REPUBLIC OF TURKEY
ERCIYES UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF AGRICULTURAL SCIENCES AND TECHNOLOGIES

EFFECTS OF DIFFERENT ORGANIC FERTILIZERS ON SOME IMPORTANT PARAMETERS OF CHERRY TOMATO CULTIVARS

(MSc. Thesis)

Preperad By
Rasha IRFANULDEN ABDULHADI QAHRAMAN

Supervisor
Prof. Dr. Osman GÜLŞEN
Assoc. Prof. Dr. Adem GÜNEŞ

December 2017
KAYSERI

REPUBLIC OF TURKEY
ERCIYES UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF AGRICULTURAL SCIENCES AND TECHNOLOGIES

EFFECTS OF DIFFERENT ORGANIC FERTILIZERS ON SOME IMPORTANT PARAMETERS OF CHERRY TOMATO CULTIVARS

(MSc. Thesis)

Preperad By
Rasha IRFANULDEN ABDULHADI QAHRAMAN

Supervisor
Prof. Dr. Osman GÜLŞEN
Assoc. Prof. Dr. Adem GÜNEŞ

This study was supported by Erciyes University Scientific Research Projects Unit Under the Code of FYL-2017-7283

December 2017
KAYSERI

SCIENTIFIC ETHICS SUITABILITY

I declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. At the same time, I declare that I have transported and referenced all materials and results that are not directly obtained by this work by giving proper citing to all, as required by the mentioned rules and ethical conduct.

RASHA IRFANULDEN ABDULHADI QAHRAMAN

COMPLIANCE WITH GUIDE

This Master of Science Degree thesis entitled: **"**Effects of different organic fertilizers on some important parameters of cherry tomato cultivars**"** has been prepared in accordance with the Thesis Proposal and with the Guidelines for Writing Thesis of Erciyes University.

Thesis Prepared by
Rasha Irfanulden Abdulhadi
QAHRAMAN

Supervisor
Prof. Dr. Osman GÜLŞEN
Assoc. Prof. Dr. Adem GÜNEŞ

Head of Department
Assoc. Prof. Dr. Mehmet Ulaş ÇINAR
Department of Agricultural Sciences and Technologies

ACCEPTANCE AND APPROVAL

Under supervisor of Prof. Dr. Osman GÜLŞEN and Assoc. Prof. Dr. Adem GÜNEŞ, this writeup on the topic "Effects of different organic fertilizers on some important parameters of cherry tomato cultivars" was prepared by Rasha Irfanulden Abduldadi QAHRAMAN was accepted as Master's Degree by the Department of Agricultural Science and Technologies; Graduate School of Natural Science, Erciyes University.

25/12/2017

JURY:

Supervisor : Prof. Dr. Osman GÜLŞEN ....

Juror : Prof. Dr. Halit YETİŞİR ....

Juror : Asst. Prof. Dr. Hakan BAŞAK ....

APPROVAL:

That the acceptance of this thesis has been approved by the decision of the Institute's Board of Directors with the 26/12/2017 date and 2017/55-29 numbered decision.

26/12/2017

Prof. Dr. Mehmet AKKURT

Director of Institute

ACKNOWLEDGEMENT

My profound gratitude goes to my spiritual motivation "My Parents", I am grateful for every sacrifice which they were made for me.

My profound gratitude goes to my supervisor Prof. Dr. Osman Gülşen for his advises, his humanity, suggestions, contributions and constructive criticisms that led to the success of this work. I would like to express my gratitude to my co-advisor Assoc. Prof. Dr. Adem Güneş, also who supervised this study with his right guidance. My sincere appreciations go to Mrs. Akife Dalda, a research assistant at the Horticulture Department who supported and helped me in each step of this work. I also thank to Assoc. Prof. Dr. Mustafa Demirkaya and Assist. Prof. Dr. Nihat Yılmaz of S.Ç. Vocational School of Erciyes University for helping during the experimental set-up.

Not forgetting AbdulL-Quddus Bayuko Abubakar who sacrificed their precious times to support me during my works. I would like to acknowledge the Scientific Research Projects Coordination Unit (BAP) of the Erciyes University, Yüksel Seed Company and ANAMAS Seed Company for financially supporting (ERU-BAP under Project code of FYL-2017-7283) and providing seeds in this project, respectively. And to Avin Qahraman, Marwah Qahraman, Evrard Kouadia, Kuddusi Kuru, Firdes Ulaş, Başak Oruç, Arif Acar, Serdar Cenk Bülbül and Aydoğan Ekici also deserve many thanks for all that they have done for me. Finally, I wish to thank all my friends who aided me in one-way or the other throughout my study. May the Almighty Allah bless you all.

Rasha Irfanulden Abdulhadi Qahraman

EFFECTS OF DIFFERENT ORGANIC FERTİLİZERS ON SOME IMPORTANT PARAMETERS OF CHERRY TOMATO CULTIVARS

Rasha Irfanulden Abdulhadi Qahraman

Erciyes University, Graduate School of Natural and Applied Sciences
Thesis of Master of Science, December 2017
Advisors: Prof. Dr. Osman GÜLŞEN
Assoc. Prof. Dr. Adem GÜNEŞ

ABSTRACT

This research was carried out in the organically managed and certified field of Agricultural Research Center at Erciyes University, Kayseri, Turkey. The objective of this study was to investigate the effects of four types of applications (compost, microbial, mixture (2 ton/da manure + 2 ton/da compost+300 g/100 L microbial fertilizer), manure) on some morphological, pomological parameters and bioactive compounds of three hybrid cherry tomato cultivars (İnci F1, Yeniçeri F1 and Pekbal F1) as plant materials which were obtained from two Turkish seed companies. This experiment was laid in split-plot designed. There was an interaction between cultivars and fertilizers for total fruit yield, marketable yield. The most yielding combination was of Pekbal and compost (17900 g/10 plant) and Inci and compost (17800 g/10 plant) followed by Inci and mix (11800 g/10 plant), Pekbal and manure (10500 g/10 plant), and Pekbal and mix (10200 g/10 plant). Yeniçeri was the least producing cultivar with a mean of 4748 g per plant with four different fertilizer applications. There was no interaction between the cultivars and fertilizers for TSS, fruit diameter, fruit length, titratable acidity, vitamin C, distance from the first flower, micro-macro nutrient contents (N, P, K, Ca, Mg, Na, Fe, Cu) in tomato fruits while significant interaction between the cultivars and fertilizers for Mn, Zn, plant height, steam diameter, flower number per cluster, fruit number and cluster number at alpha 5% level. TSS values, an important parameter for fruit quality, differed among the cultivars ($P < 0.001$), but not among the fertilizers ($P = 0.165$). Inci F1 had the highest TSS (8.82%) followed by Yeniçeri (7.64%) and Pekbal (6.90%). Another important parameter, vitamin C, was the highest (32.18 mg.100 gr^{-1}) in Inci F1 followed by Yeniçeri (30.44 mg.100 gr^{-1}) and Pekbal (30.20 mg.100 gr^{-1}). This study indicated Pekbal and Inci cultivars were the most productive under the application used in this study in Central Anatolia conditions elevating 1100 m from the sea level. Among the fertilizers, the compost application was the most productive application with all three cherry tomato cultivars. Overall, presence of interaction between cultivars and fertilizers suggest importance of performance comparisons prior to program.

Keywords: Organic agriculture, organic fertilizers, compost, microbial, mixture fertilizers, hybrid cherry tomato.

FARKLI ORGANİK GÜBRELERİN KİRAZ DOMATES ÇEŞİTLERİNİN BAZI ÖNEMLİ PARAMETRELERİ ÜZERİNE ETKİLERİ

Rasha Irfanulden Abdulhadi Qahraman

Erciyes Universitesi, Fen Bilimleri Enstitüsü
Yüksek Lisans Tezi, Aralık 2017
Danışmanlar: Prof. Dr. Osman GÜLŞEN
Doç. Dr. Dr. Adem GÜNEŞ

ÖZET

Bu çalışma Erciyes Üniversitesi-Kayseri'inde organic olarak sertifikalandırılmış Tarımsal Araştırma Merkezinde yürütülmüştür. Çalışmanın amacı üç farklı F1 kiraz domates çeşidinin (İnci F1, Yeniçeri F1 and Pekbal F1) morfolojik, pomolojik özellikleri ve bioaktif bileşikleri üzerine dört farklı organik tarımda kullanılan gübrenin (kompost, mikrobial, karışım, çiftlik gübresi) etkisini araştırmaktır. Çalışma faktöryel deneme deseni ve bölünen-bölünmüş parseller uygulama desenine göre yürütülmüştür. Toplam verim ve pazarlanabilir verim açısından üç F1 hibrit domates çeşidi ile gübre uygulamaları arasında interaksiyon tespit edilmiştir ($P < 0.01$). En verimli çeşit Pekbal ve kompost (17900 g/10 bitki) ve Inci ve kompost (17800 g/10 bitki) olurken onları sırasıyla Inci ve karışım (11800 g/10 bitki), Pekbal ve çiftlik gübresi (10500 g/10 bitki), ve Pekbal ve karışım (10200 g/10 bitki) olmuştur. Çeşitler arasında Yeniçeri F1 çeşidi bütün gübre uygulamaları göz önüne alındığında 4748 g/10 bitki ortalamasıyla en az verimli çeşit olmuştur. Çeşitler ile gübreler arasında SÇKM, meyve genişliği, meyve uzunluğu, titre edilebilir asitlik, C vitamini, ilk dalın yerden uzaklığı, mikro-makro besin içerikleri (N, P, K, Ca, Mg, Na, Fe, Cu açısından istatistiksel olarak %5 seviyesinde önemli bir interaksiyon tespit edilmezken, Mn, bitki yüksekliği, gövde çapı, çiçek sayısı, meyve sayısı ve dal sayısı bakımından %5 düzeyinde interaksiyon tespit edilmiştir. Önemli bir kalite parametrasi olan SÇKM çeşitler arasında farklılık gösterirken ($P < 0.001$) gübre uygulamaları arasında farklılık göstermemiştir, but not among the fertilizers ($P = 0.165$). Inci F1 en yüksek SÇKM (8.82%) oranına sahip olurken onu sırasıyla Yeniçeri (7.64%) ve Pekbal (6.90%) izlemiştir. Diğer önemli bir parameter olan C vitamini Inci çeşidinde en yüksek (32,18 mg.100 gr^{-1}) olurken onu sırasıyla Yeniçeri (30,44 mg.100 gr^{-1}) ve Pekbal (30,20 mg.100 gr^{-1}) izlemiştir. Bu çalışmada Orta Anadolu'da deniz seviyesinden 1100 m yüksekliğe sahip çalışma koşullarında Pekbal ve Inci çeşitleri en verimli çeşit olmuştur. Kompost organik gübre uygulaması ise gübre uygulamaları arasında bütün kiraz domates çeşitlerinde en yüksek verimlilik oluşturan uygulama olmuştur. Genel sonuç olarak kiraz domates çeşitleri ile gübre uygulamaları arasında interaksiyon varlığı üretim planlanmasından önce mutlaka genel kombinasyon çalışmalarının yapılması gerektiğini ortaya koymuştur.

Keywords: Organik tarım, organik gübreler, kompost, mikrobial, gübre karışımı, F1 kiraz domates, organik tarım

TABLE OF CONTENTS

EFFECTS OF DIFFERENT ORGANIC FERTILIZERS ON SOME IMPORTANT PARAMETERS OF CHERRY TOMATO CULTIVARS

CHAPTER 4

RESULTS

CHAPTER 5

DISCUSSION AND CONCLUSION

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

P- Value: level of marginal significance within a statistical hypothesis test representing the probability of the occurrence of a given event.

°C	: Degrees Celsius
NaOH	: Sodium hydroxide
OM	: Organic matter
TSS	: Total Soluble Solids
TA	: Titratable acidity
SCM	: Separated cow manure
AVOVA	: Analysis of variance
PME	: pectin methyl esterase.
PG	: Polygalacturonase
LOX	: Lipoxygenase
N	: Nitrogen
P	: Phosphorus
Ca	: Calcium
Mn	: Manganese
Mg	: Magnesium
Cu	: Copper
K	: Potassium
Zn	: Zinc
Na	: Sodium

CHAPTER 1
INTRODUCTION

Potato, tomato, pepper and eggplant are members of the economically important *Solanaceae* family. The tomato itself is possibly the most popular vegetable in the world and plays a significant role in human's diet worldwide (Ferrari et al., 2008). The tomato crop is grown virtually everywhere, and its growing conditions range from the warmest climate (the tropics) to the coldest climate (within a few degrees of the Arctic Circle).

Turkey is a very prominent producer of vegetables (with its 31.7 million tons of production annually) and it ranks fourth in the world by production. Among these vegetables, tomatoes make up 12.6 million tons (TUIK, 2016) with the highest production in the country.

The tomato fruits are produced for two reasons: fresh consumption and processed fruits such as juice, soup, paste, chopped and peeled tomatoes (Grandillo et al., 1999).

Tomatoes derive their nutritional value from several compounds such as vitamin A, E and C. They also include antioxidants, which protect the cells from oxidative chemicals. Examples are lycopene and anthocyanins (Foland et al., 2012; Sacco et al., 2013). Not only this, but the tomato is rich in organic acids, pigments, carbohydrates, amino acids, together with several minerals important in human nutrition. Because of these compounds, the human health greatly benefits from the tomatoes and their ingredients. (Raffo et al., 2006; Toor et al., 2006; Singh et al., 2007; George et al., 2011; Sonmez and Ellialtioglu, 2014). They are also used to make appetizers before main food for some.

Tomato production can be done either organically or conventionally. In general, mineral, phenolic, antioxidant and vitamin C content were higher in organically produced tomatoes than in crops produced according to conventional cultivation (Ozer, 2012), and, according to Ozer and Uzun, (2013), human nutrition is of prime importance for organic cultivation of vegetables. In order to achieve this goal, the improvements of the soil vitality and nutrition rather than the plant nutrition, and higher yield are generally obtained with good treatment of the soil and organic fertilization.

Agricultural crop producers, because of the increase in world population and the great increase in the demand for food, used chemicals to increase productivity. This, of course, led to increased pollution and the consequent criticism for polluting the environment. Thus, alternative crop production techniques were sought from the early 1900's in many countries. Important studies have also been carried out on the subject of organic production in Turkey since the 1980's (Sandallioglu, 2014).

Amongst the alternative production techniques are the development of an organic cropping system to take the place of the traditional system with its high percentage of fertilizer-use and agrochemical use to boost productivity despite their adverse effects on the population's health (Borguini, 2006). Due to not using chemical fertilization, the organic cropping system is an ecologically sound agricultural practice. This system has a marked potential for growing vegetables of high nutritional value, and this is particularly true for tomato.

The important source of organic matter (OM) and for nutrients for organic farming in these geographic regions are composts. Composts have beneficial effects on the soil: they increase the macro and micro element contents and also improve the organic matter and humus contents together with the biological activity and physical-chemical characteristics. Obviously, these benefits are especially evident in the lower quality soils. However the higher quality soils benefit from them also. The fact is that the physical, chemical and nutritional aspects of the soil together with the crops yield are efficiently amended by organic manure fertilizer. Soil pH value is decreased and the nutrient uptake by the plants is increased by using compost.

With the target of sustainability and the production of higher quality food, organic agriculture establishes appropriate patterns for agricultural systems. These designs incorporate economic, ethical, environmental, social, political and cultural elements (Kokuszka, 2005).

Health-awareness worldwide has dramatically increased recently. This has caused a greatly increased awareness of the benefits of organic farming and of organic food. It has been found that individuals who eat organic foods show an increased level of mental awareness, energy, physical strength and stamina, protection from infection, resistance to stress, protection from infection, healthy skin and facial appearance, together with the ability to avoid degenerative illnesses (BSAEM/BSNM, 1994; Clayton, 2001). As far as degenerative illness is concerned, medical researchers and nutritionist believe that it has become increasingly common because of (a) increasing levels of stress, and (b) the inferior nutrient levels in peoples' diet (Sinclair, 1990; Berganer, 1997; Holford, 1998). In this regard, the effectiveness of organic farming stems from producing vegetables by using a natural supplier of nutrients, for example compost, crops remainder, manure and natural process of crops and weed-control, in place of chemical or inorganic compounds.

The first importance of organic farming is the increasing of biological variety–upping the biological process of the soil, using renewables in locally controlled farming arrangements, supporting the safe use of soil, water, and atmosphere as well as identifying pollution that is due to farming practices (Codex Alimentarius, 1999). It should be noted here that in organic farming the mineral elements in the organic matter returned to the soil must be recycled in the biological process of the soil before they are ready for absorption by the plants (Hodges et al., 1981).

It can be said that organic agriculture is a holistic production management system. It promotes and magnifies agro ecosystem health, and this includes biodiversity, biological cycles and soil biological activity. The use of management practices is particularly emphasized as opposed to off-farm inputs, realizing that regional conditions require local solutions as far as management is concerned.

An organic production system is designed to:

a) Improve biological diversity within the system

b) Enhance the biological activity of the soil

c) Establish the long-term fertility of the soil

d) Return nutrients to the land by recycling wastes of plant and animal origin, thus minimizing the use of nonrenewable resources

e) Use the renewable resources in locally organized agricultural systems

f) Foster the healthy use of soil, water, and air, as well as minimize pollution that may result from agricultural systems (*Codex Alimentarius* 1999, 2)**.**

As results of agricultural practices under organic conditions offers great environmental benefits as listed Table 1. For example crop rotation decreases plant pathogen concentration present in soil while balancing nutritional availability of soil. Another example is that avoiding pesticides greatly contributes saving beneficial insects and microorganisms present in growing conditions.

Table 2. Organic farming practices and their benefits (OFRF, 2011)

Organic Farming Practice	**Environmental benefits**
Crop rotation	Improves soil quality, destroys weed, insect, and disease life cycles, sequesters carbon and nitrogen, diversifies production
Manure, compost, green manure use	Heightens soil quality, sequesters carbon and nitrogen, contributes to productivity
Cover cropping	Enhances soil quality, reduces erosion, sequesters carbon and nitrogen, prevents dust (protects air quality), improves soil nutrients, and contributes to productivity
Exclusion of synthetic fertilizers	Avoids contamination of surface and ground waters, enhances soil quality, sequesters carbon, mitigates salinization (in many cases)
Exclusion of synthetic pesticides	Enhances biodiversity, improves water quality, enhances soil quality, assists in effective pest management, prevents disruption of pollinators, reduces costs of chemical inputs
Establishing habitat corridors, borders, and/or insectaries	Improves biodiversity, supports biological pest management, provides wildlife habitat
Buffer areas	Improves water quality, enhances biodiversity, prevents wind erosion

CHAPTER 2
PREVIOUS STUDIES

Sir Albert Howard (1873–1947) pioneered the concept of organic farming and it was developed in the period before 1940. F.H. King's book, *Farmers of Forty Centuries* backed up the theory of Howard on soil fertility and the need to recycle waste materials such as sewage sludge onto farmland. Howard's composting system became very widely used, and his concept of fertility of the soil centered on increasing soil humus emphasizing how soil life was intertwined with the health of crops, of livestock and of mankind as a whole. Lady Eve Balfour's *The Living Soil* furthered the cause of organic farming, and in the US, Jerome Rodale did much to popularize the concept of organic farming to his countrymen. The Federal Organic Foods Production Act (1990) was a milestone in organic farming in the US, to be followed by the equally important official labelling as "USDA Certified Organic" in 2002.

Since these important milestones, many investigations considering various aspects of applications in agriculture have been carried out. A Brazilian study suggested that organically grown tomatoes were more nutritious in some ways than the conventionally grown variety (Ordóñez-Santos, 2009). Though they are smaller, organically grown tomatoes present higher levels of vitamin C, organically grown tomatoes have more plant phenols, acting as antioxidants, than the conventionally produced tomatoes.

Pinhol et al. (2011) evaluated the physicochemical and nutritional characteristics of cherry tomatoes produced simultaneously in organic and conventional production systems. Because there is evidence that tomato properties vary over the harvesting period, cherry tomatoes were harvested at two different ages: 30 and 45 days using 2x2 factorial design (2 cropping systems x 2 harvesting times) with five repetitions. The parameters analyzed were fruit color, centesimal composition, total energetic value, carotenoids and bioactive amine content. Organically grown cherry tomatoes had higher contents of β-carotene, lycopene and bioactive amine. On the other hand, tomatoes from conventional cropping system were more alkaline and brighter. In conclusion, organic tomatoes are more nutritious than conventionally grown tomatoes, and if allowed to ripen for up to 45 days, contain higher levels of TSS, carotenoids and total bioactive amines.

Compost is a main source of organic matter (OM) and of nitrogen for organic farming in arid and semiarid regions. An effort has been made to reduce nitrogen loss during composting of separated cow manure (SCM) using high C/N additives wheat straw, (WS), grape marc (GM) and slightly acidic additive such as orange peels (OP) (Raviv et al. 2004). The resulting composts contained 2.63%, 2.84% and 2.39% N for the GM-SCM, OPSCM and WS-SCM, respectively. Values of N loss from the raw mixtures were 18%, 5% and 2% for the three compost types, respectively. Organic matter values were 70%, 57% and 53% for the three compost types, respectively. Nutritional contribution of the composts was assessed using cherry tomato as a test plant, growing in the composts as growing media. Peat moss served as a control medium. The media were either unfertilized or fertilized with guano. Plant responses suggest that growth is mainly affected by nitrogen availability while flower production and fruit set is also affected by potassium availability. It was found that fertilization was not necessary for at least 2 months after planting for orange peels-separated crow manure and wheat straw- separated cow manure. Soils of arid and semiarid regions are characterized by low soil microbial activity resulting mainly from low soil organic matter. Low microbial activity leads, in turn, to slow nutrient cycling rate and thus to low soil fertility.

Sakai et al. (1997) studied tomato cultivation without using pesticides. Six cultivars of cherry tomato were tested on the coast of the Island of Hawaii for growth and fruit production using organic fertilizers and no pesticides. During the 10 week harvest period they evaluated fruit yield. They found out that the cultivar 'CHT 104' produced the highest fruit weight (3.7 kg per plant). With a three times a week harvest schedule greatest losses of unmarketable fruit were due to over ripe or fruit damaged during harvesting with a combined high total of 23.7% in '20-6-0-0' and low total of 12.7% in 'Super Sweet 100'. Loss due to fruit flies was less than 4%. Overall, the cultivar CHT 104 was most suitable under the conditions of this trial. It was concluded that cherry tomato can be a valuable diversified agricultural crop for the windward coast of the Island of Hawaii.

Zhang et al. (2016) reviewed effects of long-term nitrogen and organic fertilization on antioxidants content of tomato fruits. Tomatoes are superior source of vitamin C, vitamin E, folic acid, potassium, and antioxidants. The main antioxidants in tomato fruit are carotenoids, phenols and flavonoids. These important compounds of tomato fruit were investigated in different N levels in combination with organic fertilizer. The N mixed with organic fertilizer treatment had higher content of β- carotene, and AN2 achieved 34.2 μg/g. At red ripening stage, the content of lycopene of BN1 and BN2 were very close, respectively 180.8 μg/g and 182.5 μg/g. The content of lutein at red ripening stage was nearly three times higher than that at turning stage. At red ripening stage, content of lutein ranged from 2.85 μg/g to 8.87 μg/g. In the all of phenolic acid, coffeic acid was the highest levels. The highest caffeic acid content (73.7 μg/g) was observed in the AN2 (double N and organic fertilizer), and in only organic fertilizer (AN0) was no significant difference with BN1 (single N). Rutin content in tomato fruit had no difference in three N levels (N0, N1, N2). AN0 had the highest quercetin content in tomato fruits in all treatment, by 66.4 μg/ g. In addition, their research results showed that N combination with organic fertilizer can promote tomato yield and quality of tomato.

Anissa Riahi et al. (2013) focused on the total phenols content and lycopene content affected by different cultivars under fertilization. In this study, it was determined that the antioxidant properties of two main tomato varieties of Florenze and Rio Grande in the open field fertilized with different organic fertilizer combinations. Lycopene, total phenols and flavonoid contents, lipophilic, hydrophilic and total antioxidant activities were investigated. There were significant differences between lycopene and antioxidant activity. Florenze variety showed higher lycopene, lipophilic, hydrophilic and total antioxidant activities compared to Rio Grande. On the other hand, although antioxidant activity is affected by different organic fertilizer applications, tomato bioactive compounds are not affected.

Mojeremane et al. (2016) studied the effects of organic fertilizers on morphological and growth characteristic of tomato and reactions of tomato with organic fertilizers through experiment was set up by using four different level of fertilizers; 0.0, 5.0, 7.5 and 10.0 kg m-2 with three replications. Plant height, stem thickness, canopy diameter, number of leaves, fruits and fruit weight were determined. They reported that the relationship between quantity of organic fertilizers and these parameters were positive and the higher organic fertilizers increase the rate of soil fertility (Mohapatra et al. 2009; Berova et al. 2010; Dinesh et al. 2010) and increase from nitrogen, phosphorus and potassium (Eliiot et al. 1991). These types of fertilizers keep the environmental pure (El Sayed et al., 2002), keep soil from degradation and decrease any pollution maybe will happen (Swift et al., 2001) and organic manure working on increase of production biomass of vegetable and photosynthesis, the reason is the amount of carbon, nitrogen, pH, cation exchange capacity and exchangeable Ca, Mg and K increase through using organic manure (Ayoola et al., 2008; Dinesh et al., 2010).

Kalbani et al. (2016) studied the effect of some animal waste on growth, yield and quality of four different tomato cultivars, they used four animals waste; cow manure at the rate of 18 kg for plot, chicken+ cow at the rate of 3 18 kg for plot, chicken manure pellet at the rate of 18 kg for plot, agro fish pellet at the rate 18 kg for plot. Fruits grown in chicken manure treated plots had values as regarded to investigated characteristics comparing with others fertilizers types. The results of sensory evaluation of tomatoes showed that the chicken manure application had influence the overall quality of fruits of Sadia F1 and Sun cherry tomato variety. Whereas agro fish pellet and mixed manure had affected on the quality of Isabella F1 and Lelord tomato variety respectively. So, using chicken manure and agro fish pellet at the stage of flowering and fruit set and application of mixed fertilizer before harvest had increased the quality of tomato fruits.

A study by Araujo *et al.* (2015) examined what sensory, physical and chemical traits are currently in use to determine tomato quality. The 14 cultivars were analyzed by 75 individuals, using a hedonic scale of seven points, but only eight cultivars obtained the best scores in all sensorial traits evaluated (flavor, color of the pericarp, internal color, texture and overall impression). It explained the importance of selection of good genotypes responding toward organic farming and has the positive influence on sensory, biochemical characteristics and productivity aspects of plants.

Understanding how the environment, crop management, soil fertility affects the composition and quality of food products is essential for the production of quality nutritious foods. Flavonoid aglycones quercetin and kaempferol were measured in dry tomato samples (*Lycopersicon esculentum* L. cv. Halley 3155) archived between 1994 and 2004 by Mitchell *et al*. (2007). The study reported on organic and conventional ways in terms crop management, the medium levels of flavonoids quercetin and kaempferol, the percentage was 79% and 97% in organic farming higher than those in conventional tomatoes, respectively.

The tomato fruit quality was evaluated by Ferreira *et al*. (2006). The topics were the pH level and the soluble solids with increasing doses of nitrogen (N) and with or without the use of organic manure. The field experiments were conducted in the spring and summer. They discovered that there was no difference at the level of nitrate enlarged when happened the increasing of N rates without adding organic manure, whereas the level of nitrate remained constant with the addition of organic matter.

Vinha *et al*. (2014) studied the effects of organic and conventional agricultural systems on the physicochemical parameters, bioactive compounds content, and sensorial attributes of tomatoes ("Redondo" cultivar). The influence on phytochemicals distribution among peel, pulp and seeds was also accessed. Organic tomatoes were richer in lycopene (+20%), vitamin C (+30%), total phenolics (+24%) and flavonoids (-+21%) and had higher (+6%) in vitro antioxidant activity. In the conventional fruits, lycopene was mainly concentrated in the pulp, whereas in the organic ones, the peel and seeds contained high levels of bioactive compounds. Only the phenolic compounds had a similar distribution among the different fractions of both types of tomatoes.

Hallmann et al. (2012) estimated the total sugar content, organic acids, vitamin C and phenolic compounds (quercetin-3-*O*-rutinoside) in experiment conducted in Poland. The tomatoes were grown at three certified organic farms and three conventional farms located in the vicinity to ensure similar climatic and soil conditions. They discovered that their levels in organic crops higher than in conventional crops. In North-Eastern Greece by another work for a couple of researchers, Kapoulas et al. (2011) made a research to compare fruit quality parameters in some tomato types and they found out that the quantity of vitamin C, total acidity, lycopene, and carbohydrate did not showed significant differences between, organically and conventionally grown tomato fruits..

In the National Thesis Search Center of Turkey, only three studies were available. Two of them were on storage conditions and one on performance for yield. In the first study, the experiment performed in the late spring growing period and ten cultivars of standard, hybrid and cherry tomatoes were used (Urkmez et al., 1996). The experiment was conducted as a randomized block design with 3 replications and there were 30 plots in 270 plants. The most suitable cultivar which can be recommended for the early yield was Belleveu F1 which was followed by Galant F1 and Gardener's Delight. The most suitable cultivar for the total fruit yield was the standard cultivar Moneymaker with 4678 g/plant yield. The F1 cultivar 1361/90 gave the highest yield with 4552 g/plant in the hybrid cultivars. The yield was the lowest in cherry tomato cultivar Gardener's Delight with 2598 g/plant. In general F1 cultivars are preferred to standard cultivars for early yield, high yielding, cold, disease and pest resistant. But in this experiment, Moneymaker standard cultivar gave the highest yield when it was grown in the late spring growing period.

The second study was that of Daş (2004). The objective of this study was to analyze the growth/survival of *Salmonella enteritidis* at spot-inoculated or stem-injected cherry tomatoes during passive modified atmosphere packaging (MAP), controlled atmosphere (CA) and air storage at 7 and 22°C. During MAP, CA and air storage, *S. enteritidis* with initial population of 7.0 log10 CFU/tomato survived on tomato surfaces with an approximate decrease of 4.0-5.0 log10 CFU/tomato in population within the storage period; however, in the case of initial population of 3.0 log10 CFU/tomato, cells died completely on day 4 during MAP storage and on day 6 during CA and air storage.

In the third study, the effects of freezing methods and frozen storage on cherry tomato quality were studied (Yaygaz, 2015). Four different freezing treatments; developing of freezing, individual quick freezing, static freezing and individual quick freezing after vacuum treatment were applied on tomatoes. The samples were analyzed for methanol production with pectin methyl esterase (PME), polygalacturonase (PG), lipoxygenase (LOX) activities, lycopene, pH, titratable acidity, total dry matter, skin cracking ratio and color at raw material, 1, 2, 3, 4, 5 and 6th months of storage at -20°C. During storage period, there was not any significant change in the level of titratable acidity, pH, soluble solid and total dry matter. First month of frozen storage caused increase in methanol production related with PME activity. In the same cases, first month of storage lead to increase in PG activity except progressive freezing. Tomatoes frozen by individual quick freezing had the highest methanol production, PG activity and skin cracking ratio. The level of fruits cracking of tomatoes frozen by progressive and static freezing was found similar. Methanol production and PG activity reduced from first month of storage. LOX activity in first month decreased significantly compared to raw material. Statistically significant difference between LOX activities of tomatoes in 2, 3, 4, 5 and 6th months of storage was not found.

The trend towards a safe environment which is free from any pollutant has stimulated us in the present study to emphasize and underline the freshness of organic crops and their various benefits for people’s health under Central Anatolia conditions elevating 1000 meters or above from the sea level. For this purpose, three hybrid cherry tomato cultivars and four different organic amendments (compost, manure, microbial and mixture) were used in this study to estimate the effects of fertilizers, cultivars and/or combinations on some selected plant parameters such as harvest time, yield and fruit quality (TSS, pH, acidity and vitamin C).

CHAPTER 3
MATERIAL AND METHODS

3.1. Description and preparation of field

This research was carried out in the organically managed and certified field of Agricultural Research Center of Safiye Çıkrıkçıoğlu Vocational High School of Erciyes University located in Melikgazi, Kayseri, Turkey.

Figure 6. Field preparation

3.2. Plant materials

Tree cherry tomato species (Inci F1, Yeniçeri F1 and Pekbal F1) was used as plant material. Seeds were obtained from two companies in Turkey. Yeniçeri F1 and Pekbal F1 seeds were obtained from Yüksel Seed Company and Inci F1from ANAMAS Seed Company. Seedlings were germinated and grown in the heated greenhouse in April 2017. The maximum of temperatures degree inside the greenhouse was 37.4°C and the minimum was 15°C with a relative of humidity between 27% and 47%. After two days of planting, Inci F1 and Yeniçeri F1germinated while Pekbal F1 cultivar were germinated after five days of sowing (Figure 2). Then, before transferring the seedling to the field (organically managed and certified), field were plowed, cleaned from weeds and stones. Drip irrigation system was installed. L-shaped iron bars (30x40 mm) were inserted on the rows with the distance of 5 m and the distance between the rows was 1 m (Figure 6). On the 4 of May 2017, seedlings were transplanted to the field. The plants were maintained under regular applications.

Figure 7. Planting seeds

3.3. The Cultivars and Their Properties According to the Suppliers

3.3.1. Inci F1 cultivar

Average weight of its fruits is 10-15 gr, it is from a round type of cherry tomato, vigor very high, and it is suitable for spring and summer greenhouse cultivation. The distance between nodes is short, and its fruit has a dark red color (Figure 3).

Figure 8. İnci F1 cultivar

3.3.2. Yeniçeri F1 cultivar

Its fruits are early appearing, and it is a strong plant, its activity in terms growing is high. It has very high quality; their fruits are red color, the average of fruits weight is 10-15 g (Figure 4).

Figure 9. Yeniçeri cultivar

3.3.3. Pekbal F1 cultivar

It has a short internodes. Its fruits has an oval shape, 20-30 fruits in each cluster. The average of fruit weight is 20-25 gr. Its fruits have red color. Its shape looks like date fruit (Figure 5).

Figure 10. Pekbal Cultivar

3.4. Fertilizers

3.4.1. Compost

The brand named as HEXAKOMP, ORGANOFERM 7.4.4 with organic certificate was purchased from Hexaferm Company-Beşiktaş-İstanbul, Turkey. It includes total organic matter of 65%, nitrogen of 2.5, P_2O_5 of 1%, water soluble K_2O of 1% and total humic+fulvic acid of 25% with pH = 5 to 7. Compost is decomposed organic matter. Composting is a natural procedure of recycling organic material such as leaves and waste vegetable into a rich soil improvement. It was added it to the soil then mixed together.

3.4.2. Manure

Manure is organic matter used as fertilizer in agriculture. It was purchased from the market and product of cow. It was provided by Park and Environmental Management Office of Erciyes University which purchased from the market.

3.4.3. Microbial

Microbial is *Bacillus megaterium* M3, *Peanibacillus polymyxa* and *Bacillus subtilis* Plant Growth-Promoting Rhizobacterial (PGPR) strains were used in this study. All the bacterial strains have capacity to grow in nitrogen-free conditions and/or to solubilize phosphate that obtained from the culture collection unit in the Department of Plant Protection, Faculty of Agriculture at Atatürk University, Erzurum, Turkey. Bacterial cultures were grown on nutrient agar (NA) for routine use, and maintained in Nutrient

Broth (NB) with 15% glycerol at -80˚C for long-term storage. Frozen bacterial cultures were streaked on Nutrient Agar (NA, Oxoid) plates. The cultures were individually incubated in NA at 27°C for 24 h. After incubation period, a single colony was transferred to 1000-ml flasks containing Nutrient Broth (NB, Oxoid), and grown aerobically in the flasks on a rotating shaker (150 rpm) for 48 h at 27°C (Merck, Germany) and diluted to a final concentration of 10^8 CFU.mL^{-1} (colony forming units) using sterile distilled water (Kotan et al., 2005; Erman et al., 2010).

The microbial fertilizer was applied at a dose of 600 ml/100 L (by solved it with water in a hand sprayer then sprayed it on the soil), while the plant height was 10 cm.

3.4.4. Mixture

Mixture is a mixture of several types of organic fertilizers among the manure, compost and microbial to get more benefit for plant growing and soil fertility. For mixing application, 2 ton/da manure + 2 ton/da compost+300 ml/100 L microbial fertilizer were applied (130 kg manure, 130 kg compost, 150 ml microbial mentioned above dissolved in 16 L of water).

3.5. Treatment and Experimental Design

Treatment design was factorial (three cultivars and four fertilizers). Four different types of organic fertilizers were used such as manure, compost, mixture, microbial; all the fertilizers were in a solid shape except microbial fertilizer was in a liquid shape. Experimental design was split-plot with fertilizer was main plot.

On the fourth of May 2017, the seedling were transferred to the open field when their length became about 12 cm, seven cherry tomatoes plant were planted on five lines inside each plot, the spacing between each plant was 70 cm and the spacing between rows was 1m (Figure 6). Weed controls, irrigation, pruning of suckers was performed when necessary. Growth of plants was ended by cutting the top of the plants before last 2-3 weeks of harvest.

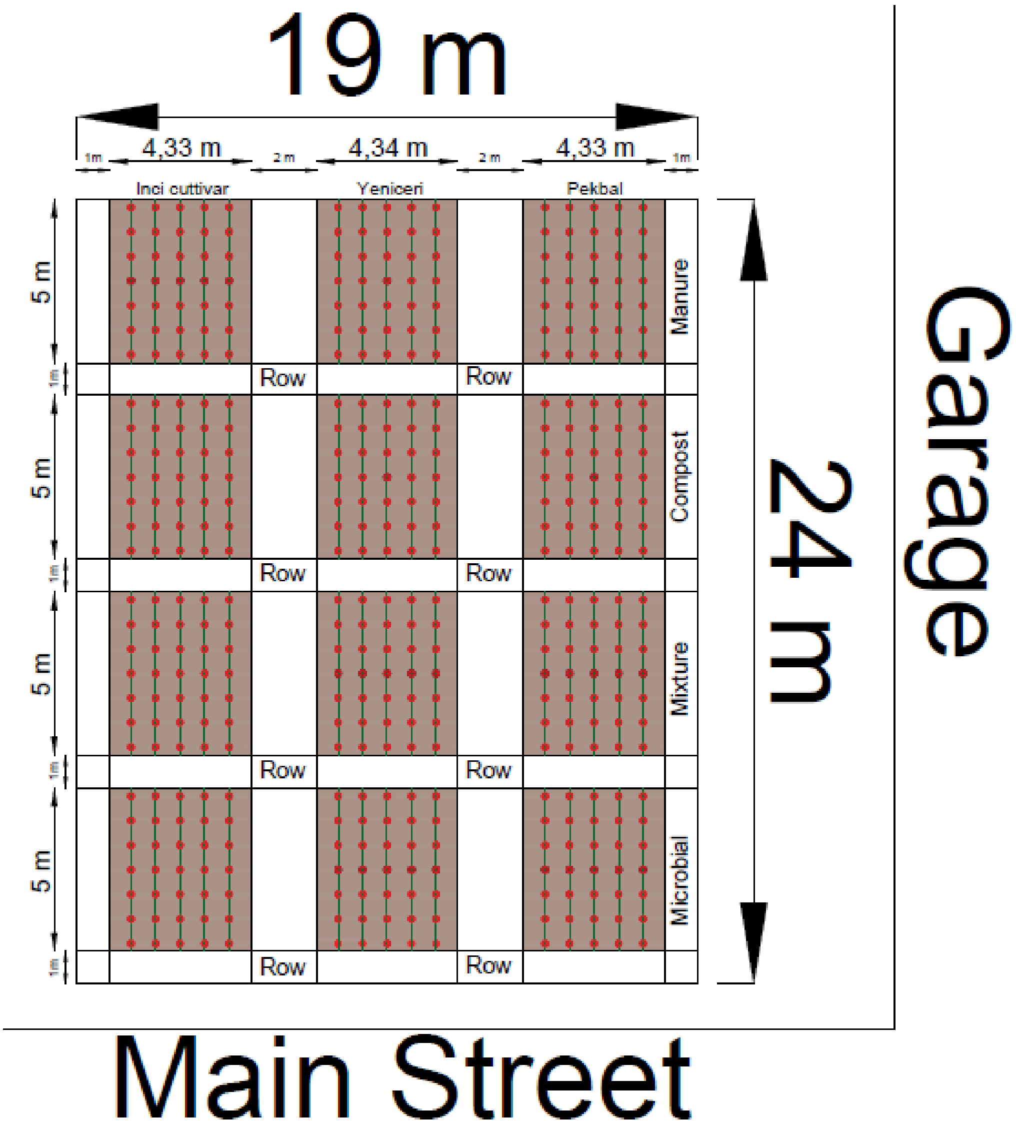

Figure 6. Diagram of experimental area indicating treatment and replications in the field of S. Cikrikcioglu Vocational High School of Erciyes University.

3.6. Measurements and Analyzes

3.6.1. Soil Analysis

Soil samples were taken from 0-30 cm soil layers from a soil profile opened between plant lines and some chemical analyzes were made in these samples at the Lab at Erciyes University, Kayseri-Turkey.

1. Soil Texture: The textures of the soil was determined by the Bouyoucus Hydrometer method (Gee and Hortage, 1986).

2. Soil Reaction: Soil pH was measured potentiometrically with a "Glass Electrode" pH meter in a 1: 2.5 soil-water suspension (McLean, 1982).
3. Lime Calculation: The lime contents of soils was determined volumetrically by Scheibler Classification (Nelson, 1982).
4. Organic Substance: Organic matter content of soils was determined by Smith-Weldon method (Nelson and Sommer, 1982).
5. Cation Exchange Capacities: Cation exchange capacities of soils were determined by ICP-OES Inductively Coupled Plasma spectrophotometer (Perkin-Elmer) in solutions extracted with ammonium acetate (1 N, pH = 7.0) after sodium adsorption in samples was given with sodium acetate (1 N, pH = 8.2) Elmer, Optima 4300 DV, ICP / OES) (Rhoades, 1982a).
6. Interchangeable Cations: The Na, K, Ca, Mg ICP-OES inductively Coupled Plasma spectrophotometer (Perkin-Elmer, Optima 4300 DV, ICP / OES) was used after shaking and extraction of the soil's exchangeable cations with Ammonium Acetate (Rhoadas, 1982b).
7. Electrical Conductivity Test: It EC was determined as mmhos/cm by electrical conductivity instrument in the extraction solutions obtained from the prepared saturating devices (Demiralay, 1993).

3.6.2. Plant Analysis

1. Total Nitrogen Determination of the Plant: The nitrogen content of the plant samples was determined by microchannel analysis (Bremner and Mulvaney, 1982) after being subjected to aging with a mixture of salicylic acid and sulfuric acid.
2. Determination of other elements in plants: P, K, Ca, Mg, Na, Fe, Mn, Zn and Cu contents of plant samples were determined by ICP OES spectrophotometry after being subjected to burning with nitric acid-perchloric acid (Mertens 2005a) (Perkin-Elmer, Optima 2100 DV, ICP / OES, Shelton, CT 06484-4794, USA).

3.6.3. General Observations

At the end of the vegetation period, total yields, marketable yields, discard yields in harvested plants. Titratable acidity (TA), pH, Total soluble solids (TSS), vitamin C and nutrient element were determined in tomato fruits. Macro-micro nutrient contents of plants and some chemical properties and nutrient contents of soil were determined.

3.6.3.1. Yield Measurements

1. Yield (kg/plant): The total yield after weighing was determined numerically.
2. Marketable fruit (%) (kg/da): Green, except for those affected by disease and physically damaged; are regarded as marketable.
3. Fruit diameter (mm), fruit size (mm) and average weight (g): 20 fruits selected randomly in each plot were measured (Vural et al., 2000)
4. Discard yield: Fruits that were not marketable in the trial were recorded as per 10 plant.

3.6.3.2. Plant measurements

1. Plant Height: Measured with the aid of ruler.
2. Leaf Number: The leaves on the plant were counted
3. Stem Diameter: Measured with the aid of calipers (Figure 8).
4. Flower number: Flowers on the plant were counted
5. Fruit Number**:** Fruits on the plant were counted
6. Cluster number: Cluster on the plant were counted
7. Disease and Pest: Observed and recorded diseases and harms in plants.
8. Fruit Diameter: Measured with the aid of calipers.
9. Fruit length: Measured with the aid of calipers.
10. Fruit weight: Determined with scales (Figure 7).
11. Harvest: At the fourteenth of July, first harvesting, the harvesting was done, the harvesting was repeated twice a week, reddish, orange and yellowish fruits were harvested.
12. Chlorophyll SPAD Figure 8: It was measured by using Chlorophyll meter.

Figure 7. Fruits harvesting

Figure 8. Morphological measurements

3.6.3.3. Other Analyzes

1. Vitamin C (mg / 100g): As stated in Cemeroğlu (1992), 250 g of sample weighed and mixed with 6% metaphosphoric acid solution equal to the weight of the sample. Then, 25 g of the homogenized sample was transferred to a 100 ml balloon and the balloon was completed with 100 ml of 3% metaphosphoric acid solution and the sample was thoroughly shaken and filtered. 10 ml of the filtered sample was titrated with 2.6 dichlorophenolindophenol solution to pink color.

The example acid was calculated using the following equation.

Ascorbic acid (mg / 100 g) = V.F. 100 / W

V: The amount of 2,6 dichlorophenolindophenol solution consumed in the titration (ml)

F: Factor of 2,6 dichlorophenolindophenol solution, i.e. the amount of ascorbic acid (mg) in which 1 ml of this solution is equivalent, W: The amount of sample contained in the filtrate used in the titration (g) (Figure 9).

Figure 9. Vitamin C analysis

2. Total Soluble Solids (TSS) (%): The tomato samples in the laboratory were measured by squeezing the water onto the refractometer prince in 1-2 drops and the water soluble dry matter expressed as brix 9% (Figure 10).

Figure 10. Total Soluble Solids measurement

3. Titratable Acid (TA): As indicated by Cemeroğlu (1992), 10 ml of the samples taken from pulped tomato samples were titrated with 0.1 N NaOH solutions to a pH of 8.1. Titration results were calculated as% citric acid according to the form below.

Titration Acidity (%) = V.F.E.100 / M

V: Amount of wasted 0.1-N NaOH (ml)

F: The normality of the base used in the titration (F = 1 if the normality of the solution is 0.1)

E: Equivalent amount of acid (g) of 1 ml 0.1-N NaOH

M: Actual amount of titrated sample (ml or g) 4.

pH: The pH of samples pulverized by blending with laboratory water was measured by pH meter (Figure 11).

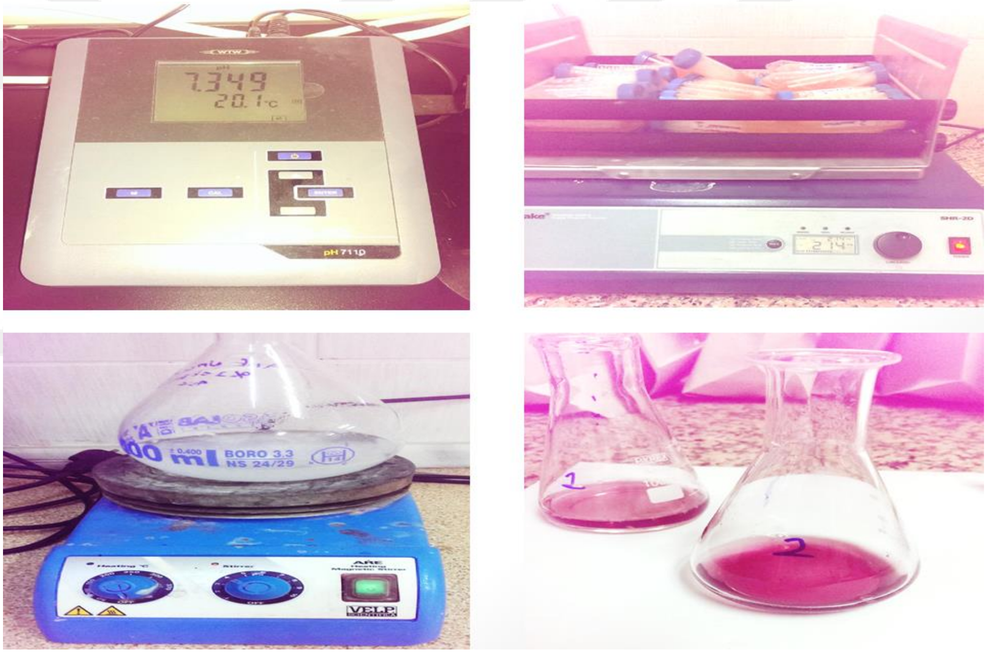

Figure 11. Titratable acid measurement

3.7. Statistical analyses

Two-way ANOVA (cultivars and treatments) was used to evaluate the single or interactive effects of cultivars and treatment on the some parameters. Interactions between the levels of factors were also calculated. Data was determined with the Duncan test option in analysis of variance using the SPSS 16.0 SPSS Inc. Chicago, IL, USA). The level of significance used in tests was $P < 0.05$.

CHAPTER 4

RESULTS

4.1. Effects of Organic Fertilizer on Tomato Yield

The effect of different organic fertilizer applications on the yield of different tomato varieties was examined statistically (Table 2). From the ANOVA test, the effects of cultivars and organic fertilizer application on total yield were found to be statistically significant ($P < 0.01$). Cultivar and organic fertilizer application interactions were also statistically significant ($P < 0.01$) except for non-marketable. Therefore specific combinations of cultivars and fertilizers were important for determining the best combination.

Table 2. ANOVA of different organic fertilizer applications on tomato yield

Source	Dependent Variable	df	Mean Square	F	Sig.
Cultivar	Non marketable yield	2	9580274.740	25.986	< 0.001
	Total yield	2	2.560E8	44.883	<0.001
	Marketable yield	2	1.665E8	41.911	<0.001
Fertilizer	Non marketable yield	3	8138974.461	22.076	<0.001
	Total yield	3	2.052E8	35.980	<0.001
	Marketable yield	3	1.368E8	34.439	<0.001
Cultivar * Fertilizer	Non marketable yield	6	730561.667	1.982	0.089
	Total yield	6	2.431E7	4.263	0.002
	Marketable yield	6	1.742E7	4.383	0.001
Error	Non marketable yield	44	368673.278		
	Total yield	44	5703235.082		
	Marketable yield	44	3973249.893		
Total	Non marketable yield	56			
	Total yield	56			
	Marketable yield	56			

When the effects of different fertilizer applications and cultivars on marketable and non-marketable yields were evaluated, the effect of variety and
fertilizers application was found statistically significant ($P < 0.01$). Cultivar and organic fertilizer application interactions were insignificant ($P > 0.05$).

When the effects of different organic fertilizer applications on İnci cultivar were examined, the highest total yield (17800 g/10 plant) was obtained from compost application (Table 3). The lowest total yield (4438 g/10 plant) was obtained from microbial fertilizer application. When the effects of different organic fertilizer applications on Pekbal cultivar were examined, the highest total yield (17900 g/10 plant) was obtained from compost application and the lowest total yield (6976 g/10 plant) was obtained from microbial fertilizer application. Similarly, in the Yeniçeri cultivar, the highest total yield (6678 g/10 plant) was obtained from the compost, while the lowest total yield (2848 g/10 plant) was taken from the application of the microbial fertilizer.

As a result of manure application and mixture fertilizer applications, total yield values were close to each other and total yield values were obtained as 11500 g/10 plant and 11800 g/10 plant, respectively.

There was an interaction between cultivars and fertilizers for total fruit yield, marketable yield. The most yielding combination was of Pekbal and compost (17.900 g/10 plant) and Inci and compost (17800 g/10 plant) followed by Inci and mix (11800 g/10 plant), Pekbal and manure (10500 g/10 plant), and Pekbal and mix (10200 g/10 plant). Yeniçeri was the least producing cultivar with a mean of 4748 g/10 plant with four different fertilizer applications.

Table 3. Effect of different organic fertilizer applications and cultivars on tomato total, and marketable yield

Species	Application	Non marketable yield, g/10 plant	Total yield, g/10 plant(per plant)	Marketable yield, g/10 plant
İnci	Compost	3361±1098 a	17800±2351a (1780 g/plant)	14400±1602 a
	Manure	2350±1245 a	8702±3128a (870 g/plant)	6351±2056a
	Microbial	655±282 b	4438±1719 b (443 g/plant)	3783±1476 b
	Mix	2334±587 a	11800±3597 a (360 g/plant)	9502±3217 a
	Mean	***2175 A***	***10685 A*** (1069 g/plant)	***8509 A***
Pekbal	Compost	3225±528 a	17900±3155 a (1790 g/plant)	14700±2699a
	Manure	2643±530 ab	10500±1415 b (1050 g/plant)	7869±1241 b
	Microbial	1441±348 b	6976±1182 b (697 g/plant)	5535±1131 b
	Mix	1994±593 b	10200±3851 b (1020 g/plant)	8232±3300 b
	Mean	***2326 A***	***11394 A*** (1139 g/plant)	***9084 A***
Yeniçeri	Compost	1421±234 a	6678±1890 a (668 g/plant)	5257±1714 a
	Manure	1244±365 a	4991±1305 ab (499 g/plant)	3747±1243 ab
	Microbial	437±211 b	2848±1010 b (285 g/plant)	2412±822 b
	Mix	1032±648 a	4474±1967 ab (447 g/plant)	3442±1461 ab
	Mean	***1033 B***	***4748 B*** (475 g/plant)	***3714 B***

The marketable yield values of different applications were determined according to the varieties (Figure 12). Compost application yielded the highest in all varieties.

While manure and mixture fertilizer applications showed close effect, mixture fertilizer provided slightly higher efficiency in Inci cultivar.

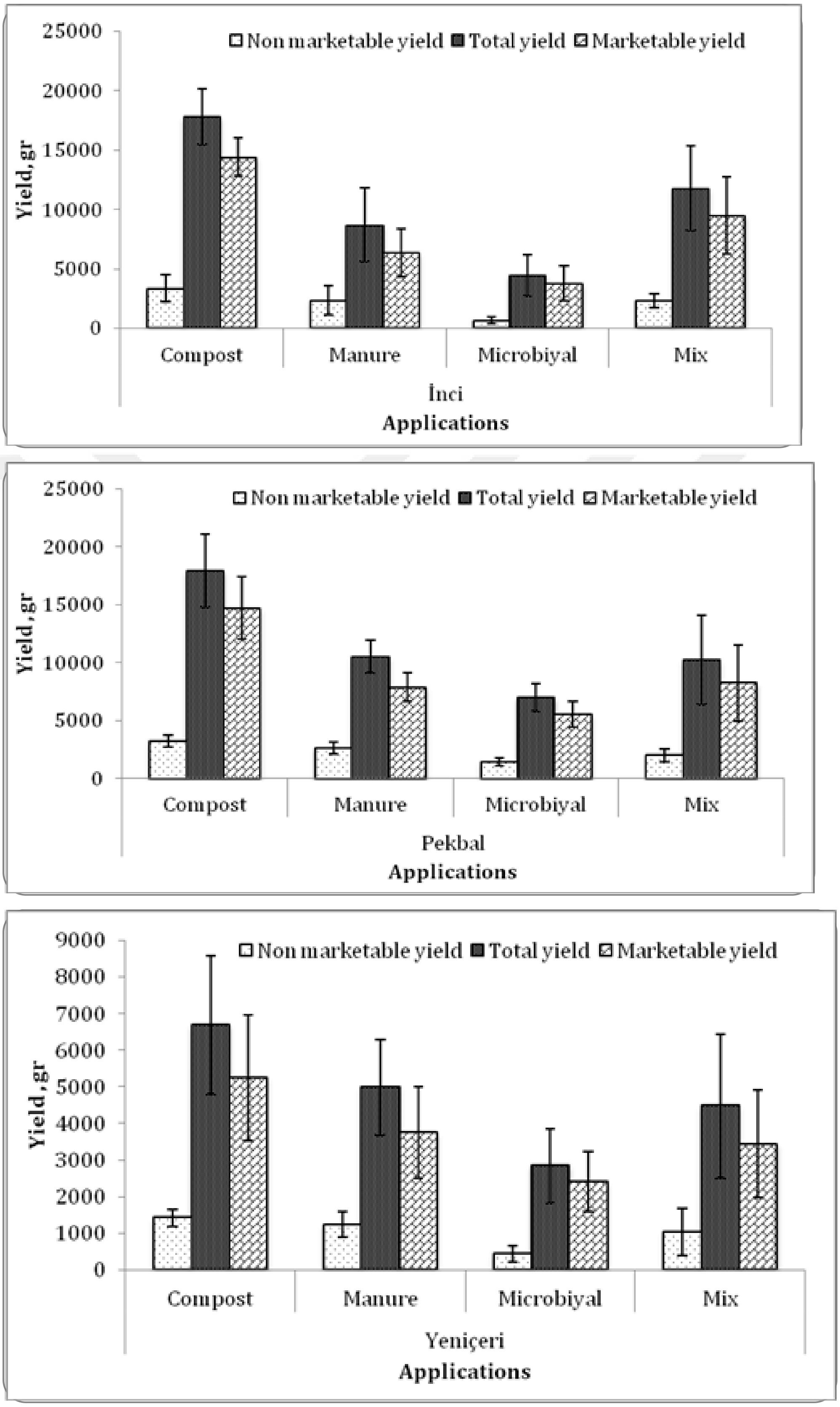

Figure 12. Total and marketable yields in g/10 plant of cultivars grown with different organic fertilizers.

4.2. Effects of Organic Fertilizer on Morphological Parameters of Tomato Plant

The effect of different organic fertilizer applications on the some morphological parameters of different tomato varieties was examined statistically (Table 4). The effects of cultivars and organic fertilizers application on the some morphological parameters were found to be statistically significant (*P* < 0.01). Generally, cultivar and fertilizer interaction was statistically significant that the some morphological parameters (*P* > 0.05), except for leaf number, and distance first flower.

Table 4. ANOVA table of different organic fertilizer applications on some morphological parameters

Source	Dependent Variable	df	Mean Square	F. value	P. value.
Cultivar	Plant height	2	13427.630	35.263	< 0.001
	Leaf number	2	1134.312	30.618	< 0.001
	Steam diameter	2	106.488	18.131	< 0.001
	Distance first flower	2	291.362	8.706	< 0.001
	Flower number	2	1348.813	9.040	< 0.001
	Fruit number	2	33179.174	42.536	< 0.001
	Cluster number	2	160.841	26.974	< 0.001
Fertilizer	Plant height	3	12558.911	32.982	< 0.001
	Leaf number	3	863.419	23.306	< 0.001
	Steam diameter	3	89.074	15.166	< 0.001
	Distance first flower	3	76.501	2.286	0.083
	Flower number	3	1015.608	6.807	< 0.001
	Fruit number	3	16427.968	21.061	< 0.001
	Cluster number	3	119.542	20.048	< 0.001
Cultivar * Fertilizer	Plant height	6	1323.983	3.477	0.004
	Leaf number	6	68.038	1.837	0.099
	Steam diameter	6	19.093	3.251	0.006
	Distance first flower	6	54.141	1.618	0.149
	Flower number	6	336.780	2.257	0.043
	Fruit number	6	2876.486	3.688	0.002
	Cluster number	6	15.445	2.590	0.022
Error	Plant height	107	380.782		
	Leaf number	107	37.047		
	Steam diameter	107	5.873		
	Distance first flower	107	33.468		
	Flower number	107	149.202		
	Fruit number	107	780.033		
	Cluster number	107	5.963		
Total	Plant height	119			
	Leaf number	119			
	Steam diameter	119			
	Distance first flower	119			
	Flower number	119			
	Fruit number	119			
	Cluster number	119			

The analysis of variance on the effects of different organic fertilizer applications on plant height (cm) as shown in (Table 5) indicates that; Inci cultivar had the longest plant (161.1 cm) under all fertilizer treatments whereas Pekbal had the shortest (128.4 cm) plants. Inci with approximately 45 leaves/plant had the highest number of leaves whereas Pekbal had the lowest leaf number with approximately 35 leaves/plant. Inci again had the largest stem diameter (15 mm) and Pekbal with the smallest (12 mm) stem diameter as shown in Table 5.

Table 5. Effect of different organic fertilizer applications and cultivars on some plant morphological parameters

Cultivar	Fertilizer	Plant Height (cm)	Leaf number (per 10 plant)	Steam diameter (mm)
İnci	Compost	189.8±15.5 a	51.0±4.1 a	17.0±2.6 a
	Manure	170.4±14.1 b	49.8±4.3 a	15.3±1.4 a
	Microbial	122.0±21.8 c	35.2±5.7 c	11.0±2.2 b
	Mix	162.2±17.9 b	44.7±5.0 b	16.5±3.8 a
	Mean	***161.1 A***	***45.2 A***	***15.0 A***
Pekbal	Compost	158.6±14.7 a	42.6±4.4 a	14.4±1.1 a
	Manure	115.8±22.1 c	34.7±7.7 b	9.8±2.0 b
	Microbial	109.2±14.9 c	28.4±6.2 c	10.5±2.8 b
	Mix	130.1±23.4 b	33.0±5.3 bc	13.1±3.4 a
	Mean	***128.4 C***	***34.7 C***	***12.0 C***
Yeniçeri	Compost	139.9±20.7 a	43.6±6.5 a	12.5±1.1 ab
	Manure	131.8±19.5 a	43.9±5.3 a	12.6±1.6 ab
	Microbial	107.8±26.1b	36.0±7.0 b	11.0±2.6 b
	Mix	142.1±18.3 a	41.9±9.2 ab	13.2±2.7 a
	Mean	***130.4 B***	***41.4 B***	***12.3 B***

The analysis of variance on the effects of different organic fertilizer applications on distance to first cluster (cm) as shown in (Table 6) indicates that, Yeniçeri cultivar had the longest distance to first cluster (29.0 cm) under all fertilizer treatments whereas

Pekbal had the shortest (23.8 cm) distance to first flower. Inci with approximately (21 flowers/cluster) produced the highest number of flowers whereas Yeniçeri had the lowest flower number with approximately (9 flowers/cluster). Inci with approximately 104 fruits produced the highest number of fruits whereas Yeniçeri had the lowest fruit number with approximately (49 fruits/cluster). Inci again had the highest clusteres number with (13 cluster/plant) and Yeniçeri with the lowest with (10 cluster/plant) as shown in Table 6.

Table 6. Effect of different organic fertilizer applications and cultivars on some plant morphological parameters

Species	Application	Distance first flower(cm)	Flower number (per cluster)	Fruit Number (per cluster)	Cluster number (per plant)
İnci	Compost	24.4±2.5	34.9±18.1 a	141.9±45.6 a	15.4±1.7 a
	Manure	25.0±3.5	19.9±13.4 b	121.4±13.9 ab	15.5±1.8 a
	Microbiyal	25.3±8.4	7.1±4.9 c	48.8±27.2 c	9.6±2.5 b
	Mix	28.6±7.5	21.9±11.3 b	106.4±47.5 b	14.7±2.8 a
	Mean	***25.8 B***	***21.0 A***	***104.6 A***	***13.8 A***
Pekbal	Compost	24.9±9.2	25.3±22.2	93.1±42.3 a	13.3±2.1 a
	Manure	25.7±6.0	13.8±10.7	57.9±27.4 b	9.4±2.9 b
	Microbiyal	22.6±6.2	16.9±15.8	38.4±13.5 b	7.4±3.2 b
	Mix	21.9±3.0	13,1±9.9	57.2±11.7 b	9.8±1.8 b
	Mean	***23.8 C***	***17.3 B***	***61.7 B***	***11.6 B***
Yeniçeri	Compost	27.8±3.3	10.8±4.7 a	58.5±15.5 a	11.9±2.2 a
	Manure	33.2±6.4	10.9±8.6 a	47.3±15.9 ab	10.9±2.2 ab
	Microbiyal	25.3±3.4	4.7±2.8 b	34.2±15.8 b	9.1±2.8 b
	Mix	29.7±5.1	11.8±7.9 a	59.4±20.1 a	11.2±2.8 ab
	Mean	***29.0 A***	***9.6 C***	***49.9 C***	***10.8 C***

The correlations between plant height and leaf number, stem diameter, flower number, fruits number and cluster number was positive and significant (P < 0.01). However, correlation with cultivar and organic fertilizer was negative but significant. Correlation between plant height and distance to first flower was positive but not significant as shown in (Table 7).

The correlation between leaf number and stem diameter, flower number, fruit number and cluster number were positively correlated and significant (P < 0.01). Cultivar and fertilizer treatments were negatively correlated but significant ($P < 0.01$). Correlation between leaf number and distance to first flower was positive but not significant as shown in (Table 7).

The correlation between stem diameter and flower number, fruit number and cluster number was positive and significant ($P < 0.01$). However, correlation with cultivar was negative but significant ($P < 0.01$). Correlation between stem diameter and distance to first flower and fertilizers were negative and significant as shown in (Table 7).
The correlation between distance to first flower and cluster number was positive but not significant. Correlation between distance to first flower and flower number, fruit number, cultivar, and fertilizers were negative and not significant as shown in (Table 7).
The correlation between flower number and fruit number and cluster number was positive and significant ($P < 0.01$) (Table 7). The correlation between fruit number and cluster number was positive and significant ($P < 0.01$).

Table 7. Correlations between different morphological parameters

	Leaf number	Steam diameter	Distance first flower	Flower number	Fruit number	Cluster number	Species	Application
Steam diameter		1	-0.042	0.458**	0.716**	0.315**	-0.383**	-0.098
Distance first flower			1	-0.174	-0.096	0.003	-0.133	-0.008
Flower number				1	0.439**	0.305**	-0.106	-0.234*
Fruit number					1	0.347**	-0.412**	-0.277**
Cluster number						1	-0.145	-0.107

**. Correlation is significant at the 0.01 level

*. Correlation is significant at the 0.05 level

4.3. Effects of Organic Fertilizer on Bioactive Compounds and Pomological Parameters of Tomato Fruits

The effect of different organic fertilizer applications on some bioactive compounds and pomological parameters of the different tomato cultivars were examined statistically

(Table 8). The effects of cultivar on some bioactive compounds and pomological parameters were found to be statistically significant (*P* < 0.05) except for C vitamins. Only the effect of organic fertilizer applications on the diameter and length of the fruit were statistically important. Cultivar and organic fertilizer application interaction was statistically insignificant (*P* > 0.05) for TSS, fruit diameter, fruit length, titratable acidity and vitamin C, but for titratable acidity with an alpha value of 0.053. This means this parameter may be the result of interaction.

Table 8. ANOVA of effect of different organic fertilizer applications on some bioactive compounds and pomological parameters.

Source	Dependent Variable	DF	Mean Square	F	Sig.
Cultivar	TSS	2	18.729	34.080	<0.001
	Fruit diameter	2	11.625	4.559	0.015
	Fruit length	2	1199.562	217.120	<0.001
	Titratable acidity	2	0.248	5.591	0.007
	C vitamins	2	23.091	1.797	0.177
Fertilizer	TSS	3	0.975	1.773	0.165
	Fruit diameter	3	8.775	3.441	0.024
	Fruit length	3	20.482	3.707	0.018
	Titratable acidity	3	0.070	1.577	0.207
	C vitamins	3	16.539	1.287	0.290
Cultivar*Fertilizer	TSS	6	0.271	0.492	0.811
	Fruit diameter	6	2.766	1.085	0.385
	Fruit length	6	3.527	0.638	0.699
	Titratable acidity	6	0.100	2.266	0.053
	C vitamins	6	18.749	1.459	0.213
Error	TSS	47	0.550		
	Fruit diameter	47	2.550		
	Fruit length	47	5.525		
	Titratable acidity	47	0.044		
	C vitamins	47	12.848		
Total	TSS	59			
	Fruit diameter	59			
	Fruit length	59			
	Titratable acidity	59			
	C vitamins	59			

The analysis of variance on the effects of different organic fertilizer applications and cultivar on some bioactive compounds and pomological parameters, for TSS as shown in (Table 9) indicates that, Inci cultivar had the highest level about 8.82 under all fertilizer treatments whereas Pekbal had the lowest level 6.90. Inci had the highest fruit diameter (23.03 mm) whereas Pekbal had the lowest fruit diameter (21.82 mm) as shown in (Table 9). Pekbal had the highest fruit length (36.20 mm) whereas Inci cultivar had the lowest fruit length (22.40 mm). Inci again had the highest TA with 0.64% but Yeniçeri and Pekbal had an equal TA level with 0.44% as shown in (Table 9). Inci cultivar had the highest level of vitamin C with 32.18 ppm and Pekbal cultivar had the lowest vitamin C with 30.20 ppm as shown in (Table 9).

Table 9. Effect of different organic fertilizer applications and cultivars on some bioactive compounds and pomological parameters.

Cultivar	Fertilizer	TSS (%)	Fruit diameter (mm)	Fruit length (mm)	Titratable acidity (%)	Vitamin C (ppm)
İnci	Compost	9.25±0.57	24.34±1.08 a	23.36±0.89 a	0.69±0.33	31.26±3.57 ab
	Manure	8.85±1.94	22.86±1.92 ab	22.59±1.94 ab	0.83±0.17	32.22±2.37 ab
	Microbiyal	8.43±0.35	21.49±1.87 b	20.81±1.48 b	0.55±0.37	30.16±1.78 b
	Mix	8.74±0.65	23.43±1.92 ab	22.93±1.58 ab	0.47±0.10	35.06±4.31 a
	Mean	***8.82 A***	***23.03 A***	***22.40 B***	***0.64 A***	***32.18 A***
Pekbal	Compost	7.47±0.43 a	22.77±1.09	38.82±2.66	0.47±0.15 ab	30.30±3.47
	Manure	6.50±0.31 b	20.84±1.06	34.64±4.00	0.29±0.14 b	30.20±3.74
	Microbiyal	6.73±0.23 b	21.79±1.98	35.29±4.22	0.46±0.10 ab	28.84±2.11
	Mix	6.91±0.36 b	21.87±0.99	35.86±1.98	0.53±0.17 a	31.46±3.20
	Mean	***6.90 C***	***21.82 C***	***36.20 A***	***0.44 B***	***30.20 C***
Yeniçeri	Compost	7.76±0.46	22.5±1.46	24.16±1.54	0.63±0.18	30.38±7.40
	Manure	7.37±0.79	22.35±1.14	23.14±0.66	0.45±0.29	33.54±2.97
	Microbiyal	7.75±0.54	20.64±2.12	21.65±2.53	0.29±0.16	29.80±2.48
	Mix	7.69±0.53	20.95±1.82	22.86±1.51	0.43±0.13	28.04±3.76
	Mean	***7.64 B***	***21.56 B***	***22.89 C***	***0.44 B***	***30.44 B***

Correlation with TSS and titratable acidity was negative and significant (Table 10). The correlation between TSS and fruit length was negative and significant ($P < 0.01$). However, the correlation with fruit diameter had and positive and significant ($P < 0.05$). Correlation between TSS and titratable acidity was positive but not significant. Correlation between TSS and vitamin C was negative and not significant. The correlation between fruit diameter and vitamin C was positive and significant (*P* < 0.01). Correlation with fruit length and titratable acidity were positive but not significant. The correlation between fruit length and titratable acidity and vitamin C were negative but not significant. However, the correlation between titratable acidity and vitamin C was positive but not significant as shown in (Table 10).

Table 10. Correlations of between different pomological parameters

	Fruit diameter	Fruit length	Titratable acidity	C vitamins
TSS	0.317*	-0.525**	0.199	-0.033
Fruit diameter		0.131	0.147	0.354**
Fruit length			-0.183	-0.072
Titratable acidity				0.061

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4.4. Effects of Organic Fertilizer on Macro and Micro Plant Nutrition Content of Tomato Fruits

The effect of different organic fertilizer applications on macro and micro elements of the different tomato cultivars were found to be statistically significant (*P* > 0.05) for only copper (Cu), manganese (Mn) and zinc (Zn) (Table 11). Effect of organic fertilizer applications had a significant (*P* < 0.05) impact on macro and micro element except for potassium (K) and magnesium (Mg). Interaction effect between cultivar and organic fertilizer application was also found to be statistically insignificant (*P* > 0.05) for many of the elements analyzed except for Mn and Zn.

Table 11. ANOVA table of effect of different organic fertilizer applications on macro-micro nutrients contents of tomato fruits.

Source	Dependent Variable	df	Mean Square	F	Sig.
Cultivar	N	2	0.008	0.243	0.785
	P	2	0.001	0.621	0.542
	K	2	0.002	0.137	0.872
	Ca	2	0.001	0.086	0.918
	Mg	2	8841.517	0.246	0.783
	Na	2	4823.150	0.952	0.393
	Fe	2	4.272	1.745	0.186
	Cu	2	2.360	4.607	0.015
	Mn	2	11.374	13.688	< 0.001
	Zn	2	9.422	5.044	0.010
Fertilizer	N	3	0.185	5.438	0.003
	P	3	0.028	22.155	< 0.001
	K	3	0.013	0.790	0.506
	Ca	3	0.036	5.721	0.002
	Mg	3	27065.200	0.753	0.526
	Na	3	22397.600	4.420	0.008
	Fe	3	38.450	15.702	< 0.001
	Cu	3	5.305	10.354	< 0.001
	Mn	3	21.860	26.307	< 0.001
	Zn	3	6.500	3.480	0.023
Cultivar * Fertilizer	N	6	0.057	1.660	0.151
	P	6	0.002	1.891	0.102
	K	6	0.025	1.489	0.202
	Ca	6	0.006	0.929	0.483
	Mg	6	12300.983	0.342	0.911
	Na	6	6732.017	1.329	0.263
	Fe	6	2.546	1.040	0.412
	Cu	6	1.079	2.106	0.070
	Mn	6	2.384	2.869	0.018
	Zn	6	10.411	5.573	0.001
Error	N	48	0.034		
	P	48	< 0.001		
	K	48	0.017		
	Ca	48	0.006		
	Mg	48	35945.050		
	Na	48	5066.975		
	Fe	48	2.449		
	Cu	48	0.512		
	Mn	48	0.831		
	Zn	48	1.868		
Total	N	60			
	P	60			
	K	60			
	Ca	60			
	Mg	60			

Na	60
Fe	60
Cu	60
Mn	60
Zn	60

The analysis of the effects of different organic fertilizer applications and cultivars on macro nutrient contents as shown in (Table 12) indicates that, Inci and Pekbal cultivars had the highest and equal level of nitrogen 2.51% under all fertilizer treatment whereas Yeniçeri had the lowest level of N 2.47%. The highest level of phosphorus (0.38%) was recorded in Yeniçeri whereas Inci and Pekbal had the lowest and an equal level of N with 0.37% as shown in (Table 12). Inci and Pekbal cultivars had the highest and an equal level of potassium with 1.30% whereas the lowest level of K was recorded in Yeniçeri with 1.26% as shown in (Table 12). Yeniçeri and Pekbal cultivars again had the highest and an equal level of C with 1.29% and Inci cultivar had the lowest level of Ca with 1.28% (Table 12). Yeniçeri had the highest level of magnesium with 1854 ppm and Inci cultivar had the lowest level of Mg with 1813 ppm. Pekbal had the highest level of sodium with 306.0 ppm while Yeniçeri had the lowest Na concentration with 274.95 ppm as shown in (Table 12).

Table 12. Effect of different organic fertilizer applications and cultivars on macro nutrient contents of tomato fruits

Cultivar	Fertilizer	N, %	P, %	K, %	Ca, %	Mg, mg kg^{-1}	Na mg kg^{-1}
İnci	Compost	2.55±0.12 a	0.44±0.02 a	1.30±0.33	1.34±0.07	1826±132	254±36.58 b
	Manure	2.49±0.18 ab	0.35±0.03 b	1.25±0.04	1.30±0.08	1836±274	247±20.47 b
	Microbiyal	2.34±0.13 b	0.33±0.04 b	1.21±0.07	1.25±0.07	1787±189	291±74.90 ab
	Mix	2.65±0.12 a	0.37±0.04 b	1.29±0.08	1.25±0.07	1804±141	375±121.4 a
	Mean	***2.51 A***	***0.37 B***	***1.30 A***	***1.28 B***	***1813 C***	***292.1 B***
Pekbal	Compost	2.65±0.25	0.41±0.04 a	1.20±0.09 b	1.38±0.07 a	1852±209	340±78.13 ab
	Manure	2.44±0.13	0.34±0.03 b	1.22±0.07 b	1.24±0.03 b	1742±142	278±95.76 ab
	Microbiyal	2.51±0.16	0.37±0.04 ab	1.36±0.07 a	1.32±0.08 ab	1815±130	244±39.89 b
	Mix	2.43±0.22	0.34±0.03 b	1.33±0.08 a	1.23±0.09 b	1885±276	361±89.31 a
	Mean	***2.51A***	***0.37 B***	***1.30 A***	***1.29 A***	***1824 B***	***306.0 A***
Yeniçeri	Compost	2.64±0.26 a	0.46±0.05 a	1.17±0.05	1.35±0.10	1871±224	288±73.61
	Manure	2.40±0.25 ab	0.37±0.04 b	1.34±0.19	1.32±0.12	1821±113	282±63.70
	Microbiyal	2.25±0.17 b	0.35±0.02 b	1.25±0.07	1.26±0.07	1770±185	234±34.80
	Mix	2.60±0.12 a	0.33±0.03 b	1.28±0.09	1.24±0.06	1953±171	295±56.13
	Mean	***2.47 B***	***0.38 A***	***1.26 B***	***1.29 A***	***1854 A***	***274.95 C***

The analysis of the effects of different organic fertilizer applications and cultivars on micro nutrient contents as shown in (Table 13) indicates that, Pekbal cultivar had the highest level of Iron contents with 11.21 ppm under all fertilizer treatments whereas Inci had the lowest level of Fe with 10.28 ppm. Pekbal had the highest level of Cupper with 4.76 ppm whereas the lowest level of Cu was recorded in Yeniçeri with 4.14 ppm (Table 13). Yeniçeri cultivar had the highest level of Manganese with 8.06 ppm whereas Inci had the lowest level of Mn with 6.57 ppm. Zinc content of fruits were significantly affected by cultivars., Pekbal cultivar again had the highest level of Zinc with 12.87 ppm and Inci cultivar had the lowest level of Zn with 11.63 ppm as shown in (Table 13).

Table 13. Effect of different organic fertilizer applications and cultivars on micro nutrient contents of tomato fruits

Cultivars	Fertilizers	Fe, mg kg^{-1}	Cu, mg kg^{-1}	Mn, mg kg^{-1}	Zn, mg kg^{-1}
İnci	Compost	8.29±1.80 b	3.68±0.41 b	4.55±0.65 b	12.42±1.46 a
	Manure	12.34±1.55 a	4.26±0.66 b	7.49±0.57 a	9.98±0.94 b
	Microbiyal	9.01±2.07 b	3.51±0.70 b	7.28±0.69 a	11.35±1.78 ab
	Mix	11.51±1.43 a	5.32±0.66 a	6.95±1.03 a	12.78±1.78 a
	Mean	***10.28 C***	***4.19 B***	***6.57 C***	***11.63 C***
Pekbal	Compost	8.55±1.59 b	3.84±0.65 b	5.51±0.72 b	13.69±1.36 a
	Manure	12.95±1.36 a	4.94±0.75 ab	7.87±0.81 a	12.84±1.14 ab
	Microbiyal	11.20±1.57 a	4.89±0.52 ab	7.84±0.87 a	11.92±1.01 b
	Mix	12.13±1.34 a	5.38±1.17 a	8.95±1.03 a	13.01±1.24 ab
	Mean	***11.21 A***	***4.76 A***	***7.54 B***	***12.87 A***
Yeniçeri	Compost	9.27±1.99 b	3.55±0.71 b	6.71±1.04 b	11.99±0.94 b
	Manure	11.29±1.22 ab	4.98±0.78 a	8.96±1.32 a	11.55±1.28
	Microbiyal	10.68±1.14 ab	3.79±0.54 b	9.11±0.95 a	15.50±1.69
	Mix	11.92±142 a	4.25±0.78 ab	7.44±0.98 b	12.06±1.41
	Mean	***10.79 B***	***4.14 C***	***8.06 A***	***12.78 B***

However, correlation with N, K, Ca, Mg, Na, Fe, and Cu was found positive but not significant (Table 14).

The correlation between N and Mn was found negative and significant ($P < 0.01$). However correlation with P, Na was showed negative but significant ($P < 0.05$). Correlations between N and Ca, Mg and Cu was positive, however correlations between

N and Ca, Mg and Cu was not significant. Correlation between N and K, Fe and Zn was negative and not significant (Table 14).

The correlation between P and Mn was showed negative and significant ($P < 0.01$). Correlation between P and Ca was positive and significant ($P < 0.05$). Correlation with Mg was positive and not significant. The correlation between P and K, Na, Cu, Zn was showed negative and not significant (Table 14).

The correlation between K and Ca, Na, Fe, Cu, and Mn was positive and not significantThe correlation between Ca and Fe was negative and significant ($P < 0.05$). Correlation with Mg, Cu, Mn, and Zn was negative and not significant as shown in (Table 14).

Table 14. Correlations of between macro-micro nutrients contents of tomato fruits

	P	K	Ca	Mg	Na	Fe	Cu	Mn	Zn
N	0.262*	-0.118	0.106	0.185	0.289*	-0.091	0.242	-0.354**	-0.034
P		-0.170	0.293*	0.030	-0.152	-0.330*	-0.161	-0.508**	-0.049
K			0.180	-0.048	0.238	0.056	0.196	0.089	-0.116
Ca				-0.006	0.022	-0.275*	-0.074	-0.210	-0.031
Mg					0.085	0.079	-0.042	-0.035	-0.120
Na						0.105	0.174	0.047	0.189
Fe							0.579**	0.449**	-0.158
Cu								0.346**	0.028
Mn									0.117

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

4.5. Pest Injury Observed in the Field

4.5.1. The Mouse Damage

The mice built their house under tomatoes plants directly, in addition, they ate a little piece of fruits damaged fruit by mice were discarded (Figure 13).

4.5.2. Aphid Damage

Many of plant in a beginning stage of their growing were infested with aphid (left) and damaged by mouse (Figure 13).

Figure 13: Mouse (right) and Aphid (left) Damage

4.5.3. Calcium Deficiency

Calcium deficiency were observed on the leaf blade as black and spots yellow, this symptom was observed on each cultivar leaves, but the symptom of blossom-end rot has appeared just on Pekbal fruits but with a little ratio (Figure 14).

Figure 14: Calcium deficiency

4.5.4. Brown Stink Insect

Brown stink insect damage was observed with a little ratio, especially on Pekbal's fruits (Figure 15).

Figure 15: Brown Stink Insect damage

4.5.5. Gold Flecking on Fruits

We observed symptoms of this physiological disorder as yellow randomly spot or as yellow flower shape around the base of fruit. Sometimes the gold flecking was happened not because there were mite or trips feeding on the fruit itself but there are other reasons cause this cases; a) the high temperature and humidity, b) the actual ‘fleck’ in gold flecking is caused by calcium salt crystals that form inside a cell, c) the third reason that is rare for field production tomatoes is excessive levels of calcium and phosphorous. In our cases, the temperature at that time was very high and probably because of that, this disease was spreaded (Figure 16).

Source: https://extension.udel.edu/weeklycropupdate/?p=8553

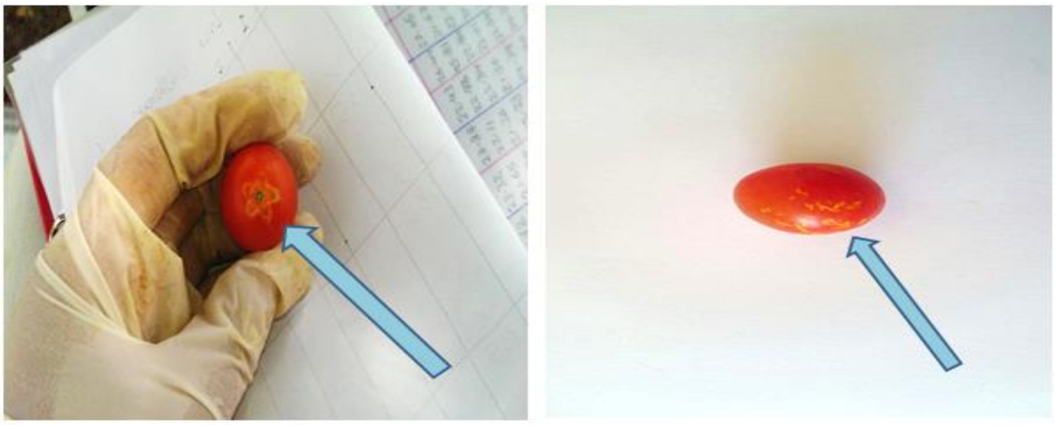

Figure 16: Gold flecking on fruits

4.5.6. Tomato Spotted Wilt Virus

Tomato spotted wilt virus (TSWV) may occur in the field, greenhouse, or high tunnel. Prevention, early identification, and management will help reduce plant and yield losses. Tomato spotted wilt is caused by a viral pathogen. Viral pathogens result in systemic infections, meaning that even though only certain parts of the plant may exhibit symptoms. In our field the wilt occurred occasionally (Figure 17).

Source: https://kentuckypestnews.wordpress.com/2017/.../vegetable-diseases-to-scout-for-tom

Figure 117: Tomato Spotted Wilt Virus

4.5.7. Deformed Tomato Fruit Noses

Tomato fruits with a strange shape look like “nose” from blossom end. Such a weird-shaped tomatoes may have what looks like horns as well. The causes may be are a physiological/genetic disorder and this case occurs in about 1 out of every 1,000 plants (Figure 18). We also observed occasional this disorder.

Source: https://www.gardeningknowhow.com/edible/vegetables/tomato/weird-shaped-tomatoes.htm

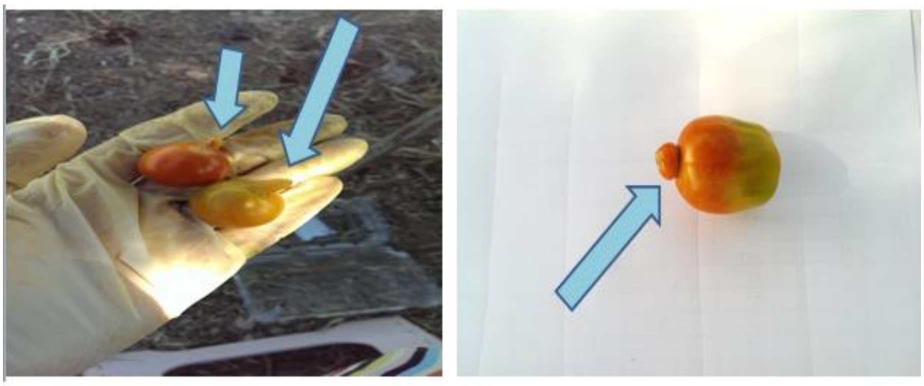

Figure18: Deformed Tomato Fruit Noses

4.5.8. Zippering

This case is related with pollination problems, often attributed to low or high temperatures or high humidity during pollination. Cultivars vary in susceptibility. In our field this problem occasionally occurred probably because of high temperature during the cultivation (Figure 19).

Source:www.omafra.gov.on.ca/IPM/english/tomatoes/diseases-and.../abnormal-fruit.html

Figure 19: Zippering

4.5.9. Cracking

Cracking was very common in our field and probable reason was irregular irrigation. Particularly, Inci F1 cultivar and compost treatment caused significant amount of cracking (Figure 20).

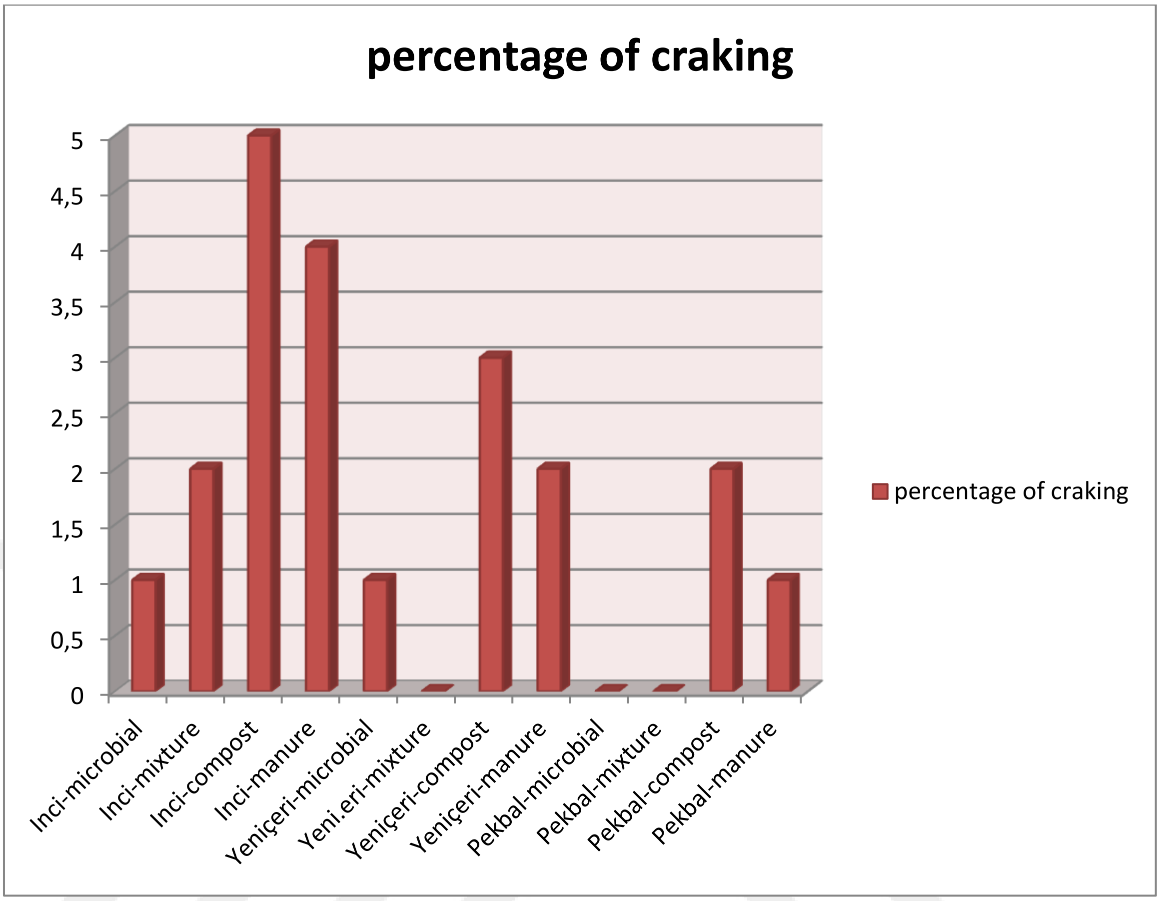

Figure 20: Percentage of cracking

CHAPTER 5

DISCUSSION AND CONCLUSION

The effects of different varieties of hybrid cherry tomatoes combined with four different treatments were evaluated for plant growth, yield, TSS, vitamin C and plant plant nutrition contents of fruits. Conclusions of this study may be beneficial to the growers and consumers wishing improved quality and quantity. Overall, conclusions of this study were agree with of previous studies conducted by Singh and Siataramaiah (1970); Hoitink and Boehn (1999); Bulluck et al. (2002); Bulluck and Ristaino (2002); Arancon et al. (2004); Heeb et al. (2005a); Heeb et al. (2005b); Heebet al. (2006); Liu et al. (2007); Tonfack et al. (2009); Yanar et al. (2011).

Among the organic fertilizers, higher yield (16400 gr) was obtained from compost fertilizer comparing with microbial fertilizer which had the lowest effect on the yield (4438gr/plant) (Table 3). The results obtained were in agreement with Abbasi et al., (2002). There was no major difference between manure and mixture fertilizers in terms yield and total yield values obtained as 11500 and 11800 gr/plant, respectively (Table 3).

Interaction between cultivars and fertilizer was statistically significant except for leaf number and distance first flower ($P > 0.05$) (Table 4). Regarding plant height, leaf number, stem collar diameter, flower number, fruits number and clusteres number, significant responses to organic fertilizers were observed with Inci cultivar. The organic fertilizer used in the present study increased plant height probably by improving the physio-chemical properties of the soil as reported by previous studies (Deboszet et al., 2002; Zheljazkov and Warman, 2004; Zhang *et al*., 2012). Stem diameter increased with increasing organic fertilizer amendments. This is in agreement with Hou et al. (2013). The higher number of fruits produced by organic fertilizer amended plants could be attributed to improved soil physical, biological contents and nutrient availability (Stephenson *et al*., 2005; Gutiérrez-Miceli, 2007).

In present experiment, a significant impact of cultivars was recorded on pomological parameters of fruits except for vitamin C, sometimes the level of vitamin C in tomato fruits was determined by the structure of nitrogen fertilizer used. For example pepper plant which is from the same botanical family of tomato, it was found the content of vitamin C was less when ammonium nitrogen (NH4+) had been used than in the case of use of nitrate (NO_3) (Golcz and Kozik, 2004). Using a big amount of nitrogen fertilizer in the form of nitrate contributed to increased vitamin C content in tomato fruits of standard and cherry verities (Golcz and Kozik, 2004). However, according to the studies by Rossi *et al*., (2008) 11 organically grown tomatoes (147.5 mg 100 g DW^{-1}) contained significantly less vitamin C compared to conventional ones (289.19 mg 100 g DW^{-1}).

While cherry tomato fruits were responded significantly to organic fertilizers, the cultivar and organic fertilizer application was not significantly affected most of the pomological parameters except for Mn and Zn ($P > 0.05$) (Table 8). Probably pomological parameters of the tomato fruits need further research.

The content of bioactive compounds in selected cherry tomato fruits was influenced by organic fertilizers and cultivars. From our experiment, it was obvious that the Inci cultivar had the highest level of TSS (8.82), titratable acidity (0.64%) and vitamin C (32.18 ppm), while Pekbal cultivar had the lowest level of TSS (6.90) and vitamin C (30.20 ppm). There was no significant difference between Yeniçeri and Pekbal cultivars in terms of titratable acidity (0.44 %) (Table 9).

Significant response to cultivars was observed ($P > 0.05$) for copper, manganese and zinc, significant response to organic fertilizers was observed in fruit plant nutrition contents ($P < 0.05$) except for K and Mg. Potassium is known to strongly affect tomato production (Fontes et al., 2000) by interfering with the uptake of Mg.

For the variety Inci F1, N (2.51) and K (1.3) concentration tended to be the highest level, while P (0.37), Ca (1.28) and Mg (1813) tended to be the lowest level in Inci cultivar. Yeniçeri variety had the highest level of P (0.38), Ca (1.29) and Mg (1854) but it had the lowest level of N, K and Na.

The influence of organic nutrient sources can be based on management ways such as combination used, application rate, application time, and methods of combination.

Therefore a combination of organic sources should be considered to achieve a better and balanced nutrient supply. Furthermore, composts incorporated into soil or planting mixes can provide effective biological control of diseases caused by soil-borne plant pathogens as well as foliar pathogens (Abbasi *et al*., 2002; Chellemi and Lazarovits, 2002; Bulluck and Ristaino, 2002;).

One of the important physiological states in tomato is fruit cracking which is generally controlled by genetic factors. There were different levels of cracking were observed on hybrid cherry tomato fruits in this study. The highest ratio of fruit cracking was recorded in Inci F1 cultivar and compost fertilizer, followed by Inci and manure; and Yeniçeri and compost applications. Furthermore, it was reported that other factors such as ecological conditions and production practices were effective on cracking rates of tomato fruits (Ohta et al., 1998; Dorias *et al*., 2001; Huang and Snapp, 2004; Suzuki and Yanase, 2005; Kennely, 2009; Masarirambi *et al*., 2009).

CONCLUSION

Three cultivars (Inci F1, Pekbal F1 and Yeniçeri F1) and four treatments (compost, manure, microbial and mixtures) were used to investigate their effects on some fruit and plant characteristics of three cherry tomato F1 cultivars (Inci, Pekbal, Yeniçeri) under Central Anatolia conditions elevating about 1000 m from the sea level. Overall, presence of interaction between cultivars and fertilizers suggest importance of performance comparisons prior to planning production. The results of this experiment also indicated, in general, that compost had the highest impact on fruit yield followed by manure and mixture fertilizers which had equal effect nearly on the cherry tomato yield then microbial which had the lowest effect on the yield. Cherry tomatoes varieties did not differ in vitamin C with a P value of 0.177, and important nutritional aspect, but in TSS and titratable acidity with $P > 0.01$.

REFERENCE

Abbasi PA, Al-Dahmani J, Sahin F, Hoitink HAJ, Miller SA (2002). Effect of compost amendments on disease severity and yield of tomato in organic and conventional production systems. **Plant Dis.,*86*:** 156-161.

Abou El-Magd MM, Hoda AM, Fawzy FZ. 2005. Relationship growth, yield of Broccoli with increasing N, P or K ratio in a mixture of NPK fertilizers (Brassica oleracea var. italica plenck). **Annals Agricultural Science Moshtohor, 43**(2):791-805.

Arancon NQ, Edwards CA, Bierman P, Metzger JD, Lee S, Welch C (2004). Effects of vermicomposts on growth and marketable fruits of field-grown tomatoes, peppers and strawberries. **Pedobiologia, 47**(5- 6): 731-735.

Araujo, J. C., Telhado, S. F. P. 2015. A Comparative Study of the Effect of Tomato Cultivars and Cultivation Conditions on the Physico-Chemical Properties, *Foods* — **Open Access Food Science Journal 4**: 263-270.

Araujo, J.C.; Silva, P.P.M.; Telhado, S.F.P.; Sakai, R.H.; Spoto, M.H.F.; Melo, P.C.T. 2014. Physico-chemical and sensory parameters of tomato cultivars grown in organic systems. Hortic. **Bras. 32:** 205–209.

Ayoola OT, Makinde EA. Performance of green maize and soil nutrient changes with fortified cow dung. **African Journal of Plant Science. 2008**; 2:19-22.

Balch JF and Balch PA, 1997, *Pres for Natural Healing*, 2nd Edition, Avery, USA

Bergner P, 1997, The Healing Power of Minerals, Special Nutrients and Trace Elements, PrimaPublishing, Rocklin, CA, p 312.

Berova M, Karanatsidis G, Sapundzhieva K, Nikolova V. Effect of organic fertilization on growth and yield of pepper plants (*Capsicum annuum* L.). **Folia Horticulturae.** 2010; 22:3-7.

Booth J. 1993. 'Food intolerance in a child with urticaria', **Journal of Human Nutrition and Dietietics 6**: 377–379.

Borguini, R.G. 2006. Avaliação do Potencial Antioxidante e de Algumas Características Físico-Químicas do Tomate (*Lycopersicon esculentum*) Orgânico em Comparação ao Convencional. Ph.D. Thesis, Universityof São Paulo, São Paulo, SP, Brazil.

BSAEM/BSNM, 1994, *Effective Allergy Practice*, The first report of the BSAEM/BSNM subcommittee on allergy practice, British Society for Allergy and Environmental Medicine with the British Society for Nutritional Medicine, UK

Bulluck LR, Brosius M, Evanylo GK, Ristaino JB (2002). Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. **Appl. Soil Ecol., 19**(2): 147-160.

Bulluck LR, Ristaino JB (2002). Effect of synthetic and organic soil fertility amendments on southern blight, soil microbial communities, and yield of processing tomatoes. **Phytopathology, 92**: 181-189.

Buresh R.J., Smithson P.C. 1997. Building soil phosphorus in Africa, **Soil Sci. Soc. Am. J. (Spec. publ.) 51** 111–149.

Carper J. 1994. Food Your Miracle Medicine, Simon and Schuster Press, UK

Chellemi DO, Lazarovits G (2002). Effect of organic fertilizer applications on growth yield and pests of vegetable crops. Proceedings of Florida State Horticultural Society.

Clayton P. 2001. *Health Defence*, Accelerated Learning Systems, Bucks, UK, p 246.

Clayton P, 2001, *Heath Defence*, Accelerated Learning Systems Publishers, Aylesbury, UK.

CodexAlimentarius, 1999, **http://www.fao.org/fao-who-codexalimentarius/ standards/ list-of-standards/en/** date of access: 06.11.2017.

Das, E. 2004. Effect of controlled atmosphere storage, modified atmosphere packaging and gaseous ozone treatment on the survival characteristics of Salmonella enteritidis at cherry tomato cultivars. Middle East Technical University, Institute of Sciences, Ankara, Turkey.

Debosz K, Petersen SO, Kure KL, Ambus P. 2002. Evaluating effects of sewage sludge and household compost on soil physical, chemical and microbiological properties. **Applied Soil Ecology, 19**:237-248.

Dinesh R, Srinivasan V, Hamja S, Mahjusha A. 2010. Short term incorporation of organic manures and fertilizers influences biochemical and microbial characteristics of soil under an annual crop turmeric. **Bioresource Technology 101**: 4697-4702.

Dr Elaine Ingham, 2001, ‘The soil food web’,*Proceedings of the 12th National Conference on OrganicFood Production*, 5–7 January 2001, Cirencester College, UK.

EC Multicentre Study on Antioxidants, 1997.

El sayed AA, Mansure MA. 2002. Response of basil (*Ocimum basilicum* L.) to different chemical and organic fertilization treatments. **Journal of Agriculture Science 20**: 401-1418.

Elliot HA, Dempsey BA. Agronomic effects of land application of water treatment sludges. **Journal of American Waste Water Association.1991**;83(4):126-131.

Erasmus U, 1999, *Fats That Heal, Fats That Kill*, 2nd Edition, Alive Books, Canada

Ferrari A.A., De Nadai Fernandes EA, Tagliaferro FS, Bacchi MA, Martins TCG (2008). Chemical composition of tomato seeds affected by conventional and organic production systems. **J. Radioanal. Nucl. Chem.278**:399-402.

Ferreira, M.M.M.; Ferreira, G.B.; Fontes, P.C.R.; Dantas, J.P. Qualidade do tomate em função de doses de nitrogênio e da adubação orgânica em duas estações. **Hortic. Bras.24,** 2006, 141–145.

Foolad, M. R., & Panthee, D. R. (2012). Marker-assisted selection in tomato breeding. **Critical reviews in plant sciences, 31**(2), 93-123.

Fontes P.C.R., Sampiao R.A., Finger F.L.. 2000. Fruit size, mineral composition and quality of trickle-irrigated tomatoes as affected by potassium rates, **Pesqui. Agropecu. Bras. 35** (1) 21–25.

Gaskell M., Mitcheli J., Smith R., Koike S.T., Fouche C., Soil fertility management for organic crops, Org. Veg. Prod. Calif. Ser., Publ. 7249, 2000, 5 p. in ferralitic soils, **Biores. Technol. 45** (1) (1993) 21–25.

Golcz A and Kozik E, (2004). Effect of several agrotechnical factors on vitamin C content in pepper (Capsicum annuum L.) and lettuce (Lactuca sativa L.). **Rocz Akad Rol w Poznaniu CCCLVI**:67–74.

Grandillo, S., Ku, H. M., & Tanksley, S. D. (1999). Identifying the loci responsible for natural variation in fruit size and shape in tomato. **Theoretical and Applied Genetics, 99**(6), 978-987.

Gutiérrez-Miceli FA, Santiago-Borraz J, Molina JAM, Nafate CC, Abud-Archila M, Llaven, MAO, Rincon-Rosales R, Dendooven L. 2007. Vermicompost as a soil supplement to improve growth, yield and fruit quality of tomato (Lycopersicon esculentum). **Bioresource Technology, 98**(15):2781-2786.

Györe-Kis, G.; Deák, K.; Lugasi, A.; Csúr-Varga, A.; Helyes, L. Comparison of conventional and organic tomato yield from a three-year-term experiment. **Acta Aliment.** 41, 2012, 486–493.

Hallmann, E. The influence of organic and conventional cultivation systems on the nutritional value and content of bioactive compounds in selected tomato types. **J. Sci. Food Agric. 92,** 2012, *92*, 2840–2848.

Hanssen M and Marsden J, 1987, *E for Additives*, 2nd Edition, Harper Collins, UK.

Hasan uzzaman M, Ahamed KU, Khalequzzaman KM, Shamsuzzaman AMM, Nahar K. 2008. Plant characteristics, growth and leaf yield of Aloe vera as affected by organic manure in pot culture. **Australian Journal of Crop Science, 2**(3):158-163.

Heeb A, Lundegardh B, Ericsson T, Savage G P (2005a). Effects of nitrate- ammonium- and organic-nitrogen-based fertilizers on growth and yield of tomatoes. **J. Plant Nut. Soil Sci, 168**(1): 123-129.

Heeb A, Lundegardh B, Ericsson T, Savage GP (2005b). Nitrogen form affects yield and taste of tomatoes. **J. Sci. Food Agric, 85**: 1405- 1414.

Hodges RD, 1981, 'A qualitative comparison between conventional and biological agriculture', in *Biological Husbandry – a Scientific Approach to Organic Farming*, Stonehouse B (ed.), Butterworths Publishers, p 287–301.

Hoitink HAJ, Boehn MJ (1999). Biocontrol within the context of soil microbial communities: A substrate dependent phenomenon. **Ann. Rev. Phytopath, 37**: 427-446.

Holford P, 1998, *100% Health*, Piatkus, UK.

Hou Y, Hu X, Yan W, Zhang S, Niu L. 2013. Effect of organic fertilizers used in sandy soil on the growth of tomatoes. **Agriculture Science, 4**(5B):31-34.

Kalbani, F. O. S.A.,SalemM. A., Cheruth, A. J.,Kurup SH. S., A. Senthilkumar, Effect of some organic fertilizers on growth, yield and quality of tomato (*Solanum lycopersicum*), **International Letters of Natural Sciences**, *2016.*

Kapoulas, N.; Ilić, Z.S.; Đurovka, M.; Trajković, R.; Milenković, L. Effect of organic and conventional production practices on nutritional value and antioxidant activity of tomatoes. **Afr. J. Biotechnol. 10.** 2011, 15938–15945.

Lipton RB, 1989, ‘Aspartame as a dietary trigger of headache’, *Headache* 29(2), p 90–92.

Liu B, Gumpertz ML, Hu S, Ristaino JB (2007). Long-term effects of organic and synthetic soil fertility amendments on soil microbial communities and the development of southern blight. **Soil Biol. Biochem, 39**: 2302-2316.

Mensink RM *et al*, 1990, *New Eng J Med* 323, p 439–445

Migliori, C.; di Cesare, L.F.; lo Scalzo, R.; Campanelli, G.; Ferrari, V. Effects of organic farming and genotype on alimentary and nutraceutical parameters in tomato fruits. **J. Sci. Food Agric. 92,** 2012, 2833–2839.

Mitchell, A.E.; Hong, Y.J.; Koh, E.; Barrett, D.M.; Bryant, D.E.; Denison, R.F.; Kaffka, S. Ten-year comparison of the influence of organic and conventional crop management practices on the content of flavonoids in tomatoes**. J. Agric. Food Chem. 55**, 2007, 6154–6159.

Mohapatra SC, Das, TK. Integrated effect of bio-fertilizers and organic manure on turmeric (*Curcuma longa* L.). **Environmental Ecology. 27**(3A): 2009;1444-1445

Mojeremane, W.,Moseki, O., Mathowa, T., Legwaila, G.M., Machacha, S., Yield and Yield Attributes of Tomato as Influenced by Organic Fertilizer, American **Journal of Experimental Agriculture, 12**(1); 1-10, 2016.

OFRF,2011**http://ofrf.org/sites/ofrf.org/files/pdf/OrganicFarmingforHealthandProsperity.pdf** date of access: 01.11.2017

Oliveira, A.B.; Moura, C.F.H.; Gomes-Filho, E.; Marco, C.A.; Urban, L.; Miranda, M.R.A. The Impact of Organic Farming on Quality of Tomatoes Is Associated to Increased Oxidative Stress during Fruit Development. **PLoS ONE** 2013, *8*, e56354.

Ordóñez-Santos, L.E.; Arbones-Maciñeira, E.; Fernández-Perejón, J.; Lombardero-Fernández, M.; Vázquez-Odériz, L.; Romero-Rodríguez, A. 2009, Comparison of physicochemical, microscopic and sensory characteristics of ecologically and conventionally grown crops of two cultivars of tomato (*Lycopersicon esculentum* Mill.). **J. Sci. Food Agric., 89**:743–749.

Otani T., Ae N. 1997. The status of inorganic and organic phosphorous in some soils in relation to plant availability, **Soil Sci. Plant Nutr. 43** (2) 419–429.

Özer H and Uzun S., 2013. Effects of some organic fertilizers on yield and quality parameters in organic tomato (Solanum lycopersicum L.) cultivation in open field. Turkey V. Organic Agriculture Symposium, 25-27 September, Samsun.

Özer H., 2012. The Effect Of Different Raised Beds, Mulch Types And Organic Manures On The Growth, Development, Yield And Quality Of Organically Grown Tomato (*Solanum lycopersicum* L.) PhD Thesis, Ondokuz Mayıs University Institute of Science, Samsun.

Palaszczuk, H. (2000) Organic food focus for Queensland farmers, Queensland MediaStatement from the Queensland Minister for Primary Industries and Rural Communities, 2 July

Pinho1, L. A.C. Almeida, C.A. Costa, M.C.D Paes, M. B. A. Glória, R.M. Souza. 2011. Nutritional properties of cherry tomatoes harvested at different times and grown in an organic cropping. **Horticultura Brasileira 29**: 205-211.

Raffo A., LaMalfa G. and Fogliano V., 2006. Seasonal variations in antioxidant components of cherry tomatoes (*Lycopersicon esculentum* cv. Naomi F1). **Journal of Food Composition and Analysis, 19**: 11-19.

Raviv, M, S. Medina, A. Krasnovsky and H. Ziadna. 2004. Organic Matter and Nitrogen Conservation in Manure Compost for Organic Agriculture. **Compost Science & Utilization : 12**: 6-10.

Riahi A., Hdider C. (2013) Bioactive compounds and antioxidant activity of organically grown tomato *(Solanum lycopersicum L.)* cultivars as affected by fertilization. **Scientia Horticulturae151**: 90-96.

Roberts HJ, 1990, *Aspartame (Nutrasweet) – is it safe?*, The Charles Press, USA

Rodríguez, A.; Ballesteros, R.; Ciruelos, A.; Barreiros, J.M.; Latorre, A. Sensory evaluation of fresh tomato from conventional, integrated, and organic production. **Acta Hortic.** 2001, *542*, 277–282.

Rossi F, Godani F, Bertuzzi T, Ferrari F and Gatti S, (2008). Health-promoting substances and heavy metal content in tomatoes grown with different farming techniques. **Eur J Nutr 47**:266–272

Sacco, A., Di Matteo, A., Lombardi, N., Trotta, N., Punzo, B., Mari, A., & Barone, A. (2013). Quantitative trait loci pyramiding for fruit quality traits in tomato. **Molecular Breeding, 31**(1), 217-222.

Sakai, WS, L.H. Chow, A. Miyasaki, R. Short, D. Poteet, G. Nielsen. 1997. Production of Eight Cherry Tomato Cultivars Using Organic Fertilizers and Grown Without Pesticides.

Sandallıoğlu, A. (2014). Consumption of organic agricultural products and consumer tendencies in Adana. Doctorate Thesis, Cukurova University Graduate School of Natural and Applied Sciences, Department of Agricultural Economics, Adana.

Source:**https://kentuckypestnews.wordpress.com/2017/.../vegetable-diseases-to-scout-for-tom** date of access: 06.11.2017

Source: **https://www.gardeningknowhow.com/edible/vegetables/tomato/weird-shaped-tomatoes.htm** date of access: 06.11.2017

Source:**www.omafra.gov.on.ca/IPM/english/tomatoes/diseases-and.../abnormal-fruit.html** date of access: 06.11.2017

Sinclair H, 1990, ‘Food quality and its effects on health’, *Food Quality: Concepts and Methodology*, EFRC Colloquium, p 5–6.

Singh RS, Sitaramaiah K (1970). Control of plant parasitic nematodes with organic soil amendments. I**nt. J. Pest Manage. 16**(2): 287-297.

Singh J., Upadhyay AK., Prasad K., Bahadur A and Rai M., 2007. Variability of carotenes, vitamin C, E and phenolics in brassica vegetables. **Journal of Food Composition and Analysis, 20**: 106-112.

Stephenson AH, McCaskey TA, Ruffin BG. A survey of broiler litter composition and potential value as a nutrient resource. **Biological Wastes. 34**(1):1-9.

Swift RS. Sequestration of carbon by soils. **Soil Science. 2001**;166:858-871.

Tisdale S, 1999, *Soil Fertility and Fertilisers: an Introduction to Nutrient Management*, 6th edition, Prentice Hall, New Jersey

Toledo D.S.; Costa C.A.; Baccı L.; Fernandes L.A.; Souza M.F., 2011. Production and quality of tomato fruits under organic management. **Horticultura Brasileira 29**: 253-257.

Tonfack LB, Bernadac A, Youmbi E, Mbouapouognigni VP, Ngueguim M, Akoa A (2009). Impact of organic and inorganic fertilizers on tomato vigor, yield and fruit composition under tropical andosol soil conditions. **Fruits, 64**: 167-177.

Tuik (2016) **http://www.tuik.gov.tr/**, date of access: 06.11.2017

TÜİK 2015. Crop production statistics. **http://www.tuik.gov.tr/bitkiselapp** date of access: 06.11.2017

Ürkmez, B. 1996. The Comparison pf growth and yield of hybrid standart and cherry tomatoes in a cold glashouse. Trakya University / Institute of Sciences, Tekirdağ, Turkey.

Vinha, A.F.; Barreira, S.V.P.; Costa, A.S.; Alves, R.C.; Oliveira, M.B.P.P. Organic *versus* conventional tomatoes: Influence on physicochemical parameters, bioactive compounds and sensorial attributes. **Food Chem. Toxicol**. 2014, *67*, 139–144.

Wyshak G, 2000, ‘Teenage girls, carbonated beverage consumption and bone fractures’, **Archives of Paediatric and Adolescent Medicine 154**(6),p 610–613.

Yanar, D., Naif, G., Yusuf Y., Aydin, M., ,Çakmak, P.(2011). Effect of different organic fertilizer on yield and fruits quality of indeterminate tomato *(Solanum lycopersicum L.)*. **Scientific research of Essays, 6**(17), 3623-3628.

Yaygaz, A. 2015. Effect of freezing method and storage on frozen cherry tomato quality. Institute of Sciences, Aegean University, Izmir, Turkey.

Zhang, E., Y. Duan, F. Tan and S. Zhang. 2016. Effects of Long-term Nitrogen and Organic Fertilization on Antioxidants Content of Tomato Fruits. J Hortic 3:1.

Zhang GY, Ran W, Zhang LP, Huang QW, Wie MF, Fan QL, Liu Z, Shen QR, Xu GH. 2012. Effect of Glomus mosseae on maize growth at different organic fertilizer application rates. **Journal of Plant Nutrition, 35**(2):165-175.

Zheljazkov VD, Warman PR. 2004.Sourceseparated municipal solid waste compost application to Swiss chard and basil. **Journal of Environmental Quality, 33**:542-552.

CURRICULUM VITEA

PERSONAL INFORMATION

Name, last name	: Rasha Qahraman
Origin	: Iraq
Birth date and place	: 13/10/1984
Phone number	: 00905343456923
e-mail addresse	: ridk84@yahoo.com
regular addresse	: Iraq,Baghdad

EDUCATION

Degree	Institute offered	Year
Batchelor	: University of Baghdad	2006
High School	: Agriculturel of Baghdad	2002

FOREIGN LANGUAGE

English