Analysis of Quality of Two Different Varieties of Peaches with Respect to Organic and Conventional Cultivation Techniques

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ANALYSIS OF QUALITY OF TWO DIFFERENT VARIETIES OF PEACHES WITH RESPECT TO ORGANIC AND CONVENTIONAL CULTIVATION TECHNIQUES

By

Shruti D Sawant

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ABSTRACT

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Shruti Sawant, Master of Science

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The demand for organic produce is based on a general belief that organically grown produce is more nutritious than conventionally cultivated produce. To date, there have been several studies both supporting and contradicting these assumptions and at this point there is no clear consensus. However, there has been one accepted and appreciated aspect of the organic cultivation, which is, that it renders the soil more suitable for long-term cultivation and improves the ecological aspect of producing produce. For this reason, in the long term organic farming may be both economically and ecologically more desirable. The focus of this project as a whole is to study conventional and organic methods for peach cultivation to better understand them and to determine the most economically and ecologically desirable method of peach cultivation in Utah. This specific experiment involved evaluating physicochemical properties of peaches grown under 6 different organic treatments (peaches grown in a certified organic orchard using six different organic treatments) and cultivated using 5 different conventional treatments (peaches grown in a conventional orchard). Peaches were harvested on four different harvest dates to determine the effect of time of cultivation on peach fruit quality. Several different quality attributes of peaches were evaluated. Peaches cultivated under six different organic treatments were statistically compared to determine the difference in their quality attributes. Similarly, peaches cultivated under five different conventional treatments were compared statistically to determine the difference in their quality attributes. Effect of organic treatment on peach quality was not statistically compared with the effect of conventional treatment on peach quality as both treatments were used in separate orchards. No significant differences were observed in quality attributes of either variety of peaches subjected to 6 different organic treatments, nor were any differences observed amongst peaches subjected to 5 different conventional treatments. Moreover, it was observed that peaches harvested on early dates (typically 1 and 2) had more desirable quality attributes. It is interesting that the treatments affected peach growth and development, and future work will involve a correlation with sensory, and volatile analysis.

(117 pages)

PUBLIC ABSTRACT

Analysis of Quality of Two Different Varieties of Peaches with Respect to Organic and Conventional Cultivation Techniques.

Shruti Sawant.

The worldwide demand for organic produce has been on the rise in recent years. This is a result of consumer concerns about the environment and chemicals used in food production. In addition, consumers have demonstrated that they are willing to pay premium prices for organic produce based on the general assumption that organic produce is more nutritious, environmentally friendly, and better-tasting. There have been several studies that have reported significant differences with organic and conventionally grown produce. Organic fruits and vegetables have been shown to have higher dry matter, antioxidants. In addition, it has also been shown to be smaller in size and to have fewer residues of harmful chemical compounds. On the other hand, other studies have shown no difference in the nutritional quality of fruits and vegetables from organic and conventional production methods. As the data have been inconsistent, there is no consensus on whether organic products have better or worse overall quality. Nonetheless, the chemicals used in conventional treatments may adversely affect the health of the local environment. On other hand, organic fertilizers are not thought to be as ecologically harmful, and repeated application is not needed making it financially desirable on a long run.

The goal of the project was to assess a series of innovative treatment combinations on peach fruit quality. Through this research, we expect to have a better understanding of

the different management techniques which will help us yield optimal fruit quality and hence additional incentives for the growers.

This experiment is aimed at evaluating the quality of peaches grown under six different organic treatments and 5 different conventional treatments. Peaches were harvested over four different harvest dates to determine the effect of time of cultivation on peach quality. Several different physicochemical attributes of peaches were evaluated. Upon statistical analysis of quality of peaches grown using six different organic treatments, no difference in the quality of peaches was seen. Similarly, no difference was seen in quality attributes of peaches cultivated under five different conventional treatments. Moreover, peaches harvested early (typically dates 1 and 2) had higher values for the above mentioned attributes

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ABBREVIATIONS AND DEFINITIONS

SSC	Soluble Solid Concentration.
NPK	Nitrogen Phosphorus Potassium.
TA	Titratable Acidity.
SSC/TA	Solid soluble to titratable acidity ratio.
H-Light	Hue value for light spots.
H-Dark	Hue value for dark spots.
H	Hydrogen

INTRODUCTION & OBJECTIVES

Introduction

Organic produce has over time been related to healthier and more flavorsome food as well as to more sustainable agricultural practices (Azadi, Schoonbeek, Mahmoudi, Derudder, Maeyer & Witloxa, 2011). As per the definition, adopted at IFOAM (International Federation of Organic Agriculture Movements) General Assembly, organic farming is a practice that preserves the health of the soil, ecosystem, and people. It involves use of mainly local ecological processes and local biodiversity i.e. natural fertilizers to obtain better quality yield (IFOAM, 2012). In contrast, conventional farming involves the use of synthetic and chemical fertilizers, pesticides and herbicides, to produce foods (Gue´guen & Pascal, 2013).

Organic cultivation has seen a steady growth over last 15 years (USDA, 2013). In the United States of America, the total acres of land under certified organic cultivation has increased from 914,800 acres in 1995 to 5,383,119 acres in 2011 (USDA, 2013). The total acres of land under certified organic cultivation for fruits has increased from 39,013 in 2000 to 131,498 in 2011 (USDA, 2013). This trend is similar in the case of sale of organic food. The total sale has increased for over two decades now as the sales of organic food and beverages increased by $30.5 billion from 1990 to 2011 (Laux, M., 2011). In a difficult economic climate, sales of organic cultivation in 2010 grew 7.7% over the sales in 2009 (Laux, M., 2011). Sale of organic products increased by 9.5% in 2011 (Laux, M., 2011). A survey of consumers revealed varied reasons for the purchase of organic foods that include taste, environmental and socio-economic rationale, and the general belief that organic food is healthy (Zanoli & Naspetti, 2002).

One of the factors affecting consumer preference for organic food products is greater nutritional quality. Many studies have shown that foods cultivated organically generally have higher levels of micronutrients, antioxidants and health-promoting secondary metabolites, such as polyphenols and phenolic compounds, when compared to conventionally grown fruits (Bhowmik & Dris, 2004) (Woese, Lange, Boess & Bogl, 1997). A meta-analysis showed that organic products have higher vitamin C, phenolic compounds, iron, magnesium and phosphorous (Worthington, 1998). Studies conducted on strawberry, tomato and spinach have shown that organic produce has higher vitamin C and polyphenols (Citak & Somnez, 2010; Vinha, Barreira, Costa, Alves & Oliveira, 2014; Fernandes, Domingues, Freitas, Delerue-Matos & NunoMateus, 2012). One study on spinach showed that, compared to organic, conventionally grown spinach has the significantly higher amount of nitrates that have been linked to deleterious effects on human health (Citak et al., 2010). Also, another study has shown that addition of conventional NPK fertilizer increases nitrogen and phosphorous content in the flowers of the growing plants (Shaver & Chapin, 1995). Other studies have described ‘nutrient dilution’ wherein higher dry mass of organically grown fruits, compared to conventionally grown fruits, is considered to be responsible for higher nutrient content and higher secondary metabolite content which improves a plant’s defense (Pieper & Barrett, 2009). Organic methods of cultivation are also considered to be sustainable which not only improves product quality, but also improves the soil quality and hence, helps in reducing production cost (Rigby, CaÂceres & April 2001). Another study found that organic products contained significantly lower amount of synthetic fertilizer compared to conventional and integrated pest management method (Baker, Benbrook, EGroth III & Benbrook, 2002). There are several studies which also show that organically produced fruits have higher SSC content, compared to conventional or integrated method of treatment (Roussos & Gasparatos, 2009; Róth, Berna, Beullens, Yarramraju, Lammertyn, Schenk & Nicolaï, 2007; Camargo, Resende, Tominaga, Kurchaidt, Camargo & Figueiredo, 2011). However, whether organic products are more nutritious, compared to conventional products, is a challenging assessment to make, as the results have not always been consistent. Other studies have shown that organic and conventional Brazilian fruits have no significant difference in vitamin C content, carotenoid content, nutritional value or taste (Cardoso, Tomazini, Stringheta, Ribeiro & Pinheiro-Sant'Ana, 2011). A study has also shown that organic method of cultivation produces overall lower yield compared to the conventional method of cultivation (Seufert, Ramankutty & Foley, 2012), making the organic method of cultivation economically undesirable. Moreover, differences in the quality of produce cultivated either under organic conditions or under conventional conditions is a function of type of soil, local climate and weather conditions, time period of cultivation and the method of evaluating the quality differences (Lester, 2006.). These factors reinforce that determination as to whether organic cultivation is better than conventional methods is complicated as several possible contradictory factors need to be considered.

The method of cultivation has a much broader significance when considered from the point of view of local biodiversity and health of the ecosystem (Azadi, Schoonbeek, Mahmoudi, Derudder, Maeyer & Witloxa, 2011). The method of cultivation affects the quality of soil, water, biodiversity, the local climate of the ecosystem and also the quality of succeeding generations of crops (Azadi et al., 2011). One should be wise in choosing the method of cultivation because more than 99.7% of human food comes from land ecosystem (Pimentel, 2006), hence, more efficient use of available resources and minimizing the depletion of non-renewable resources, like soil, is necessary in order to meet the demands of growing human population (Azadi, Ho & Hasfiati, 2010)**.** Use of conventional mineral and chemical fertilizer degrades the soil quality (Mozumder & Berrens, 2007). In addition, use of chemical fertilizer harms the macro fauna of soil, hence, damages soil fertility and product quality (Niggli, Earley & Ogorzalek, 2007). The chemical fertilizers and pesticides also leach into groundwater, polluting and damaging the ecosystem and biodiversity, harming the health of the farm workers (Pretty, 1995). Conventional methods of cultivation are also responsible for producing about 10-20% of agricultural greenhouse gasses by N_2O emission (Scialabba & Müller-Lindenlauf, 2010). The use of organic method of cultivation not only minimizes the damaging effects of conventional fertilizer, but in turn also improves soil quality and soil fertility as a result of the employment of methods like crop rotation, crop cover, compost manure, organic additives and reduced tillage (Niggli et al., 2007). Use of organic agricultural methods also reduces the damage to the macro fauna of the soil, which can improve soil texture and soil water content, which in turn improves product yield and quality (Giller, Bignell, Lavelle

& Swift, 2003). This has been suggested as a reason for increased measure in product yield by organic cultivation in arid regions (Te Pas & Rees, 2014). The same study also showed that in arid regions and developing countries, soil subjected to organic treatment had higher nutrient content than the soil subjected to conventional treatment (Te Pas et al., 2014).

These findings suggest that using the organic method of cultivation may help in improving the quality of fruits directly and also improve soil quality and surrounding ecosystem, hence, providing improved conditions for succeeding generations of produce. This might help in improving consumer preference towards these products and also might lower the cost of production. However, as mentioned before, some studies have also shown that in certain cases there is no significant difference in quality of produce cultivated under different methods of cultivation and organic cultivation might also be economically undesirable due to lower yield. Regardless, the aim of this study is to analyze the quality of peaches grown under several organic and several different conventional conditions.

Hypothesis

The aim of this study is to analyze the quality attributes of peaches cultivated using different treatments.

Peaches cultivated using different combinations of alleyways and mulches with the organic fertilizer will have variation in physicochemical quality attributes, either due to the alleyway, mulch or the combination as a whole. Peaches cultivated using several modified types of conventional treatments will have significant variation in physicochemical quality attributes. Peaches harvested on four different harvest dates will have a difference in quality attributes if thinning of trees was not properly conducted.

Objectives

- To analyze and determine the physicochemical quality of peaches subjected to a different set of organic and different set of conventional treatments.
- To analyze and determine physicochemical quality peaches harvested on different harvest dates.
- To analyze and determine the physicochemical quality of peaches grown using two different types of alleyways (organic peaches) and different fertilizers (conventional peaches).
- To analyze and determine physicochemical quality of peaches grown using different types of weed control methods.

LITERATURE REVIEW

Fruit Quality Attributes

The acceptability of a fruit product depends on its physical, chemical and biological attributes. Chief amongst these are size, sugar content, acid content, firmness, aroma, ripeness, appearance of the skin and taste (Kader, 1999). Soluble solid content (SSC) indicates the sugar content of a fruit and can be measured by a refractometer. It is expressed in degrees Brix which is equivalent to the percentage of sucrose in the solution (Panda, 2013). SSC along with total acids plays a key role in determining sweetness, sourness and overall taste of a fruit product (Panda, 2013). Total acid content is determined by the titratable acidity of the fruit sample, and titratable acidity (TA) is represented as g/100 ml malic acid equivalents, malic acid is the dominant acid in peaches. A study conducted on different cultivars of peaches and nectarines (Colaric, Veberic, Stampar & Hudina, 2005)**,** showed that SSC/TA is positively correlated with, and, hence, affects, sensory perception, specifically, sweetness, aroma and taste, of a fruit product. Moreover, the same study also showed that SSC value had no correlation with sweetness perception of fruits but significantly positively correlated with aroma and taste perception (Colaric et al., 2005). On the other hand, total acid content correlated negatively with all three above mentioned sensory attributes (Colaric et al., 2005). However, SSC/TA ratio had a more significant correlation with all the three above mentioned sensory attributes (Colaric et al., 2005). Some recent studies have shown that for 2 varieties of peaches consumer acceptability increased significantly when SSC was > 11% compared to SSC < 11% (Crisosto and Crisosto, 2005; Delgado, Crisosto, Heymann and Crisosto, 2013). Also, the same studies showed that lesser %TA led to higher consumer acceptability for peaches (Crisosto and Crisosto, 2005; Delgado et al., 2013). Fruit pH, which can be determined using a standard electronic pH-meter, has also shown to be negatively correlated with overall liking of a fruit product in a study on different genotypes of apricot fruit (Colaric et al., 2005). Though pH and titratable acidity are both dependent on the acid content of a product, they both serve a different purpose in understanding fruit quality. Titratable acidity indicates total free anions in the fruit juice and pH indicates total positive H ions in the fruit juice (Lobit, Soing, Genard & Habib, 2002). A study also showed negative correlation between the 2 measures, however, titratable acidity is used to indicate acid content of the juice that is responsible for sensory perception of the product (Lobit et al., 2002). Whereas, pH indicates chemical and microbial stability of a product (Lobit et al., 2002). The ripeness of a peach fruit can also be determined by the color of the skin, where red colored skin indicates ripe fruit, the color is determined using a colorimeter. Firmness along with size, plays a crucial role in determining the acceptability and maturity of the fruit product. Firmness can be determined by measuring the force required by a probe of small diameter to deform, pierce or compress the fruit product (Panda, 2013). Firmness values between 9 – 13.5 N and size of around 74mm are considered to be ideal for peaches (La Rue, 1989). California's quality standards for peaches has a minimum requirement of 11% SSC with a TA $\leq$ 0.7% (La Rue, 1989).

Background: Impact of Farm Management Practices on Fruits.

The two different management practices, organic, and conventional farming, use different methods of supplying nourishment to the soil to support plant growth. The conventional method involves using synthetic NPK (Nitrogen, Phosphorous, Potassium) fertilizer & synthetic pesticides, whereas organic method involves using organic additives such as compost, crop rotation, crop covers and non-synthetic fertilizers and pesticides to supply nourishment (Gue´guen et al., 2013). These two different approaches result in significant difference in the rate at which nitrate and nitrogen is supplied to plants (Martinez-Blanco, Anton, Riverdevall, Castellari & Munoz, 2010; Lehesranta, Koistinen, Massat, Davies, Shepherd, McNicol, Cakmak, Cooper, Lück, Kärenlampi & Leifert, 2007; Rapisarda , Calabretta , Romano & Intrigliolo, 2005). Higher and faster delivery of nitrates and nitrogen, due to easy availability of soluble nitrogen added through fertilizer, in conventional farming results in increased carotenoids, increased size of fruits, increased amount of nitrates and increased protein content (Martinez-Blanco et al., 2010; Lehesranta et al., 2007; Rapisarda et al., 2005). Whereas in organic farming, low and sustained delivery of nitrogen, due to higher turnover and rapid depletion of nitrogen content in soil by microbial activity, results in comparatively smaller size and yield (Martinez-Blanco et al., 2010; Lehesranta et al.,2007; Rapisarda et al.,2005). However, it leads to higher dry mass and higher amounts of sugars, minerals, antioxidants and secondary metabolites such as phenolic compounds, as shown by several studies (Worthington, 1998; Citak et al., 2010; Vinha et al., 2014; Fernandes et al., 2012). Some other studies also suggest that in certain plants, both type of farming conditions rendered the similar amount of proteins to the plants. Also, the chemical fertilizer and pesticide load on fruits and other consumable parts of plants is significantly lower in organic produce

(Baker et al., 2002).These differences might make organic produce more preferable and nutritious.

Along with the fertilizer, several other alternate floor management techniques have been developed to minimize the use of synthetic inputs (Rowley, 2011). These newer techniques can also affect the quality and growth characteristics of produce. Chief amongst these techniques is the use of mulches and alleyways, to prevent weed growth and supply additional nourishment respectively. Organic mulches (a mulch is any layer of material added around the plant to cover the ground surface from losing moisture) have been popularly used as organic weedicides. Mulches are chosen according to the local ecological factors and economic factors. Different types of mulches differ in the way they inhibit weed growth. This difference causes changes in soil quality and might in turn affect the quality of the produce. However, the effect of mulch or groundcover on the quality of produce is poorly understood. Straw Mulch and living alyssum mulch have been previously shown to be effective weedicide (Rowley, 2011), however, rodent infestation is a potential concern while using Straw Mulch and living alyssum has been shown to compete with trees for nutrition and water that can damage the quality of produce (Rowley, 2011). Tillage is considered to be the best weed control method for organic method of cultivation. However, tillage disrupts soil quality and surface roots of the plants.

Different types of alleyways have been established for supplying additional nourishment to the plants in addition to the fertilizer. Grass alleyway has been used over a long time for organic cultivation method because of its low cost. However, grass alleyway is not efficient in supplying additional nourishment to the plants (Rowley, 2011). Several studies have showed that legume alleyway can supply higher amounts of nitrogen (Rowley, 2011; Skroch and Shribbs, 1986), which can help in increasing the size of the product and overall yield (Martinez-Blanco et al., 2010; Lehesranta et al.,2007; Rapisarda et al.,2005). Thus, it can be used to substitute for some amounts of fertilizer that can also reduce the cost. However, legume alleyway has been shown to increase the concern of pest infestation (Rowley, 2011).

Several modified conventional fertilizers, transitional and integrated, are developed to reduce synthetic inputs in conventional fertilizer and still achieve benefits like, higher yield, bigger size, etc. that comes with synthetic fertilizer. This reduction in synthetic input causes differences in rates and types of nutrients supplied to the fruits. Hence, it results in certain quality differences in peaches cultivated using reduced input methods. Previous studies have shown unclear results. Some studies show that transitional and integrated system produces yield with higher SSC and higher SSC/TA values, whereas some studies suggest there is no difference in quality due to transitional or integrated method of cultivation (Bourn and Prescott, 2002). The quality of peaches also gets affected by their location on the tree. Peaches growing on different parts of the tree are exposed to varying amounts of sunlight and carbohydrates, leading to variation in time taken to reach maturity and, hence, have quality differences. Peaches growing at the top of the tree are more exposed to sunlight and have higher amounts of carbohydrate available compared to the ones growing on the lower branches of the tree (Lopresti, Stefanelli, Ceccarelli, 2014). As a result, peaches growing at the top mature faster, are harvested early and are expected to be bigger in size, have higher SSC content, have more weight, be more firm and have more blushed skin compared to peaches growing on lower branches of the tree, which are harvested late (Lopresti et al., 2014).

Other than fertilizer and alternate components of floor management, product-related factors also influence the product quality. In this study, two varieties of peaches, Coral Star, and Starfire, are cultivated to study the effect of cultivation technique. Coral Star variety matures faster, are bigger in size, have lower SSC content and are more resistant to bacterial infection than Starfire peaches (Fallahi, Fallahi, Shafii and Amiri, 2009). Both varieties of peaches are considered to be firm and uniformly red in color (Frecon and Ward, 2013). However, since both the variety of peaches belongs to the same family of peaches, there is not much other difference in their quality and both the varieties prefer similar growing conditions (Frecon and Ward, 2013). Further information is not available regarding consumer acceptability.

EXPERIMENTAL DESIGN AND METHODS

Experimental Design

This study is conducted on two varieties of peaches, Coral Star, and Starfire. There are two main treatment groups for each variety, organic group, and conventional group. The organic group was cultivated in a certified organic orchard, and the conventional group was cultivated in a separate conventional orchard.

Total of 880 peach samples of 2 varieties (440 samples/variety), Starfire & Coral Star, cultivated under 11 different treatments (40 samples/treatment/Variety) and were harvested over 4 harvest dates (10 samples/harvest date/treatment).

The organic group consists of 6 treatments. The conventional group consists of 5 treatments. The experimental design for both the groups is a randomized block design with four sampling dates and for each sampling date, ten samples were harvested per treatment. The description of treatment in both the groups and the block design of both the orchards is as follows.

In organic group (Table 1) (Figure 1), the first four treatments are experimental treatments and treatment 5 and treatment 6 are known standard organic treatments. In conventional group (Table 2) (Figure 2), treatment 7 is a standard conventional/ synthetic input treatment, whereas, treatment 11 is a standard organic treatment. Treatment 8 is a transitional treatment (conventional treatment changed to organic treatment after one year of cultivation) and 9 and 10 are integrated treatments (either one of the fertilizer, mulch or herbicide is organic, rest of the components are conventional).

Table 1: List and Description of Organic Treatments

Treatment Number	Organic Treatments:-
1	Straw Mulch + Compost N, rye grass/fescue alley.
2	Straw Mulch + Compost N, legume alley.
3	Sandwich system allysum + Compost N, grass alley.
4	Sandwich system allysum + Compost N, legume alley.
5	Tillage + N compost, rye grass/fescue alley.
6	Weed fabric + Compost N, rye grass/fescue alley.

Table 2: List and Description of Conventional Treatments

Treatment Number	Conventional Treatments:-
7	Herbicide + NPK
8	Herbicide + NPK convert to organic after tree establishment
9	Herbicide + Compost N
10	Straw or paper mulch + reduced herbicide + NPK
11	Straw or paper mulch + organic herbicide + compost N

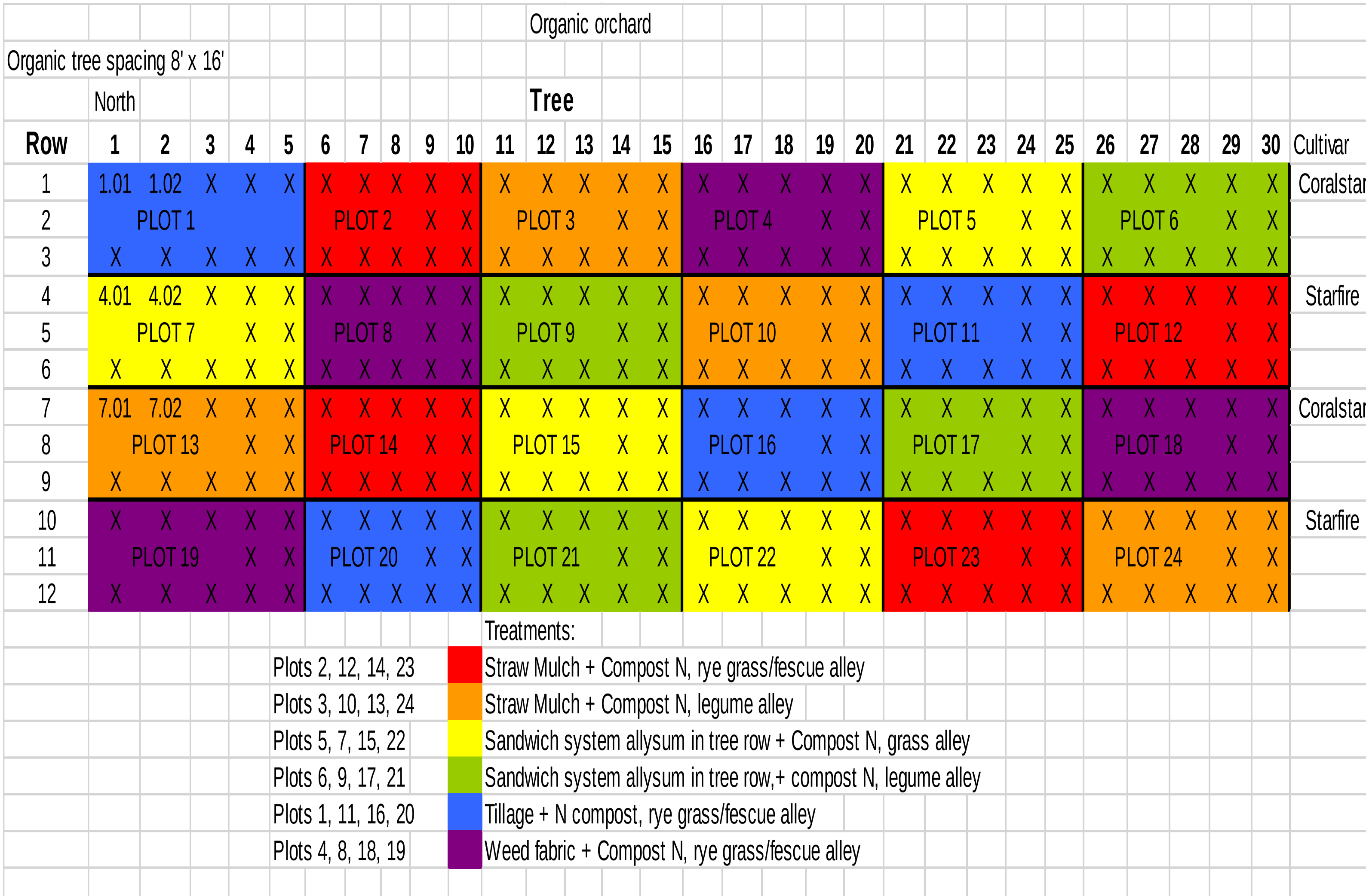

Figure 1: Block Design for Organic Orchard

Figure 2: Block Design of Conventional orchard

Materials and Methods:

For determining the quality of the fruit, the various parameters to be analyzed are as follows (Table 3):-

Table 3: List of Parameters Analyzed

Physical Parameters	**Chemical Parameters**
Color [dark and light spots]	Titratable acidity
Texture [5 from each treatment]	pH
Weight	Brix
Pit size	
Peach diameter	

Peach Size Measurement

The size of the peach fruit was analyzed by measuring two parameters equatorial diameter and top diameter. It was measured using a digital Vernier scale (Carrera Precision 5906, La Verne, CA). The top diameter was measured around apex and end of the fruit stem, and equatorial diameter was measured between 2 midpoints, one on each half, of the mid portion of the peach fruit. Pit size was measured using the same Vernier scale. For pit size fruit was cut into 2 and the length and the width of the pit were measured. Fruit diameter and pit size were measured in all the peach samples harvested for all the 11 treatments for each of the variety. One observation was taken per sample.

Fruit Color Measurement

The color of peach fruit was measured as light spots and dark spots using a Hunterlab colorimeter. It acts as a detector and helps in recording the color of the fruit as a numerical value of lightness or darkness (St.-Pierre, 2006). The derived color scales Hunter L, a and b or the CIE (The Commission International de l'Eclariage) L^* a^* b^* representing the lightness (L), degree of redness or greenness (±a) and the degree of yellowness or blueness (±b) was used to measure the color of the peaches. The instrument was standardized using a Hunterlab black and a white reference tiles (Erikson & Hung, 1997). A positive 'a' value indicates redness and a negative value indicates greenness: a positive 'b' value represents yellowness, and a negative value indicates blueness; a value of 0 represents black, and a value of 100 represents white. Fruit color was measured in all the peach samples harvested for all the 11 treatments, for each of the variety. One observation was taken per sample.

Firmness

Peach fruit firmness was evaluated to define the texture of the peaches using a TMS Pro texture analyzer (Food Technology corp., Sterling, VA) with 9 mm probe and a 50 kg load cell moving at a speed of 12 cm min^{-1} which measures the force (N) required to puncture the fruit as an indicator of fruit firmness. The samples that are under-ripe are too firm, and the ones that are over-ripe are too soft (St.-Pierre, 2006). Fruit flesh firmness (N) was determined by peeling the skin at the fruit equator on both sides without damaging the inner flesh and the fruit was placed in a cylindrical ring so that it doesn't slip during the experiment. Fruit firmness was measured in 5 peach samples/ harvest date/treatment, for each of the variety. One observation was taken per sample.

Fruit Weight

The weight of the fruit that is a basic parameter of quality was measured using an electronic weighing balance, Denver Instrument (Bohemia, NY). All the peach samples, harvested for all the 11 treatments, for each of the variety, were analyzed once for fruit weight. One observation was taken per sample.

Solid Soluble Content (SSC)

For chemical analysis, peaches were cut into pieces and stored in two separate 50ml centrifuge tubes (Fisher Scientific, Denver, CO) in -80 ^{o}C freezer. One of the tubes was used for analyzing the pH, titratable acidity, and the Brix values. For the chemical analysis, to measure the pH, titratable acidity and the Brix, the peach sample from one tube was used to extract clear juice using cloth filter and lemon squeezer and juice was used for analysis. While taking the measurements, the juice samples were kept in an ice box to prevent its degradation at room temperature. Hanna Instruments HI 96801 digital refractometer (Ann-Arbor, MI) was used to measure the % Brix of the peach samples. It gives us the measurement of the soluble solids which is mainly sucrose (Panda, 2013). A small amount of the liquid sample was placed on the glass surface that is the prism using a dropper. The refractometer was standardized using distilled water in between peaches from different treatment and the glass surface/ prism and between samples from the same treatment it was cleaned using tissue wipes and distilled water. The refractometer measured the percentage of sugar in the peach samples by measuring the refractive index of the samples which was expressed as % Brix. There were no variations in temperature while taking the readings. Temperature affects the reading on the refractometer as the temperature increases the density of the juice sample decreases giving lower solid readings (Mcpherson & Gaonkar, 2006). All the peach samples, harvested for all the 11 treatments, for each of the variety, were analyzed for SSC content. One observation was taken per sample.

pH

The pH was measured using a Eutech Eco tester pH1 digital pH meter (Vernon Hills, Illinois) and the pH meter was standardized using buffering solutions before taking the readings. The tip was cleaned in between samples using distilled water. All the peach samples, harvested for all the 11 treatments, for each of the variety, were analyzed for pH. One observation was taken per sample.

Titratable Acidity (TA)

Titratable acidity was measured using a Mettler Toledo G20 compact titrator (Columbus, OH) by diluting 2 ml of the sample with distilled water to a 50 ml mark. Diluted sample was then titrated with 0.1N sodium hydroxide until pH 8.2 was reached. TA is expressed as grams malic acid per 100 ml sample. All the peach samples, harvested for all the 11 treatments, for each of the variety, were analyzed for TA. One observation was taken per sample

Statistical Analysis

The statistical analysis was performed using SAS version 9.4 (SAS Institute, Inc., Cary, NC, USA). To analyze the result, a preliminary F-test was conducted, an abbreviated ANOVA test and is called as type III fixed effect test. Multiple comparison tests, Tukey-Kramer test was conducted to confirm the results for individual interaction between each group. Statistical analysis was conducted by using PROC MIXED and PROC GLIMMIX function. Mixed model analysis was done by selecting treatment and time (harvest dates) as fixed effect factors, whereas, block, plot and repeated measures were selected as random effect factors. A 2 X 2 factorial model for split plot design was used to analyze the effect of 2 different types of mulches (Straw Mulch vs. sandwich allysum) and 2 different types of alleyways (legume vs grass) on response variable for organic treatments, and, to analyze the effect of 2 different types of herbicides (synthetic vs Straw Mulch) and 2 different types of fertilizers (NPK vs compost N) on response variable for conventional treatments. The comparison was conducted between 6 different organic treatments and between 5 different conventional treatments. The analysis was not conducted to compare organic vs. conventional treatments as both the groups were cultivated in different orchards.

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RESULTS & DISCUSSION

Results and Discussion:

Equatorial Diameter:

Organic Peaches: The preliminary F-test showed that there is no significant difference (*P > 0.05*) in equatorial diameter between peaches grown under six different organic treatments for both the varieties. Peaches grown under experimental treatments 1-4 had similar equatorial diameter compared to standard treatments 5-6. Multiple comparison tests, Tukey-Kramer test, confirmed the same result for six organic treatments for Starfire peaches (Table 4).

Table 4: Tukey-Kramer Grouping for Treatment Effect on Equatorial Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**Equatorial Diameter (mm)**		**Treatment**	**Equatorial Diameter (mm)**	
4	71.99 ± 3.00	A	1	78.34 ± 3.76	A
2	71.93 ± 2.76	A	3	77.23 ± 3.31	A
5	71.78 ± 2.48	A	2	77.22 ± 3.60	A
6	71.38 ± 3.52	A	5	77.06 ± 3.71	A
1	71.20 ± 3.50	A	4	75.94 ± 10.33	A
3	71.10 ± 3.48	A	6	75.74 ± 3.95	A

* Estimate with the same letter on right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Organic Starfire peaches harvested at four different harvest dates showed some significant difference from each other (*P < 0.005*) in equatorial diameter, as per the results of F-test. According to the results from Tukey-Kramer test, organic Starfire peaches harvested on harvest date 1 were significantly bigger ($P < 0.005$) in equatorial diameter compared to peaches harvested on harvest dates 2, 3 & 4. The peaches harvested on dates 2, 3 & 4 were not significantly different in equatorial diameter from each other ($P > 0.05$) (Table 5). In contrast to the Starfire peaches, Coral Star organic peaches, harvested at four different harvest dates, did not show any significant difference in equatorial diameter (P > 0.05) (Table 5).

Table 5: Tukey-Kramer Grouping for Harvest Date Effect on Equatorial Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Equatorial Diameter (mm)**		**Harvest Date**	**Equatorial Diameter (mm)**	
1	74.22 ± 2.56	A	2	77.67 ± 3.79	A
2	71.61 ± 3.61	B	1	77.49 ± 3.37	A
4	70.3 ± 2.53	B	3	76.84 ± 3.13	A
3	70.13 ± 2.12	B	4	75.69 ± 8.81	A

* Estimate with the same letter on the right column are not significantly different ($P > 0.05$) & with different letters are significantly different from each other ($P < 0.05$).

The preliminary F-test and Tukey-Kramer test for 2 X 2 factorial model to compare the effect of 2 different types of mulch and 2 different types of alleyway on response parameter, which in this case is equatorial diameter, showed that there is no significant difference ($P > 0.05$) in equatorial diameter between organic peaches of both varieties cultivated under Straw Mulch or allysum mulch (Table 6).

Table 6: Tukey-Kramer Grouping for Mulch Effect on Equatorial Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Mulch	**Equatorial Diameter (mm)**		**Equatorial Diameter (mm)**	
Straw	71.58 ± 11.02	A	77.8 ± 3.73	A
Allysum	71.55 ± 11.41	A	76.59 ± 7.62	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other *(P < 0.05)*.

neither was any significant difference seen in equatorial diameter between peaches of Starfire as well as no difference was seen in the same parameter between organic Coral Star peaches, cultivated using legume alleyway or grass alleyway *(P > 0.05)* (Table 7).

Table 7: Tukey-Kramer Grouping for Alleyway Effect on Equatorial Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Alleyway	**Equatorial Diameter (mm)**		**Equatorial Diameter (mm)**	
Legume	71.98 ± 2.86	A	76.60 ± 7.69	A
Grass	71.15 ± 3.26	A	77.79 ± 3.75	A

* Estimate with the same letter on right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).

Conventional: The preliminary F-test showed that there is no significant difference (P > 0.05) in equatorial diameter between peaches grown under five different conventional treatments. Multiple comparison tests, Tukey-Kramer test, confirmed the same results for five conventional treatments for Starfire peaches as well as for Coral Star peaches (Table 8).

Table 8: Tukey-Kramer Grouping for Treatment Effect on Equatorial Diameter Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Treatment	**Equatorial Diameter (mm)**		**Treatment**	**Equatorial Diameter (mm)**	
11	69.61 ± 2.12	A	8	76.79 ± 5.09	A
9	68.69 ± 2.89	A	9	76.18 ± 4.20	A
7	68.46 ± 4.62	A	7	75.40 ± 6.21	A
10	68.44 ± 2.6	A	11	74.98 ± 2.99	A
8	67.09 ± 2.63	A	10	74.60 ± 5.47	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other *(P < 0.05)*.

Conventional Starfire peaches harvested at four different harvest dates showed some significant difference from each other (P < 0.005) in equatorial diameter, as per the results of F-test. Tukey-Kramer test results confirmed that conventional Starfire peaches harvested on harvest date 1, 2 & 3 were significantly bigger (P < 0.005) in equatorial diameter compared to peaches harvested on harvest date 4. However, peaches harvested on dates 1, 2 & 3 were not significantly different in equatorial diameter between each other (P > 0.05) (Table 9). Conventional Coral Star peaches harvested at four different harvest dates showed some significant difference from each other (P < 0.005) in equatorial diameter, as per the results of F-test. Tukey-Kramer test results confirmed that conventional Coral Star peaches harvested on harvest date 1 & 2 were significantly bigger (P < 0.005) in equatorial diameter compared to peaches harvested on harvest date 3 & 4. However, peaches harvested on dates 1 & 2 were not significantly different in equatorial diameter between each other, similarly peaches harvested on dates 3 & 4 were not significantly different in equatorial diameter between each other (P > 0.05) Consistent with the results for organic peaches, conventionally grown peaches had higher equatorial diameter when harvested on harvest date 1 and had the least diameter when harvested on later harvest date, that is 3 or 4 (Table 9).

Table 9: Tukey-Kramer Grouping for Harvest Date Effect on Equatorial Diameter estimate of conventional peaches (Alpha=0.05). (Estimate is represented as Mean ± standard deviation and is arranged in descending order).

Harvest Date	**Equatorial Diameter (mm)**		**Harvest Date**	**Equatorial Diameter (mm)**	
1	69.36 ± 2.97	A	1	77.95 ± 5.60	A
2	69.32± 2.58	A	2	77.65 ± 3.45	A
3	69.11 ± 2.27	A	4	73.81 ±3.93	B
4	66.04 ± 3.59	B	3	72.94 ± 4.89	B

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

The preliminary F-test and Tukey-Kramer test for 2 X 2 factorial model, to compare the effect of 2 different types of weed control methods and 2 different types of fertilizers, used in cultivation of conventional peaches, on response parameter, which in this case is equatorial diameter, showed that there is no significant difference (P > 0.05) in equatorial diameter between conventional peaches cultivated using Straw Mulch or synthetic herbicide as weed control method (Table 10). Neither was any significant difference seen in equatorial diameter between peaches cultivated using compost N or inorganic NPK as fertilizers (P > 0.05) (Table 11).

Table 10: Tukey-Kramer Grouping for Weed Control Effect on Equatorial Diameter Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Weed Control	**Equatorial Diameter (mm)**		**Weed control**	**Equatorial Diameter (mm)**	
Straw Mulch	69.11 ± 10.52	A	Herbicide	75.79 ± 5.24	A
Herbicide	68.57 ± 11.27	A	Straw Mulch	74.79 ± 4.45	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 11: Tukey-Kramer Grouping for Fertilizer Effect on Equatorial Diameter of Conventional Peaches (Alpha=0.05) (Represented as Mean ± Standard Deviation)

Fertilizer	**Equatorial Diameter (mm)**		**Fertilizer**	**Equatorial Diameter (mm)**	
Compost	69.23 ± 2.51	A	Compost	75.58 ± 3.65	A
NPK	68.45 ± 3.49	A	NPK	74.995 ± 5.69	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

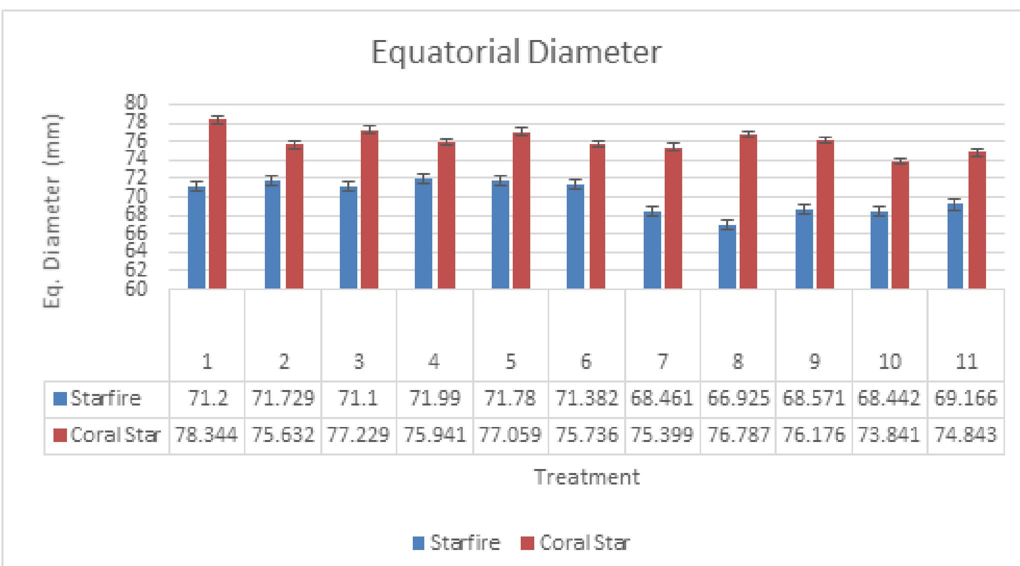


Figure 3: Equatorial Diameter Mean Values of Peaches Subjected to 11 Different Treatments

Figure 3 summarizes the results for equatorial diameter for both the varieties of peaches subjected to 11 different treatments. No significant difference was seen in equatorial diameter for peaches subjected to 11 different treatments (Figure 3). Coral Star peaches have a bigger diameter than the Starfire peaches (Figure 3). However, this cannot be proved statistically as they were cultivated in different blocks. Coral Star peaches being larger in size than Starfire peaches has been reported previously. Hence, the observed results are consistent with previous findings (Fallahi et al., 2009). Moreover, Coral Star peaches can be classified as large (> 74 mm) and Starfire peaches can be classified as small (< 74 mm) (Blasco, Alexios and Molto, 2003). One more trend is evident from the results, peaches harvested early typically on date 1 were significantly larger in equatorial diameter compared to the peaches harvested late, typically date 4 or 3 (except organic Coral Star peaches). This is in accordance with previous findings (Lopresti et al., 2014). As suggested by the previous study, this difference could be because of the height at which the peaches were grown and their relative exposure to sunlight. As previously indicated, peaches harvested earlier, that is dates 1 or 2, mature faster because they are located at a higher carbohydrate containing top portion of the tree and are more exposed to sunlight, which enables them to be bigger in size and several other attributes discussed later. Moreover, organic peaches appear to have greater diameters than conventional peaches which is not consistent with the hypothesis (Martinez-Blanco et al., 2010; Lehesranta et al., 2007; Rapisarda et al., 2005). However, this is just an observational result, and no statistics can be performed to evaluate the difference. Even though legume alleyway supplies more nitrogen to the soil than grass alleyway (Rowley, 2011), peaches grown using legume alleyway were not significantly different in equatorial diameter than peaches grown using grass alleyway.

Solid Soluble Content:

Organic: Both varieties of peaches cultivated under six different organic treatments did not show any significant difference in soluble solid content (P > 0.05). However, treatment 2 cultivated peaches had highest SSC and peaches cultivated under treatment 1 (for Starfire) or treatment 3(for Coral Star) had lowest (Table 12).

Table 12: Tukey-Kramer Grouping for Treatment Effect on SSC Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**SSC (%Brix)**		**Treatment**	**SSC (% Brix)**	
2	11.03 ±1.57	A	2	9.87 ± 1.33	A
5	11.02 ± 1.33	A	6	9.67 ± 1.24	A
4	10.92 ± 1.64	A	5	9.48 ± 1.20	A
6	10.68 ± 1.62	A	1	9.44 ± 1.28	A
3	10.64 ± 1.30	A	4	9.15 ± 1.27	A
1	10.57 ± 1.26	A	3	9.10 ± 1.12	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).

There was no difference in SSC content in peaches harvested over four different harvest dates, for both the varieties (P > 0.05) (Table 13).

Table 13: Tukey-Kramer Grouping for Harvest Date Effect on SSC Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**SSC (% Brix)**		**Harvest Date**	**SSC (% Brix)**	
1	11.48 ± 1.08	A	1	9.97 ± 1.50	A
2	10.74 ± 1.62	A	2	9.63 ± 1.02	A
3	10.53 ± 1.33	A	4	9.16 ± 1.32	A
4	10.50 ± 1.56	A	3	9.04 ± 0.89	A

* Estimate with the same letter on the right column are not significantly different ($P > 0.05$) & with different letters are significantly different from each other ($P < 0.05$).

There was no significant difference observed in SSC content in organic peaches cultivated either under Straw Mulch or allysum ($P > 0.05$) (Table 14). There was no significant difference observed in SSC content in organic peaches cultivated using legume or grass alleyway ($P > 0.05$) (Table 15).

Table 14: Tukey-Kramer Grouping for Mulch Effect on SSC Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Mulch	**SSC (% Brix)**		**Mulch**	**SSC (% Brix)**	
Allysum	10.78 ± 1.46	A	Straw	9.65 ±1.33	A
Straw	10.75 ± 1.41	A	Allysum	9.12 ±1.24	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 15: Tukey-Kramer Grouping for Alleyway Effect on SSC Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Alley	**SSC (% Brix)**		**Alley**	**SSC (% Brix)**	
Legume	10.92 ± 1.60	A	Legume	9.51 ± 1.30	A
Grass	10.60 ± 1.37	A	Grass	9.27 ± 1.21	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Conventional: The conventional peaches of both the varieties cultivated under five different treatments did not show any significant difference in soluble solid content ($P > 0.05$) (Table 16).

As opposed to organic peaches, there was a significant difference in SSC content in Starfire peaches harvested over four different harvest dates ($P < 0.05$) (Table 17). Peaches harvested on harvest date 1 & 2 had significantly higher SSC content compared to peaches harvested on harvest date 3 & 4. There was no significant difference in SSC content between peaches harvested on date 1 when compared to the ones harvested on date 2. Similarly, no significant difference was found in SSC content amongst peaches harvested on date 3 & 4. However, no difference in SSC content was observed in Coral Star conventional peaches harvested over four different harvest dates (Table 17).

Table 16: Tukey-Kramer Grouping for Treatment Effect on SSC Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**SSC (% Brix)**		**Treatment**	**SSC (% Brix)**	
11	10.44 ±1.04	A	7	9.87 ± 0.95	A
8	10.33 ± 1.24	A	10	9.84 ± 1.11	A
10	10.14 ± 1.09	A	8	9.78 ± 1.53	A
7	9.90 ± 1.28	A	11	9.29 ± 1.11	A
9	9.74 ± 0.90	A	9	9.14 ± 1.05	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 17: Tukey-Kramer Grouping for Harvest Date Effect on SSC Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**SSC (% Brix)**		**Harvest Date**	**SSC (% Brix)**	
1	10.64 ± 1.62	A	1	10.07 ± 0.90	A
2	10.24 ± 1.62	A	4	9.59 ± 1.34	A
3	9.91 ± 1.45	B	2	9.35 ± 1.24	A
4	9.65 ± 1.65	B	3	9.32 ± 1.13	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).

There was no significant difference observed in SSC content in conventional peaches cultivated either using Straw Mulch weed control or using synthetic weed control (P > 0.05) (Table 18). Similarly, there was no significant difference observed in SSC content in conventional peaches cultivated using either compost N fertilizer or inorganic NPK fertilizer (P > 0.05) (Table 19).

Table 18: Tukey-Kramer Grouping for Weed Control Effect on SSC Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Weed Control	**SSC (% Brix)**		**Weed Control**	**SSC (% Brix)**	
Straw Mulch	10.29 ± 1.07	A	Straw Mulch	9.56 ±1.10	A
Herbicide	9.82 ± 1.19	A	Herbicide	9.51 ±1.23	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 19: Tukey-Kramer Grouping for Fertilizer Effect on SSC Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Fertilizer	**SSC (% Brix)**		**Fertilizer**	**SSC (% Brix)**	
Compost	10.09 ± 0.86	A	NPK	9.86 ± 1.24	A
NPK	10.02 ± 1.17	A	Compost	9.21 ± 1.13	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

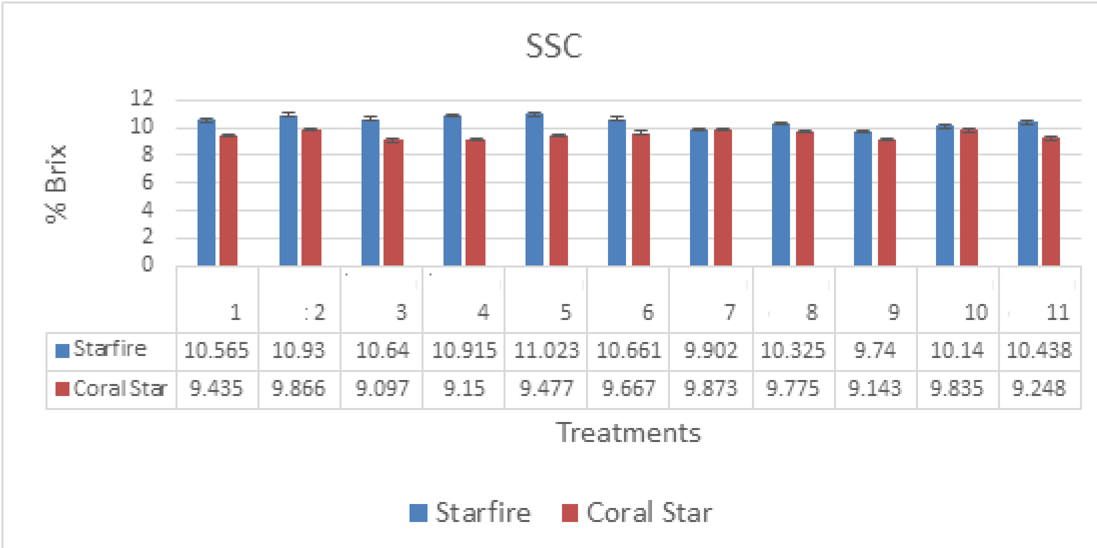


Figure 4: SSC Mean Values of Peaches Subjected to 11 Different Treatments

Figure 4 summarizes findings for treatment effect on SSC values for peaches. In addition, Starfire peaches, both organically as well as conventionally cultivated, seems to have higher SSC content and Coral Star peaches have lower SSC values. It has been previously reported that Starfire peaches have higher SSC value than conventional peaches and values obtained in this study are similar to the values obtained in a previous study on different cultivars of peaches (Fallahi et al., 2009). However, this cannot be statistically compared and proved in this study as they both were cultivated in different blocks, but, given the similarity in two varieties it is a notable observation to make. Also, in all the four groups SSC content decreased from harvest dates 1 to 4. However the difference was not significant except for conventional Starfire peaches. This is against the hypothesis, as a decrease in SSC values with increase in harvest dates was expected to be significant for all the peaches as per previous findings (Lopresti et al., 2014). Since, SSC results are consistent in both organic Starfire and organic Coral Star peaches, it might indicate that

Straw Mulch in combination with legume alleyway (treatment 2) might impart higher SSC to cultivated product; however, this can turn out to be not true as the difference in SSC for both type of organic peaches was not significant. Moreover, Starfire peaches produced under organic treatment 2, and treatment 3 might prove to be more acceptable to consumers as their SSC value is > 11% and usually peaches having SSC values > 11% are significantly more acceptable to the consumers than peaches having < 11% SSC (Crisosto and Crisosto, 2005: La Rue, 1989). Mature peaches have SSC values between 9-14%. Hence, all the peaches have SSC value in the acceptable range (La Rue, 1989).

Titratable Acidity:

Organic: Peaches of both the varieties grown under six different organic cultivation conditions were not significantly different (P > 0.05) in % titratable acidity (Table 20).

Table 20: Tukey-Kramer Grouping for Treatment Effect on TA Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**T A (%)**		**Treatment**	**TA (%)**	
4	0.87 ± 0.14	A	5	0.68 ± 0.08	A
5	0.87 ± 0.16	A	1	0.68 ± 0.10	A
2	0.80 ± 0.12	A	2	0.66 ± 0.11	A
3	0.80 ± 0.13	A	3	0.65 ± 0.10	A
1	0.80 ± 0.11	A	4	0.65 ± 0.11	A
6	0.74 ± 0.13	A	6	0.61 ± 0.11	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).

Starfire organic peaches harvested on 4 different harvest dates did not significantly differ in %TA, however, organic Coral Star peaches harvested on date 4 had significantly higher %TA compared to the ones harvested on dates 1,2 and 3. Peaches harvested on dates 1, 2 and 3 did not significantly differ in %TA content (Table 21).

Table 21: Tukey-Kramer Grouping for Harvest Date Effect on TA Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**TA (%)**		**Harvest Date**	**TA (%)**	
4	0.84 ± 0.16	A	1	0.74 ± 0.11	A
1	0.83 ± 0.12	A	4	0.66 ± 0.08	B
2	0.83 ± 0.14	A	3	0.61 ± 0.06	B
3	0.76 ± 0.11	A	2	0.61 ± 0.09	B

* Estimate with the same letter on the right column are not significantly different ($P > 0.05$) & with different letters are significantly different from each other ($P < 0.05$).

The effect of 2 different kinds of mulches used and 2 different kinds of alleyways, on %TA was insignificant as peaches of both varieties cultivated with different set of conditions did not significantly differ in %TA ($P > 0.05$) (Table 22 and 23).

Table 22: Tukey-Kramer Grouping for Mulch Effect on TA Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Mulch	**TA (%)**		**Mulch**	**TA (%)**	
Allysum	0.84 ±0.14	A	Straw	0.67 ± 0.11	A
Straw	0.80 ±0.12	A	Allysum	0.65 ± 0.10	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 23: Tukey-Kramer Grouping for Alleyway Effect on TA Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Alley	**TA (%)**		**Alley**	**TA (%)**	
Legume	0.84 ± 0.13	A	Grass	0.67 ± 0.10	A
Grass	0.80 ± 0.14	A	Legume	0.65 ± 0.11	A

* Estimate with the same letter on right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).

Conventional: Peaches of both varieties grown under 5 different conventional cultivation conditions were not significantly different (P > 0.05) in % titratable acidity (Table 24).

Table 24: Tukey-Kramer Grouping for Treatment Effect on TA Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**TA (%)**		**Treatment**	**TA (%)**	
11	0.72 ± 0.23	A	8	0.60 ± 0.12	A
8	0.71 ± 0.14	A	9	0.60 ± 0.09	A
10	0.70 ± 0.10	A	7	0.60 ± 0.08	A
9	0.66 ± 0.10	A	11	0.60 ± 0.09	A
7	0.66 ± 0.10	A	10	0.59 ± 0.10	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).

The effect of 4 different harvest dates, 2 different kinds of weed control methods used and 2 different kinds of fertilizers used, on %TA was not significant as peaches cultivated with different sets of conditions did not significantly differ in %TA (P > 0.05) (Table 25, 26 and 27).

Table 25: Tukey-Kramer Grouping for Harvest Date Effect on TA Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**TA (%)**		**Harvest Date**	**TA (%)**	
1	0.73 ± 0.15	A	4	0.63 ± 0.10	A
2	0.73 ± 0.14	A	1	0.62 ± 0.10	A
3	0.67 ± 0.12	A	3	0.57 ± 0.10	A
4	0.64 ± 0.22	A	2	0.56 ± 0.07	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 26: Tukey-Kramer Grouping for Weed Control Effect on TA Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

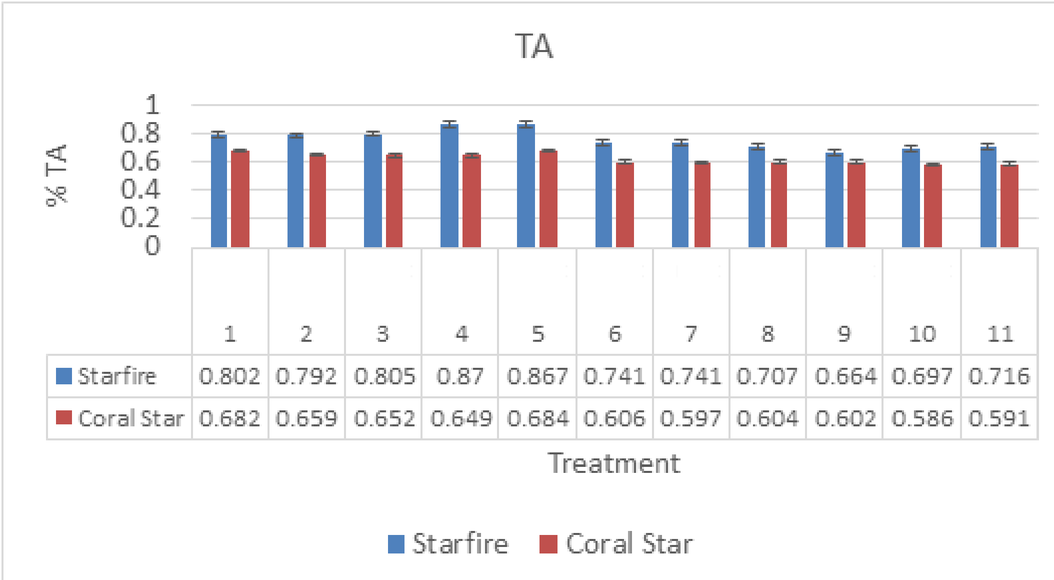
Starfire			**Coral Star**		
Weed Control	**TA (%)**		**Weed Control**	**TA (%)**	
Straw Mulch	0.71 ± 0.18	A	Herbicide	0.60 ± 0.10	A
Herbicide	0.66 ± 0.11	A	Straw Mulch	0.59 ± 0.10	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 27: Tukey-Kramer Grouping for Fertilizer Effect on TA Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Fertilizer	**TA (%)**		**Fertilizer**	**TA (%)**	
Compost	0.69 ± 0.18	A	Compost	0.60 ± 0.09	A
NPK	0.68 ± 0.11	A	NPK	0.60 ± 0.10	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other (P < 0.05).



	1	2	3	4	5	6	7	8	9	10	11
Starfire	0.802	0.792	0.805	0.87	0.867	0.741	0.741	0.707	0.664	0.697	0.716
Coral Star	0.682	0.659	0.652	0.649	0.684	0.606	0.597	0.604	0.602	0.586	0.591

Figure 5: %TA Mean Values for Peaches Subjected to 11 Different Treatments

%TA of 0.7%-0.9% are well accepted by consumers, and this is the range of TA found in mature peaches (La Rue, 1989). Hence, all the Starfire peaches cultivated under all the treatment conditions have an acceptable amount of %TA (Figure 5). It has been shown previously that consumer acceptability of several varieties of peaches increased with a decrease in %TA (Crisosto and Crisosto, 2005; Delgado, Crisosto, Heymann and Crisosto, 2013). Since peaches harvested on different harvest dates are at same stage of maturity, significant difference in %TA amongst peaches harvested on 4 different harvest dates was not expected, as %TA is not affected by sunlight exposure or availability of carbohydrate to the fruit, and it is only affected by the change in the stage of maturity (Tosun, Ustun & Tekguler, 2008). Hence, the difference seen in the case of organic Coral Star peaches, harvested along four different dates, is against the hypothesis. Organic peaches in this study have shown higher values for %TA, and conventional peaches have shown lower values for %TA, however, this cannot be analyzed statistically. In a previous study, organic produce had been shown to have higher %TA than conventional peaches (Dangour, Dodhia, Hayter, Allen, Lock, & Uauy, 2009). Figure 5 summarizes %TA values for peaches of both the varieties cultivated using 11 different treatments. Coral Star peaches have consistently low %TA values (Figure 5).

SSC/TA Ratio:

Organic: Starfire peaches cultivated under six different organic treatments were not significantly different from each other in SSC/TA ratio (P > 0.05) (Table 28).

Table 28: Tukey-Kramer Grouping for Treatment Effect on SSC/TA Ratio Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**SSC/TA**		**Treatment**	**SSC/TA**	
6	14.50 ± 2.34	A	6	16.38 ± 1.88	A
2	13.83 ± 1.48	A	2	15.21 ± 3.53	A
3	13.49 ± 1.58	A	4	14.26 ± 1.95	A
1	13.38 ± 2.56	A	3	14.1 ± 1.98	A
5	12.9 ± 1.35	A	1	14.01 ± 2.06	A
4	12.68 ± 1.55	A	5	13.99 ± 2.06	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Starfire organic peaches harvested on four different harvest dates did not differ significantly in SSC/TA values. Coral Star peaches harvested on date 2 had significantly higher SSC/TA ratio than the ones harvested on date 1, 3 and 4. This might indicate that peaches harvested as according to harvest date 2 could be more liked during sensory evaluations (Colaric et al., 2005) (Table 29).

Table 29: Tukey-Kramer Grouping for Harvest Date Effect on SSC/TA Ratio Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**SSC/TA**		**Harvest Date**	**SSC/TA**	
1	14.03 ± 1.80	A	2	16.18 ± 2.99	A
3	13.93 ± 1.49	A	3	14.94 ± 1.97	B
2	13.07 ± 1.45	A	4	13.98 ± 2.24	B
4	12.83 ± 2.59	A	1	13.54 ± 1.53	B

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

2 different types of mulches used, 2 different types of alleyways used, did not affect SSC/TA ratio of peaches of both the varieties grown under each of the above mentioned conditions as the difference in SSC/TA ratio amongst peaches grown under each of the above conditions was not statistically significant (P > 0.05) (Table 30, 31).

Table 30: Tukey-Kramer Grouping for Mulch Effect on SSC/TA Ratio Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Mulch	**SSC/TA**		**Mulch**	**SSC/TA**	
Straw	13.58 ± 2.15	A	Straw	14.61 ± 3.09	A
Allysum	13.09 ± 1.64	A	Allysum	14.18 ± 2.01	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 31: Tukey-Kramer Grouping for Alleyway Effect on SSC/TA Ratio Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Alley	**SSC/TA**		**Alley**	**SSC/TA**	
Grass	13.44 ± 1.92	A	Legume	14.74 ± 2.90	A
Legume	13.23 ± 1.55	A	Grass	14.06 ± 1.98	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Conventional: Peaches of both the varieties cultivated under 5 different conventional treatments were not significantly different from each other in SSC/TA ratio (P > 0.05) (Table 32). 4 Harvest dates, 2 different types of weed control used, 2 different types of fertilizers used, did not affect SSC/TA ratio of peaches grown under each of the above mentioned conditions as the difference in SSC/TA ratio amongst peaches grown under each of the above conditions was not statistically significant (P > 0.05) (Table 33, 34 & 35).

Table 32: Tukey-Kramer Grouping for Treatment Effect on SSC/TA Ratio Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**SSC/TA**		**Treatment**	**SSC/TA**	
7	15.16 ± 1.51	A	10	17.16 ± 2.83	A
8	14.88 ± 2.03	A	7	16.80 ± 1.76	A
9	14.84 ± 1.64	A	8	16.50 ± 2.63	A
10	14.76 ± 2.27	A	11	15.83 ± 2.55	A
11	14.68 ± 3.01	A	9	15.39 ± 2.20	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 33: Tukey-Kramer Grouping for Harvest Date Effect on SSC/TA Ratio estimate for conventional peaches (Alpha=0.05) (Estimate is represented as Mean ± standard deviation and is arranged in descending order).

Starfire			**Coral Star**		
Harvest Date	**SSC/TA**		**Harvest Date**	**SSC/TA**	
4	15.55 ± 3.72	A	2	16.77 ± 1.84	A
3	14.91 ±1.4	A	3	16.67 ± 3.12	A
1	14.83 ± 2.1	A	1	16.45 ± 2.59	A
2	14.17 ± 1.24	A	4	15.45 ± 2.02	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 34: Tukey-Kramer Grouping for Weed Control Effect on SSC/TA Ratio Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Weed Control	**SSC/TA**		**Weed Control**	**SSC/TA**	
Herbicide	15.00 ± 1.73	A	Straw Mulch	16.50 ± 2.68	A
Straw Mulch	14.72 ± 2.66	A	Herbicide	16.10 ± 2.25	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 35: Tukey-Kramer Grouping for Fertilizer Effect on SSC/TA Ratio Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Fertilizer	**SSC/TA**		**Fertilizer**	**SSC/TA**	
NPK	14.96 ± 1.96	A	NPK	16.98 ± 2.49	A
Compost	14.76 ± 3.65	A	Compost	15.61 ± 2.47	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

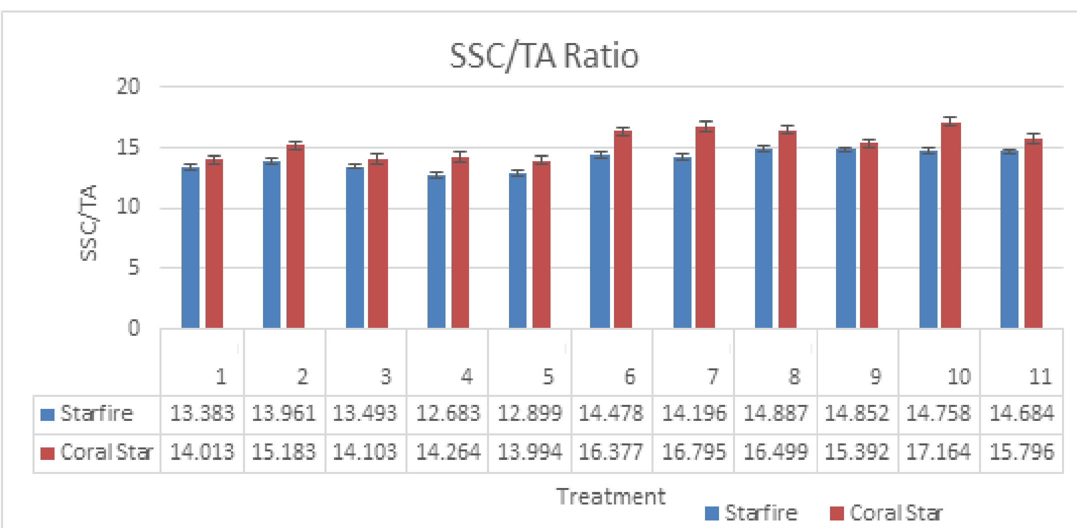


Figure 6: SSC/TA Ratio Mean Values for Peaches Subjected to 11 Different Treatments

Figure 6 summarizes the results for SSC/TA values for peaches cultivated using 11 different treatments. It is worth noting that peaches subjected to experimental treatments did not differ in SSC/TA values from the standard treatments and this means that they might have similar sensory quality as compared to the ones cultivated using standard treatments (Colaric et al., 2005). Peaches harvested on 4 different harvest dates did not differ in SSC/TA values this could be because of the fact that SSC and TA values did not differ among peaches harvested on 4 different dates, apart from few exceptions. Coral Star peaches seem to have higher SSC/TA values, however, there are no previous reports comparing the two varieties for SSC/TA values.

pH:

Organic: Organic peaches of both the varieties grown under six different organic treatment did not show any significant difference between each other in pH of the fruit juice ($P > 0.05$) (Table 36).

Significant difference was observed in juice pH in Starfire organic peaches harvested on 4 different dates, more precisely, ones harvested on date 3 had significantly higher juice pH compared to the ones harvested on dates 2, 1 and 4. Moreover, juice pH of fruits harvested on dates 1, 2 and 4 were not significantly different from each other (Table 37). Coral Star organic peaches, harvested on four different harvest dates, did not differ from each other in fruit juice pH (Table 37).

Table 36: Tukey-Kramer Grouping for Treatment Effect on the pH Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Treatment	**pH**		**Treatment**	**pH**	
2	3.81 ± 0.08	A	2	3.86 ± 0.08	A
3	3.80 ± 0.10	A	6	3.85 ± 0.07	A
6	3.79 ± 0.09	A	4	3.82 ± 0.10	A
4	3.78 ± 0.08	A	3	3.82 ± 0.09	A
1	3.76 ± 0.08	A	1	3.81 ± 0.07	A
5	3.74 ± 0.07	A	5	3.77 ± 0.07	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 37: Tukey-Kramer Grouping for Harvest Date Effect on the pH Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Harvest Date	**pH**		**Harvest Date**	**pH**	
3	3.83 ± 0.06	A	3	3.86 ± 0.08	A
2	3.8 ± 0.06	B	4	3.83 ± 0.07	A
4	3.76 ± 0.07	B	1	3.80 ± 0.09	A
1	3.73 ± 0.11	B	2	3.78 ± 0.07	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

2 different types of mulches used and 2 different types of alleyway used did not impact the pH of the fruit juice as peaches produced under each of the above mentioned cultivation conditions did not significantly differ in their fruit juice pH (P > 0.05) (Table

38 and 39). The pH has shown to affect overall likability of the fruit product (Coalric et al., 2005).

Table 38: Tukey-Kramer Grouping for Mulch Effect on the pH Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Mulch	**pH**		**Mulch**	**pH**	
Allysum	3.79 ± 0.09	A	Straw	3.83 ± 0.07	A
Straw	3.78 ± 0.08	A	Allysum	3.82 ± 0.10	A

* Estimate with the same letter on the right column are not significantly different (P > 0.05) & with different letters are significantly different from each other *(P < 0.05)*.

Table 39: Tukey-Kramer Grouping for Alleyway Effect on the pH Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Alley	**pH**		**Alley**	**pH**	
Legume	3.80 ± 0.08	A	Legume	3.84 ± 0.09	A
Grass	3.78 ± 0.09	A	Grass	3.81 ± 0.08	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Conventional: Similar to organic peaches, there was no significant difference in pH of the juices of peaches of both the varieties cultivated under 5 different conventional treatments or amongst peaches harvested at 4 different harvest dates or amongst the peaches grown either using synthetic herbicide or Straw Mulch weed control or grown using either of NPK fertilizer or compost fertilizer (P > 0.05) (Table 40-43).

Table 40: Tukey-Kramer Grouping for Treatment Effect on pH Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Treatment	**pH**		**Treatment**	**pH**	
9	3.81 ± 0.13	A	10	3.87 ± 0.09	A
10	3.80 ± 0.10	A	11	3.86 ± 0.08	A
7	3.79 ± 0.13	A	9	3.82 ± 0.08	A
11	3.76 ± 0.12	A	7	3.81 ± 0.09	A
8	3.70 ± 0.13	A	8	3.8 ± 0.05	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 41: Tukey-Kramer Grouping for Harvest Date Effect on pH Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Harvest Date	**pH**		**Harvest Date**	**pH**	
3	3.83 ± 0.08	A	3	3.86 ± 0.07	A
4	3.76 ± 0.09	A	4	3.84 ± 0.09	A
1	3.76 ± 0.10	A	2	3.83 ± 0.07	A
2	3.74 ± 0.18	A	1	3.80 ± 0.09	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 42: Tukey-Kramer Grouping for Weed Control Effect on pH Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

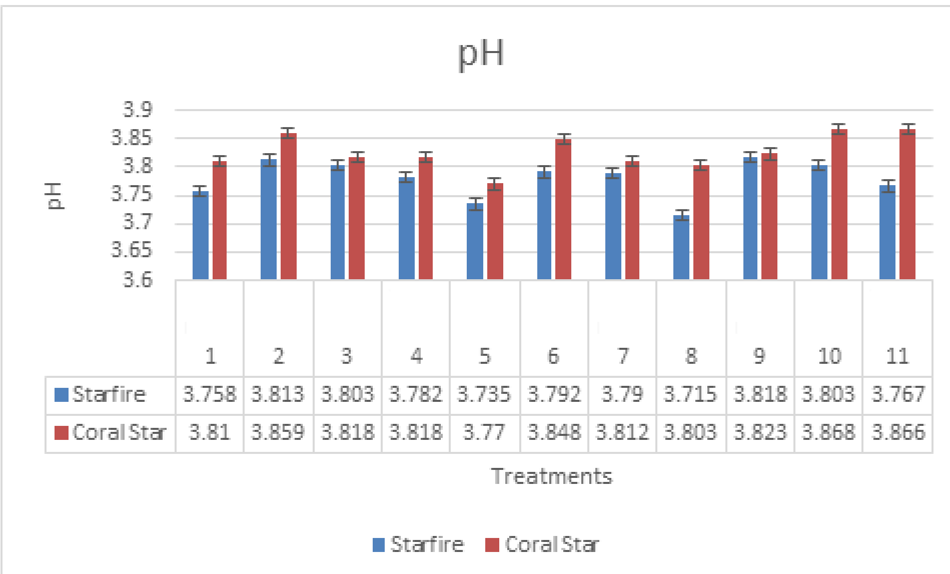
Weed Control	**pH**		**Weed control**	**pH**	
Herbicide	3.80 ± 0.13	A	Straw Mulch	3.87 ± 0.09	A
Straw Mulch	3.78 ± 0.11	A	Herbicide	3.82 ± 0.08	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 43: Tukey-Kramer Grouping for Fertilizer Effect on pH Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Fertilizer	**pH**		**Fertilizer**	**pH**	
NPK	3.80 ± 0.13	A	Compost	3.84 ± 0.08	A
Compost	3.79 ± 0.12	A	NPK	3.84 ± 0.084	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.



	1	2	3	4	5	6	7	8	9	10	11
Starfire	3.758	3.813	3.803	3.782	3.735	3.792	3.79	3.715	3.818	3.803	3.767
Coral Star	3.81	3.859	3.818	3.818	3.77	3.848	3.812	3.803	3.823	3.868	3.866

Figure 7: pH Mean Values for Peaches Subjected to 11 Different Treatments

The pH is usually used as an indicator for microbial stability and shelf of the product. The pH increases with maturity and should not be different amongst peaches held at same maturity but differently exposed to carbohydrate content and sunlight (Tosun et al., 2008), and, results of this study are consistent with this finding except for organic Starfire peaches. The pH was not at all affected by different treatments used, and Figure 7 summarizes this finding. Peaches with pH > 3.7 are known to be more acceptable to consumers are known to be of good quality (La Rue, 1989). Peaches from all the treatments have pH > 3.7.

Weight:

Organic: organic peaches of both varieties were not significantly affected by 6 different organic treatments, 2 different mulches and 2 different types of alleyways used, as peaches subjected to each of the above condition did not significantly differ in weight from each other (P > 0.05) (Table 44, 45 and 46).

Table 44: Tukey-Kramer Grouping for Treatment Effect on Weight Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**Weight (gm)**		**Treatment**	**Weight (gm)**	
4	200.39 ± 22.45	A	1	251.82 ± 36.45	A
2	200.02 ± 20.22	A	2	245.12 ± 36.30	A
5	199.16 ± 19.66	A	5	245.00 ± 39.94	A
1	198.02 ± 23.29	A	3	243.79 ± 29.86	A
6	192.67 ± 21.6	A	4	236.22 ± 34.99	A
3	190.31 ± 27.84	A	6	230.79 ± 41.23	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 45: Tukey-Kramer Grouping for Mulch Effect on Weight Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Mulch	Weight (gm)		Mulch	Weight (gm)	
Straw	198.97 ± 21.70	A	Straw	248.47 ± 36.73	A
Allysum	195.35 ± 25.50	A	Allysum	240.01 ± 32.63	A

* Estimate with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 46: Tukey-Kramer Grouping for Alleyway Effect on Weight Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Alley	**Weight (gm)**		**Alley**	**Weight (gm)**	
Legume	200.15 ± 21.15	A	Grass	247.80 ± 37.20	A
Grass	194.16 ± 23.41	A	Legume	240.67 ± 36.15	A

* Estimate with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Starfire peaches harvested on four different harvest dates significantly differed from each other in weight (P < 0.05). Peaches harvested on date 1 were significantly heavier compared to the ones harvested on date 2, 3 and 4. Peaches harvested on date two significantly weighed less than the ones harvested on date 1 and significantly weighed more than the ones harvested on dates 3 and 4. Peaches harvested on date 3 and 4 did not significantly differ in weight from each other (Table 47). Coral Star organic peaches harvested on 4 different harvest dates did not significantly differ from each other (P > 0.05). However, they followed the similar trend with peaches harvested early, that is on dates 1 and 2, weighed more and peaches harvested late, that is on dates 3 and 4, weighed less (Table 47).

Table 47: Tukey-Kramer Grouping for Harvest Date Effect on Weight Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Weight (gm)**		**Harvest Date**	**Weight (gm)**	
1	214.97 ± 21.25	A	2	251.15 ± 38.86	A
2	202.21 ± 22.39	B	1	245.70 ± 30.19	A
4	186.58 ± 17.21	C	3	243.60 ± 34.71	A
3	183.30 ± 17.04	C	4	228.05 ± 39.85	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Conventional: Weight of conventional peaches of both varieties were not significantly affected by 5 different conventional treatments, 2 different types of weed control used and 2 different types of fertilizers used, as peaches subjected to each of the above condition did not significantly differ in weight from each other ($P > 0.05$) (Table 48, 49 and 50).

Table 48: Tukey-Kramer Grouping for Treatment Effect on Weight Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Treatment	**Weight (gm)**		**Treatment**	**Weight (gm)**	
11	183.65 ± 17.42	A	8	245.95 ± 47.19	A
9	174.47 ± 16.13	A	9	239.08 ± 36.34	A
7	174.38 ± 32.07	A	11	232.29 ± 31.04	A
10	172.71 ± 17.68	A	7	225.76 ± 52.04	A
8	158.92 ± 18.83	A	10	221.25 ± 27.08	A

* Estimate with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 49: Tukey-Kramer Grouping for Weed Control Effect on Weight Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Weed Control	**Weight (gm)**		**Weed Control**	**Weight (gm)**	
Straw Mulch	178.66 ± 17.46	A	Herbicide	232.42 ± 45.62	A
Herbicide	174.39 ± 25.1	A	Straw Mulch	226.77 ± 29.03	A

* Estimate with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 50: Tukey-Kramer Grouping for Fertilizer Effect on Weight Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Fertilizer	**Weight (gm)**		**Fertilizer**	**Weight (gm)**	
Compost	179.50 ± 16.74	A	Compost	235.68 ± 34.24	A
NPK	173.54 ± 25.08	A	NPK	223.51 ± 44.28	A

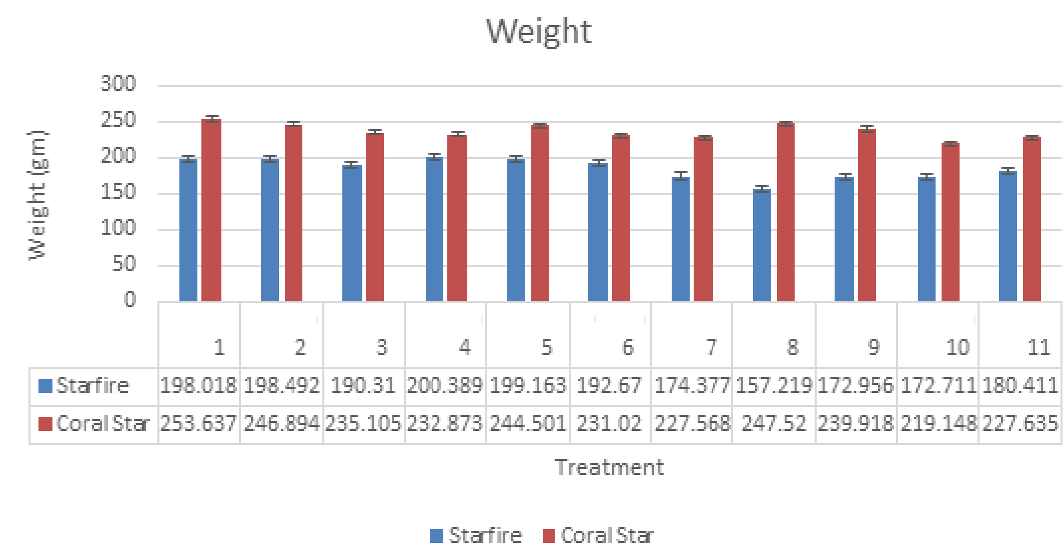
* Estimate with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Peaches harvested on four different harvest dates significantly differed from each other in weight ($P < 0.05$). Peaches harvested on date 1 and 2 were significantly heavier compared to the ones harvested on date 3 and 4. Peaches harvested on date 1 and 2 did not significantly differ in weight from each other, neither did the ones harvest date 3 and 4 differ significantly from each other in weight. (Table 51). Peaches harvested on date 1 and 2 were significantly heavier compared to the ones harvested on date 3 and 4. Peaches harvested on date 1 and 2 did not significantly differ in weight from each other, neither did the ones harvest date 3 and 4 differ significantly from each other in weight (Table 51).

Table 51: Tukey-Kramer Grouping for Harvest Date Effect on Weight Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Weight (gm)**		**Harvest Date**	**Weight (gm)**	
1	182.16 ± 22.67	A	1	254.03 ± 34.28	A
2	177.92 ± 18.39	A	2	249.33 ± 34.39	A
3	174.93 ± 13.19	B	4	217.76 ± 38.00	B
4	157.07 ± 24.44	B	3	210.33 ± 36.96	B

* Estimate with the same letter in right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.



	1	2	3	4	5	6	7	8	9	10	11
Starfire	198.018	198.492	190.31	200.389	199.163	192.67	174.377	157.219	172.956	172.711	180.411
Coral Star	253.637	246.894	235.105	232.873	244.501	231.02	227.568	247.52	239.918	219.148	227.635

Figure 8: Weight Mean Values for Peaches Subjected to 11 Different Treatments

It is clear from the results (Figure 8) that Coral Star peaches are heavier than Starfire peaches, which is consistent with previous study and also with the fact that Coral Star peaches have bigger size (Fallahi et al., 2009). Except Coral Star organic peaches, all the other peaches were significantly heavier when harvested on dates 1 or 2 and weighed significantly less when harvested on dates 3 or 4. This is again consistent with previous studies, and this phenomenon again can be attributed to location of the fruit on the tree, relative amount of carbohydrate available, exposure to sunlight and crop load, as described previously (Lopresti et al., 2014)**.** Organic peaches have higher weight, and conventional peaches seem to have a lower weight. This could be because of the fact that organic peaches tend to have higher dry mass as per previous studies (Worthington, 1998; Citak et al., 2010; Vinha et al., 2014; Fernandes et al., 2012). Figure 8 summarizes the results of weight for peaches subjected to 11 different treatments. Moreover, peaches grown using legume alleyway did not weigh more than peaches grown using grass alleyway, which is against expectations since legume alleyway supplies more nitrogen and can make produce weigh more (Rowley, 2011; Skroch and Shribbs, 1986).

Firmness:

Organic: The firmness values for organic peaches of both the peaches did not get affected by 6 different organic treatments, 4 harvest dates, 2 different mulches and 2 different types of alleyways used, as peaches subjected to each of the above condition did not significantly differ in firmness from each other (P > 0.05) (Table 52 - 55). Starfire peaches appear to be firmer and Coral Star peaches appear to be less firm, however, this has not been reported previously. Peaches harvested on early dates, that is date 1 or 2 appear to be firmer and peaches harvested later, that is on dates 3 or 4 appear to be less firm.

Table 52: Tukey-Kramer Grouping for Treatment Effect on Fruit Firmness Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**Firmness (N)**		**Treatment**	**Firmness (N)**	
6	35.12 ± 10.45	A	1	25.3 ± 9.65	A
3	32.57 ± 11.86	A	2	25.16 ± 11.70	A
4	31.61 ± 11.37	A	6	24.15 ± 11.41	A
5	31.22 ± 9.06	A	3	23.91 ± 11.41	A
1	29.76 ± 12.38	A	4	23.54 ± 10.88	A
2	28.39 ± 9.45	A	5	22.94 ± 9.89	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 53: Tukey-Kramer Grouping for Harvest Date Effect on Fruit Firmness Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Firmness (N)**		**Harvest Date**	**Firmness (N)**	
2	35.12 ± 7.54	A	1	27.19 ± 10.23	A
3	33.10 ± 12.84	A	2	25.22 ± 10.51	A
1	29.94 ± 10.09	A	4	23.48 ± 10.85	A
4	27.62 ± 10.18	A	3	20.77 ± 10.28	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 54: Tukey-Kramer Grouping for Mulch Effect on Fruit Firmness Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Mulch	**Firmness (N)**		**Mulch**	**Firmness (N)**	
Allysum	32.09 ± 11.66	A	Straw	25.23 ± 10.55	A
Straw	29.07 ± 10.82	A	Allysum	23.73 ± 11.02	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 55: Tukey-Kramer Grouping for Alleyway Effect on Fruit Firmness Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Alley	**Firmness (N)**		**Alley**	**Firmness (N)**	
Grass	31.17 ± 11.18	A	Grass	24.61 ± 10.40	A
Legume	29.998 ± 10.81	A	Legume	24.35 ± 11.14	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Conventional: The firmness values for conventional peaches of both the varieties did not get affected by 5 different conventional treatments, 4 harvest dates, 2 different types of weed control used and 2 different types of fertilizer used, as peaches subjected to each of the above condition did not significantly differ in firmness from each other (P > 0.05) (table 56-59). Peaches cultivated using treatment 7 were most firm. However, the difference was statistically not significant.

Table 56: Tukey-Kramer Grouping for Treatment Effect on Fruit Firmness Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**Firmness (N)**		**Treatment**	**Firmness (N)**	
7	30.80 ± 14.02	A	7	25.52 ± 12.78	A
8	28.70 ± 13.63	A	10	19.92 ± 02.76	A
9	28.7 ± 11.56	A	11	17.84 ± 12.73	A
10	28.48 ± 13.23	A	8	17.76 ± 11.74	A
11	27.26 ±11.58	A	9	17.66 ± 10.09	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 57: Tukey-Kramer Grouping for Harvest Date Effect on Fruit Firmness Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Firmness (N)**		**Harvest Date**	**Firmness (N)**	
1	30.72 ± 11.43	A	3	23.60 ±12.08	A
3	30.36 ± 11.66	A	1	19.83 ±11.99	A
4	27.40 ± 13.45	A	2	18.58 ±10.77	A
2	26.67 ± 13.57	A	4	16.95 ±11.57	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 58: Tukey-Kramer Grouping for Weed Control Effect on Fruit Firmness Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Weed Control	**Firmness (N)**		**Weed Control**	**Firmness (N)**	
Herbicide	29.75 ± 12.89	A	Herbicide	21.59 ± 11.33	A
Straw Mulch	27.87 ± 12.25	A	Straw Mulch	18.88 ± 11.88	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 59: Tukey-Kramer Grouping for Fertilizer Effect on Fruit Firmness Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Fertilizer	**Firmness (N)**		**Fertilizer**	**Firmness (N)**	
NPK	29.64 ± 13.90	A	NPK	22.72 ± 11.48	A
Compost	27.98 ± 12.02	A	Compost	17.75 ± 12.02	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

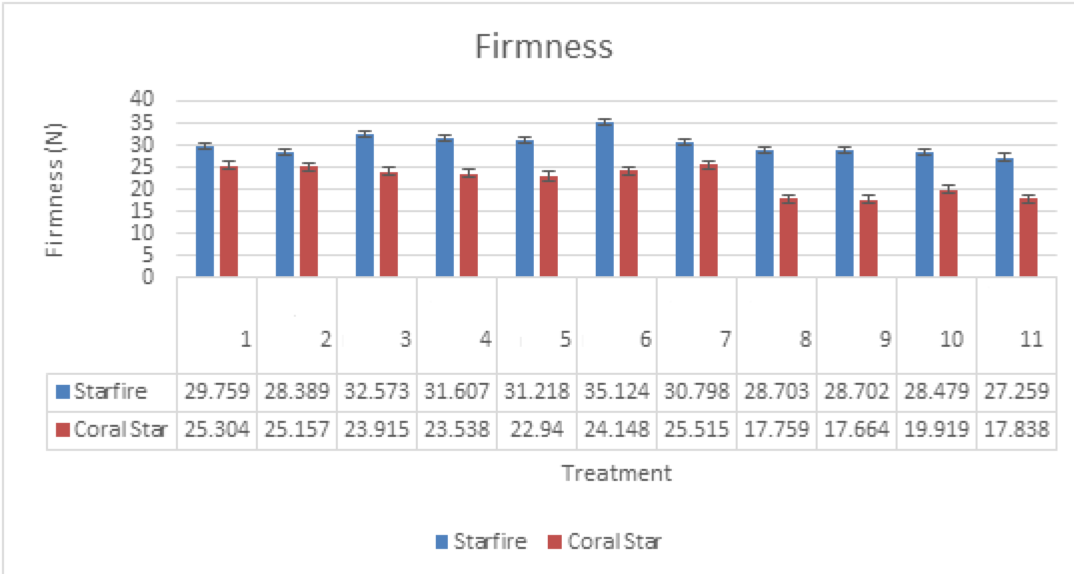


Figure 9: Fruit Firmness Mean Values for Peaches Subjected to 11 Different Treatments

Firmness is used as a marker for determining fruit maturity (Infante, Aros, Cantador, and Rubio, 2012). Starfire and Coral Star peaches belong to the stellar family of peaches, and they tend to be firm in nature (Fallahi et al., 2009; Frecon and Ward, 2013). By observing the results for organic and conventional peaches closely (Figure 9), it seems that organic peaches are firmer and conventional peaches are less. This could be because of the fact that organic products tend to accumulate higher dry mass (Worthington, 1998; Citak et al., 2010; Vinha et al., 2014; Fernandes et al., 2012). Since this pattern is seen in both variety of peaches it could be because of the treatment effects, but, it cannot be compared statistically. Previous studies have shown mixed results with some of them showing organic products to be firmer and some other studies showing conventional produce to be more firm (Bourn and Prescott, 2002), since firmness values are affected by many factors pertaining to cultivation. Firmness values of 17 N, for peaches, have been shown to be significantly more accepted by the consumers (Delgado et al., 2013). Coral Star conventional peaches have firmness values close to 17 N.

Pit Size:

Pit size was measured using two parameters pit length and pit width.

Starfire Organic: 6 different organic treatments, or cultivating under two different types of mulches, or cultivating using two different types of alleyways did not significantly affect the pit size of organic peaches. The organic peaches cultivated under each of the above mentioned conditions did not significantly differ in their pit size (both pit length and pit width were similar) ($P > 0.05$). However, peaches cultivated on harvest date 4 had significantly smaller pit size compared to the ones cultivated on harvest date 1, 2 and 3 ($P < 0.05$).

Table 60: Tukey-Kramer Grouping for Treatment Effect on Pit Length and Pit Width Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	**Pit Length (mm)**		**Pit Width (mm)**	
1	34.96 ± 1.87	A	25.96 ± 2.39	A
2	35.07 ± 2.87	A	26.14 ± 1.4	A
3	34.17 ± 3.38	A	25.90 ± 1.63	A
4	35.74 ± 1.70	A	26.65 ± 1.3	A
5	34.59 ± 2.13	A	26.04 ± 1.77	A
6	35.08 ± 2.25	A	26.65 ± 1.71	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 61: Tukey-Kramer Grouping for Harvest Date Effect on Pit Length and Pit Width Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	Pit Length (mm)		Pit Width (mm)	
1	35.69 ± 2.33	A	26.99 ± 1.66	A
2	35.06 ± 1.80	A	26.92 ± 1.87	A
3	35.38 ± 2.88	A	25.80 ± 1.50	B
4	33.61 ± 2.32	B	25.18 ± 1.37	B

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 62: Tukey-Kramer Grouping for Mulch Effect on Pit Length and Pit Width Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Mulch	Pit Length (mm)		Pit Width (mm)	
Straw	35.00 ± 2.45	A	26.04 ± 1.99	A
Allysum	34.96 ± 2.75	A	26.27 ± 1.53	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 63: Tukey-Kramer Grouping for Alleyway Effect on Pit Length and Pit Width Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Alley	Pit Length (mm)		Pit Width (mm)	
Legume	35.39 ± 2.38	A	26.38 ± 1.41	A
Grass	34.57 ± 2.52	A	25.93 ± 1.91	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Starfire Conventional: Peaches subjected to 5 different types of conventional treatments and the ones cultivated under 2 different herbicides as well as the ones cultivated using 2 different types of fertilizers, did not significantly differ in pit size from each other

(P > 0.05). Peaches harvested on harvest date 1 had significantly bigger pit size compared to the ones cultivated on harvest date 2, 3 and 4 (P < 0.05). Peaches harvested on date 2 and 3 had smaller pits compared to the ones harvested on date 1, but significantly (P < 0.05) bigger pits when compared to the ones harvested on date 4.

Table 64: Tukey-Kramer Grouping for Treatment Effect on Pit Length and Pit Width Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	**Pit Length (mm)**		**Pit Width (mm)**	
7	34.18 ± 1.96	A	25.18 ± 1.19	A
8	32.61 ± 2.8	A	24.49 ± 2.99	A
9	33.51 ± 2.24	A	24.64 ± 1.5	A
10	33.77 ± 1.63	A	25.52 ± 1.31	A
11	34.24 ± 2.21	A	25.32 ± 1.36	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05).*

Table 65: Tukey-Kramer Grouping for Harvest Date Effect on Pit Length and Pit Width Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**Pit Length (mm)**		**Pit Width (mm)**	
1	34.99 ± 1.91	A	25.99 ± 1.13	A
2	34.39 ± 1.83	A	25.29 ± 1.23	B
3	33.03 ± 2.30	B	24.72 ± 2.32	B
4	32.24 ± 1.88	B	24.13 ± 1.47	C

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05).*

Table 66: Tukey-Kramer Grouping for Weed Control Effect on Pit Length and Pit Width Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Weed Control	**Pit Length (mm)**		**Pit Width (mm)**	
Straw Mulch	34.06 ± 1.94	A	25.42 ± 1.34	A
Herbicide	33.85 ± 2.35	A	24.92 ± 2.05	A

* Estimates with the same letter in right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 67: Tukey-Kramer Grouping for Fertilizer Effect on Pit Length and Pit Width Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Fertilizer	**Pit Length (mm)**		**Pit Width (mm)**	
NPK	33.98 ± 2.16	A	25.35 ± 1.96	A
Compost	33.94 ± 2.22	A	24.99 ± 1.43	A

* Estimates with the same letter in right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Coral Star Organic: 6 different organic treatments, or cultivating under two different types of mulches, or cultivating using two different types of alleyways did not significantly affect the pit size of organic Coral Star peaches. The organic peaches cultivated under each of the above mentioned conditions did not significantly differ in their pit size (both pit length and pit width were similar) ($P > 0.05$) (table 68-70).

Table 68: Tukey-Kramer Grouping for Treatment Effect on Pit Length and Pit Width Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	Pit Length (mm)		Pit Width (mm)	
1	36.12 ± 2.41	A	27.41 ± 1.34	A
2	35.68 ± 2.06	A	27.1 ± 1.53	A
3	36.29 ± .07	A	27.03 ± 1.49	A
4	35.71 ± 2.15	A	26.97 ± 1.52	A
5	36.75 ± 2.32	A	27.05 ± 1.50	A
6	35.60 ± 1.80	A	26.9 ± 1.995	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05).*

Table 69: Tukey-Kramer Grouping for Mulch Effect on Pit Length and Pit Width Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Mulch	Pit Length (mm)		Pit Width (mm)	
Allysum	36.00 ± 2.1	A	27.00 ± 1.50	A
Straw	35.90 ± 2.26	A	27.26 ± 1.43	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05).*

Table 70: Tukey-Kramer Grouping for Alleyway Effect on Pit Length and Pit Width Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Alley	Pit Length (mm)		Pit Width (mm)	
Grass	36.20 ± 2.18	A	27.2200 ± 1.59	A
Legume	35.69 ± 2.10	A	27.0388 ± 1.52	A

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05).*

However, peaches cultivated on harvest date 1 had significantly bigger pit size compared to the ones cultivated on harvest date 2, 3 and 4 (P < 0.05). Ones harvested on date 2 and 3 had significantly smaller pits compared to ones harvested on date 1, but significantly (P < 0.05) bigger pits when compared to the ones harvested on date 4 (table 71).

Table 71: Tukey-Kramer Grouping for Harvest Date Effect on Pit Length and Pit Width Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**Pit Length (mm)**		**Pit Width (mm)**	
1	36.69 ± 2.06	A	27.65 ± 1.32	A
2	36.03 ± 2.05	AB	26.94 ± 1.36	AB
3	36.54 ± 2.02	AB	27.19 ± 1.82	AB
4	34.83 ± 2.08	B	26.53 ± 1.82	B

* Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05).*

Coral Star conventional: Peaches subjected to 5 different types of conventional treatments and the ones cultivated under 2 different herbicides as well as the ones cultivated using 2 different types of fertilizers, did not significantly differ in pit size from each other (P > 0.05). Peaches harvested on date 1, 2 and 3 were significantly bigger in pit size compared to the ones harvested on harvest date 4 (table 72-75).

Table 72: Tukey-Kramer Grouping for Treatment Effect on Pit Length and Pit Width Estimate of Conventional Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	**Pit Length (mm)**		**Pit Width (mm)**	
7	35.04 ± 2.62	A	26.97 ± 1.86	A
8	36.08 ± 2.32	A	27.89 ± 1.78	A
9	35.69 ± 3.16	A	27.19 ± 1.54	A
10	34.77 ± 2.24	A	27.03 ± 1.84	A
11	35.52 ± 2.80	A	26.75 ± 1.57	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 73: Tukey-Kramer Grouping for Harvest Date Effect on Pit Length and Pit Width Estimate of Conventional Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**Pit Length (mm)**		**Pit Width (mm)**	
1	36.41 ± 2.16	A	28.02 ± 1.32	A
2	35.87 ± 2.12	A	27.53 ± 1.36	A
3	35.70 ± 2.85	A	27.08 ± 1.82	A
4	33.70 ± 2.69	B	26.03 ± 1.82	B

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 74: Tukey-Kramer Grouping for Weed Control Effect on Pit Length and Pit Width Estimate of Conventional Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Weed Control	**Pit Length (mm)**		**Pit Width (mm)**	
Herbicide	35.37 ± 2.71	A	27.08 ± 1.78	A
Straw Mulch	35.15 ± 2.52	A	26.89 ± 1.70	A

* Estimate with the same letter on the right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.

Table 75: Tukey-Kramer Grouping for Fertilizer Effect on Pit Length and Pit Width estimate of conventional Coral Star peaches (Alpha=0.05) (Estimate is represented as Mean ± standard deviation and is arranged in descending order).

Fertilizer	Pit Length (mm)		Pit Width (mm)	
Compost	35.61 ± 2.98	A	26.97 ± 1.55	A
NPK	34.9 ± 2.44	A	26.997 ± 1.87	A

* Estimate with the same letter on right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

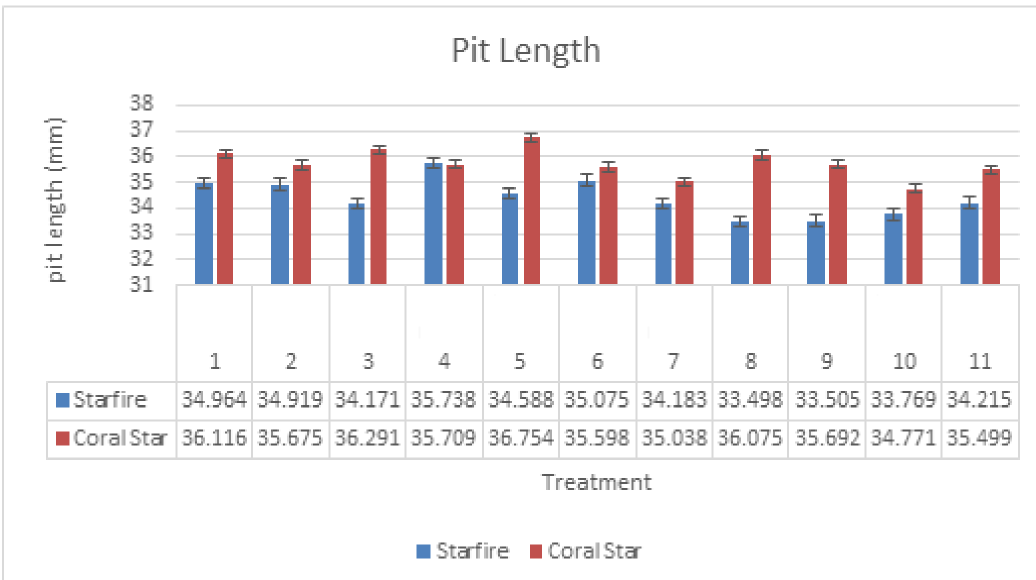
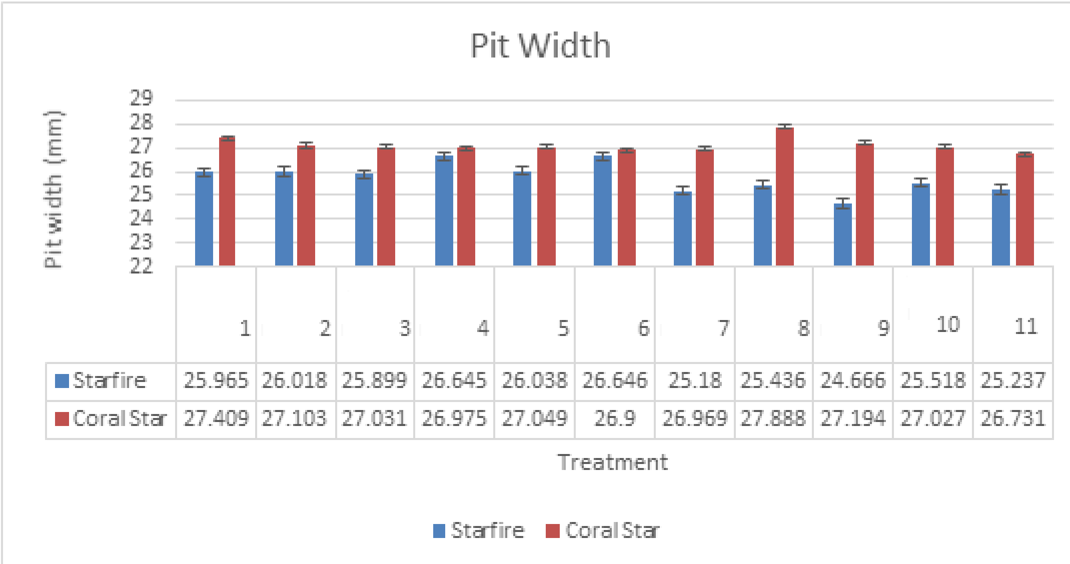


Figure 10: Pit Length Mean Values for Peaches Subjected to 11 Different Treatments



	1	2	3	4	5	6	7	8	9	10	11
Starfire	25.965	26.018	25.899	26.645	26.038	26.646	25.18	25.436	24.666	25.518	25.237
Coral Star	27.409	27.103	27.031	26.975	27.049	26.9	26.969	27.888	27.194	27.027	26.731

Figure 11: Pit Width Mean Values for Peaches Subjected to 11 Different Treatments

Figure 10 and 11 summarizes the results for treatment effect on pit size of both varieties of peaches. Effect of cultivation method on pit size is not very well understood. Pit size is usually related to the diameter of the fruit. This explains the reason behind peaches harvested on date 1 having significantly bigger pit size compared to peaches harvested date 4. As seen earlier, in this study and also in the previous study, peaches harvested on date 1 or 2 are bigger in equatorial diameter and weight compared to peaches harvested on date 3 or 4. This might be the reason behind peaches harvested on date 1 having bigger pit size compared to peaches harvested on date 4.

Top Diameter:

Organic: Peaches cultivated under 6 different organic treatments did not significantly differ amongst each other in top diameter ($P > 0.05$) (Table 76), this indicates that experimental treatments produced peaches of almost similar size compared to the ones cultivated using standard treatments, which are treatment 5 and 6.

Table 76: Tukey-Kramer Grouping for Treatment Effect on Top Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**Top Diameter (mm)**		**Treatment**	**Top Diameter (mm)**	
5	64.09 ± 3.22	A	1	70.17 ± 5.18	A
1	63.53 ± 4.25	A	5	69.11± 4.47	A
2	63.37 ± 3.31	A	2	69.11 ± 3.97	A
6	63.07 ± 4.33	A	6	68.58 ± 4.36	A
4	63.03 ± 4.13	A	3	68.4 ± 3.15	A
3	62.15 ± 3.38	A	4	68.18 ± 3.60	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Organic Starfire peaches harvested on date 1 were significantly bigger in size compared to the ones harvested on date 2, 3 and 4 (Table 77). Organic Coral Star peaches harvested on 4 different harvest dates did not differ in top diameter from each other (table 77).

Table 77: Tukey-Kramer Grouping for Harvest Date Effect on Top Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Top Diameter (mm)**		**Harvest Date**	**Top Diameter (mm)**	
1	67.17 ± 3.24	A	2	69.7 ± 3.99	A
2	63.01 ± 3.48	B	3	69.35 ± 3.81	A
4	61.5 ± 2.89	B	1	69.03 ± 4.79	A
3	61.14 ± 2.96	B	4	67.61 ± 3.77	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Peaches of both varieties cultivated using legume alleyway were not significantly bigger in size when compared to the ones cultivated using grass alleyway (P > 0.05). The 2 types of mulches used did not affect top diameter as peaches produced using each of the mulch did not significantly differ in top diameter from the other group (P > 0.05) (Table 78 and 79).

Table 78: Tukey-Kramer Grouping for Mulch Effect on Top Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Mulch	**Top Diameter (mm)**		**Mulch**	**Top Diameter (mm)**	
Straw	63.49 ± 3.73	A	Straw	69.64 ± 4.61	A
Allysum	62.59 ± 3.66	A	Allysum	68.29 ± 3.39	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 79: Tukey-Kramer Grouping for Alleyway Effect on Top Diameter Estimate of Organic Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Alley	**Top Diameter (mm)**		**Alley**	**Top Diameter (mm)**	
Legume	63.24 ± 3.58	A	Grass	69.29 ± 4.37	A
Grass	62.84 ± 3.82	A	Legume	68.64 ± 3.78	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Conventional: 5 different conventional treatments, 2 different types of herbicides and 2 different types of fertilizers, did not significantly affect the top diameter as the peaches cultivated under each of these conditions did not significantly differ in top diameter when compared to one another (P > 0.05) (Table 80-82).

Table 80: Tukey-Kramer Grouping for Treatment Effect on Top Diameter Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Treatment	**Top Diameter (mm)**		**Treatment**	**Top Diameter (mm)**	
11	62.96 ± 3.20	A	9	68.98 ± 5.15	A
9	61.40 ± 2.82	A	8	68.79 ± 5.3	A
7	61.08 ± 4.84	A	11	67.63 ± 3.96	A
10	60.81 ± 2.10	A	7	66.61 ± 4.88	A
8	58.5 ± 3.17	A	10	66.18 ± 3.35	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 81: Tukey-Kramer Grouping for Weed Control Effect on Top Diameter Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Weed Control	**Top Diameter (mm)**		**Weed Control**	**Top Diameter (mm)**	
Straw Mulch	61.89 ± 2.72	A	Herbicide	67.79 ± 5.11	A
Herbicide	61.23 ± 3.999	A	Straw Mulch	66.91 ± 3.65	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 82: Tukey-Kramer Grouping for Fertilizer Effect on Top Diameter Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			Coral Star		
Fertilizer	**Top Diameter (mm)**		**Fertilizer**	**Top Diameter (mm)**	
Compost	62.17 ± 3.03	A	Compost	68.3 ± 4.72	A
NPK	60.94 ± 3.76	A	NPK	66.40 ± 4.67	A

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Starfire conventional peaches harvested on four different dates did not differ in top diameter. Peaches harvested on date 3 were significantly smaller in top diameter compared to the ones harvested on date 1, 2 and 4 (Table 83). Coral Star peaches harvested on dates 1, 2 and 4 did not differ from each other in top diameter (Table 83).

Table 83: Tukey-Kramer Grouping for Harvest Date Effect on Top Diameter Estimate of Conventional Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation and is Arranged in Descending Order).

Starfire			**Coral Star**		
Harvest Date	**Top Diameter (mm)**		**Harvest Date**	**Top Diameter (mm)**	
1	61.81 ± 3.16	A	2	69.18 ± 4.1	A
3	61.47 ± 2.51	A	1	69.01 ± 4.59	A
2	60.53 ± 3.34	A	4	67.20 ± 4.88	A
4	59.99 ± 4.65	A	3	65.16 ± 4.06	B

* Estimate with the same letter on the right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

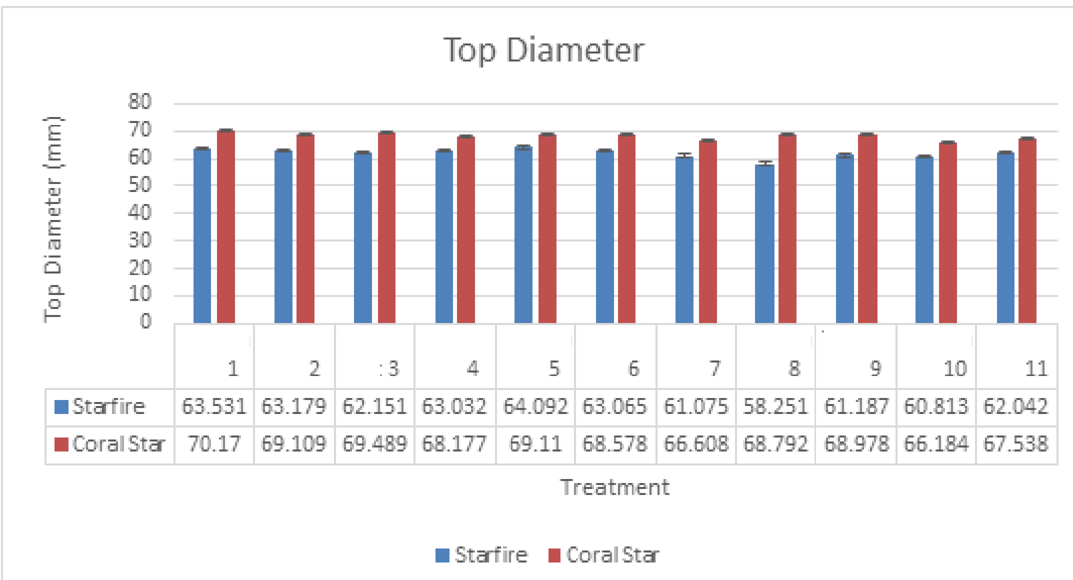


Figure 12: Top Diameter Mean Values for Peaches Subjected to 11 Different Treatments

Figure 12 summarizes the results for the effect of 11 treatments on the top diameter of peaches of both the varieties. Top diameter is a measure of the size of the fruit; however, equatorial diameter is used more often to report the size of the fruit. As seen previously in this study, top diameter was only significantly different among peaches harvested on 4 different harvest dates. The reason behind this difference is the same as mentioned in case of equatorial diameter, that is, different amount of sunlight and carbohydrate available to peaches located at different heights on the tree causes this difference in top diameter (Lopresti et al., 2014).

Fruit Color

The color was determined by measuring dark spots and light spots L*, a* and b*. Hue angle is calculated using these values which indicate the color of the fruit. Hue values give an indication of fruit color on a scale from 0-360. A Hue value of 0 = redness, 90 = yellowness, 180 = greenness, 240 = blueness).

Starfire Organic: Hue values gives an indication of fruit color on a scale from 0-360. After doing statistical analysis it was confirmed that Hue values for light spots and dark spots did not significantly get affected by cultivating under 6 different organic treatments, 2 different types of mulches, 2 different types of alleyways or harvesting at 4 different harvest dates, as peaches grown under all the different conditions did not significantly differ ($P > 0.05$) from each other in Hue values for light spots and dark spots (Table 84 - 87).

Table 84: Tukey-Kramer Grouping for Treatment Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	**H-Light**		**H-Dark**	
1	64.38 ± 10.20	A	36.19 ± 7.13	A
2	63.10 ± 7.51	A	35.06 ± 4.34	A
3	62.83 ± 8.71	A	37.18 ± 9.58	A
4	64.72 ± 10.46	A	35.26 ± 3.43	A
5	65.49 ± 10.26	A	36.46 ± 5.08	A
6	63.78 ± 9.47	A	35.16 ± 5.07	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 85: Tukey-Kramer Grouping for Harvest Date Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**H-Light**		**H-Dark**	
1	67.17 ± 9.81	A	37.68 ± 8.62	A
2	63.47 ± 9.33	AB	35.29 ± 4.99	A
3	66.18 ± 8.60	A	36.07 ± 4.63	A
4	59.38 ± 8.18	B	34.5 ± 4.999	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 86: Tukey-Kramer Grouping for Mulch Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Mulch	**H-Light**		**H-Dark**	
Allysum	63.77 ± 9.40	A	36.22 ± 7.38	A
Straw	63.74 ± 8.96	A	35.63 ± 5.95	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 87: Tukey-Kramer Grouping for Alleyway Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Alley	**H-Light**		**H-Dark**	
Legume	63.91 ± 8.84	A	35.16 ± 3.91	A
Grass	63.6 ± 9.68	A	36.69 ± 7.44	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Starfire Conventional: After doing statistical analysis it was confirmed that Hue values for light spots and dark spots did not significantly get affected by cultivating under 5 different conventional treatments, 2 different types of weed control methods, 2 different types of fertilizers, as peaches grown under all the different conditions did not significantly differ (P > 0.05) from each other in Hue values for light spots and dark spots (Table 88 - 91). Harvesting Starfire conventional peaches at 4 different harvest dates did not significantly affect Hue values for dark spots amongst peaches (P > 0.05), however, peaches harvested on date 3 had significantly lower Hue values for light spots compared to the values for peaches harvested on date 1, 2, and 4 9 (Table 89).

Table 88: Tukey-Kramer Grouping for Treatment Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	**H-Light**		**H-Dark**	
7	59.68 ± 10.30	A	34.7 ± 6.05	A
8	55.80 ± 9.74	A	36.33 ± 4.96	A
9	52.58 ± 9.64	A	35.45 ± 5.13	A
10	59.73 ± 8.36	A	36.54 ± 4.61	A
11	62.18 ± 9.24	A	32.94 ± 3.77	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 89: Tukey-Kramer Grouping for Harvest Date Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**H-Light**		**H-Dark**	
1	62.09 ± 9.45	A	35.36 ± 4.4	A
2	57.49 ± 9.34	A	36.997 ± 4.67	A
3	55.68 ± 9.45	B	34.71 ± 5.997	A
4	56.72 ± 10.57	A	33.7 ± 4.58	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 90: Tukey-Kramer Grouping for Weed Control Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Weed Control	**H-Light**		**H-Dark**	
Straw Mulch	60.96 ± 8.72	A	34.74 ± 4.29	A
Herbicide	56.13 ± 10.34	A	35.06 ± 5.55	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 91: Tukey-Kramer Grouping for Fertilizer Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Starfire Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Fertilizer	**H-Light**		**H-Dark**	
NPK	59.71 ± 9.44	A	35.62 ± 5.41	A
Compost	57.38 ± 14.22	A	34.18 ± 7.98	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Coral Star Organic: After doing statistical analysis it was confirmed that Hue values for light spots and dark spots did not significantly get affected by cultivating under 6 different organic treatments, 2 different types of mulches, 2 different types of alleyways, as peaches grown under all the different conditions did not significantly differ (P > 0.05) from each other in Hue values for light spots and dark spots (Table 92, 94 and 95). However, similar to Starfire conventional peaches, Hue values for light spots was significantly lower (P < 0.05) for peaches harvested on dates 3 and 4 when compared to peaches harvested on dates 2 and 1. Hue values for dark spots were not significantly affected due to harvesting on four different dates (Table 93).

Table 92: Tukey-Kramer Grouping for Treatment Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Treatment	**H Light**		**H-Dark**	
1	60.49 ± 9.1	A	35.7 ± 4.22	A
2	58.14 ± 7.77	A	33.80 ± 5.15	A
3	59.51 ± 6.81	A	34.75 ± 6.49	A
4	60.81 ± 7.18	A	34.36 ± 5.69	A
5	59.21 ± 6.67	A	34.21 ± 4.13	A
6	57.87 ± 9.20	A	34.24 ± 6.22	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 93: Tukey-Kramer Grouping for Harvest Date Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**H-Light**		**H-Dark**	
1	63.33 ± 6.83	A	33.42 ± 5.92	A
2	59.57 ± 8.39	A	34.13 ± 5.49	A
3	57.8 ± 7.56	B	34.85 ± 6.07	A
4	56.64 ± 7.03	B	35.65 ± 3.46	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 94: Tukey-Kramer Grouping for Mulch Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Mulch	**H-Light**		**H-Dark**	
Allysum	60.16± 7.08	A	34.75 ± 6.07	A
Straw	59.31± 8.45	A	34.56 ± 4.69	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 95: Tukey-Kramer Grouping for Alleyway Effect on Hue Values for Light Spots and Dark Spots Estimate of Organic Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Alley	**H-Light**		**H-Dark**	
Grass	59.999 ± 7.99	A	35.23 ± 5.36	A
Legume	59.48 ± 7.43	A	34.08 ± 5.40	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Coral Star conventional: After doing statistical analysis it was confirmed that Hue values for light spots and dark spots did not significantly get affected by cultivating under 5 different conventional treatments, 2 different types of weed control methods, 2 different types of fertilizers, as peaches grown under all the different conditions did not significantly differ (P > 0.05) from each other in Hue values for light spots and dark spots (Table 96, 98 and 99). However, similar to Starfire conventional peaches, Hue values for light spots were significantly lower (P < 0.05) for peaches harvested on date 3 when compared to peaches harvested on dates 2, 1, and 4. Hue values for dark spots were not significantly affected due to harvesting on four different dates (Table 95).

Table 96: Tukey-Kramer Grouping for Treatment Effect on Hue Values for Light Spots and Dark Spots estimate of conventional Coral Star peaches (Alpha=0.05) (Estimate is represented as Mean ± standard deviation).

Treatment	**H-Light**		**H-Dark**	
7	56.7 ± 7.9	A	33.56 ± 6.35	A
8	57.65 ± 14.02	A	32.61 ± 5.20	A
9	55.86 ± 8.59	A	34.34 ± 6.80	A
10	59.61 ± 9.79	A	32.14 ± 4.78	A
11	55.98 ± 9.63	A	35.92 ± 4.81	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 97: Tukey-Kramer Grouping for Harvest Date Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

Harvest Date	**H-Light**		**H-Dark**	
1	62.10 ± 10.97	A	33.27 ± 6.26	A
2	59.32 ± 9.66	A	33.71 ± 6.31	A
3	55.96 ± 8.31	A	33.23 ± 5.42	A
4	51.27 ± 9.14	B	34.63 ± 4.83	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 98: Tukey-Kramer Grouping for Weed Control Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

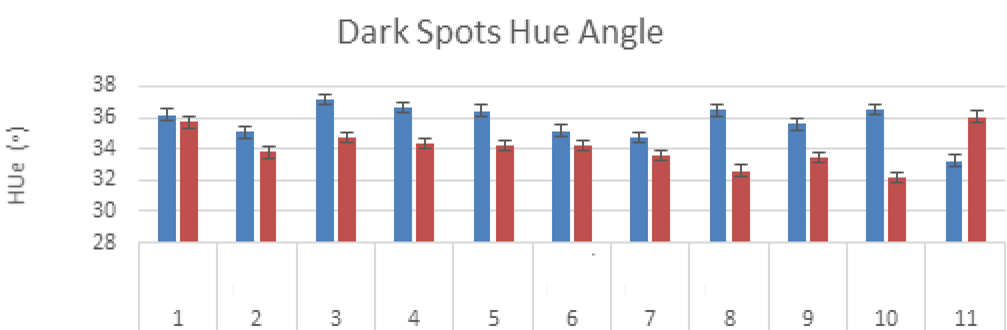
Weed Control	**H-Light**		**H-Dark**	
Straw Mulch	57.80 ± 9.76	A	34.03 ± 4.82	A
Herbicide	56.28 ± 10.45	A	33.95 ± 6.26	A

*Estimates with the same letter in right column are not significantly different *(P > 0.05)* & with different letters are significantly different from each other *(P < 0.05)*.

Table 99: Tukey-Kramer Grouping for Fertilizer Effect on Hue Values for Light Spots and Dark Spots Estimate of Conventional Coral Star Peaches (Alpha=0.05) (Estimate is Represented as Mean ± Standard Deviation).

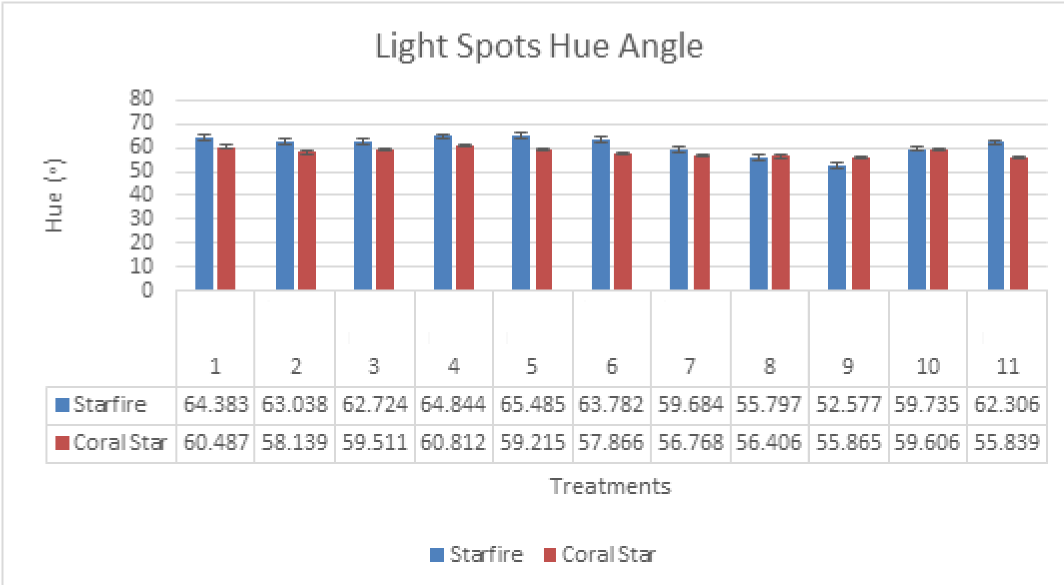
fertilizer	H-Light		H-Dark	
NPK	58.16 ± 10.9	A	32.85 ± 5.69	A
Compost	55.92 ± 9.07	A	35.13 ± 5.86	A

*Estimates with the same letter in right column are not significantly different *($P > 0.05$)* & with different letters are significantly different from each other *($P < 0.05$)*.



	1	2	3	4	5	6	7	8	9	10	11
Starfire	36.193	35.064	37.181	36.626	36.455	35.163	34.702	36.461	35.571	36.541	33.241
Coral Star	35.704	33.797	34.754	34.356	34.215	34.239	33.545	32.607	33.475	32.143	36.063

Figure 13: Dark Spots Hue Values for Peaches Subjected to 11 Different Treatments



	1	2	3	4	5	6	7	8	9	10	11
Starfire	64.383	63.038	62.724	64.844	65.485	63.782	59.684	55.797	52.577	59.735	62.306
Coral Star	60.487	58.139	59.511	60.812	59.215	57.866	56.768	56.406	55.865	59.606	55.839

Figure 14: Light spots Hue Values for Peaches Subjected to 11 Different Treatments

Figure 13 and 14 summarizes the results of Hue value for both light and dark spots. Fruit color is an indicator for fruit maturity with higher redness representing mature fruit and green to yellow color representing immature fruit (Kader, 1999). Since, both varieties of peaches belong to the Stellar family of peaches, it is a known fact that both varieties of peaches have higher red to orange skin color. The results from this study also show that on dark spots, peach color for both varieties is closer to redness values, and on light spots it is closer to light red to orange color values. It was expected that Hue values would increase with increase in harvest dates, since, peaches harvested early are located higher on the trees and are more exposed to sunlight and their skin tends be more blushed (Lopresti et al., 2014). Peaches harvested later are located on lower branches and are expected to be less blushed due to lesser exposure to sunlight (Lopresti et al., 2014).

Hence, from the results we can derive that Starfire organic peaches were generally in the group of small size (Blasco, Alexios and Molto, 2003) peaches as per the previous studies. Starfire organic peaches have observationally higher SSC than Coral Star. However, this is just an observational result and not statistically proven. More notably, treatment 2 had higher SSC/TA ratio amongst all the organic Starfire peaches cultivated using experimental treatments, which suggests that treatment 2 (Straw Mulch + compost N + legume alleyway) peaches might be liked more by consumers in sensory evaluations. Moreover, only peaches produced under treatment 2 and six satisfied minimum SSC standard (La Rue, 1989). Also, as mentioned before there was no significant difference observed between peaches grown under different treatments. This could also mean that peaches grown under experimental treatments (1-4) had a similar quality to peaches produced under standard treatments 5 and 6. As, mentioned earlier, peaches harvested on dates 1 and 2 were generally bigger in size, had higher SSC/TA values, higher weight, and were more firm. Using two different mulches did not alter the quality parameters significantly, as all the parameters were not significantly different amongst peaches grown either using Straw Mulch or living allyssum mulch. Similar results were obtained for peaches grown either under legume alleyways or grass alleyways. For conventionally grown peaches as well, there was no significant difference observed in any of the quality parameters between peaches grown under five different conventional methods. The effect of harvest date was similar to the one seen in organic peaches with peaches harvested on date 1 and 2 having more desirable quality parameter values compared to the ones harvested on date 3 and 4. 2 different types of herbicides, and 2 different types of fertilizers did not significantly affect the quality of cultivated peaches.

For Coral Star peaches as well similar results were observed. No significant effect was seen for six organic treatments, five conventional treatments, two different mulches, two different herbicides, two different fertilizers or two different alleyways on peach quality parameters. The peaches harvested on date 1 and 2 had more desirable values for quality parameters. Treatment 2 and 6 cultivated peaches as well as for conventional treatment 7 and 10 cultivated peaches had higher SSC and SSC/TA values. Moreover, all the Coral Star peaches are larger compared to star fire and can be considered large as diameter values are > 74mm (Blasco, Alexios and Molto, 2003).

Conclusion

The project on peach cultivation, under organic cultivation and several different types of conventional techniques (which includes transition method and integrated method), was undertaken with an objective of characterizing and better understanding the effects of cultivation methods on fruit quality. This data should provide Utah growers with information necessary to rationally design peach production to be economically as well as ecologically favorable.

Physicochemical analysis of several peach quality attributes and its subsequent analysis did not show any statistically significant difference in any of the quality attributes for either the Starfire or the Coral Star peaches subjected to 11 different treatments. Neither were any significant difference in quality attributes observed for either variety of peaches grown using 2 different types of mulches (Straw Mulch vs allysum sandwich) or using 2 different alleyways (grass alleyway vs legume alleyway) for organic orchard (which differ in N supply), nor was any significant difference observed for peaches grown using 2 different herbicides (Straw Mulch vs synthetic herbicide) or using 2 different fertilizers (compost N vs NPK) for conventional orchard. This means that experimental treatments produced peaches that were of similar quality to the peaches produced by standard treatments. This means that any of the 11 treatments can be used as an alternative to cultivation, which is most favorable in ecological & economical perspective. The most notable difference for most of the quality attributes was observed due to the difference in harvest dates. As expected, peaches harvested early, on dates 1 and 2, had bigger size, higher SSC values, and were more firm. This difference in quality attributes due to the difference in harvest dates can be minimized by proper thinning.

Hence to conclude, no significant difference was observed in any of the evaluated parameters amongst the peaches cultivated under 11 different treatments. However, a pattern of data was observed, where peaches from certain treatments had higher size or SSC/TA values, this can be verified by conducting the sensory evaluation. Moreover, peaches cultivated using an alternate management system (that is weed control, alleyway, and herbicides) yielded peaches having quality attributes similar to the ones produced using standard treatments. However, peaches harvested on early dates, dates 1 and 2, had better size, firmness and weight, and other parameter values were similar to the peaches harvested on dates 3 and 4. To further understand the effect of the treatments on peaches, it is necessary to undertake further studies, which includes sensory analysis, volatile analysis and metabolomics analysis.

REFERENCES

Azadi, H., Schoonbeek, S., Mahmoudi, H., Derudder, B., De Maeyer, P., & Witlox, F. (2011). Organic agriculture and sustainable food production system: main potentials. *Agriculture, Ecosystems & Environment*, *144*(1), 92-94.

Baker, B. P., Benbrook, C. M., III, E. G., & Benbrook, K. L. (2002). Pesticide residues in conventional, integrated pest management (IPM)-grown and organic foods: insights from three US data sets. *Food Additives & Contaminants*, *19*(5), 427-446.

Bhowmik, P. K., & Dris, R. (2004). Enzymes and quality factors of fruits and vegetables. In *Production practices and quality assessment of food crops* (pp. 1-25). Springer Netherlands.

Blasco, J., Aleixos, N., & Moltó, E. (2003). Machine vision system for automatic quality grading of fruit. *Biosystems Engineering*, *85*(4), 415-423.

Bourn, D., & Prescott, J. (2002). A comparison of the nutritional value, sensory qualities, and food safety of organically and conventionally produced foods. *Critical reviews in food science and nutrition*, *42*(1), 1-34.

Camargo, L. K., de Resende, J. T. V., Tominaga, T. T., Kurchaidt, S. M., Camargo, C. K., & Figueiredo, A. S. T. (2011). Postharvest quality of strawberry fruits produced in organic and conventional systems. *Horticultura Brasileira*, *29*(4), 577-583.

Cardoso, P. C., Tomazini, A. P. B., Stringheta, P. C., Ribeiro, S. M., & Pinheiro-Sant'Ana, H. M. (2011). Vitamin C and carotenoids in organic and conventional fruits grown in Brazil. *Food Chemistry*, *126*(2), 411-416.

Citak, S., & Sonmez, S. (2010). Effects of conventional and organic fertilization on spinach (Spinacea oleracea L.) growth, yield, vitamin C and nitrate concentration during two successive seasons. *Scientia horticulturae*, *126*(4), 415-420.

Colaric, M., Veberic, R., Stampar, F., & Hudina, M. (2005). Evaluation of peach and nectarine fruit quality and correlations between sensory and chemical attributes. *Journal of the Science of Food and Agriculture*, *85*(15), 2611-2616.

Crisosto, C. H., & Crisosto, G. M. (2005). Relationship between ripe soluble solids concentration (RSSC) and consumer acceptance of high and low acid melting flesh peach and nectarine (Prunus persica (L.) Batsch) cultivars. *Postharvest Biology and Technology*, *38*(3), 239-246.

Dangour, A. D., Dodhia, S. K., Hayter, A., Allen, E., Lock, K., & Uauy, R. (2009). Nutritional quality of organic foods: a systematic review. *The American journal of clinical nutrition*, *90*(3), 680-685.

Delgado, C., Crisosto, G. M., Heymann, H., & Crisosto, C. H. (2013). Determining the primary drivers of liking to predict consumers' acceptance of fresh nectarines and peaches. *Journal of food science*, *78*(4), S605-S614.

Erickson, M., & Hung, Y. C. (2012). *Quality in frozen food*. Springer Science & Business Media.

Fallahi, E., Fallahi, B., Shafii, B., & Amiri, M. E. (2009). Bloom and harvest dates, fruit quality attributes, and yield of modern peach cultivars in the intermountain western United States. *HortTechnology*, *19*(4), 823-830.

Fernandes, V. C., Domingues, V. F., de Freitas, V., Delerue-Matos, C., & Mateus, N. (2012). Strawberries from integrated pest management and organic farming: Phenolic composition and antioxidant properties. *Food chemistry*, *134* (4), 1926-1931.

Frecon, J. L., Ward, D., (2013). Yellow fleshed peach varieties for New Jersey. Retrieved from http://www.jerseypeaches.com/pdfdocs/FS1072-Yellow-Flesh-Peach-Varieties.pdf

Giller, K. E., Bignell, D., Lavelle, P., Swift, M., Barrios, E., Moreira, F., & Hopkins, D. W. (2005). Soil biodiversity in rapidly changing tropical landscapes: scaling down and scaling up. *Biological diversity and function in soils*, 295-318.

Gue´guen, L. and Pascal, G. (2013). Organic Foods. National Institute for Agricultural Research (INRA), Paris, France. *Encyclopedia of Human Nutrition. Vol. 3*: 413-417.

IFOAM, (2012). The IFOAM norms for organic production and processing, version 2012. Retrieved from http://www.ifoam.bio/sites/default/files/page/files/ifoam_norms_version_august_2012_with_cover.pdf

Infante, R., Aros, D., Contador, L., & Rubio, P. (2012). Does the maturity at harvest affect quality and sensory attributes of peaches and nectarines? *New Zealand Journal of Crop and Horticultural Science*, *40*(2), 103-113.

Kader, A. A. (1999). Fruit maturity, ripening, and quality relationships. *Acta Hort*, *485*, 203-208.

Köpke, U. (2003). Influence of organic and conventional farming systems on nutritional quality of food. *Impacts of Agriculture on Human Health and Nutrition. In: Encyclopedia of Life Support Systems (EOLSS). Developed under the auspices of the UNESCO. Eolss Publishers. Oxford. [http://www. eolss. net]*.

LaRue, J. H. (1989). *Peaches, plums, and nectarines: Growing and handling for fresh market* (Vol. 3331). UCANR Publications.

Laux, M. (2012). Organic food trends profile. Retrieved from http://www.agmrc.org/markets__industries/food/organic-food-trends-profile/

Lehesranta, S. J., Koistinen, K. M., Massat, N., Davies, H. V., Shepherd, L. V., McNicol, J. W., ... & Leifert, C. (2007). Effects of agricultural production systems and their components on protein profiles of potato tubers. *Proteomics*, *7*(4), 597-604.

Lester, G. E. (2006). Organic versus conventionally grown produce: quality differences, and guidelines for comparison studies. *HortScience*, *41*(2), 296-300.

Lobit, P., Soing, P., Génard, M., & Habib, R. (2002). Theoretical analysis of relationships between composition, pH, and titratable acidity of peach fruit. *Journal of Plant Nutrition*, *25*(12), 2775-2792.

Lopresti, J., Stefanelli, D., & Ceccarelli, A. How does crop load and fruit position influence variability in Rose Bright nectarine quality? Retrieved from http://www.researchgate.net/profile/Dario_Stefanelli/publication/270105630_How_does_crop_load_and_fruit_position_influence_variability_in_Rose_Bright_nectarine_quality/links/54a087ca0cf256bf8bae1a9d.pdf

Martínez-Blanco, J., Antón, A., Rieradevall, J., Castellari, M., & Muñoz, P. (2011). Comparing nutritional value and yield as functional units in the environmental assessment of horticultural production with organic or mineral fertilization. *The International Journal of Life Cycle Assessment*, *16*(1), 12-26.

Mcpherson A., Gaonkar A. (2005). *Ingredient Interaction effect on food quality: Sweeteners. CRC Press. Taylor and Francis*, second edition. 175-178.

Mozumder, P., & Berrens, R. P. (2007). Inorganic fertilizer use and biodiversity risk: An empirical investigation. *Ecological Economics*, *62*(3), 538-543.

Niggli, U., Earley, J., & Ogorzalek, K. (2007). Issues paper: organic agriculture and environmental stability of the food supply. In *Conference Proceedings. International Conference on Organic Agriculture and Food Security, Rome, Italy*.

Retrieved from http://orgprints.org/10752/1/niggli-et-al-2007-environmental-stability.pdf

Panda. H. (2013). The complete book on fruits, vegetables & food processing: Vegetables and Fruits. NIIR Project consulting services. 397-399.

Pieper, J. R., & Barrett, D. M. (2009). Effects of organic and conventional production systems on quality and nutritional parameters of processing tomatoes. *Journal of the Science of Food and Agriculture*, *89*(2), 177-194.

Pimentel, D. (2006). Soil erosion: a food and environmental threat. *Environment, development and sustainability*, *8*(1), 119-137.

Pretty, J. N. (1995). Participatory learning for sustainable agriculture. *World development*, *23*(8), 1247-1263.

Rapisarda, P., Calabretta, M. L., Romano, G., & Intrigliolo, F. (2005). Nitrogen metabolism components as a tool to discriminate between organic and conventional citrus fruits. *Journal of agricultural and food chemistry*, *53*(7), 2664-2669.

Richard G. St.-Pierre. (2006). Quality & nutritive value of Saskatoon fruit. Prairie elements phytochemical services. 1-6. Retrieved from http://www.prairie-elements.ca/saskatoon/14.3-quality.pdf

Rigby, D., & Cáceres, D. (2001). Organic farming and the sustainability of agricultural systems. *Agricultural systems*, *68*(1), 21-40.

Róth, E., Berna, A., Beullens, K., Yarramraju, S., Lammertyn, J., Schenk, A., & Nicolaï, B. (2007). Postharvest quality of integrated and organically produced apple fruit. *Postharvest Biology and Technology*, *45*(1), 11-19.

Roussos, P. A., & Gasparatos, D. (2009). Apple tree growth and overall fruit quality under organic and conventional orchard management. *Scientia Horticulturae*, *123*(2), 247-252.

Rowley, M. A., (2011), Orchard Floor Management (Master's thesis). Retrieved from, All Graduate Theses and Dissertations. Paper 1103. http://digitalcommons.usu.edu/etd/1103

Sánchez, G., Besada, C., Badenes, M. L., Monforte, A. J., & Granell, A. (2012). A non-targeted approach unravels the volatile network in peach fruit. *PLoS One*, *7*(6), e38992.

Scialabba N., Müller-Lindenlauf M. (2010). Organic agriculture and climate change. *Renewable Agriculture and Food Systems*. 25(2): 158–169.

Seufert, V., Ramankutty, N., & Foley, J. A. (2012). Comparing the yields of organic and conventional agriculture. *Nature*, *485*(7397), 229-232.

Shaver, G. R., & Chapin, F. S. (1995). Long–term responses to factorial, NPK fertilizer treatment by Alaskan wet and moist tundra sedge species. *Ecography*, *18*(3), 259-275.

Shribbs, J. M., & Skroch, W. A. (1986). Influence of 12 ground cover systems on young Smoothee Golden Delicious apple trees. I: Growth. *Journal of the American Society for Horticultural Science*, *111*(4), 525-528.

Te Pas, C. M., & Rees, R. M. (2014). Analysis of differences in productivity, profitability and soil fertility between organic and conventional cropping systems in the tropics and sub-tropics. *Journal of Integrative Agriculture*, *13*(10), 2299-2310.

Tosun, I., Ustun, N. S., & Tekguler, B. (2008). Physical and chemical changes during ripening of blackberry fruits. *Scientia Agricola*, *65*(1), 87-90.

USDA (U.S. Department of Agriculture), (2013). ERS/USDA data-organic production; Table 3: Certified organic and total U.S. acreage, selected crops and livestock, 1995-2011 Retrieved from http://www.ers.usda.gov/data/organic

Vinha, A. F., Barreira, S. V., Costa, A. S., Alves, R. C., & Oliveira, M. B. P. (2014). Organic versus conventional tomatoes: Influence on physicochemical parameters, bioactive compounds and sensorial attributes. *Food and Chemical Toxicology*, *67*, 139-144.

Woese, K., Lange, D., Boess, C., & Bögl, K. W. (1997). A Comparison of Organically and Conventionally Grown Foods--Results of a Review of the Relevant Literature. *Journal of the Science of Food and Agriculture*, *74*(3), 281-293.

Worthington, V. (1998). Effect of agricultural methods on nutritional quality: a comparison of organic with conventional crops. *Alternative therapies in health and medicine*, *4*(1), 58-69.

Zanoli, R., & Naspetti, S. (2002). Consumer motivations in the purchase of organic food: a means-end approach. *British food journal*, *104*(8), 643-653.