EFFECT OF INTEGRATED ORGANIC AND INORGANIC FERTILIZERS ON GROWTH, YIELD AND QUALITY ATTRIBUTES OF SAU YELLOW CHERRY TOMATO

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CERTIFICATE

This is to certify that thesis entitled, ***"EFFECT OF INTEGRATED ORGANIC AND INORGANIC FERTILIZERS ON GROWTH, YIELD AND QUALITY ATTRIBUTES OF SAU YELLOW CHERRY TOMATO"*** *submitted to the Faculty of Agriculture, Sher-e- Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in HORTICULTURE,*** *embodies the result of a piece of bona fide researchwork carried out by* ***FAIRUJ ANIKA TONNY***, *Registration No.* **19-10175** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: December, 2021
Dhaka, Bangladesh

Prof. Dr. Khaleda Khatun
Supervisor

Never give up hope of Allah's soothing mercy: truly no one despairs of Allah's soothing mercy, except those who have no faith.

(Surah Yusuf 12:87)

DEDICATED TO

MY BELOVED PARENTS

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- The author

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ABSTRACT

A field experiment was conducted in Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka-1207 during November 2020 to March 2021 to evaluate the effect of different doses of organic and inorganic fertilizers on growth, yield and quality attributes of SAU yellow cherry tomato. The experiment was outlined in the Randomized Complete Block Design with 3 replications using 14 treatments. The treatments were T_1=N_{0kg} P_{50kg} K_{80kg} $V_{6t/ha}$, T_2=N_{60kg} P_{50kg} K_{80kg} $V_{6t/ha}$, T_3=N_{120kg} P_{50kg} K_{80kg} $V_{6t/ha}$, T_4=N_{180kg} P_{50kg} K_{80kg} $V_{6t/ha}$, T_5=N_{120kg} P_{0kg} K_{80kg} $V_{6t/ha}$, T_6=N_{120kg} P_{25kg} K_{80kg} $V_{6t/ha}$, T_7=N_{120kg} P_{75kg} K_{80kg} $V_{6t/ha}$, T_8=N_{120kg} P_{50kg} K_{0kg} $V_{6t/ha}$, T_9=N_{120kg} P_{50kg} K_{40kg} $V_{6t/ha}$, T_{10}=N_{120kg} P_{50kg} K_{120kg} $V_{6t/ha}$, T_{11}=N_{120kg} P_{50kg} K_{80kg} $V_{0t/ha}$, T_{12}=N_{120kg} P_{50kg} $K_{80kg}V_{3t/ha}$, T_{13}=N_{120kg} P_{50kg} K_{80kg} $V_{9t/ha}$ and T_{14}=N_{0kg} P_{0kg} $K_{0kg}V_{0t/ha}$ (control). Nitrogen (N), phosphorus (P) and potassium (K) were supplied to the plants from inorganic sources of fertilizers and vermicompost (V) was applied as organic fertilizer. Significant variation was found with the treatments. Among the treatments, the maximum plant height (191.9 cm), flowers number (1347.1/plant), fruits number (1061.3/plant), fruit yield (4.8 kg/plant) and (108.6 t/ha) were found from T_4 while minimum fruit yield (1.2 kg/plant) and (26.6 t/ha) were found from T_{14} treatment. The quality contributing parameter, brix % (7.5) was highest from treatment T_4. The best skin and flesh color was also obtained from the fruits treated with T_4 (N_{180kg} P_{50kg} K_{80kg} $V_{6t/ha}$). In view of the overall performances, the growth, yield and quality attributes of SAU yellow cherry tomato provided the best results for the treatment T_4 (N_{180kg} P_{50kg} K_{80kg} $V_{6t/ha}$).

TABLE OF CONTENT

CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF PLATES

LIST OF APPENDICES

ABBREVIATIONS AND ACCORONYMS

Agric.	=	Agricultural
Agron.	=	Agronomy
AEZ	=	Agro-ecological Zone
ANOVA	=	Analysis of Variance
Biol.	=	Biology
Biochem.	=	Biochemistry
Biotech.	=	Biotechnology
Chem.	=	Chemistry
cm	=	Centimeter
cv.	=	Crop variety
CV	=	Coefficient of variance
DAT	=	Days after transplanting
df	=	Degrees of freedom
Environ.	=	Environmental
et al..	=	And others
FAO	=	Food and Agriculture organization
ha	=	Hectare
Hort.	=	Horticulture
i.e.	=	That is
INM	=	Integrated nutrient management
Int.	=	International
J.	=	Journal
L	=	Liter
LSD	=	Least Significant Difference
m	=	Meter
mm	=	Millimeter
Res.	=	Research
VC	=	Vermicompost
Viz.	=	Namely

CHAPTER I

INTRODUCTION

Cherry tomato (*Solanum lycopersicum* L. var. cerasiforme) belonging to the Solanaceae family is a popular taste-bud delight, delicious and nutritious table tomato which is considered as an additional genetic intermediate between wild-type and home garden tomatoes (Nesbitt and Tanksley, 2002). Cherry tomato is believed to be the direct ancestor of modern cultivated tomatoes and is the only wild tomato found outside South America (Kiple and Ornelas, 2000). It is round to cylindrical in shape, similar to a cherry juicy and meaty berry, bigger than 1.5 cm in diameter (Silva and Giordano, 2000). Cherry tomatoes are also very colorful (red, black, green, bi-Color, white, stripped, yellow-orange and pink) and their unique size makes them more attractive to the consumers (Kobryn and Hallmann, 2005). It can be eaten raw in salads and sandwiches, cooked, or processed into ketchup, sauces, juices or dried powder. Cherry tomatoes contribute significantly to human nutrition by supplying essential amino acids, vitamins, and minerals. In recent years, consumption of tomato is also suggested for lowering the risk of human diseases (Massot *et al.*, 2010; Al-Amri, 2013).

The crop is rich in vitamin C and contains lycopene, a very vital antioxidant which prevents cancers (Beckles, 2012). It also contains carotinoids which are useful against breast cancer and prostate cancer (Singh *et al.*, 2011). Tomato is ranked among the top five vegetables in terms of antioxidant activity (Easdown, 2004). Cherry tomato fruits contain protein, fat, carbohydrates, minerals (such as calcium, phosphorus, and iron), carotene, thiamine, nicotinic acid, riboflavin, and ascorbic acid (Duke, 1985).

It is becoming very popular to many small farmers, special gardeners and green house managers around the world (Abdel-Razz *et al*., 2013) due to its higher commercial value compared to regular tomatoes (Menezes *et al.*, 2012). Growing cherry tomato could be a profitable activity for Bangladeshi farmers because it is a novel crop in Bangladesh and consumers are always interested in new vegetables.

Nutrient management plays an important role in yield and quality of tomatoes (Murmu *et al.*, 2012; Souri and Dehnavard, 2017). Adequate supply of nutrient and water will result in better resource utilization and to avoid stress situations (Souri and Hatamian, 2019) and control production (Raviv and Blom, 2001). The amount and type of nutrients supplied to tomato can influence not only its yield but also its nutrient content, taste and post-harvest storage quality (Sainju *et al.*, 2003).

Organic and inorganic nutrient sources are frequently used in good integrated nutrient management practices. Though various studies on cherry tomatoes have been conducted, the effect of organic and inorganic fertilizers on SAU yellow cherry tomato has not been studied previously in Bangladesh. Tomato requires large quantities of both organic and inorganic nutrients for its economic yields. Fertilizers play an important role in tomato production, both in terms of quantity and quality. Kumar *et al.,* (2004) reported that the use of organic fertilizer sources with mineral nitrogen, phosphorus and potassium fertilizers were found more beneficial in terms of maximum yield and in providing macronutrients in tomato.

Application of different levels of nitrogen increases the plant growth significantly by increasing the plant height, number of branches, number of leaves ultimately resulted in increase the yield of tomato fruits. Nitrogen is a chlorophyll component and it promotes vegetative growth and green coloration of foliage (Jones *et al*., 1983). It also enhances flowering and fruit set of tomato but excess of nitrogen delays maturity and decreases fruit size (Bose and Som, 1990). Phosphorus is recognized as the "key of life" for plant because of its direct involvement in most life processes. It is an important nutrient for tomato plant growth and development, as deficiency of phosphorus leads to reduced growth and reduced yields (Hochmuth *et al.,* 2009). Phosphorus aids in root development, flower initiation, seed and fruit development. Tomatoes have the greatest demand for phosphorus at the early stages of development (Csizinszky, 2005). Potassium is the most prominent inorganic chemical influencing plant physiology with a significant role to play in the plant energy status for storage of assimilates and tissue water relation (Marschner, 1995). It is also important in plant development because it plays a major role in physiological and biochemical processes such as enzyme activation; metabolism of carbohydrates and protein compounds (Zhen *et al.*, 1996). Furthermore, potassium improves fruit size and stimulates root growth hence contributing enormously to fruit quality (El-Bassiony, 2006). Potassium also protects the plant when the weather is cold or dry, strengthening its root system and preventing wilt (Ewulo *et al.*, 2016).

Vermicompost is one of the important organic sources of nutrients for plant. Edwards (1988) reported that vermicompost could promote early and vigorous growth of seedlings. Vermicompost has found to effectively enhance the root formation, elongation of stem and production of biomass in vegetables, ornamental plants etc. (Grappelli *et al.*, 1985; Kale and Bano, 1986; Kale *et al.*, 1987; Kale, 1998; Bano *et al*., 1993; Atiyeh *et al*., 1999). Vermicompost stimulates to influence the microbial activity of soil, increases availability of oxygen, maintains normal soil temperature, increases soil porosity and infiltration of water, improves nutrient content and increases growth, yield and quality of plant (Arora *et al.*,2011).

Because of the economic and nutritional value of cherry tomato, increasing its production and productivity with good yield and high quality is a major goal for farmers. As a result, an attempt was made to investigate the effect of different levels of organic and inorganic fertilizers on the growth, yield, and quality of SAU yellow cherry tomato with the following objectives:

- To find out the effective nutrients combination for maximum vegetative growth and yield contributing characters of SAU yellow cherry tomato.
- To investigate a suitable combination of organic and inorganic fertilizers for better yield and quality of SAU yellow cherry tomato.

CHAPTER II

REVIEW OF LITERATURE

A thorough and critical review of previous research is critical for any scientific investigation. It not only provides knowledge of previous work done in the field, but also insight into methods and procedures. It also serves as a foundation for operational definitions of major concepts. Relevant reviews also support the study's findings and discussion.

Since the SAU yellow cherry tomato is a crop that has only just been planted in Bangladesh, little research has been done on the amounts of organic and inorganic fertilizers that will enhance the growth, yield and quality of the variety. However, some of the most important domestic and international research projects relating to this experiment are detailed in this chapter.

Arul *et al.*, (2022) carried out an investigation during rabi season 2016-17 at College orchard, Department of Horticulture, Agricultural College and Research Institute, Madurai to study the effect of spacing and nitrogen levels on growth, yield and quality of Cherry Tomato (*Lycopersicon esculentum var.* cerasiforme). The crop was laid out in Factorial Randomized Block Design with 3 replications and 16 treatment combination. Four levels of nitrogen *viz.*,75, 100, 125 and 0 kg ha^{-1} of recommended dose as urea, Four levels of spacing *viz.*, 90x40cm, 100x40cm, 110x40cm and 120x40cm with Phosphorus and Potassium each @50 kg ha^{-1} as basal were tried in all possible combinations. The study revealed that the effect of spacing and nitrogen had significant effect on growth, yield and yield attributing characters. All the growth, yield and quality characters were the highest at 100 kg N ha^{-1}, 50 kg phosphorus and potassium.

Sigaye *et al.*, (2022) carried out an experiment to find suitable levels of nitrogen and phosphorus fertilizers under balanced fertilizer and to assess the economic feasibility of N and P fertilizer at Meskan, Gurage districts of Ethiopia. This experiment was designed in a Randomized Complete Block Design with the factorial arrangement in three replicates. Treatments were four nitrogen levels (0, 46, 92, and 138 kg ha^{-1}) and four phosphorous levels (0, 20, 40, and 60 kg ha^{-1}).

The results of this study revealed that there are highly significant ($P < 0.01$) interaction effects of nitrogen and phosphorus fertilizer application during all growing seasons on total and marketable fruit yields of tomatoes. The maximum marketable fruit yield; 55.1, 60.1, and 52.8 t ha^{-1} were obtained during the 2019, 2020 and 2021 growing seasons respectively by application of 138 kg ha^{-1} of N and 40 kg ha^{-1}. Similarly, the maximum total fruit yield (59.5, 62.9, and 56.8 t ha^{-1}) was obtained during the 2019, 2020 and 2021 growing seasons respectively by application of 138 kg ha^{-1} of N and 40 kg ha^{-1}. Therefore, application 138 kg ha^{-1} of N combined with 40 kg ha^{-1} P fertilizers pointed out that the fertilizer level seems to allow a good balance of production and productivity and is economically advisable for farmers in the study area for better tomato production and similar soil types and agro-ecologies.

Carricondo-Martínez *et al.*, (2021) conducted a study to evaluate the effects of organic amendments derived from vegetable residues on the yield and quality of tomato. The following fertilization treatments were carried out: fresh vegetable residues (4 kg m^{-1}), compost (3 kg m^{-1}) and vermicompost at two different doses (3 and 9 kg m^{-1}), all derived from previous tomato crop vegetable residues, an organic treatment with goat manure (3 kg m^{-1}) and a control mineral fertigation treatment. The highest yield was obtained with conventional mineral fertigation management, followed by vermicompost treatments at two different doses (3 and 9 kg m^{-1}) with no statistical differences. The organic treatments with fresh crop residues, compost and goat manure resulted in lower yield. Regarding quality parameters, the lycopene content was higher in the mineral fertilization and vermicompost at 3 kg m^{-1} treatment, while the other antioxidants measured were more concentrated in tomatoes fertilized with vermicompost treatment at 9 kg m^{-1} and goat manure. The plant nutrient management with vermicompost is the best circular solution, as it allows reintegrating the residues generated in previous crop cycles into the soil, obtaining a yield equal to chemical input management and tomatoes with high nutritional quality.

Khan *et al.*, (2021) had a field experiment at the Landscaping Section of the Department of horticulture, Bangladesh Agricultural University, Mymensingh during the period from October 2018 to April 2019. The aim of the experiment was to study the growth and yield of cherry tomato cv. BINA tomato-10 as influenced by the effects of different types of staking and inorganic fertilizers. The experiment included three types of staking viz., S0 = Single staking, S1 = Double staking, S2 = Trellis and five different levels of inorganic fertilizers treatment viz., T0 = Control, T1 = Nitrogen (N) @ 181 kg ha^{-1}, T2 = Phosphorus (P) @ 160 kg ha^{-1}, T3 = Potassium (K) @ 142 kg ha^{-1}, T4 = N+P+K @ (181+160+142) kg ha^{1}. The experiment was laid out in the randomized complete block design with three replications. Different types of staking and inorganic fertilizers had significant influence on all the growth and yield contributing parameters under study. Results revealed that all the growth and yield parameters showed better performance in trellis plants along with N+P+K @ (181+160+142) kg ha^{-1} like highest plant height (150.84 cm), number of leaves (38.71) and branches per plant (7.56), longest leaf length (36.14 cm), maximum number of flower clusters (26.48), flowers (786.99) and fruits per plant (310.67), longest fruit length (4.4 cm) and diameter (2.9 cm), maximum individual fruit weight (10.0 g) and highest fruit yield (93.0 t/ha) while the parameters gave the lowest value from single staked plants with control. Therefore, trellis along with combined application of N+P+K @ (181+160+142) kg ha^{-1} was found to be better in respect of growth and yield of cherry tomato.

Nahar *et al.,* (2021) studied combined effect of organic and inorganic fertilizer on tomato for yield and yield contributing character of fruits using vermicompost and different types of inorganic fertilizers at the farms of Ishurdi Sub-station of Bangladesh Institute of Nuclear agriculture (BINA) during Rabi season, 2020. One variety (BINA tomato-11) and ten different treatments T_1 = control (no fertilizer), T_2 = 100% CF (Chemical Fertilizer), T_3 = 70% CF, T_4= 70% CF + 1 t ha^{-1} VC (Vermicompost), T_5 = 70% CF + 2 t ha^{-1} VC, T_6 = 70% CF + 3 t ha^{-1} VC, T_7= 85% CF, T_8 = 85% CF+ 1 t ha^{-1} VC, T_9 = 85% CF+ 2 t ha^{-1} VC and T_{10} = 85% CF + 3 t ha^{-1} VC were used as experimental materials. Results showed that plant height (120.67 cm), number of fruits/plant (53.33), single fruit weight (95 gm), fruit yield (63.33 t/ha), number of fruit picking (5 times) were higher in T_5 (70% Chemical fertilizers + 2t ha^{-1} VC) than control and other treatments. No significant difference was observed in days to 1st flowering response to the treatments. The study revealed that combined effect of vermicompost and inorganic fertilizers affected tomato plant significantly.

Shova *et al.*, (2021) investigated the effect of crop nutrient management on growth and yield of two tomato varieties in the Chittagong Hill Tracts (CHTs) region of Bangladesh. Two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Factor A was two varieties of tomato namely, V_1: BARI Tomato 2 and V_2: BARI Tomato 15. Factor B was different types of fertilizer like F_0 (Farmers practices), F_1 (vermicompost), F_2 (inorganic fertilizers), F_3 (combined fertilizer: 3/4 vermicompost+ 1/4 inorganic fertilizers), F_4 (control, no fertilizer). Plant growth, flowering and fruit characters, and yield were found significantly different ($p<0.05$). The highest plant height, flowering and fruit characters related to higher production were found in BARI Tomato 15 (V_2) variety influenced by combined application of fertilizer F_3 (3/4 vermicompost + 1/4 inorganic fertilizers). The maximum number of flower clusters per plant (9.66), fruit clusters per plant (8.13), individual fruit weight (117.7 g), fruit numbers per plant (51.17) was found in V_2F_3 and the same parameters were the lowest in V_1F_4. The results showed the highest production (95.50 t ha^{-1}) in V_2F_3 followed by V_2F_0 (81.70 t ha^{-1}), V_2F_1 (72.17 t ha^{-1}) and V_2F_2 (68.06 t ha^{-1}), and the lowest yield (27.70 t ha^{-1}) in V_1F_4. The highest fruit yield ((95.50t ha^{-1}) found in V_2F_3 showed 80.84% higher compared to the V_1F_4 (27.70 t ha^{-1}) treatment. Combined application of vermicompost and inorganic fertilizers performed best as the nutrient management and BARI Tomato 15 was found as a suitable variety for the CHTs climatic condition.

Ali *et al.*, (2020) investigated the influence of planting date and fertilizer management on the growth and yield of tomato cv. Ratan. The experiment consisted of two factors; Factor A: three planting dates, viz. 20 October, 5 November, 20 November and Factor B: four different doses of fertilizer, viz., control; 100 kg urea + 75 kg TSP + 100 kg MOP ha^{-1}; 200 kg urea + 150 kg TSP + 200 kg MOP ha^{-1} and 300 kg urea +225 kg TSP + 300 kg MOP ha^{-1} were used in 12 treatment combinations. Combined effects of planting date and fertilizer management exhibited significant variation on plant height at 30 DAT, 45 DAT, and 60 DAT, number of flowers per plant, number of mature fruits per plant, fruit diameter, weight of individual fruit, weights of fruits per plant, fruit yield per plot and fruit per hectare. The highest fruit yields per plot (23.94 kg) as well as per hectare (73.89 t) were achieved from the treatment combination of planting at 5 November with 200 kg urea + 150 kg TSP + 200 kg MOP ha^{-1}.

Hasnain *et al.,* (2020) evaluated the effects of fertilizer type and application time on soil properties, plant traits, yield and quality of tomato. Compared to the control treatment, this study comprehensively evaluated the effects of four mixed ratios of compost with chemical fertilizer, two nitrogen application times of chemical fertilizer, and their interaction on the soil properties, plant traits, yield, and quality of tomato plants. The soil properties, plant traits, and yield of tomato with all compost-mixed fertilizers performed better than the treatment without fertilizer. Furthermore, the amounts of available nitrogen, phosphorus, organic matter, plant weight, and yield in a 30% chemical fertilizer + 70% compost treatments (CF30) were even better than those with pure chemical fertilizer (CF100).

Kai *et al.,* (2020) conducted an experiment on small sized tomato at the Kurokawa Field Science Center, Meiji University, Kanagawa Prefecture, Japan to investigate the effect of organic and inorganic fertilizers on growth, yield and quality. The chemical experimental treatment was carried out using the chemical fertilizer plan recommended for cherry tomatoes (N: P_2O_5: K_2O = 180: 200: 180 kg ha^{-1}) by Kanagawa Prefecture, Japan, and solid fertilizer was added to commercial black soil as the standard basal dressing.

Ddamulira *et al.,* (2019) conducted a study to determine the effect of nitrogen (N) and potassium (K) fertilizer rates on cherry tomato growth and yield. The experiment was conducted in a field during the seasons 2016 and 2017 at Namulonge. The treatments included; (100, 60, 100) and (200, 60, 200) kg ha^{-1} of

N, P, K and the control with no fertilizer application, these were laid out in a split plot design with three replications. Results revealed that tomato plants significantly ($P < 0.05$) responded to nitrogen and potassium fertilizer application by increasing their height and yield. The highest tomato height and yield were obtained from plots applied with 100,60, 100 kg ha^{-1} of N, P and K. This rate was considered as the optimal application rate because plants applied. On the other hand, plants applied with nitrogen and potassium fertilizers below 100, 60, 100 kg ha^{-1} flowered and matured earlier than those in the control plots. The study showed that N and K fertilizer influenced plant height, flowering, maturity period and yield of cherry tomato. Based on these findings, use of 100, 60, 100 kg ha^{-1} of N, P and K is recommended for improving cherry tomato production in central Uganda, where the study was conducted, and any fertilizer rate above 100, 60, 100 kg ha^{-1} in the same area may be un-economical to use in cherry tomato growing.

Gill *et al.,* (2018) conducted an experiment to assess the effect of levels of N, P and K on yield and quality of cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) at the research farm of the department of Soil Science and Water Management, Nauni, Solan-Himachal Pradesh during kharif seasons of 2014 and 2015. Results revealed that maximum yield of fruit (22.41 q ha^{-1}), shoot (15.22 q ha^{-1}) and root dry matter (4.16 q ha^{-1}) were recorded under T6 (125% recommended dose of NPK) treatment and minimum yield of fruit (16.54 q ha^{-1}), shoot (13.59 q ha^{-1}) and root dry matter (3.72 q ha^{-1}) were recorded under T1 (without NPK fertilizers) treatment. Maximum fruit size (3.36 cm^2), fruit weight (9.29 g) and TSS (8.69^0 Brix) were recorded under T6 treatment and the minimum fruit size (2.73 cm^2), fruit weight (8.26 g) and TSS (7.53^o Brix) were recorded under T1 treatment. Maximum number of fruits per cluster (18.94), number of cluster per plant (8.27) and number of fruits per plant (156.55) were also recorded under T6 treatment and minimum number of fruits per cluster (18.08), number of cluster per plant (7.33) and number of fruits per plant (132.63) were recorded under T1 treatment. The recommended dose of NPK applied in cherry tomato cv. Solan red round was- nitrogen (N)-100 kg ha^{-1}, phosphorus (P2O5)-75 kg ha^{-1} and potassium (K2O)-55 kg ha^{-1}.

Jayasinghe *et al.,* (2018) made a study to find out the effect of compost and different levels of NPK fertilizer on growth and yield performance of three different recommended tomato varieties under different field conditions at Walimada, Sri Lanka. Treatment consisted of three tomato varieties (Roma, Thilina, and T 245) and five different fertilizer levels including compost & NPK fertilizers. Treatments were considered as control (without compost and NPK fertilizer), 100% of compost, 100% of recommended dosage of NPK fertilizers, 50% of compost with 50% of recommended dosage of NPK fertilizers, and 75% of compost with 25% of recommended dosage of NPK fertilizers. According to results, there was a significant different among control treatment and treatment consisted with 50% of compost with 50% of NPK fertilizer treated Roma and Thilina on days to attained 50% of flowering. Results showed that all treatments except chemical fertilizer application improved the soil organic C, total N, P and K status. Increase in microbial biomass C and N was observed in soils receiving organic manures only or with the combined application of organic and chemical fertilizers.

Singh *et al.,* (2018) carried out an investigation to study the effect of organic and inorganic fertilizer on growth, yield and quality of tomato (*Solanum lycopersicum* L.) hybrid cv. (GS-600) under protected cultivation at research station, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Science, Allahabad, India, during 2013-14. Ten treatments were tested in randomized block design with three replications where treatment T7 (50%RDF + 25% FYM + 25%VC) showed significant and best results in term of maximum plant height (259.13 cm), more number of flowers per cluster (7.40) and number of clusters per plant (9.80), highest fruits set percentage (97.33), highest number of fruits per cluster (7.63), and similarly showed significant contribution in yield related traits i.e. maximum number of fruits per plant (113.33), maximum average fruit weight (196.67g), highest fruit yield per plant (22.28kg), highest fruit yield per plot (222.70kg), higher yield per 151.87m^2 (2236.57kg), and also in quality parameters i.e. maximum juice percent (95.57), maximum specific gravity (0.97g), maximum vitamin C (19.73mg/100g of fruit juice) and maximum T.S.S. (4.00˚B). Due to the better yield and quality results in treatment T_7 (50% RDF + 25% FYM + 25% VC), the economic analysis proved it as a best treatment in term of maximum net return (₹ 24390.29) and Benefit cost ratio (2.19). Therefore, these treatments may be recommended to exploit the better eco-friendly economic yield of tomato. It will ensure the sustainability in production and soil health. Manures and fertilizers were applied according to recommended dose for tomato, i.e. 5-20 t ha^{-1} FYM, 2.5-10 t ha^{-1} vermicompost and 2-8 t ha^{-1} poultry manure along with fertilizers N_2: P_2O_5 : K_2O @ 120 : 80 : 60 kg ha^{-1}.

Islam *et al.*, (2017) conducted field trials on tomato for yield and quality of fruits using different types of organic and inorganic fertilizers at the horticulture farm of Bangladesh Agricultural University (BAU), Mymensingh. Fertilizer treatments were tested on two varieties of tomato ca. Roma VF and BARI 15. The fertilization treatments were T_1, vermicompost (12 t ha^{-1}); T_2, compost (10 t ha^{-1}); T_3, integrated plant nutrient system (IPNS) or mixed fertilizers (organic 2/3 part and inorganic 1/3 part); T_4, inorganic fertilizers; and a control (T_5). Results showed growth and yield (20.8 t ha^{-1}) in tomato were higher in the IPNS treatment. A higher number of fruits per plant (73.7) and plant height (73.5 cm) were obtained from mixed fertilizers (organic 2/3 + inorganic 1/3) or IPNS (integrated plant nutrient system) in Roma VF than other treatments.

Khan *et al.*, (2017) carried out an experiment to investigate the effect of compost and inorganic fertilizers on yield and quality of tomato on silt loam soil at Nuclear Institute of Food and Agriculture (NIFA), Peshawar during summer 2016. The experiment was arranged in a Randomized Complete Block Design (RCBD) with three (3) replications and seven (7) treatments. N, P and K fertilizers at 180, 100 and 60 kg ha^{-1} respectively were applied with or without compost, while compost was applied at 20 tons ha^{-1}. The sources of N, P and K were urea, triple super phosphate and muriate of potash. The results of the study showed that yield and quality parameters of tomato fruit were significantly affected by the combined use of compost and inorganic fertilizers. Maximum tomato fruit and dry matter yields, fruit density, number of fruit kg^{-1}, N, P and K uptake by tomato plant were obtained from treatment where full dose of N, P and K with10 tons of compost were applied. Maximum vitamin C content in tomato fruit was observed where full doses of compost and mineral fertilizers were applied. It is concluded that combination of plant residue compost and mineral fertilizers significantly improved the yield, quality of tomato fruit and sustained soil fertility status.

Adhikary *et al.,* (2016) carried out on yield response of tomato (*Lycopersicon esculentum* Mill.) under different combination of manures and fertilizers at Hogladanga village under the Batiaghata upazilla of Khulna district during November, 2013 to March, 2014. The experiment was set up in a Randomized Complete Block Design (RCBD) with three replications. The experiment consisted of seven treatments. The treatments were T_1 = Recommended doses of NPK (Urea @ 350 kg ha^{-1}, TSP @ 250 kg ha^{-1} , MoP 300 kg ha^{-1} , respectively), T_2 = cowdung @10 t ha^{-1}, T_3 = vermicompost @ 10 t ha^{-1}, T_4 = Trichoderma compost @10 t ha^{-1}, T_5 = 50 % cowdung + 50 % recommended doses of fertilizer, T_6 = 50 % vermicompost + 50 % recommended doses of fertilizer and T_7 = 50 % Trichoderma compost + 50 % recommended doses of fertilizer. The response on growth and physio-morphological characteristics, yield attributes and yield of tomato were positively and significantly influenced by the application of vermicompost with recommended doses of NPK and also Trichoderma compost with the recommended doses of NPK. In most cases T_6 (50% vermicompost + 50% recommended doses of fertilizer) treatment performed better. However, the maximum yield of tomato (78.02 t ha^{-1}) was obtained from the treatment receiving 50% vermicompost + 50% recommended doses of fertilizer and the lowest yield of tomato (42.36 t ha^{-1}) was obtained from treatment T_2 (cowdung @10 t ha^{-1}). The highest benefit cost ratio (BCR) of tomato (3.15) was obtained from application of 50% vermicompost + 50% recommended doses of fertilizer due to higher yield and market value. So, 50 % vermicompost + 50% recommended dose of fertilizer treatment (T_6) was proved more profitable and sustainable for cultivation of tomato obtaining better yield.

Biswas *et al.,* (2015) studied the growth and yield response of tomato. Experiments consisted of four nitrogen levels viz. Control: No nitrogen, N1: 100 kg ha^{-1}, N2: 150kg ha^{-1} and N3: 200 kg ha^{-1} using Randomized Complete Block Design with three replications. Tallest plant (91.4 cm) was found from N2. Maximum number of leaves (97.8 $plant^{-1}$), number of branches (10.7 $^{-1}$plant), number of flowers (6.4 $cluster^{-1}$), number of fruits (5.1 $cluster^{-1}$), number of clusters (15.3 $plant^{-1}$), fruit diameter (15.6 cm), individual fruit weight (73.1 g), yield (22.2 kg $plot^{-1}$ and 61.4 t ha^{-1}) and Total Soluble Solid (TSS) (5.5%) were found from N2 while minimum from N0. It was observed that yield, growth parameters and yield contributing attributes are positively correlated with nitrogen levels except control; 150 kg/ha nitrogen was found the best compared to other nitrogen level used in this experiment for growth and yield of BARI Tomato - 9.

Mukta *et al.,* (2015) conducted a pot experiment to investigate the yield and nutrient content of tomato (*Lycopersicon esculentum*) as influenced by the application of vermicompost and chemical fertilizers. The experiment was laid out in a completely randomized design (CRD) with 3 replications and comprised of 8 treatments *viz.*, T_1 - control, T_2 - recommended dose of NPK fertilizers (CF), T_3 - vermicompost @ 5 t ha^{-1} (VC_1), T_4 - vermicompost @ 10 t ha^{-1} (VC_2), T_5 - VC_1 + 50% CF, T_6 - VC_1 + 75% CF, T_7 - VC_2 + 50% CF and T_8 - VC_2 + 75% CF. Application of vermicompost @ 10 t ha^{-1} along with 50% chemical fertilizers showed the best performance for plant height, number of leaves $plant^{-1}$, number of flowers $branch^{-1}$, number of fruits $branch^{-1}$, number of fruits $plant^{-1}$, fruit size and yield of tomato. . Results of the study demonstrate that the combined application of vermicompost and chemical fertilizers would help to maintain the long term soil productivity for sustainable tomato cultivation.

Kisetu *et al.,* (2014) studied to compare effects of poultry manure and NPK (23:10:5) fertilizer to the performance of tomato (*Lycopersicon esculentum* Mill). Poultry manure was applied at 2, 4 and 8 t ha^{-1} and NPK fertilizer at 20, 40 and 80 kg ha^{-1}. Results showed that the highest number of leaves (70) and shoot length (93 cm) were recorded at 8 t ha^{-1} and lowest (46 and 57 cm, respectively) at 2 t ha^{-1} of poultry manure. These variables were far small (18 and 55 cm, respectively) for absolute control. In addition, 40 kg NPK ha^{-1} recorded the highest shoot length (91 cm) and 20 kg NPK ha^{-1} lowest (60 cm). Many tomato fruits (31) were produced at 8 t ha^{-1} poultry manure compared with 22 in 40 kg NPK ha^{-1} and differed significantly ($p<0.001$) with absolute control (5) and among treatments. The smallest (823 g) and highest (2338 g) weights of fruits recorded per plant at 2 and 8 t ha^{-1} poultry manure, respectively, differed significantly ($p<0.01$) among treatments and absolute control (341 g). The smallest (676 g) and highest (1668 g) weights recorded at 20 and 40 kg NPK ha^{-1}, respectively, also differed significantly ($p<0.01$).

Nangliya (2014) conducted an experiment in tomato and obtained maximum benefit cost ratio of 8.81 in T_6 (112:90:45 kg ha^{-1} NPK + 10 kg ha^{-1} vermicompost + 10kg ha^{-1} FYM) and minimum benefit cost ratio of 3.37 in control (no fertilizer).

Chaitanya *et al.,* (2013) reported that the N (103.76 kg ha^{-1}), P (17.40 kg ha^{-1}) and K (61.82 kg ha^{-1}) uptakes by tomato crop at harvesting stage respectively, were highest in 75% RDN (Recommended dose of nutrient) through fertilizers +25% RDN through vermicompost. The fruit yield (84.97 q ha^{-1}) of tomato was highest in 75% RDN through fertilizers + 25% RDN through vermicompost. The highest available P_2O_5 (42.4 kg ha^{-1}) and K_2O (332.9 kg ha^{-1}) were recorded in 50% RDN through vermicompost + 50% RDN through poultry manure at harvesting stage of the crop.

Manoj *et al.,* (2013) conducted a field experiment during the winter season of (2009-2010) to study the effect of nitrogen, phosphorus and potassium fertilizers on the growth, yield and quality of tomato var. Azad T-6 at the Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow. Three types of fertilizers (nitrogen, phosphorus and potassium) in different combinations were tested in a Randomized Block Design with 3 replications. Tomato plants were fertilized with different rates of chemical fertilizers *i.e.* two doses of nitrogen fertilizers N_1 and N_2 (120 and 180 kg ha^{-1}), single dose of phosphorus P_1 (80 kg ha^{-1}) and potassium K_1 (75 kg ha^{-1}).

The highest plant height, the maximum number of primary and secondary branches, number of flowers and fruits plant-1 as well as the greatest fruit size, fruit yield plant-1 and fruit yield ha^{-1} were obtained from the application of the recommended dose of nutrients viz., 120 kg N + 80 kg P + 75 kg K ha^{-1}. The results revealed that significantly the highest plant height higher yield and yield attributing characters were recorded with the application of 100% NPK i.e. 180 kg N ha^{-1} along with 80 kg P $ha^{-1}$and 75 kg K ha^{-1}.

Pandey and Chandra (2013) studied the impact of integrated nutrient management on tomato yield under farmers' field conditions. The benefit cost ratio was found to be maximum in case of recommended dose of INM (10 t ha^{-1} + NPK @ 150:80:60 kg ha^{-1} + 1% Azotobacter + 20 ppm ferrous ammonium sulphate) for both seasons; Rabi, 2008 (4.25) and Kharif, 2009 (4.23).

Singh *et al.*, (2013) A field experiment was conducted for two years to investigate the effect of vermicompost, organic mulching and irrigation level on growth, yield and quality attributes of tomato (*Solanum lycopersicum* L.). Results showed that the application of vermicompost @ 5 tonnes ha^{-1}, 5 cm thick mulching with dried crop residues, two-thirds dose of NPK fertilizer (80:40:40 kg ha^{-1}) and 30 % irrigation is optimum for obtaining better quality and productivity of field grown tomatoes during dry period of mild-tropical climate.

Chinnaswami and Mariakulandai (2012) studied that influence of organic and inorganic manures on the storage life of tomato and reported that combination of FYM and inorganic mixture (120:106:84 NPK kg ha^{-1}) significantly enhanced the keeping quality over control treatments.

Goutam *et al.*, (2011) conducted Field trials using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared where T1 was kept as control and five others were treated by different category of fertilizers (T2-Chemical fertilizers, T3-Farm Yard Manure (FYM), T4-Vermicompost, T5 and T6- FYM supplemented with chemical fertilizers and vermicompost supplemented with chemical fertilizer respectively).The treatment plots (T6) showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N.P.K treated plots (T5) displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.

Prativa and Bhattarai (2011) studied maximum plant height and number of leaves per plant was observed with treatment 16.66 t ha^{-1} FYM + 8.33 t ha^{-1} vermicompost + NPK. Highest number of fruit clusters, maximum fruit weight and fruit yield (25.74 mt ha^{-1}) were also recorded in treatment 16.6 t ha^{-1} FYM + 8.33 m t ha^{-1} vermicompost + NPK (100:80:60 kg ha^{-1}) in tomato crop.

Reddy and Reddy (2011) studied integrated use of organic manures and inorganic fertilizers for crop response in tomato-onion cropping system. Application of organic manures with inorganic fertilizers significantly increased the availability of N, P and K with the increase level of organic manures application and with no fertilizer registered maximum but at par with 50 and 75 per cent manure levels while the 25 per cent level of organic manure recorded minimum. The study concluded that the combined use of organic manures and inorganic fertilizers is suitable for sustaining yield and maintaining soil health.

Singh *et al.,* (2010) was conducted a field experiment with an objective to investigate the effects of vermicompost and NPK fertilizer application on morpho-physiological traits, yield and quality attributes of tomato (*Solanum lycopersicum* L.) with an ultimate aim of optimizing nutrient requirements of tomato in mild-tropical agro-climate. The application of vermicompost together with NPK fertilizer increased plant height, leaf area, leaf weight, fruit weight, fruit yield, fruit density, post-harvest life and TSS of tomato. Application of vermicompost alone too increased the shelf-life by 250% and TSS beyond 4.5%, both of which are traits highly desirable for summer production of tomato and the related processing industry. Present study reveals that application of vermicompost in the amount of 7.5 t ha^{-1} in combination with 50% dose of NPK fertilizer (60:30:30 kg ha^{-1}) was optimum for obtaining better quality and productivity of field grown tomatoes in mild-tropical agro-climate, eventually integrated nutrient supply will sustain the soil fertility and plant productivity eco-friendly.

Mudasir *et al.*, (2009) reported that in tomato crop application of 3.5 t of Poultry Manure + 95 N + 75 P + 55 K kg ha^{-1} results in maximum plant height (130.06 cm), highest number of branches per plant (11.46), number of fruits per plant (62.31), fruit diameter (5.25 cm), fruit weight (59.75 g) and fruit yield (53.34 t ha^{-1}), while minimum was observed in control (69.51cm, 5.69, 29.75, 3.16 cm,35.24 g and 24.92 t ha^{-1}), respectively.

Pascale *et al.*, (2004) studied the role of nitrogen (N) as yield-limiting factor was evaluated over a 2-year period in tomato under conventional and organic management. Three N fertilization rates (0, 100, 200 kg N ha^{-1}) and three tomato cultivars were compared under organic and conventional cropping systems. It was found that increasing nitrogen fertilization from 0 to 200 kg N ha^{-1} resulted in tomato yield increase and fruit quality improvement.

Hebbar *et al*., (2004) conducted an experiment to study the effect of NPK drip fertigation on tomato. He observed that NPK uptake was maximum in case of WSF (Water soluble fertilizer) fertigation (165.7, 16.5, 113.5 kg ha^{-1}) while lowest was recorded in case of furrow irrigation control (109.3, 9.5, 69.1kg ha^{-1}).

Natarajan *et al.,* (2004) reported the effect of organic and inorganic fertilizers on growth and yield of tomato. They observed application of 50 per cent RDF (100:50:50 NPK kg ha^{-1}) and 50 per cent FYM 12.5 t ha^{-1} resulted in highest vegetative growth and yield (586.51 q ha^{-1}).

Harikrishna *et al.*, (2002) conducted an experiment to study the effect of integrated nutrient management (INM) on availability and uptake of nutrients and yield of tomato, reported that the application of recommended dose of fertilizers (115:100:60 kg N: P_2O_5: K_2O ha^{-1}) recorded higher uptake of N (74.73 kg ha^{-1}), P (15.58 kg ha^{-1}) and K (160.69 kg ha^{-1}) over 50.33, 11.06 and 123.94 kg ha^{-1} N, P and K with FYM @ 25 t ha^{-1}. However, percent N (1.25) and P (0.26) in tomato were maximum with recommended dose of fertilizers whereas, percent K (2.81) was maximum with 50.33, 11.06 and 123.94 kg ha^{-1} N, P and K with FYM @ 25 t ha^{-1}.

Kumar (2002) conducted an experiment in tomato and observed the maximum benefit cost ratio of 3.88 in T_8 (200:112:50 kg ha^{-1} NPK) followed by T_{16} (200:75:100 kg ha^{-1} NPK) whereas minimum benefit cost ratio of 3.04 was observed in treatment T_{12} (100:150:100 kg ha^{-1} NPK).

Vasanthi *et al.*, (1995) reported that vermicompost application along with inorganic fertilizers increased the organic carbon content and available nitrogen status of the soil by 87.7 and 42.9 per cent, respectively.

Reports also revealed that vermicomposting significantly increased the organic carbon by 17.88 per cent, available nitrogen by 20.93 per cent, available phosphorous by 6.82 per cent and available potassium by 15.93 per cent (Bangar and Jatgar, 1995).

Aasi (1992) on the basis of three years study under mid-hill conditions of Himachal Pradesh reported that K removal by whole tomato plant increased with increasing levels of K. The tomato plant removed 96.22, 108.85 and 115.69 kg K_2O ha^{-1} when K was applied @ 30, 60 and 90 kg ha^{-1}, respectively.

Orphanos and Papadopolus (1980) while studying the NPK requirement of tomato under greenhouse condition in Cyprus, reported that for producing 7 kg fruit per plant, the fertilizer required will be 17g N, 4.0g P (9.16g P_2O_5) and 10 g K (12g K_2O) per plant.

Anand and Muthukrishnan (1974) studied the effect of N fertilization on tomato and observed that the leaf N progressively increased from 2.52 to 3.05 per cent with the increase in N dose from 75 to 150 kg ha^{-1}.

Sharma and Shukla (1972) observed that the tomato variety Pusa Ruby planted on sandy clay loam soil applied with N, P_2O_5 and K_2O (0-150, 0-150, 0-100 kg ha^{-1}), 5 respectively removed 117.30, 107.75 and 62.25 kg ha^{-1} of N, P and K respectively.

CHAPTER III

MATERIALS AND METHODS

This chapter demonstrates information regarding methodology that was exploited in the accomplishment of the experiment. It encompasses a brief outline of the location of the experiment, climate conditions and the materials used for the experiment. It also flourishes the treatments of the experiment, datacollection and procedures of data analysis.

3.1 Experimental site

The field experiment was conducted at Horticulture farm of Sher-e-Bangla Agricultural University, Dhaka-1207. The location of the experimental site was at 23.75^0N latitude and 90.34^0E longitudes with an elevation of 8.45 meter from the sea level.

3.2 Characteristics of the soil

The experimental site belongs to the general soil type, which is Shallow Red Brown Terrace Soils under Tejgoan Series where top soil is olive grey with common fine to medium distinct dark yellowish brown mottles and were clay loam in texture. Organic matter content was 0.84%. Soil pH ranged from 6.0-6.6, ECE 25.28 and organic carbon content is 0.45. Experimental area was flat having good drainage system and available irrigation and it is above the flood level.

From experimental field, soil sample was collected from 0-15 cm depths and analyzed by Soil Resources and Development Institute (SRDI), Dhaka. Physiochemical properties were present in the Appendix III (B).

3.3 Climatic conditions

Experimental site was located in the subtropical monsoon climatic zone, characterized by a heavy rainfall during the months from April to September (Kharif season) and a scanty rainfall during the rest of the year (Rabi season). Plenty of sunshine and moderately low temperatures prevail during October to March (Rabi season), which is suitable for cherry tomato growing in Bangladesh.

The monthly mean of daily maximum, minimum and average temperature, relative humidity, monthly total rain fall and sunshine hours received at the experimental site during the period of the study have been collected from Bangladesh Meteorological Department, Agargoan, Dhaka (Appendix II).

3.4 Planting materials

Seeds of SAU yellow cherry tomato (Golden Purna) variety were collected from the "Horticulture Innovation Lab. BD". This variety was indeterminate type.

3.5 Experimental Treatment

This single factor experiment with 14 treatments was carried out to find out suitable dose of organic and inorganic fertilizers for better growth, yield and quality. The treatments were as follows:

$T_1=N_{0kg}\,P_{50kg}\,K_{80kg}\,V_{6t/ha}$

$T_2=N_{60kg}\,P_{50kg}\,K_{80kg}\,V_{6t/ha}$

$T_3=N_{120kg}\,P_{50kg}\,K_{80kg}\,V_{6t/ha}$

$T_4=N_{180kg}\,P_{50kg}\,K_{80kg}\,V_{6t/ha}$

$T_5=N_{120kg}\,P_{0kg}\,K_{80kg}\,V_{6t/ha}$

$T_6=N_{120kg}\,P_{25kg}\,K_{80kg}\,V_{6t/ha}$

$T_7=N_{120kg}\,P_{75kg}\,K_{80kg}\,V_{6t/ha}$

$T_8=N_{120kg}\,P_{50kg}\,K_{0kg}\,V_{6t/ha}$

$T_9=N_{120kg}\,P_{50kg}\,K_{40kg}\,V_{6t/ha}$

$T_{10}=N_{120kg}\,P_{50kg}\,K_{120kg}\,V_{6t/ha}$

$T_{11}=N_{120kg}\,P_{50kg}\,K_{80kg}\,V_{0t/ha}$

$T_{12}=N_{120kg}\,P_{50kg}\,K_{80kg}\,V_{3t/ha}$

$T_{13}=N_{120kg}\,P_{50kg}\,K_{80kg}\,V_{9t/ha}$

$T_{14}=N_{0kg}\,P_{0kg}\,K_{0kg}\,V_{0t/ha}$ (control)

Here, N= Nitrogen, P=Phosphorus, K=Potassium and V=Vermicompost

3.5.1 Sources of NPK:

The sources of NPK were urea, triple super phosphate (TSP) and muriate of potash (MoP) fertilizers respectively.

3.5.2 Application of NPK and vermicompost:

Nitrogen and Potassium are applied at three split doses. First dose is applied at 2 days before transplanting. Second and third doses of nitrogen and potassium are applied at 15 and 30 days after transplanting. Total amount of phosphorus and vermicompost were applied during final land preparation i.e 2 days before transplanting.

3.6 Design and layout of the experiment:

The experiment was laid out in Randomized Complete Block Design (RCBD) having single factor with three replications. An area of 28.5 m × 8.5 m was divided into three equal blocks. Each block consists of 14 plots where 14 treatments were allocated randomly. There were 42 unit plots in the experiment. The size of each plot was 1.8 m × 1.5m. The distance between two plots was kept 0.5 m. A layout of the experiment has been shown in figure 1.

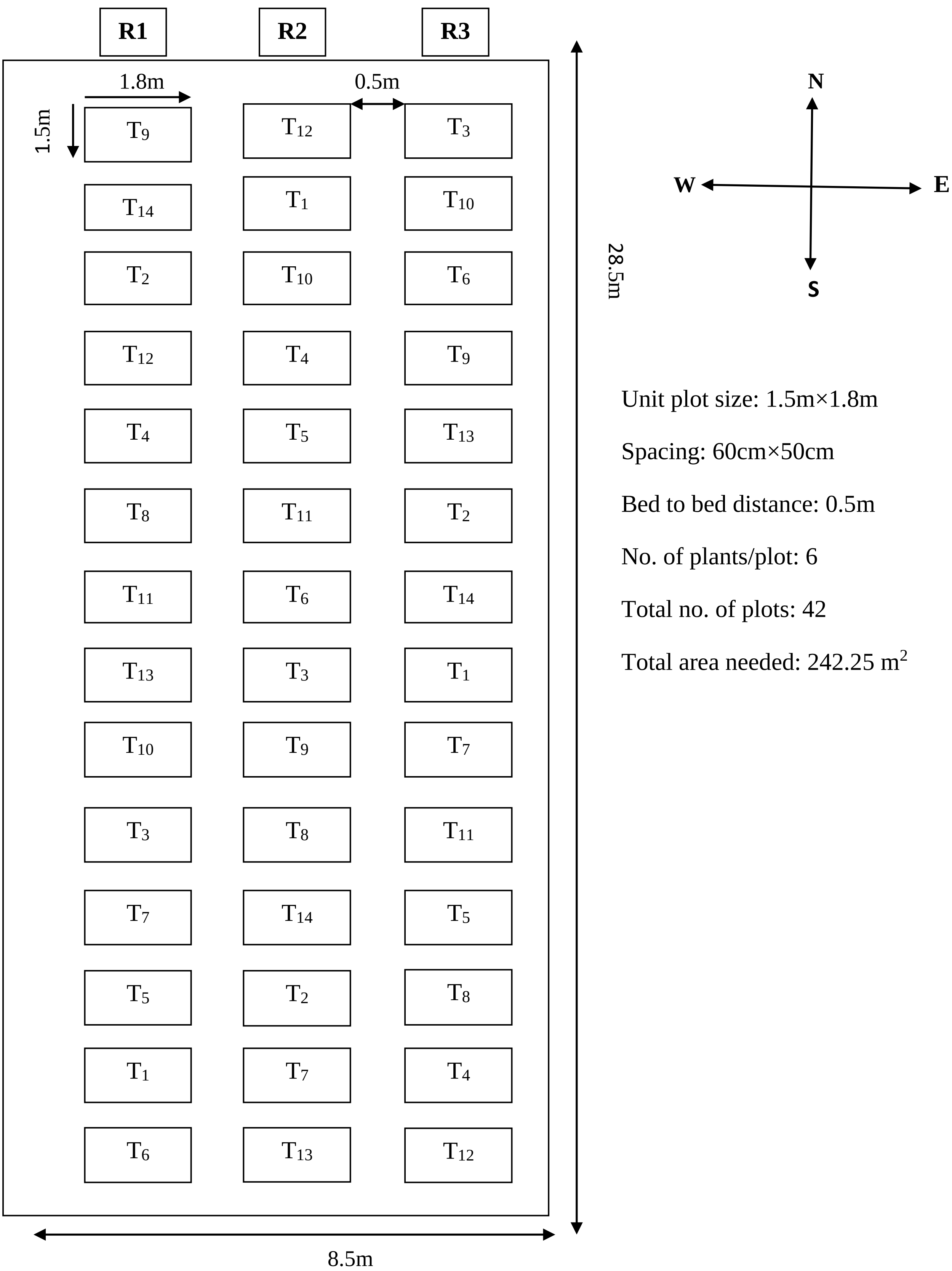

Fig 1: Layout of the experiment

3.7 Production technology

3.7.1 Raising of seedling

Tomato seedlings were raised in two seed beds of 2 m × l m and size. The soil was well prepared and converted into loose friable condition in obtaining good tilth. All weeds, stubble, dead roots were removed. Ten grams of seed were sown in each seedbed. Before sowing, seeds were treated with Captan 75 WS @ 1.5 to 2.0 g a.i./litre for 5 minutes to protect seedlings from soil borne diseases. The seeds were sown in seed bed on 4 November 2020. Seeds were then covered with light soil and shading was provided by bamboo mat to protect young seedlings from scorching sunshine and rainfall. Light watering and weeding were done as and when necessary to provide seedlings with good condition for growth (Plate 1.a).

3.7.2 Land preparation

The soil was prepared and tilth was ensured. The land of the experimental field was ploughed with a power tiller on November 2020. The experimental field was thoroughly ploughed and cleaned prior to seed sowing. Later on the land was ploughed three timesfollowed by laddering to obtain desirable tilth. The corners of the land were spaded and larger clods were broken into smaller pieces. After ploughing and laddering, all the stubbles and uprooted weeds were removed .Then the land was made ready. The field layout and design of the experiment was followed after land preparation.

3.7.3 Application of micronutrients

The sources of Zn, B and S as Zinc sulphate, boric acid, gypsum were applied respectively throughout this experiment. The entire amount of fertilizers was applied during the final land preparation. The fertilizer were applied on both sides of plants rows and mixed well with the soil.

Table 1. Fertilizers used as per BARC fertilizer recommendation guide

Fertilizers	Recommended dose
Zinc (Zn)	4 kg ha^{-1}
Boron (B)	2.5 kg ha^{-1}
Sulphur (S)	20 kg ha^{-1}

3.7.4 Transplanting of Seedlings

The Seedlings were raised in the seedbed in usual way and 25 days old seedlings were transplanted in the field on November 29, 2020 maintaining a spacing of 60×50 cm and plots were tagged according to the treatments (Plate 1.b). This allowed an accommodation of 6 plants in each plot.

3.8 Intercultural operations

After transplanting the seedlings in the field, different kinds of intercultural operations were accomplished for better growth and development of the plants, which were as follows:

3.8.1 Gap filling

A few gaps filling was done by healthy seedlings of the same stock where initial planted seedlings failed to survive.

3.8.2 Weeding

Weeding was done uniformly in all the pots when the seedlings were well established. After 20 days of the first one the second weeding was also done.

3.8.3 Staking

When the plants were well established, staking was done to each plants using bamboo sticks with rope to keep the plants erect (Plate 1.c). As the plants grew up within a few days of staking, other cultural operations were carried out.

3.8.4 Earthing Up

Soil surrounding the plant was heaped up at the base of the plant after 30 days of transplanting for better growth of roots.

3.8.5 Irrigation

Number of irrigation was given throughout the growing period by Garden pipe. The first irrigation was given immediately after transplantation. Then others were applied as and when required depending upon the condition of soil.

3.8.6 Pesticide application

In order to control pests “Yellow sticky traps” were used during the whole growing season. Moreover, to prevent disease infestation ‘Clybio’ was used for 3 times at an interval of 15 days. Ripcord was applied @ 6 ml/L against the insect pests like cut worm, leaf hopper, fruit borer etc. The insecticide application was done fortnightly after transplanting before first harvesting. Besides these a solution containing neem oil and shampoo was sprayed to protect the plant from aphid (Plate 1.d).

3.8.7 Harvesting

Harvesting of fruits were done on the basis of horticultural maturity, size, color and age being determined for the purpose of consumption as the fruit grew rapidly and soon get beyond the marketable stage. Throughout the harvesting period, frequent picking was done (Plate 1.h).

3.9 Data collection

Data were collected in respect of the following parameters:

3.9.1. Plant height

The plant height was measured in cm from bottom of the plant to the tip of the plant using measuring scale (Plate 1.e) maintaining certain days of interval and mean was computed. The plant height was measured at 30, 45, 60 and 90 DAT.

3.9.2. Number of branches per plant

The number of branches per plant was counted manually at certain days of interval from every selected plant from every plot and the average was calculated and expressed as average number of branches per plant. Branches number was counted at 30, 45 and 60 DAT.

3.9.3. Number of leaves per plant

The number of leaves per plant was counted at 30, 45, 60 days after transplanting. The average of 4 plants were computed and expressed in average number of leaves per plant.

3.9.4 Number of cluster per plant

Number of clusters was taken from selected plants after certain days of interval of transplanting. Each cluster was counted manually and the average was expressed as the number of clusters / plant (Plate 1.f).

3.9.5 Number of flowers per cluster

The number of flower per cluster was counted manually from every cluster of the selected plant at a certain days of interval and the average was computed and finally expressed as the average number of flower per cluster (Plate 1.f).

3.9.6 Number of flowers per plant

The number of flowers per plant was recorded manually from every cluster of the selected plant at a certain days of interval and the average was computed and expressed in average number of flower per plant.

3.9.7 Number of fruits per cluster

The number of fruit in every cluster was recorded manually from selected plant, then the average was calculated and expressed as the average number of fruit per cluster.

3.9.8 Number of fruits per plant

The number of fruits from selected plant was counted and then the average was calculated and expressed as the average number of fruit per plant (Plate 1.g).

3.9.9 Fruit length and diameter

Fruit length and diameter were measured by using the digital slide caliper-515 (DC515) in milimetre (mm) and mean was calculated (Plate 1.i).

3.9.10 Individual fruit weight

The fruits except 1st and last harvest were considered to take individual fruit weight. Fruit weight was measured by Electronic Precision Balance in gram (Plate 1.j). Total fruit weight of each pot was obtained by addition of weight of the total fruit number and average fruit weight was obtained from division of the total fruit weight by the total number of fruits.

3.10.11 Number of seeds per fruit

The number of seeds per fruit was counted manually after cutting and separating seeds from fruits.

3.10.12 Fruit Yield per plant (kg)

Yield per plant was calculated in kilogram (kg) by a balance from the total weight of fruits per plant which were harvested at different periods.

3.10.13 Fruit yield per plot (kg)

A pan scale balance was used to take the weight of fruit per plot and recorded in kg.

3.10.14 Fruit yield (t ha^{-1})

It was calculated by multiplying fruit yield per plot (kg) and 10000 m^2 then divided by the multiplication of area of plot (m^2) and 1000 kg.

3.10.15 Brix %

Brix % was measured by a refractometer (ERMA, Tokyo, Japan) at room temperature (Plate 1.k). At first every single fruit was blended and the juice extract was collected to measure brix and expressed in percentage. Mean was calculated from the each treatment.

3.10.16 Skin and flesh color measurement

Colorimetric measurement was done using IWAVE WF32 precision colorimeter (Shenzhen Wave) following L* (Lightness), a* and b* (two Cartesian coordinates) including C* and h_{ab} (chroma and hue angle) based on CIELab scale with standard observer 100 and standard illumination D65 (CIE, 1986: McGuire, 1998). The minimum for L* is zero which represents black. The a* and b* axes have no specific numerical limits. Positive b* is yellow and negative b* is blue. The fruits were separated and were placed under measurement port for color measurement (Plate 1.l).

3.10 Statistical analysis

The data recorded for different parameters were statistically analyzed using Statistix-10 scientific analysis software to find out the significance of variation among the treatments and treatment means were compared by Least Significant Difference (LSD) test at 1% level of probability.

(**a**)

(**b**)

(**c**) -

(**d**)

(**e**)

(**f**)

Plate 1: Pictorial presentation of the research related works and data collection (**a**) Seedling of SAU yellow cherry tomato in the seed bed ; (**b**) Seedling in the main field after transplanting; (**c**) Staking of plant; (**d**) Application of a clybio, neem oil to the plant; (**e**) Measurement of plant height with scale; (**f**) Clusters and flowers counting.

(g)

(h)

(i)

(j)

(k)

(l)

Plate 1 (Continued): Pictorial presentation on research related works and data collection (**g**) Number of fruits counting; (**h**) Fruit harvesting; (**i**) Measurement of fruit length and diameter using digital caliper-515 in milimeter (mm); (**j**) Measurement of single fruit weight using electrical balance; (**k**) A refractometer measuring brix (%); (**l**) CIELab color coordinate measurement of skin and flesh using IWAVE WF32 precision colorimeter (Shenzhen Wave).

CHAPTER IV

RESULT AND DISCUSSION

The experiment was carried out to assess the vegetative growth and yield performance and quality of SAU yellow cherry tomato under different level of organic and inorganic fertilizer treatments. This chapter presents and discusses the research work's findings. Tables and figures have been used to enhance the parallel and dissimilar traits of this chapter through discussion, comprehension and perception. In the appendix, a summary of the variance analysis for all parameters has been arrayed. The following headings are where the results have been presented, discussed and possible interpretations are given.

4.1 Plant height

Plant height was significantly influenced by the combined application of different levels of organic and inorganic fertilizers (Appendix IV). The result of the study demonstrated that at each stage, plant height increased with increased nutrients level. The height of plants was measured at four growth stages namely 30, 45, 60 and 90 days after transplanting. The highest plant height was at 90 days after transplanting.

At 30 DAT, the maximum plant height (48.4 cm) was found from T_4 (N_{180kg} P_{50kg} $K_{80kg}V_{6t/ha}$) treatment which was followed by 45.1 cm and 44.9 cm from T_{11} ($N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$) and T_8 ($N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$) and minimum plant height (37.7 cm) was observed from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$).The plant height found from T_{11} and T_8 were statistically identical. At 45 DAT, the maximum plant height (115.2 cm) was observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) followed by (110.3 cm) from T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$) and minimum plant height (88.7 cm) was observed from T_{14} treatment. At 60 DAT, the maximum plant height (149.8 cm) was recorded from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) and minimum plant height (131.5 cm) from treatment. At 90 DAT the maximum plant height (191.9 cm) was noted from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) followed by (188.1 cm) from T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$) and minimum plant height (161.3 cm) was observed from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment (Figure 2). The findings of the study are in closely conformity with the results of Singh *et al.,* (2010). Ddamulira *et al.,* (2019) conducted an experiment on cherry tomato with N, P and K and recorded that fertilizer rates significantly influence the height of cherry tomato and they found taller plant with $N_{100}P_{60}K_{100}$ fertilizer doses. Islam *et al.,* (2017) noticed that mixed fertilizer (organic+ inorganic) created the highest amount of flower clusters, fruit clusters, fruits yield and plant height than no fertilizer application. Vermicompost and inorganic fertilizer combination gave higher plant height. It is because vermicompost is a reservoir of many nutrients and it facilitates plant growth. It also creates good soil environment and helps to grow plant vigorously. It is because of rapid conversion of inorganic fertilizer into available form of nutrients to plants. As a result plant height increased day by day significantly at this treatment combination. Vermicompost had significant effect on plant height as reported by different authors. These results are in agreement with the findings of Najar and Khan (2013).They found highest shoot length with application of vermicompost @ 6 t ha^{-1}. Hence, it may be inferred that the increase in plant height could be due to balanced absorption of nutrients, increased rate of photosynthesis and stimulation of root system.

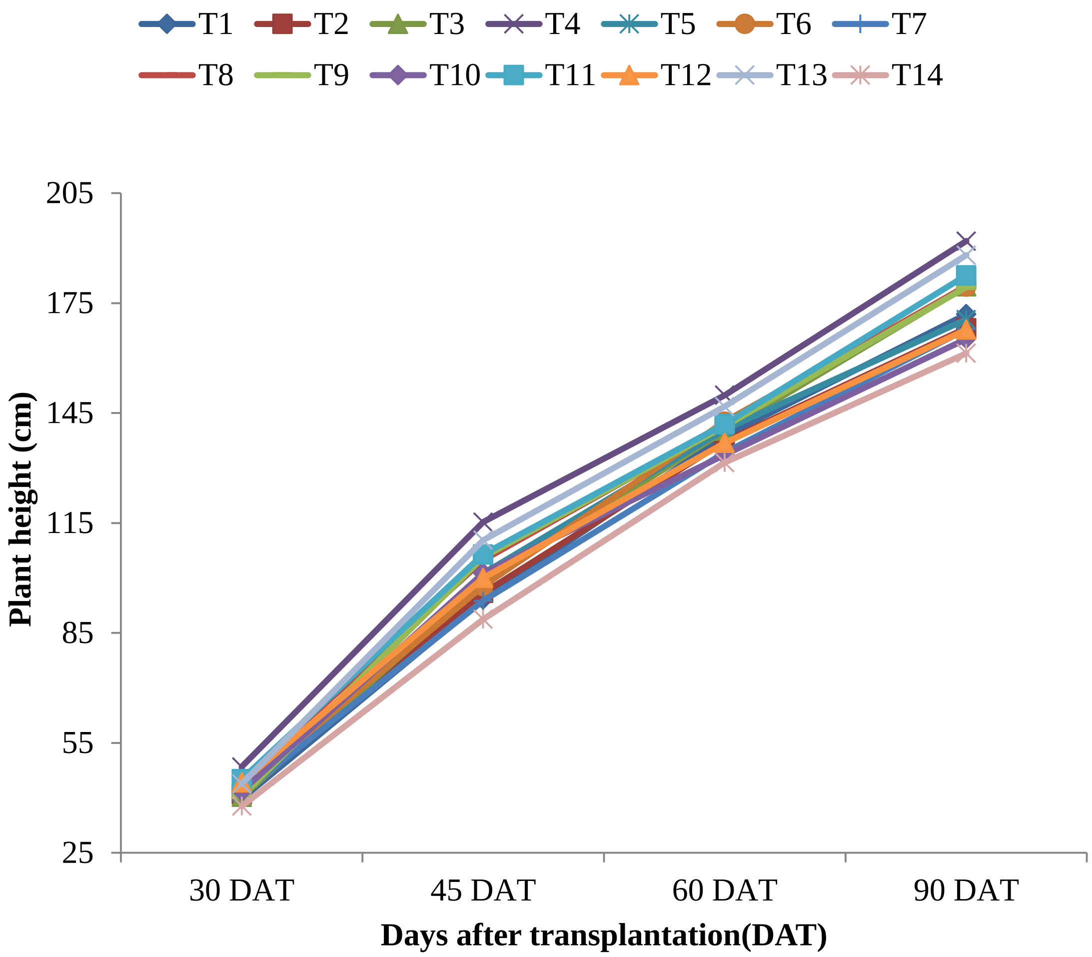

Fig. 2: Effect of different doses of organic and inorganic fertilizers on plant height (cm) of SAU yellow cherry tomato

Here,

T_1=$N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_2=$N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_3=$N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_4=$N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_5=$N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, T_6=$N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, T_7=$N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, T_8=$N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, T_9=$N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, T_{10}=$N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, T_{11}=$N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, T_{12}=$N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, T_{13}=$N_{120kg}P_{50kg}K_{80kg}V_{9t/h}$ and T_{14}=$N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.2 Number of branches per plant

Distinct variation was observed among the number of branches per plant of cherry tomato in respect of application of various levels of organic and inorganic fertilizers. Number of branches of cherry tomato plant varied significantly due to the application of macronutrients and vermicompost. It was observed 15 days interval starting from 30 DAT and continued up to 60 DAT. At 30 DAT number of branches per plant showed non-significant effect (Appendix V).

At 45 DAT, treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) showed the maximum number of branches per plant (5.2) which was statistically similar to 4.9 from treatment T_5 ($N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$) and T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment showed the lowest number of branches per plant (3.6). At 60 DAT, the maximum number of branches per plant (7.2) was observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment which was statistically similar (7.0) to T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment and the minimum number of branches per plant (5.5) was observed in from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Figure 3).That combination of $N_{180kg}P_{50kg}K_{80kg/ha}$ and $V_{6\ t/ha}$ has greatly influenced this trait. The reason for higher number of branches per plant must be explained in the way that the favourable influence and balance uptake of nutrients which were applied. According to Islam (2011) higher tomato plant spread was found from vermicompost and *Trichoderma* compost with NPK fertilizer than NPK. It is because vermicompost and recommended doses of fertilizers creates healthy and optimum condition on the soil. As a result, plant spread increased vigorously in the open air.

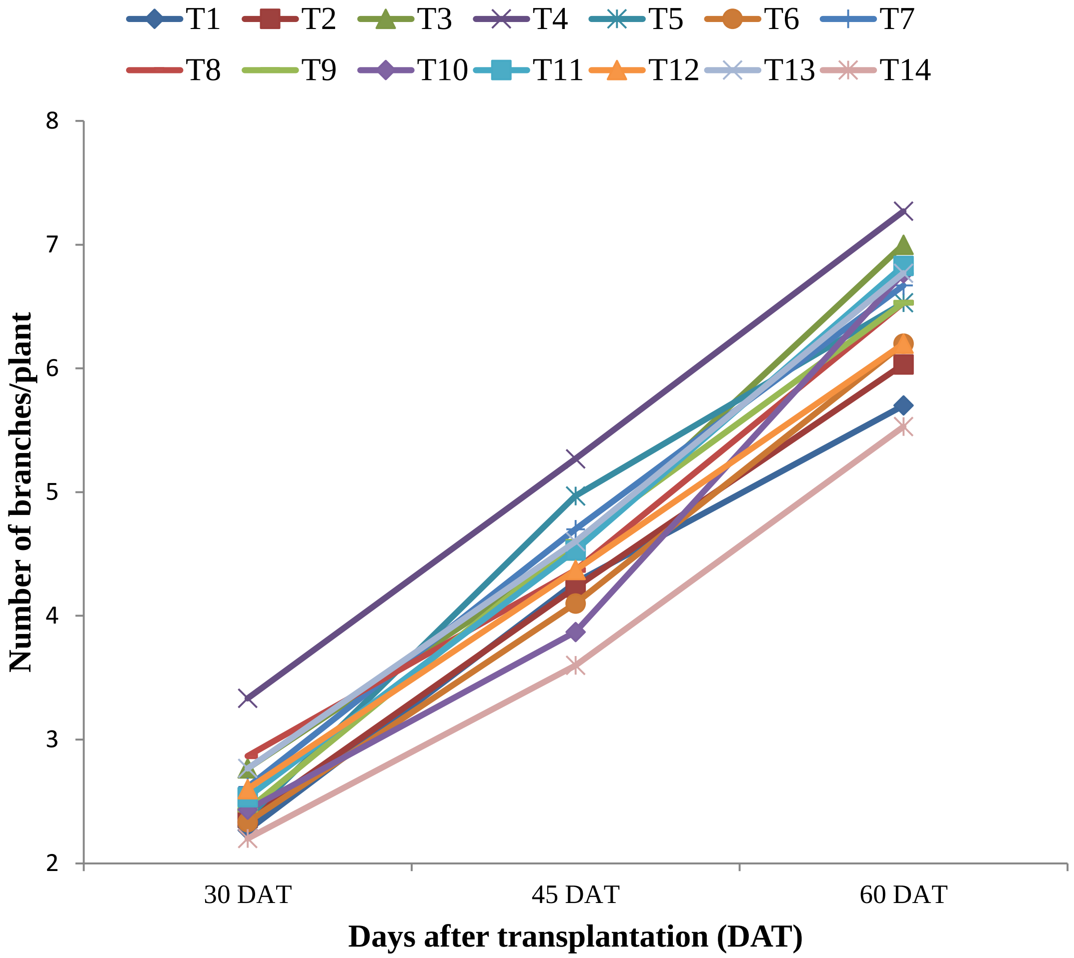

Fig. 3: Effect of different doses of organic and inorganic fertilizers on number of branches/ plant of SAU yellow cherry tomato

Here,

$T_1=N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_2=N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_3=N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_4=N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_5=N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, $T_6=N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, $T_7=N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, $T_8=N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, $T_9=N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, $T_{10}=N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, $T_{11}=N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, $T_{12}=N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, $T_{13}=N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and $T_{14}=N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.3 Number of leaves per plant

Number of leaves per plant of cherry tomato varied significantly due to the application of different levels of organic and inorganic fertilizers (Appendix VI). It was noted 15 days interval starting from 30 DAT and continued up to 60 DAT.

At 30 DAT, the maximum number of leaves per plant (14.9) was recorded from T_8 ($N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$) treatment followed by (13.8) from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) and minimum number of leaves per plant (8.8) was observed from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment. At 45 DAT, treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) produced the maximum number of leaves per plant (34.1) followed by (32.3) and (31.5) from treatment T_{11} ($N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$) and T_6 ($N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$) respectively, while T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) showed the lowest number of leaves (20.5). At 60 DAT, the maximum number of leaves per plant (45.6) was observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment and minimum number of branches per plant (32.6) was observed from T_{14} treatment (Table 2). This might be due to the balanced uptake and influence of nutrients, which improved cherry tomato vegetative growth. Vermicompost improves the physical condition of soil, increasing water retention capacity and nutrient availability and uptake by crops. This result is in agreement with the findings of Mukta *et al.*, (2015). Abbott and Parker (1981) also found that vermicompost nutrition elements are more available for plant and may increase plant growth and would be expected that vermicompost causes direct and rapid uptake of nutrients by foliage and enhances plant growth factors such as the number of leaves.

Table 2. Effect of different levels of organic and inorganic fertilizers on number of leaves per plant of SAU yellow cherry tomato**

	Number of leaves per plant		
Treatment	30DAT	45DAT	60DAT
T_1	9.2 gh	28.4 de	40.2 d-f
T_2	9.9 fg	22.7 g	39.4 fg
T_3	12.3 d	30.0 c	42.1 bc
T_4	13.8 b	34.1 a	45.6 a
T_5	11.6 de	27.3 ef	38.6 g
T_6	12.2 d	31.5 b	39.7 e-g
T_7	10.0 f	23.7 g	41.2 cd
T_8	14.9 a	26.7 f	40.7 de
T_9	11.2 e	26.3 f	40.2 d-f
T_{10}	13.1 c	28.8 cd	39.3 fg
T_{11}	13.4 bc	32.2 b	36.7 h
T_{12}	10.1 f	22.6 g	41.9 bc
T_{13}	13.1 c	26.7 f	42.5 b
T_{14}	8.8 h	20.5 h	32.6 i
LSD	0.76	1.33	1.16
CV%	7.25	4.23	5.26

**In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.01 level of probability

Here,

T_1=$N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_2=$N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_3=$N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_4=$N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_5=$N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, T_6=$N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, T_7=$N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, T_8=$N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, T_9=$N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, T_{10}=$N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, T_{11}=$N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, T_{12}=$N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, T_{13}=$N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and T_{14}=$N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.4 Number of clusters per plant

Significant difference was found as to the number of clusters per plant of cherry tomato due to varied levels of organic and organic fertilizers application (Appendix VII). Maximum number of clusters per plant (10.9) was observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment, followed by 10.0, 9.4 and 9.3 number of the cluster per plant from T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_{10} ($N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$) and T_8 ($N_{120kgh}P_{50kg}K_{0kg}V_{6t/ha}$) treatments respectively. While the minimum number of clusters per plant (7.3) was observed from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Table 3).Higher nitrogen fertilizer levels promoting the development of more clusters in an individual tomato plant which resulted in a greater number of fruits per plant and smaller fruit size (Brecht *et al.*, 1976). This result was in agreement with the findings of Nizam *et al.*, (2014) and Prodhan *et al.*, (2014) where they reported that, vermicompost stimulates flowering, increasing the number and biomass of the flowers produced in tomato.

4.5 Number of flowers per cluster

Marked variation was noted among flower numbers per cluster due to the different levels of organic and inorganic fertilizers (Appendix VII). It was found that T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment showed the maximum number of flowers per cluster (98.2), followed by the number of flowers per cluster 90.0, 89.1 from the treatment respectively T_7 ($N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$), T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$). While, control treatment ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) showed the lowest number of flowers per cluster (36.9) (Table 3). Findings of Nizam *et al.*, (2014) also obtained higher number of flower cluster^{-1} with vermicompost and recommended doses of fertilizer. Number of flowers cluster^{-1} increased in vermicompost and recommended doses of fertilizers. It might be due to the fact that vermicompost undergoes mineralization and return adequate quantities of macro and micro nutrients than other sources and helps to vigorous plant growth and increases flower number.

4.6 Number of flowers per plant

Remarkable differences were observed among the flower content in cherry tomato plants due to application of different levels of organic and inorganic fertilizers (Appendix VII).

Maximum number of flowers per plant 1347.1 were observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment, followed by 1134.0 and 925.0 number of flowers from T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$) and T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment respectively. While the minimum number of flowers per plant (402.8) were observed from T_{14} treatment ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Table 3). These results were in harmony with those obtained by Adhikary *et al.*, (2016) who recommended 50% Vermicompost + 50% recommended doses of fertilizer that significantly influenced the vegetative and reproductive growth of tomato plant.

4.7 Number of fruits per cluster

Number of fruits per cluster is one of the precious parameters which determine the yield. Significance variation was found regarding this parameter as to the various levels of organic and inorganic fertilizers. (Appendix VII).

The treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) showed the maximum number of fruits per clusters (78.6), followed by 71.5 and 70.0 from T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$) and T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$) treatments respectively. While, control treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) showed the lowest number of fruits per cluster (21.5) (Table 3). This result is in agreement with the result of Singh *et al.*, (2018) to examine the growth, yield and quality of tomato with RDF[1], FYM (farm yard manure) and vermicompost treatment.

Table 3. Effect of different levels of organic and inorganic fertilizers on number of clusters/plant, number of flowers/cluster, number of flowers/plant and number of fruits/cluster of SAU yellow cherry tomato**

Treatment	No. of clusters /plant	No. of flowers/cluster	No. of flowers /plant	No. of fruits/cluster
T_1	8.7 c-f	59.8 g	688.1 de	40.7 g
T_2	8.6 d-f	64.7 f	697.2 d	45.5 f
T_3	9.2 c-e	89.1 b	925.0 c	71.5 b
T_4	10.9 a	98.2 a	1347.1 a	78.6 a
T_5	9.2 c-e	83.2 c	847.8 c	63.1 d
T_6	8.5 ef	73.2 e	681.8 de	52.8 e
T_7	8.8 c-f	90.0 b	730.4 d	67.8 c
T_8	9.3 b-d	75.5 e	846.3 c	64.3 d
T_9	8.4 f	52.4 i	505.3 g	35.2 h
T_{10}	9.4 bc	55.6 h	598.2 ef	39.9 g
T_{11}	9.2 c-e	50.1 i	545.0 fg	32.2 i
T_{12}	8.3 f	43.0 j	556.8 fg	29.1 j
T_{13}	10.0 b	78.7 d	1134.0 b	70.0 bc
T_{14}	7.3 g	36.9 k	402.8 h	21.5 k
LSD	0.72	2.99	91.91	2.92
CV%	8.23	5.21	7.32	5.24

**In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.01 level of probability

Here,

T_1=$N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_2=$N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_3=$N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_4=$N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_5=$N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, T_6=$N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, T_7=$N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, T_8=$N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, T_9=$N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, T_{10}=$N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, T_{11}=$N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, T_{12}=$N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, T_{13}=$N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and T_{14}=$N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.8 Number of fruits per plant

Due to application of different levels of organic and inorganic fertilizers, significant variation was noted regarding the number of fruits per plant. (Appendix VIII). Highest number of fruits per plant (1061.3) was noted from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment followed by 825.5, 797.5 and 564.9 fruits per plant from respectively T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$) and T_8 ($N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$) treatments. Whereas, T_{14} treatment ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) showed the lowest number of fruits per plant (184.5) (Table 4). This might be due to application of vermicompost and other recommended doses of NPK fertilizers help to proper growth of plants. It also supports to physiological changes within the plant. As a result, number of fruits plant^{-1} increased in this combination. Similar result also found from the experiment conducted by Mukta *et al.*, (2015) who mentioned that maximum number of fruits plant^{-1} was obtained from vermicompost treated soil along with chemical fertilizers as compared to control soil. Rodge and Yadlod (2009) also found higher number of fruits plant^{-1} from the treatment combination 50% RDF (Recommended dose of fertilizer) and 50% vermicompost.

4.9 Fruit length

Remarkable differences were observed among the fruit length in cherry tomatoes due to application of different levels of organic and inorganic fertilizers (Appendix VIII). Largest fruit length (26.0 mm) was observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment, followed by fruit length 25.16 mm and 24.5 mm from the treatments respectively T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$) and T_{11} ($N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$). Whereas the smallest fruit length (17.6 mm) was observed from control treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Table 4). Similar result was found by Adhikary *et al.*, (2016) in tomato. Increased fruit size was also recorded due to NP fertilizer in tomato plants was observed by Melkamu *et al.*, (2008). Optimum doses of organic manure namely vermicompost and other NPK fertilizers facilitates proper growth of the fruit to plant and could be attributed to physiological changes within the plant and helps to increase fruit length.

4.10 Fruit diameter

Significant variation was recorded in fruit diameter per fruit due to the various levels of treatments (Appendix VIII).The treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) showed widest fruit diameter 25.7 mm followed by 24.97 mm and 24.67 mm fruit diameter of cherry tomatoes from the treatments T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_6 ($N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$) respectively. While the smallest fruit diameter (16.0 mm) was recorded from the T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment (Table 4). The results was in agreement with Mukta *et al.*, (2015) who reported that the highest breadth of fruits was obtained from vermicompost and 50% chemical fertilizers treated plants and the lowest breadth of fruits was obtained in control plant.

Table 4. Effect of different levels of organic and inorganic fertilizers on no. of fruits/plant, fruit length (mm), fruit diameter (mm) and individual fruit weight (g) of SAU yellow cherry tomato**

Treatment	No. of fruits/plant	Fruit length (mm)	Fruit diameter (mm)
T_1	521.4 c	18.9 g	20.4 f
T_2	538.3 c	20.9 f	20.2 f
T_3	797.5 b	21.0 f	19.1 g
T_4	1061.3 a	26.0 a	25.7 a
T_5	558.0 c	21.3 f	19.9 f
T_6	429.1 de	23.4 c	24.6 b
T_7	488.5 cd	22.4 de	22.4 e
T_8	564.9 c	24.3 d	23.5 c
T_9	277.0 f	22.8 cd	23.2 cd
T_{10}	359.4 ef	21.8 ef	22.9 c-e
T_{11}	329.0 f	24.5 b	23.3 cd
T_{12}	327.3 f	23.2 cd	22.7 de
T_{13}	825.5 b	25.2 b	24.9 b
T_{14}	184.5 g	17.6 h	16.0 h
LSD	88.75	0.86	0.63
CV%	3.88	5.92	6.23

**In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.01 level of probability

Here,

T_1=$N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_2=$N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_3=$N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$,

T_4=$N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_5=$N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, T_6=$N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$,

T_7=$N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, T_8=$N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, T_9=$N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$,

T_{10}=$N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, T_{11}=$N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, T_{12}=$N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$,

T_{13}=$N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and T_{14}=$N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.11 Individual Fruit weight (g)

It was observed that significant influence of different doses of organic and inorganic fertilizers on individual fruit weight of cherry tomato (Appendix VIII). Maximum weight of individual fruit (9.6 g) was recorded from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment, followed by 8.9 g, 8.8 g, 8.7 g and 8.5 g individual fruit weight from T_3 , T_{13}, T_5 and T_8 treatments respectively. While the lowest weight of individual fruit (6.2 g) was found from the T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment (Table 4). The increase in individual fruit weight might be due to NPK nutrients with vermicompost improved physiological activity like photosynthesis and translocation of food materials to the fruits. kai *et al.,* (2020) recorded increased fruit weight in small-sized tomatoes was recorded due to application of organic + chemical fertilizer. Charles *et al.,* (2012) reported that the mixed use of organic with inorganic fertilizers significantly increased total number of collected tomato and weight of harvested tomato.

4. 12 Number of seeds per fruit

Number of seed per fruit showed significant variations due to application of different levels of organic and inorganic fertilizers (Appendix IX). Maximum number of seed per fruit (122.9) was observed from T_9 ($N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$) treatment, followed by 119.0 and 115.3 seed per fruit were recorded from the treatments respectively T_{13} ($N_{120kg}P_{50kg}K_{40kg}V_{9t/ha}$) and T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$). While the minimum number of seeds per fruit (92.8) was observed from the T_2 ($N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment (Table 5). Similar results were obtained by Jahan *et al.,* (2022) who stated that highest number of seeds per fruit of sweet pepper was obtained from 75% vermicompost + 25% of recommended doses of fertilizer. Also included those applications of vermicompost in combination with other inorganic fertilizer have been proved effective to enhance growth and yield of fruit (Javed and Panwar, 2013; Chiezey and Odunze, 2009).

4.13 Brix (%)

Significance variation was noted in brix percentage of cherry tomatoes due to the various levels of organic and inorganic fertilizers (Appendix IX). Maximum brix percentage (7.5%) was observed in cherry tomato due to the T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatments, followed by 7.2 %, 7.0 % and 6.9 % brix from the treatment respectively T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_8 ($N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$) and T_6 ($N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$). But the minimum percentage of brix (4.8 %) was recorded from the T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment (Table 5).The sugar content was about 0.6% higher under organic fertilizer than chemical fertilizer (kai *et al.,* 2020). Rajya *et al.,* (2015) reported that increase in quality parameters might be due to increased availability of macro nutrients as well as micro nutrients especially nitrogen and potassium, as they play a vital role in enhancing the fruit vitamin C content of tomato and minimum might be due to lack of availability of sufficient nutrients.

Table 5. Performance of different level of organic and inorganic fertilizers on individual fruit weight (g), number of seeds/fruit, brix (%)**

Treatment	Individual fruit weight(g)	No. of seeds/fruit	Brix (%)
T_1	7.5 c-e	98.0 g	6.7 cd
T_2	7.0 e	92.8 h	5.8 gh
T_3	8.9 b	101.7 f	6.7 c-e
T_4	9.6 a	115.3 c	7.5 a
T_5	8.7 b	109.1 d	6.7 cd
T_6	7.6 cd	109.8 d	5.8 h
T_7	7.3 de	105.1 e	6.9 bc
T_8	8.5 b	109.2 d	7.0 bc
T_9	7.1 e	122.9 a	6.8 b-d
T_{10}	7.8 c	97.6 g	6.4 d-f
T_{11}	7.0 e	102.6 f	6.3 e-g
T_{12}	7.7 cd	100.7 f	6.1 f-h
T_{13}	8.8 b	119.0 b	7.2 ab
T_{14}	6.2 f	115.0 c	5.1 i
LSD	0.56	2.33	0.46
CV%	4.24	4.30	4.18

**In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.01 level of probability

Here,

$T_1=N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_2=N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_3=N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_4=N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_5=N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, $T_6=N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, $T_7=N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, $T_8=N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, $T_9=N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, $T_{10}=N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, $T_{11}=N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, $T_{12}=N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, $T_{13}=N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and $T_{14}=N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.15 Yield of fruits per plant (kg)

The difference in yield of fruits of cherry tomato per plant was significantly influenced by the application of different levels of organic and inorganic fertilizers. (Appendix X). Highest yield (4.8 kg) from an individual cherry tomato plant is recorded from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment followed by 3.5 kg, 3.2 kg and 2.6 kg yield per plant was obtained from the treatment respectively T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_3 ($N_{120k}P_{50kg}K_{80kg}V_{6t/ha}$) and T_5 ($N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$). While the lowest yield (1.2 kg) from a single plant was recorded from the treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Figure 4). The results was in agreement with Singh *et al.,* (2018) who stated that maximum yield from an individual plant was observed due to the application of 50% RDF[1] + 25% FYM + 25% vermicompost . It appears from the findings that supply of nutrients from organic and inorganic sources, i.e. vermicompost and chemical fertilizers improves the partitioning of photo-assimilates from source to sink (leaf to fruit) and thereby increases the fruit weight. The increased growth and flower attributes whichin turn lead to the increased photosynthesis and dry matter production affect the yield per plant, per plot and per hectare.

4.16 Yield of fruits per plot (kg)

Significance variation was recorded in the amount of yield per plot of cherry tomatoes due to the various levels of organic and inorganic fertilizers (Appendix X).

Maximum yield from a single plot (29.3 kg) was recorded from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment followed by 21.5 kg, 19.1 kg and 15.3 kg yield per plot was noted from the treatment respectively T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$) and T_5 ($N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$). While the minimum yield (7.1 kg) from a single plot was recorded from the control treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Figure 5). This result matches with what was reported earlier by Singh, B. *et al.*, (2010) in tomato plant. In 2018, Singh *et al.* observed greater yield performance due to the application of 50% RDF[1] + 25% FYM + 25%

vermicompost. Khan *et al.,* (2017) conducted an experiment on the "Effect of compost and inorganic fertilizers on yield and quality of tomato" the result showed the yield and quality parameters of tomato fruit increased significantly by mixed use of compost with inorganic fertilizers. The increase in fruit yield was contributed chiefly by an improvement in fruit weight and was not caused by an increase in fruit number.

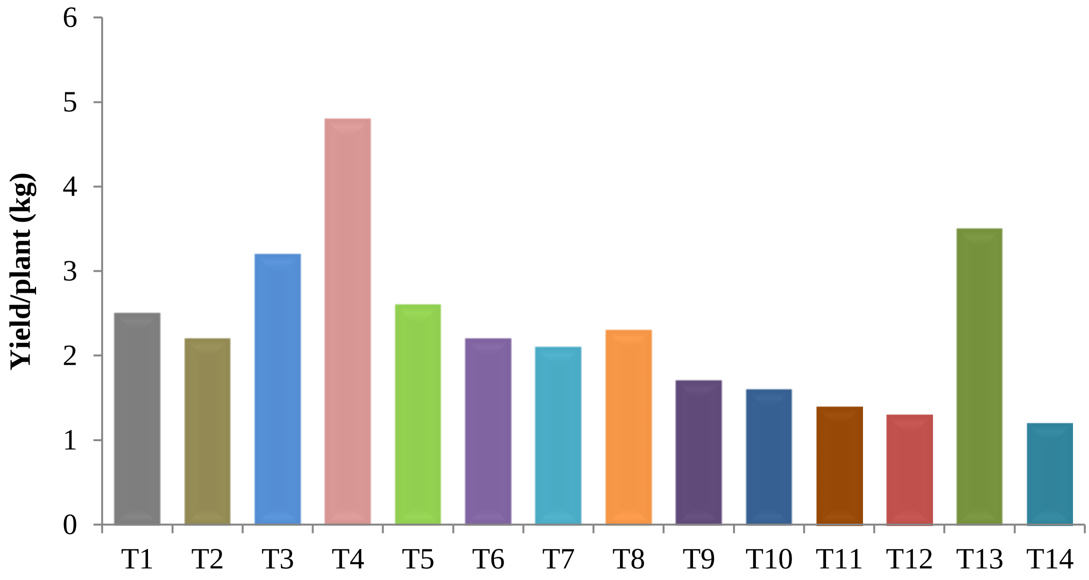

Fig. 4: Performance of different doses of organic and inorganic fertilizers on fruit yield per plant of SAU yellow cherry tomato

Here,

$T_1=N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_2=N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_3=N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_4=N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_5=N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, $T_6=N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, $T_7=N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, $T_8=N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, $T_9=N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, $T_{10}=N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, $T_{11}=N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, $T_{12}=N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, $T_{13}=N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and $T_{14}=N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

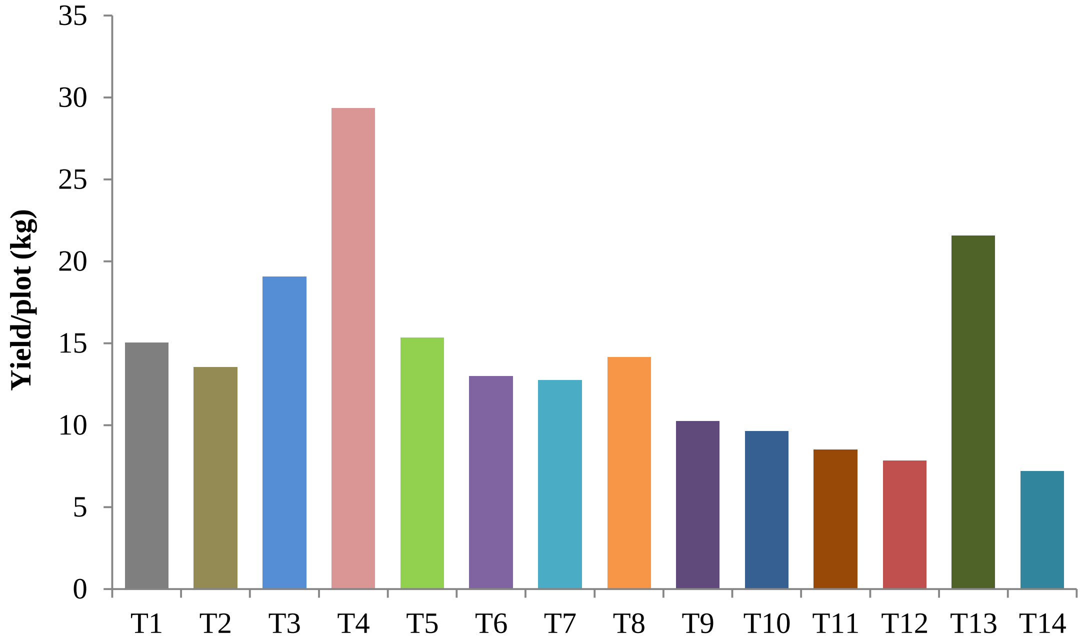

Fig. 5: Effect of different doses of organic and inorganic fertilizers on fruit yield per plot

Here,

T_1=$N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_2=$N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_3=$N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_4=$N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_5=$N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, T_6=$N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, T_7=$N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, T_8=$N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, T_9=$N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, T_{10}=$N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, T_{11}=$N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, T_{12}=$N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, T_{13}=$N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and T_{14}=$N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.17 Yield of fruits per hectare (t/ha)

Yield per hector of cherry tomatoes showed significant variations due to application of different levels of organic and inorganic fertilizers (Appendix X). Maximum yield per hector (108.6 ton) was recorded from $N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$ treatment followed by 79.8 t/ha, 70.5 t/ha and 56.9 t/ha yield were noted from the treatment respectively T_{13} ($N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$), T_3 ($N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$) and T_5 ($N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$). While minimum yield per hectare (26.6 t) was observed from ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment (Figure 6). The better performance of the tomato plants with organic and NPK fertilizers support the results of Ogundare *et al*., (2015), Adekiya and Agbede (2009) and Rajya *et al.*, (2015) who reported that maximum nutrient availability due to integrated use of organic and inorganic fertilizers increased nutrient uptake by the plant which in turn lead to dry matter production and tomato fruit yield. Goutam *et al.*, (2011) also observed that the plants treated with vermicompost supplemented with chemical fertilizers displayed better results than the plants treated separately with vermicompost, chemical fertilizer, FYM and FYM supplemented with chemical fertilizers treated plants.

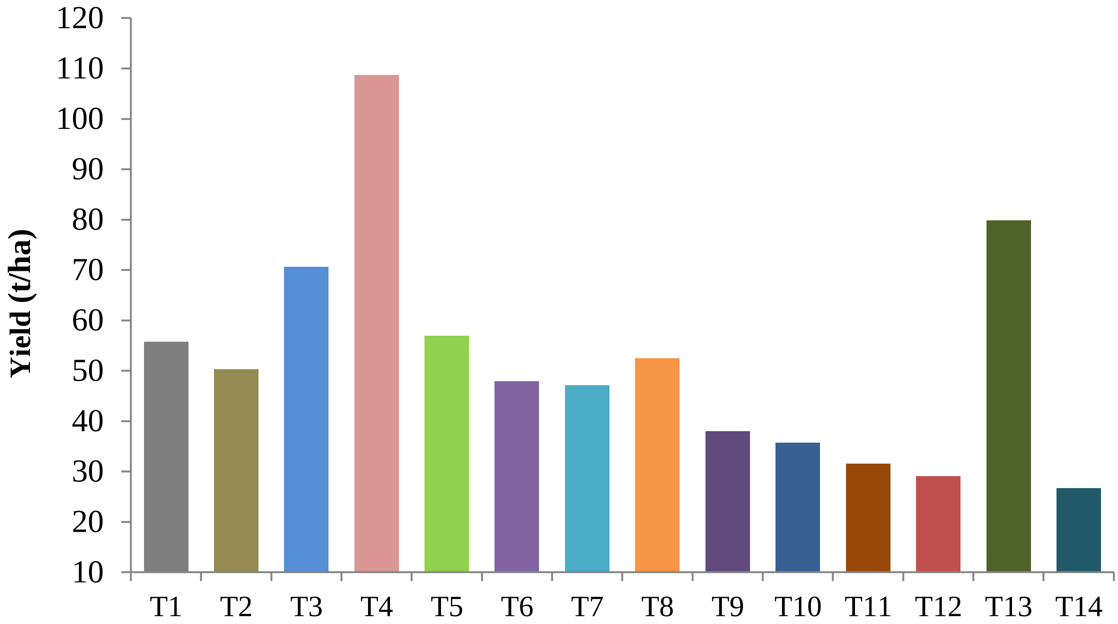

Fig. 6: Effect of different doses of organic and inorganic fertilizers on fruit yield (t/ha)

Here,

$T_1=N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_2=N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_3=N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_4=N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, $T_5=N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, $T_6=N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, $T_7=N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, $T_8=N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, $T_9=N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, $T_{10}=N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, $T_{11}=N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, $T_{12}=N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, $T_{13}=N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and $T_{14}=N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

4.18 Skin and flesh color measurement using CIELab

Tomato fruit color constitutes one of the essential and complex quality characteristics of the fruit, with the complexity being due to the presence of a diverse carotenoid pigment system subjected to both genetic and environmental conditions (López Camelo and Gómez, 2004). During the experiment, color lightness (L*) was significantly affected by the different fertilization treatments. The highest value of L* for both skin and flesh were obtained from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) and lowest from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Table 6).The a* value is the most indicative of the intensity of red color, with higher a* values being more desirable in tomatoes (Barrett et al., 2007). Higher value of a* and b* were also from the treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) and lowest from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) (Table 6). Moreover, this color value has the tendency to increase during tomato ripening, since the yellow color is the result of chlorophyll degradation and synthesis of lycopene and other carotenoids, as chloroplasts converted into chromoplasts (Nour *et al.,* 2015). The data showed that the tomato fruits on the plots treated with compost had the highest values ranging from 34.7 to 36.1 (López Camelo and Gómez, 2004). These results are in full agreement with those of Viskelis *et al.,* (2015). According to the research by López Camelo and Gómez (2004) the organic tomato fruits had significantly higher b* values than the conventional ones, and explained that chroma was significantly affected by fertilization, and the fruits harvested from the organic plots presented the high c*. Finally, as regards the effect of the year on fruit surface color, it had a great impact on the color parameters and indices. Among the color parameters, only the L* and a* values were influenced by the application of fertilizers with the highest values found in the organic treatment.

Table 6. Skin and flesh color measurement of SAU Yellow cherry tomato as influenced by different level of organic and inorganic fertilizers

Treatment	Skin color					Flesh Color				
	L*	a*	b*	C*	h_{ab}	L*	a*	b*	C*	h_{ab}
T_1	40.03	13.71	36.91	39.37	69.62	62.27	2.96	28.24	28.49	84.02
T_2	41.91	12.56	39.4	41.13	73.31	63.01	3.73	31.39	31.61	83.22
T_3	43.12	12.66	42.61	41.17	77.57	65.73	2.51	28.77	28.88	85.02
T_4	46.63	22.15	47.42	52.41	64.91	66.75	3.94	35.08	30.24	84.51
T_5	41.22	14.48	41.02	41.13	70.64	59.48	3.62	29.57	29.80	83.02
T_6	40.70	14.54	47.13	50.14	73.17	63.06	3.10	32.13	32.22	84.47
T_7	42.91	14.32	41.86	44.38	71.12	61.33	3.28	29.04	29.24	83.66
T_8	40.73	14.11	40.92	43.35	71.05	63.09	2.90	29.43	29.50	84.42
T_9	41.84	14.24	40.21	42.70	70.53	57.80	3.74	31.04	31.26	83.14
T_{10}	40.52	12.50	39.67	41.61	72.59	63.65	2.17	27.34	27.43	85.46
T_{11}	42.71	14.16	39.91	42.42	70.56	61.59	1.31	27.39	27.42	87.25
T_{12}	41.85	14.51	42.75	44.61	73.52	52.18	5.52	34.89	35.33	81.01
T_{13}	43.13	13.12	44.51	46.45	73.64	63.86	3.07	33.32	33.47	84.74
T_{14}	40.31	14.24	41.90	43.03	71.15	57.18	3.47	26.29	26.51	82.49

Here,

T_1=$N_{0kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_2=$N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_3=$N_{120kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_4=$N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$, T_5=$N_{120kg}P_{0kg}K_{80kg}V_{6t/ha}$, T_6=$N_{120kg}P_{25kg}K_{80kg}V_{6t/ha}$, T_7=$N_{120kg}P_{75kg}K_{80kg}V_{6t/ha}$, T_8=$N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$, T_9=$N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$, T_{10}=$N_{120kg}P_{50kg}K_{120kg}V_{6t/ha}$, T_{11}=$N_{120kg}P_{50kg}K_{80kg}V_{0t/ha}$, T_{12}=$N_{120kg}P_{50kg}K_{80kg}V_{3t/ha}$, T_{13}=$N_{120kg}P_{50kg}K_{80kg}V_{9t/ha}$ and T_{14}=$N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$ (control)

L*=Lightness, C*=Chroma, h_{ab}= Hue angle and a*/b* ratio indicates the brightness of color

Plate 1: Pictorial presentation of SAU yellow cherry tomato treated with different levels of organic and inorganic fertilizers

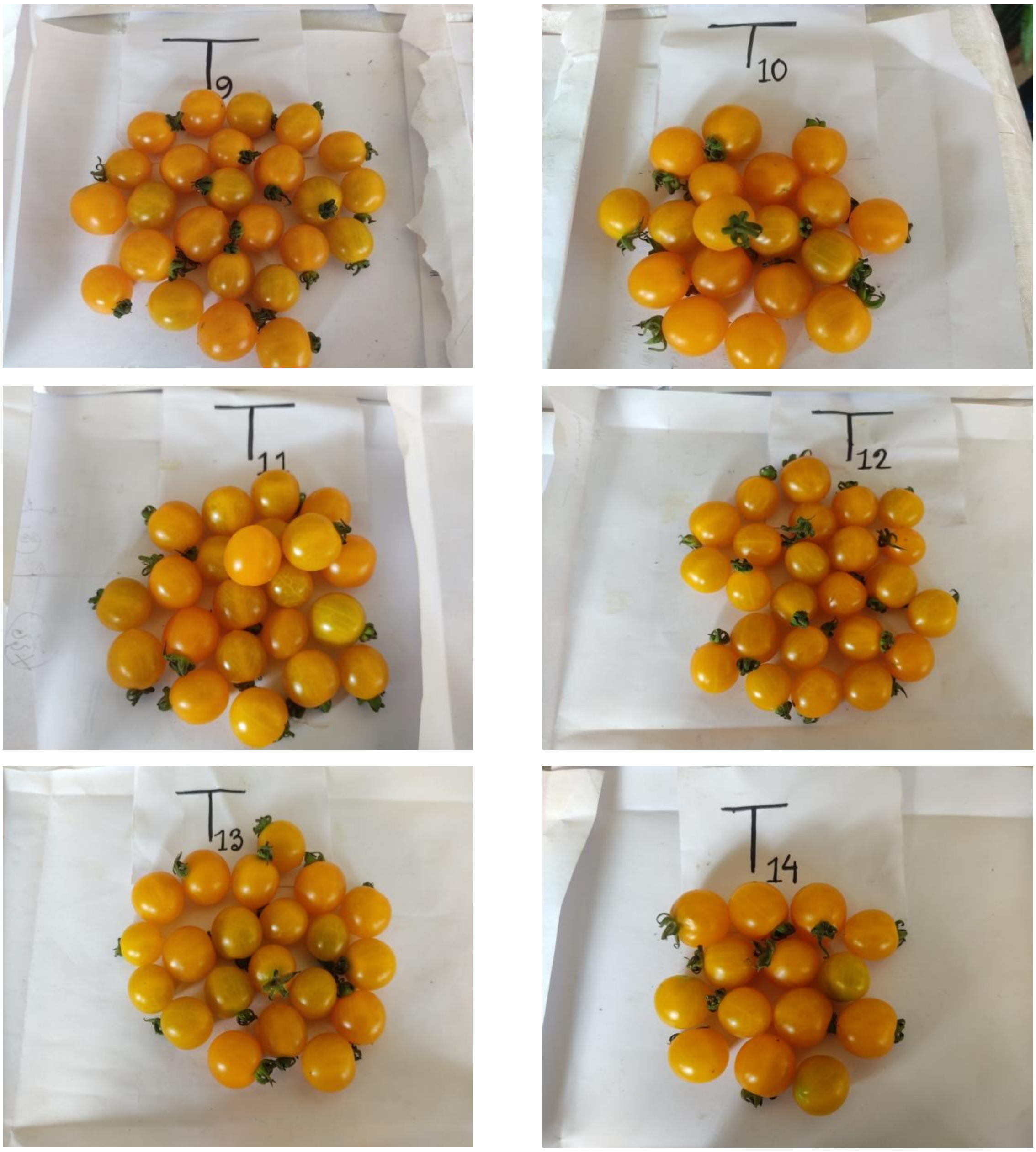

Plate 2 (continued): Pictorial presentation of SAU yellow cherry tomato treated with different levels of organic and inorganic fertilizers

CHAPTER V

SUMMARY AND CONCLUSION

This experiment was conducted in the Horticulture Farm of Sher-e-Bangla Agricultural University Dhaka 1207, Tejgaon series under (AEZ No.28) from November 2020 to March 2021, to study effect of organic and inorganic fertilizers on growth, yield and quality attributes of SAU yellow cherry tomato (golden purna). The texture of soil was silty clay loam in having pH 5.6 and organic carbon content of 0.45%. Fourteen levels of treatments were used in the study. The study was carried out in Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 1.8m×1.5m which accommodated 6 plants. The crop was harvested up to March, 2021.

Data on growth and yield contributing parameters were noted and the collected data were analyzed statistically to evaluate the treatment effects.

After transplantation plant height was observed at 30 DAT, 45 DAT, 60 DAT and 90 DAT and significant effects were recorded. The highest plant height (48.4 cm) was observed from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment. Similarly, at 45 DAT, 60 DAT and 90 DAT maximum plant height respectively 115.2 cm, 149.8 cm and 191.9 cm were observed from the same treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$). Minimum plant height 37.7 cm, 88.7 cm, 131.5 cm and 161.3 cm respectively at 30 DAT, 45 DAT, 60 DAT and 90 DAT were recorded from the control treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$).

Number of branches per plant was observed at 30 DAT, 45 DAT and 60 DAT, and significant effects were recorded. The highest number of branches 5.2 and 7.2 in a single plant respectively at 45 DAT and 60 DAT was observed at the same treatment T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$). Minimum number of branches per plant 3.6 and 5.5 respectively at 45 DAT and 60 DAT were recorded from the control treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$).

Number of leaves per plant was observed at 30 DAT, 45 DAT and 60 DAT, and significant effects were observed. At 30 DAT, maximum number of leaves in an individual plant 14.97 was observed from T_8 ($N_{120kg}P_{50kg}K_{0kg}V_{6t/ha}$) but at 45 DAT and 60 DAT maximum number of leaves per plant respectively 34.1 and 45.6 was found from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment. Minimum number of leaves per plant was 8.8, 20.5 and 32.6 respectively at 30 DAT, 45 DAT and 60 DAT due to the treatment T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$).

T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment gave highest number of clusters per plants 10.9 but lowest (7.3 clusters/plant) was reported from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment. Number of flowers per cluster shows maximum result 98.2 due to the application of T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment and lowest (flowers/cluster 36.9) noted from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment. Flowers number per plant varies from 402.8 to 1347.1 where, the maximum to the application of T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment and the minimum to the application of T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment.

The maximum numbers (fruits/cluster 78.6) were reported from the T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment whereas lowest (fruits/cluster 21.5) was in T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment. Number of fruits per plant varied from 184.5 to 1061.3, the maximum (1061.3 fruits/plant) were reported to the application of T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment whereas minimum number fruits per plant was recorded from T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment.

For the fruit length, fruit diameter and individual fruit weight, maximum result respectively 26.0mm, 25.7mm and 9.6g were observed due to the application of T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment whereas for all these characters the minimum result respectively 17.6mm, 16.0mm and 6.2g were reported to the application of T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment.

Brix percentage varied from 5.1% to 7.5% where, the maximum was reported in T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment whereas minimum from the T_{14} treatment. Number of seeds per fruit varied from 92.8 to 122.9. The minimum number of (92.8 seeds/fruit) was reported from T_2 ($N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment whereas the maximum (122.9 seeds/fruit) from the T_9 ($N_{120kg}P_{50kg}K_{40kg}V_{6t/ha}$) treatment.

For all these parameters yield per plant (kg), yield per plot (kg) and yield of fruits per hectare (t), the maximum output respectively 4.8 kg, 29.3 kg and 108.6 t were recorded to the application of T_4 ($N_{60kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment whereas minimum results for the following parameters respectively 1.2 kg, 7.1 kg and 26.6 t were noted to the application of T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$) treatment.

Conclusion

From the above results, it can be concluded that application of N, P and K fertilizer and vermicompost showed qualitative and quantitative result than the control treatment. T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) performed best among the all other 14 treatments in terms of plant height, number of flowers per cluster, number of flowers per plant, number of fruits per cluster, number of fruits per plant, yield per plant but the minimum fruit yield was found T_{14} ($N_{0kg}P_{0kg}K_{0kg}V_{0t/ha}$).The quality attributing parameters of yellow cherry tomato also showed best results from T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$). Looking upon the above circumstances, it can be easily enunciated that T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment was the most promising treatment for better growth, yield and quality of SAU yellow cherry tomato.

Recommendation

Based on the findings of the present research, such recommendation can be made:

- T_4 ($N_{180kg}P_{50kg}K_{80kg}V_{6t/ha}$) treatment could be recommended as a suitable dose for the production of SAU yellow cherry tomato in farmers field after regional participatory field trial.

Suggestion

- Results are presented on the basis of one-year experiment in a specific location; further trials are needed to substantiate the results.
- A critical study may also be conducted on some other parameters of SAU yellow cherry tomato.

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APPENDICES

Appendix I. Agro-Ecological Zone of Bangladesh showing the experimental location

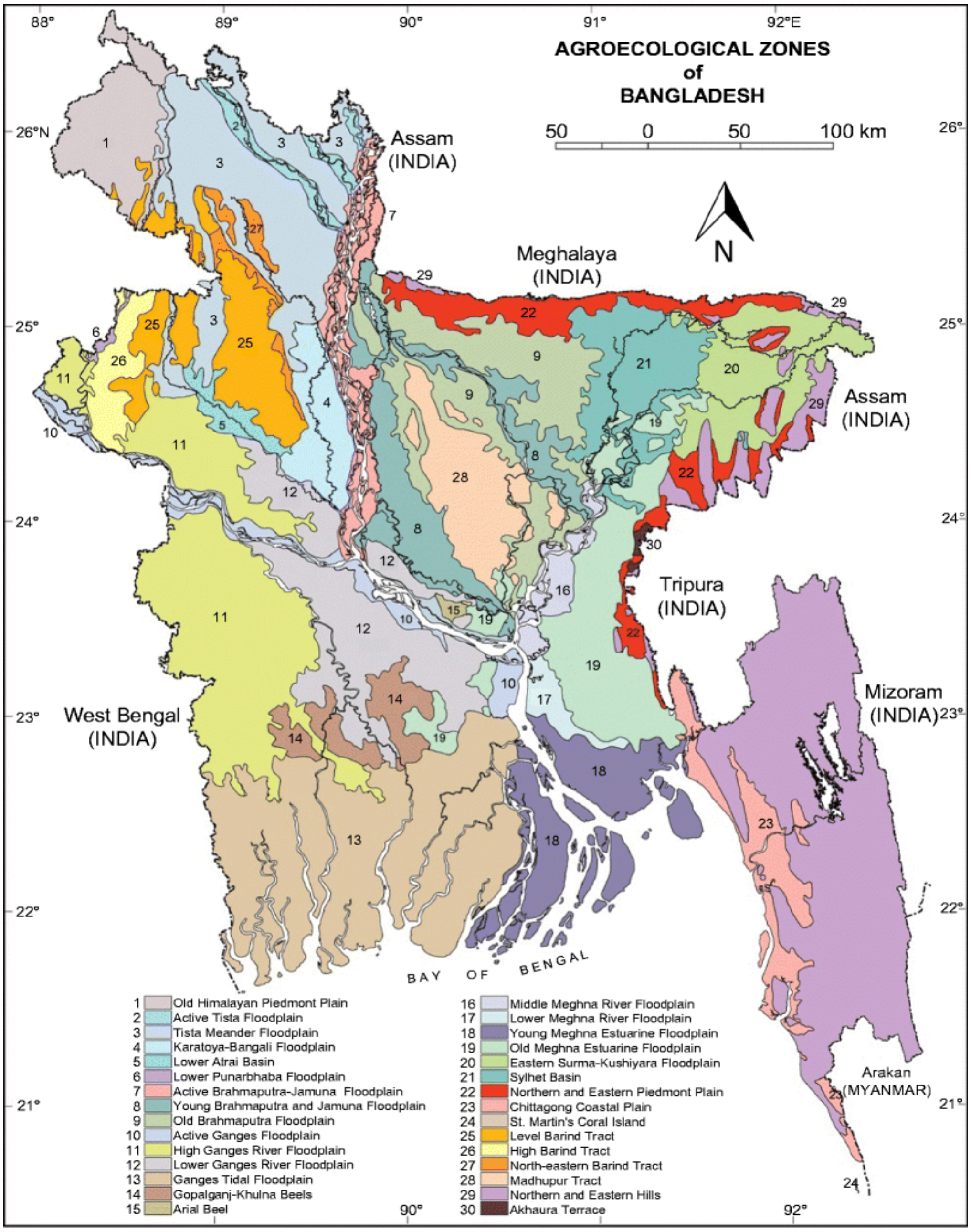

Fig.7. Experimental site

Appendix II. Monthly records of air temperature, relative humidity and rainfall during the period from November 2020 to March 2021

Month	Air temperature		Relative humidity (%)	Total rainfall (mm)	Sunshine (hr)
November,2020	29.6	19.2	65	32.4	8
December ,2020	26.4	14.1	61	12.5	8
January, 2021	25.4	12.7	58	8.7	8.5
February, 2021	28.7	15.5	53	28.4	9
March, 2021	32.5	20.4	50	63.8	7

Appendix III. Characteristics of experimental soil analyzed at Soil Resources Development Institute (SRDI), Farmgate, Dhaka

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticilture Farm, SAU, Dhaka
AEZ	Modhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Not Applicable

Source: Soil Resource Development Institute (SRDI)

B. Physical and chemical properties of the initial soil

Characteristics	Value
Partical size analysis % Sand	27
%Silt	43
% Clay	30
Textural class	Silty Clay Loam (ISSS)
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20
Exchangeable K (me/100 g soil)	0.1
Available S (ppm)	45

Source: Soil Resource Development Institute (SRDI)

Appendix IV. Analysis of variance of the data on plant height as influenced by different treatments

Source of variation	Degree of freedom (df)	Mean square of Plant height (cm)			
		30 DAT	45 DAT	60 DAT	90 DAT
Replication	2	2.4879	31.807	2.7518	0.1
Different nutrients	13	22.2968**	149.542**	74.9214**	244.188**
Error	26	2.0204	4.547	2.8231	4.629

** : Significance at 0.01 level of probability and NS : Non-significant

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Appendix V. Analysis of variance of the data on number of branches per plant as influenced by different treatments

Source of variation	Degree of freedom (df)	Mean square of Number of branches per plant		
		30 DAT	45 DAT	60 DAT
Replication	2	1.18506	0.26643	0.0431
Different nutrients	13	0.26695NS	0.53736**	0.71101**
Error	26	0.88096	0.05874	0.05463

** : Significance at 0.01 level of probability and NS : Non-significant

Appendix VI. Analysis of variance of the data on number of leaves per plant as influenced by different treatments

Source of variation	Degree of freedom (df)	Mean square of		
		Number of leaves per plant		
		30 DAT	45 DAT	60 DAT
Replication	2	0.5904	1.2931	1.1924
Different nutrients	13	10.5572**	46.7642**	26.8509**
Error	26	0.1766	0.5839	0.4285

** : Significance at 0.01 level of probability and ^{NS} : Non-significant

Appendix VII. Analysis of variance of the data on number of clusters per plant, number of flowers per clusters, number of flower per plant, number of fruits per clusters of SAU yellow cherry tomato as influenced by different treatments

Source of variation	Degree of freedom (df)	Mean square of			
		Number of clusters/plant	Number of flowers/cluster	Number of flower/plant	Number of fruits /cluster
Replication	2	0.18667	3.53	6004	1.48
Different nutrients	13	2.16342**	1074.83**	195661**	1007.49**
Error	26	0.18949	3.18	2791	3.18

** : Significance at 0.01 level of probability and ^{NS} : Non-significant

Appendix VIII. Analysis of variance of the data on Number of fruit/ plant, Fruit length (mm), Fruit diameter (mm), Single fruit weight (g) of SAU Yellow cherry tomato

Source of variation	Degree of freedom (df)	Mean square of			
		Number of fruit/ plant	Fruit length (mm)	Fruit diameter (mm)	Individual fruit weight (g)
Replication	2	2795	0.6017	0.1284	0.00596
Different nutrients	13	172468**	16.472**	21.0128**	2.73701**
Error	26	2818	0.2445	0.1411	0.11943

** : Significance at 0.01 level of probability and NS : Non-significant

Appendix IX. Analysis of variance for Brix percentage (%) and no of seeds

Source of variation	Degree of freedom (df)	Mean square of	
		Brix percentage (%)	No. of seeds/fruit
Replication	2	0.0231	10.19
Different nutrients	13	0.72031**	233.268**
Error	26	0.15745	1.32

** : Significance at 0.01 level of probability and NS : Non-significant

Appendix X. Analysis of variance of the data on yield contributing characters of SAU yellow cherry tomato as influenced by different treatments

Source of variation	Degree of freedom (df)	Mean square of		
		Yield/ plant (g)	Yield/ plot (kg)	Yield (ton/ha)
Replication	2	650	0.028	0.37
Different nutrients	13	3021292**	108.736**	1491.84**
Error	26	10178	0.369	5.07

** : Significance at 0.01 level of probability and NS : Non-significant

CHAPTER I

INTRODUCTION

CHAPTER II

REVIEW OF LITERATURE

CHAPTER III

MATERIALS AND METHODS

CHAPTER IV

RESULT AND DISCUSSION

CHAPTER V

SUMMARY AND CONCLUSION

REFERENCES

APPENDICES