25°C for fruit addition and fruit set, respectively (Sato et al., 2000). The percentage of humidity is another factor that can affect the growth of tomato plants to a great extent. The percentage of humidity is another factor that can affect the growth of tomato plants to a great extent. The relationship between the humidity percentage and temperature influenced the transpiration rate of plants (Kittas et al., 2005). ASABE (2015) recommended an average percentage of 60–90% of relative humidity for the growth of most tomato varieties in greenhouses. The spacing between the plants was reported as an important factor for plant yield per unit area. The spacing between the plants determines the density of plant leaves, which, alternatively, affects canopy light interception in tomatoes (Kaneko et al., 2015).

The production of vegetables in a controlled environment is highly advantageous, especially in cold regions. It is also important to note that some threats are also associated with this technology. Because greenhouse cultivation necessitates a significant initial investment in labor, equipment, and time, the grower must be aware of its advanced techniques in order to achieve a high yield at a low cost. In view of lowering input costs, greenhouse irrigation and fertilizer management can improve yield, conserve water, and improve product quality (Wang et al., 2022). The controlled environment can help the grower protect the plant from the attack of different diseases and also extend the production season. Though many unknown facts about greenhouse management and greenhouse benefits have already been reported, there are still many findings that require further investigation. In line with the previous idea, the present study was conducted to report the response of a local tomato variety to different greenhouse conditions. The study was based on the hypothesis that variation in green house conditions and green management will directly effect plant growth attributes, productivity, and fruit quality.

MATERIALS AND METHODS

A systematic and controlled approach experiment was carried out on tomatoes plants. to observe and measure specific variables to understand their response to different greenhouse conditions in view on plant growth development and fruit production performance.

The studies were carried out on the premises of the University of Agronomic Sciences and Veterinary Medicine of Bucharest (USAMV), at the Research Greenhouse and the Research Center for Studies of Food and Agricultural Product Quality. A Dutch hybrid Cherry tomato (*Lycopersicon esculentum* Mill.) cv. 'Cheramy F_1' seeds were sown in coconut substrate at the end of October 2022. Later on, 40 days old seedlings with first inflorescence were transplanted to coconut-containing growbag (Jiffy growbag), in a separate greenhouse compartment (Figure 1). The plants were appropriately prepared by providing optimal conditions for growth before the start of the experiment.

Tomatoes plants of similar size and physical appearance were randomly selected from each side (front, back, middle, left and right) of the greenhouse experimental compartment. All the Agricultural management practices (fertilizing, watering, and fungicide spray) were performed as per the recommendations. plant growth parameters and productivity were estimated during the period extended from 21st December 2022 to 3rd April 2023 (Table 1.). Plant growth parameters were observed on different dates with different days intervals to estimate the change in growth rate. Growth parameters included total number of leaves/plant, plant height, stem diameter, internodal branch distance. It has been reported that the internode branch distance is a proximate of plant's efficiency. Change in plant height, change in leaf growth rate was also estimated over the observation period. All the measurements were conducted using measuring tape with centimeter marking on it. To measure leaf growth, three leaves from each plant were selected and measured maximum length, distance from the base of the petiole to the distal end (Ls) and maximum width, farthest distance across the petiole (L+w) of each marked leaf were recorded. Evaluation of plant productivity was based on comprehensive assessment of productivity parameters, type of inflorescence, total number of inflorescence/ plants, length of inflorescence, number of fruits/inflorescences, total fruit mass/inflorescence, average fruit mass/Inflorescence, fruit height and circumference. The first seven inflorescences of each plant were observed. When each plant reached the stage of bearing their first eleven inflorescence were harvested to account the plant productivity and fruits physical attributes. Laboratory analysis includes fruit firmness, fruit acidity, fruit dry matter, brix (%) and nitrate contents/inflorescence (Figure 2). Fruit keeping quality was assessed by counting the number of days, fruits from each inflorescence survived the room temperature (whenever the wrinkle appears, and fruit skin becomes softer) in polythene zip bags.

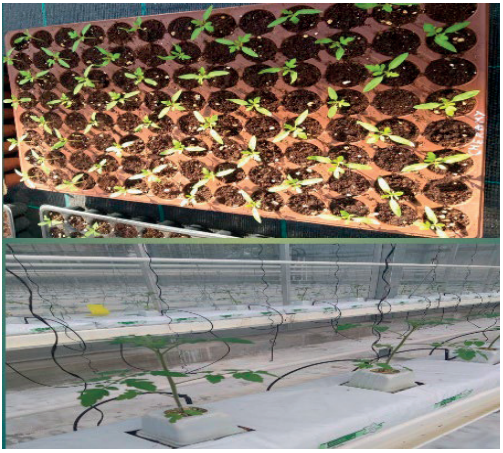

Figure1. Tomatoes plants at seedling and early growth stage

Table 1. Observations dates and days interval

Sr#	Dates	Days interval
1	21/12/2022	
2	6/1/2023	15
3	13/01/2023	6
4	20/01/2023	6
5	27/01/2023	6
6	3/2/2023	6
7	13/2/2023	10
8	2/3/2023	16
9	27/3/23	25

The graphs related to growth parameters were produced by using MS word and Jamvoi Software. The analysis of variance (ANOVA) was performed.with the subsequent use of the Normality Test (Shapiro-Wilk), Homogeneity of Variances Test (Levene's), at a confidence level of $p< 0.05$.

RESULTS AND DISCUSSIONS

Data regarding the microclimate variables, Temperature, CO_2 and light was sampled during the experimental period extended between October 2022 to March 2023. Figure 3 displays the average, maximum and minimum temperature records, while Figure 4 depicts the average, CO_2 and light data for each month. A direct relation was observed between the microclimatic conditions and plants' growth and fruiting stages. Extreme changes were observed in environmental conditions. The average temperature during the vegetative growth and flowering stage was 21.20ºC and maximum and minimum temperature was observed 25.47 ºC and 16.94 ºC respectively.
The average light amount and, CO_2 concentration during the vegetative growth and flowering stage, was 349.19 (ppm) and 240.93 (w/m²). respectively was recorded. The growth and development of different crops in Greenhouse is directly influenced by the time duration of winter season and availability of light, CO_2 and temperature.

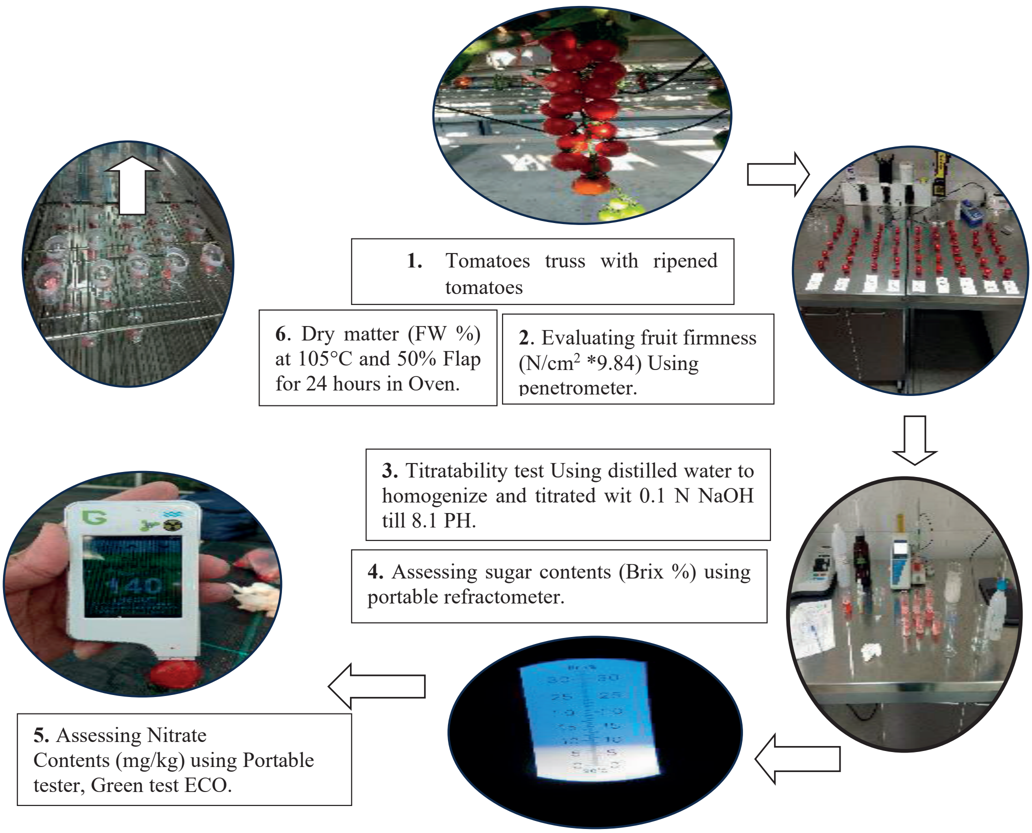

Figure 2. Laboratory analysis outline

Short-term light exposure in winter affects the growth and biochemical parameters of plants (Blom and Ingratta, 1984; Frantz et al., 2000). Plants physiological, metabolic, and developmental process are organized by endogenous biological clocks Müller et al., 2016; Thus, timely supplementation of light to plants can increase the yield and quality of fruits. Present study was also conducted in winter season under normal sunlight conditions. A significant interaction between the light duration and the concentration of different biochemical components was observed. Green house conditions have significant impacts on plant growth parameters (Katsoulas and Kittas, 2008).

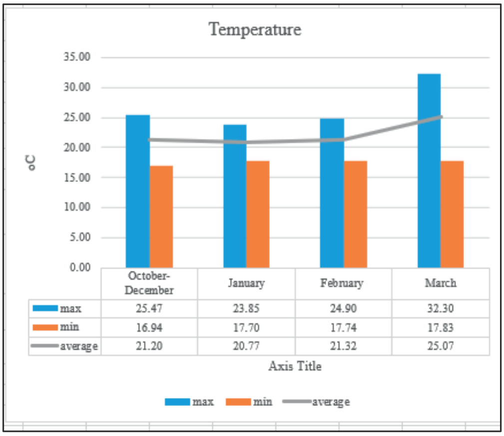

Figure 3. Monthly, average, maximum and minimum temperature ºC data

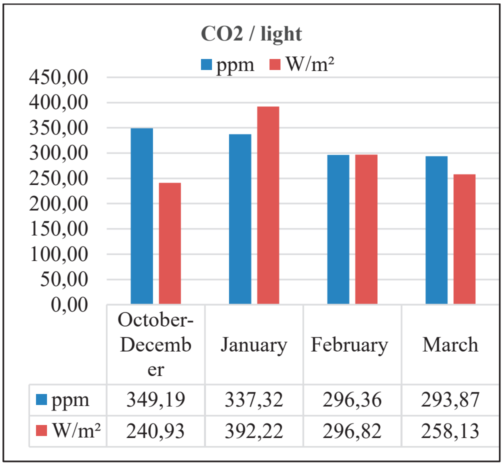

Figure 4. Average monthly data of CO_2 (ppm) & Light (w/m²)

The growth and development of different crops in Greenhouse is directly influenced by the time duration of winter season and availability of light, CO_2 and temperature. Short-term light exposure in winter affects the growth and biochemical parameters of plants (Blom and Ingratta, 1984; Frantz et al., 2000). Plants physiological, metabolic, and developmental process are organized by endogenous biological clocks (Müller et al., 2016). Thus, timely supplementation of light to plants can increase the yield and quality of fruits. Present study was also conducted in winter season under normal sunlight conditions. A significant interaction between the light duration and the concentration of different biochemical components was observed. Green house conditions have significant impacts on plant growth parameters (Katsoulas and Kittas, 2008). It has been observed that plants growth patterns have direct relation with temperature, CO_2 and light (Wheeler et al., 1990). In present study the growth and development stages of tomato plants were observed. The substantial increase in growth-related characteristics, such as total number of leaves/plants, total number of Inflorescence/plants, plant length (height), and dry weights, led to the highest overall yield. Efficiency index of tomato plants growth which decides the ability of plants to produce new material (productivity) was assessed. The results of growth parameters are mentioned in Table 2. Figures 5 and 6, presents the leaves growth rate. The data collected has showed that mature young (middle leaf) and newborn (upper leaf) significantly ($P = 0.002$, $P < 0.001$, respectively) differed from the old (base leaf) in view to observation on different dates.

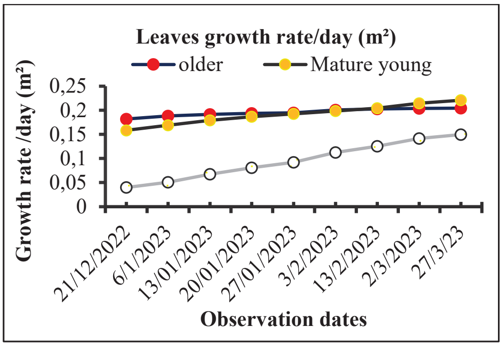

Figure 5. Leaves growth rate/day (m²)

The older leaves when reached at maximum growth stage; they stopped growing. The average growth rate of older and middle leaves was recorded (*.00034 cm/day and .00088 cm/day respectively*). The newborn leaf because of its position at top receive maximum amount of light as a result showed maximum growth per/day (*.0017cm/day*). Carmassi et al. (2007) reported a significant relation between the length of leaf and leaf position. It has also been reported that cultural practices and genetic diversity may affect the leaf morphology and leaf length Rouphael et al. (2006). Leaf growth rate was observed high in the month of March and low at the end of January (Figure 6). The change in leaf growth directly influenced by the environmental conditions (Zhang and Xiao, 2015).

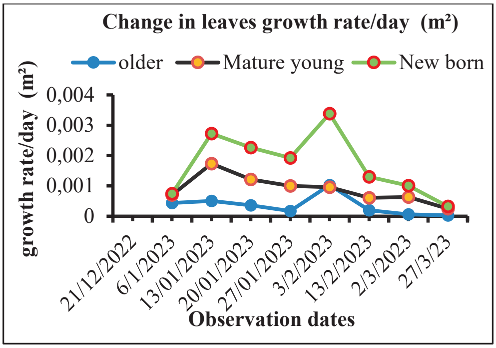

Figure 6. Change in leaves growth rate/day (m^2)

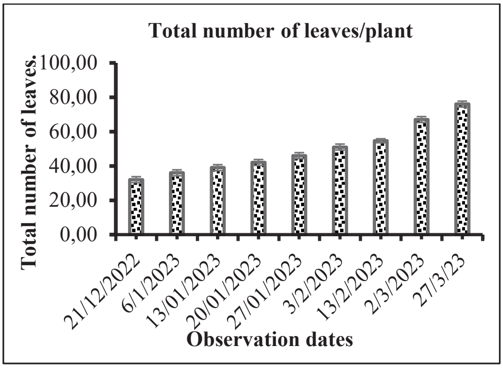

Figure 7. Total number of leaves/plants

In current time when this world has been battling with food challenges it is very important to understand the agricultural practices and scientific understanding. Growing plants in greenhouse conditions has many limitations. Plant height is a very important vegetative factor which responds directly to greenhouse conditions, temperature, humidity, carbon dioxide concentration and heat amount. Abdelmageed et al. (2003) reported a systematic and consistent difference among the tomato's plants height in response to their exposure to different heat shock treatment. Present study evaluated similar results. Figure 8 depicted the total height of plant during the observation period (December to March). A significant difference (*P<0.001)* has been found among the data collected on different dates (Table.2). It has been observed that the plant height growth rate per day drooped in the middle of February and high at the start of March (2.43 cm/day and 2.98 cm/day respectively). It was observed that average increase in plant height was within the range of 21 to 28 cm.

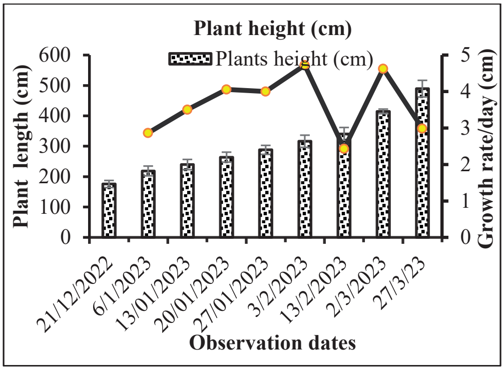

Figure 8. Plant height (cm)

There are different factors which affect the plant length (height). Rangaswamy et al. (2021) reported that high concentration of carbon dioxide increases the plant height, compared to plant grown in ambient carbon dioxide concentration. Plant height along with number of leaves have the potential to decides the future biomass production of plant. Plant height can influence the amount of light intercepted by leaves. Photosynthesis process is the driving force which increases the plant biomass. Biomass is integral component which decides the future plant productivity and overall yield. It has been reported, plant with higher number of leaves exposed to high concentration of carbon dioxide and temperature enhanced photosynthetic rate and water use efficiency (Jones, 2013). In present study findings a significant interaction (*P<0.001)* between total number of leaves and total height of plant has been observed. It was identified that number of leaves gradually increased, on average three new leaves formed every week and. In line with these findings Jo and Shin (2020) reported similar results in their comparison based study on two tomato cultivars under greenhouse conditions. There is no significant relation found between the plant heights and total number of leaves on second observation date. It was found that, Plants at the end of each row with more day length (remained exposed to daylight for maximum time) were high in height and produced a greater number of leaves (Figure 7). These results are consistent with the previous findings (Suyanto et al., 2012) which revealed that tomato plant growth rate (1.11 cm/day) is high at germination stage under the 680 nm, light compared other low wavelength light (480, 550, 650). Plants' growth rate vary from variety to variety under different growing conditions. The number of inflorescences significantly (*P<0.001*) vary between the plants on each observation date. Plants with high height produced more inflorescence compared to plants which has low growth rate. A plant with good growing condition has produced one Inflorescence per week. Adams et al. (2001) reported that temperature directly affects the number of inflorescences, high temperature causes early initiation of truss along with increase in fruit volume and size.

In terms of plant productivity, a significant relation between each inflorescence and total mass/inflorescence, average size of fruits/inflorescence, diameter of fruit/inflorescence, fruit height/inflorescence has been found. Number of fruits and fruit keeping days was not significantly affected by inflorescence number (*P = 0.176, P = 0.156, respectively*). A significant relation (*P = 0.026)* was found between total mass production and Inflorescence number. Total mass/inflorescence (expressed in grams) varied from inflorescence to inflorescence (Table 3). Inflorescence number 6 has produced maximum mass followed by inflorescence 7 and 1. Different greenhouse factors contribute in productivity of tomatoes plants. Plant day length is a key factor which directly influence the plant productivity. Alia et al. (2020) declared six hours lighting, a minimum time duration for fruit setting in tomatoes plants. Shading is another important factor which increases the productivity of tomato plants El-Aidy's (1983). Fruit mass is another parameter which help the grower to estimate the productivity tomato plants. Present study found a significant relation (*P = 0.021)* between average fruit mass and inflorescence number.

A study mentioned fruit mass a important indicator of plant productivity (Bădulescu et al., 2020). It was found that fruits from lower inflorescence have small size and low weight. Availability of carbon dioxide, Light, water and growing conditions ensure the magnitude of tomato plants productivity. Vanthoor et al. (2011) reported that average low temperatures treatment combined low light increases the productivity of tomato plant. Each part of plant receives different amount of light and other essential elements, which effect their productivity status. Moreover, increase in size of plant canopy also effect the growth of leaves and inflorescence at lower position (Sarlikioti et al., 2011). Present study has witnessed a interesting pattern in inflorescence morphology and length. Mostly inflorescences were single branched but bifurcated and trifurcated inflorescences also found. Inflorescence number three and six were bifurcated on each observed plant. Morphological nature of inflorescence plays a important role in the prediction of plant productivity.

A significant difference (*P<0.001)* found between the inflorescence length and number of inflorescences. A direct relation found between the length of Inflorescence and order of Inflorescence (Table.3) Inflorescence close to plant root (Lower Inflorescence) was small in length as compared to inflorescence above it and so on. Availability of quality water, following the process of transpiration help in moving the essential nutrients from base to metabolically active parts, leaves and inflorescence. This increases the growth rate in leaves and reproductive part and resultantly increase their length (Wei, 2017). There was no significant (*P = 0.176)* relation found between number of fruits and inflorescence number. Inflorescence number six followed by number seven and three has produced maximum number of fruits (Table 3). Previously it was discovered that as air temperature rose from 25 to 29°C, fruit number, the percentage of fruit set, and fruit weight per plant all dropped. (Shamshir et al., 2018). A study's findings reported that the number of fruits/inflorescences is directly influenced by daylight; more sunshine means more fruits will produce. Plant Fruits diameter vary significantly (*P = 0.031)* from inflorescence to inflorescence. Inflorescence number 4th followed by 3rd and 2nd appeared with high fruit diameter (Table 3). It has been previously reported that agricultural practices and treatment of different fertilizer increases the fruit size and production rate.

The complimentary actions of phosphorus and potassium, which aid in the synthesis of auxins, may also contribute to the increase in length and size of the fruits (Mudasir et al., 2009). A highly significant interactions (*P<0.001)* found between fruit dry matter and inflorescence number (Figure 9).

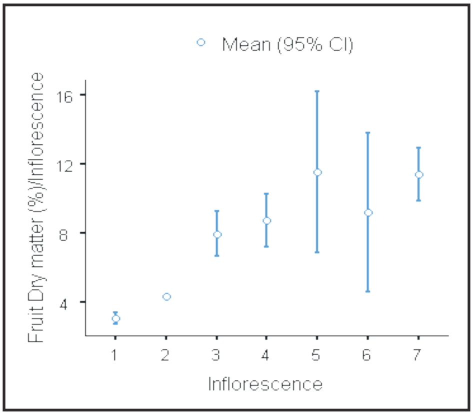

Figure 9. Fruit Dry matter (%)/Inflorescence

Inflorescence number 5 appeared with maximum fruit dry matter followed by 7th and 8th (Table 3). A study reported 7-8% increase in fruit dry matter in CO_2 treated tomato plants compared to tomato grown under conventional method (Opdam et al., 2004). Fruit firmness (N/cm^2) and its keeping quality are key attributes which decide the market value of tomato. More number of days a fruit can survive at room temperature the more it has market value. A significant interaction (*P = 0.061)* was found between fruit firmness and Inflorescence order. The 3rd inflorescence followed by 1st and 4th showed maximum resistance to applied force of penetrometer (8 mm probes). It was found that lower inflorescence fruits appeared with high fruit firmness compared to upper inflorescence (Figure 12). The reason behind this may be the physiological and biochemical activities as upper fruits branches receive maximum amount of light and key elements of the process of photosynthesis. Tadesse et al. (2015) reported that fruit anatomy and chemical composition directly affect the fruit firmness quality.

Plants physiological, metabolic, and developmental process are organized by endogenous biological clocks (Müller et al., 2016). Figures 10 and 11, significantly different concentration of nitrate (mg/kg) and Brix (%) found in all the observed inflorescence (*P = 0.010, P = 0.062, respectively)*. Following the old pattern lower inflorescence appeared low in nitrate and sugar contents compared to upper (higher) Inflorescence (Table 4).

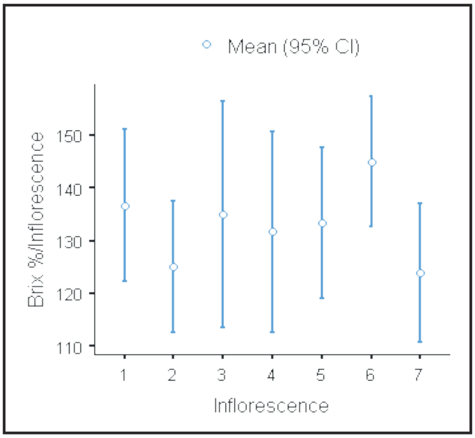

Figure 10. Brix (%)/Inflorescence

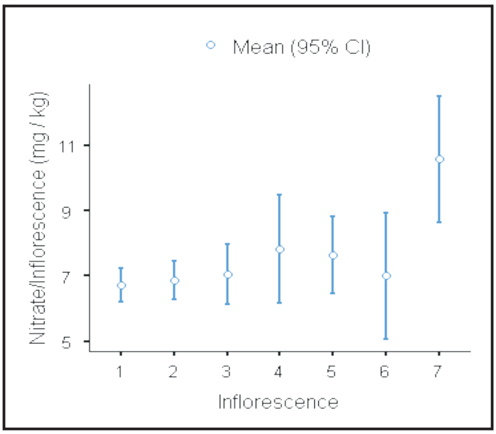

Figure 11. Nitrate contents/inflorescence (mg/kg)

The accumulation of sugar contents in the edible parts of vegetables is the result of CO_2

fixation under elevated conditions. Thus, timely supplementation of light to plants can increase the yield and quality of fruits. Previously, a non-significant interaction between the greenhouse conditions and the concentration of total titratable acidity in tomato plants was reported (Dong et al., 2014). Like this, present findings also determined a non-significant (*P=0.110)* interaction between the fruit acidity and inflorescence number. Inflorescence number three followed by 2nd and 1st show maximum value for fruit acidity (Figure 13).

Table 2. Growth parameters (Means ± SD) response to greenhouse conditions in tomato plants

Dates	Lower Older leaf	Middle Younger leaf	Upper Newborn leaf	Height of plant	Total number of inflorescences	Total number of leaves/ plants
	Mean, SD.	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**
21-12-2022	41.73±1.12	34.30±3.30	24.47±0.92	175.67±11.71	8.33±0.57	32.00±1.73
06-01-2023	42.07±1.13	35.90±1.55	26.23±1.07	218.67±16.07	9.33±0.57	36.00±1.73
13-01-2023	42.30±1.17	37.57±0.75	30.03±1.45	239.67±16.86	10.33±0.57	39.00±1.73
20-01-2023	42.73±1.02	38.47±1.19	31.90±1.13	264.00±16.46	11.33±0.57	42.00±1.73
27-01-2023	43.30±0.36	39.33±0.98	33.13±1.51	288.00±14.79	12.33±0.57	46.00±1.73
03-02-2023	43.70±0.60	40.13±0.72	34.50±1.74	316.33±20.03	13.33±0.57	51.00±1.73
13-02-2023	43.70±1.21	41.07±0.14	36.20±1.99	340.67±21.03	16.33±0.57	54.67±1.15
2-03-2022	43.90±1.21	42.17±0.75	38.37±2.50	414.33±7.50	19.33±0.57	67.00±173
27-03-2022	43.90±1.21	42.63±0.73	39.67±1.19	489.33±27.46	20.33±0.57	76.00±173

Table 3. Productivity (Means ± SD) response to greenhouse conditions in tomato plants

Inflores cence	Total mass (g)	Average fruit mass (g)	Inflorescence Length (cm)	number of fruits	Fruit Dry matter (%)	Fruit firmness N/cm2)	Fruit diameter (%)	Fruit keeping days
	Mean, SD.	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**	**Mean, SD.**
1	197.39±67.65	11.83±0.29	20.13±1.30	12.33±1.52	3.11±0.12	6.56±0.59	27.93±1.60	17.33±2.08
2	166.98±5.99	13.64±1.22	24.67±4.72	13.00±1.00	4.34±0.03	6.21±0.41	28.50±1.10	16.00±1.73
3	203.40± 13.18	11.74±0.70	29.27±0.70	15.67±2.30	7.96±0.52	7.28±1.55	27.98±1.18	14.67±1.52
4	143.94±9.91	9.84±0.49	36.07±1.09	14.00±2.00	8.75±0.61	6.37±0.49	29.25±0.48	14.00±2.00
5	170.52±14.80	10.89±0.20	39.10±1.65	15.00±2.00	11.54±1.88	6.05±0.45	26.51±0.52	13.00±2.00
6	265.40±72.95	10.36±1.47	40.60±3.83	26.33±9.01	9.23±1.85	5.73±0.36	27.47±0.98	10.67±2.51
7	242.88±44.39	9.67±1.53	38.27±0.057	26.00±7.81	11.41±0.61	5.43±0.07	27.0±0.89	12.33±1.52

Table 4. Biochemical (Means ± SD) response to greenhouse conditions in tomato plants

Inflorescence	Fruit acidity	Fruit firmness (N/cm2)	Brix %/	Nitrate (mg / kg)
1	15.94 ± 0.27	6.56 ±059	136.67 ±5.77	6.73 ± 0.20
2	16.15± 0.28	6.21±0.41	125.00±5.00	6.87 ±0.23
3	16.47±0.33	7.28±1.5	135.00±8.66	7.05 ±0.37
4	15.35±3.02	6.37±0.49	131.67±7.63	7.84 ± 0.66
5	15.28±0.43	6.05±0.45	133.33±5.77	7.63 ±0.47
6	14.42±1.77	5.73±0.36	145.00±5.00	7.01 ± 0.77
7	14.12±1.01	5.43±0.07	124.00±5.29	10.58 ± 0.77

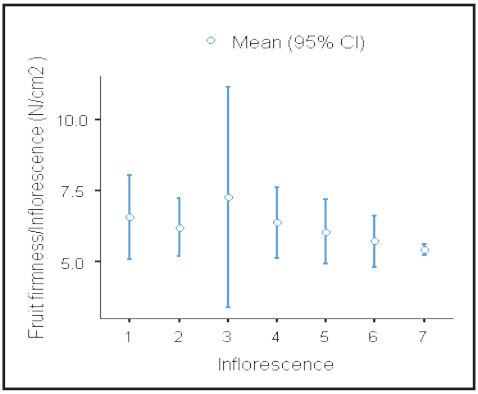

Figure 12. Fruit Firmness/Inflorescence (N/cm^2)

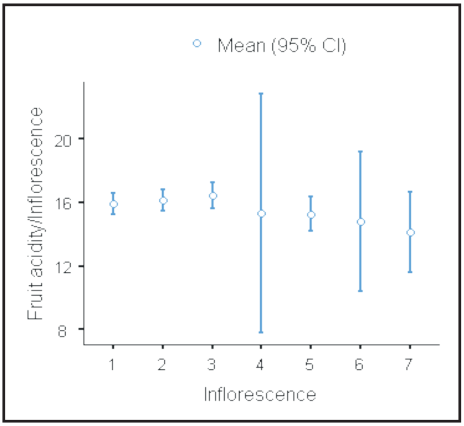

Figure 13. Fruit Acidity/Inflorescence

CONCLUSIONS

In present time, the world has been continuously battling against food scarcity problems. To meet food requirements, it is necessary to grow cereal crops and vegetables at large scale. Greenhouse is a advance method of growing vegetables and crops, which allow maintained the desired growing conditions. Tomato is one of the largest growing vegetables. It is a rich source of different minerals (potassium), vitamins (Vitamin C, Vitamin A, Vitamin K), and antioxidants. Greenhouse conditions, Temperature, humidity, Carbon dioxide and light directly influenced the growth and productivity of tomatoes. Applying growth promoting and productivity-oriented conditions one can grow tomatoes pant at large scale. Tomato as vegetable is considered as income-generating vegetable due to it high market value.

ACKNOWLEDGEMENTS

The research leading to these results has received funding from the NO Grants 2014-2021, under Project contract no. 40/2021.

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