PRUNING AND FOLIAR NUTRITION FOR REJUVENATION IN PASSION FRUIT (*Passiflora edulis* f. *edulis* Sims.) FOR ENHANCING GROWTH, YIELD AND QUALITY

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(2019-12-021)

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by

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THESIS

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KERALA, INDIA

2022

DECLARATION

I, hereby declare that this thesis entitled **"Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.) for enhancing growth, yield and quality"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.) for enhancing growth, yield and quality"** is a record of research work done independently by Mr. Sooraj C. S. (2019-12-021) under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to him.

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Sooraj C. S.

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LIST OF ABBREVIATIONS

AOAC	Association of Official Agricultural Chemists
B	Boron
B: C	Benefit cost ratio
CD	Critical difference
cm	Centimeter
cv.	Cultivar
EC	Electrical Conductivity
et al.	Co-workers/co-authors
Fe	Iron
Fig.	Figure
FYM	Farm yard manure
Ha	Hectare
ha^{-1}	Per hectare
K	Potassium
KAU	Kerala Agricultural University
Kg	Kilogram
kg ha^{-1}	Kilogram per hectare
L	Litre
M	Metre
m^2	Square metre
MAP	Months after pruning
N	Nitrogen
NS	Non-significant
No.	Number
P	Phosphorus
$Plant^{-1}$	Per plant
POP	Package of practices
RBD	Randomized block design
Sem	Standard Error of mean
T	Tons
t ha^{-1}	Tons per hectare
TSS	Total soluble solids
Zn	Zinc

LIST OF SYMBOLS

@	At the rate of
º C	Degree Celsius
%	Per cent
₹	Rupees

Introduction

1. INTRODUCTION

Passion fruit is a prominent member of the family Passifloraceae with 600 species. They are mostly vines distributed in tropical and subtropical regions. Brazil is known as centre of diversity of the Passifloraceae family. Among these species, only purple passion fruit (*Passiflora edulis* f. *edulis* Sims), yellow passion fruit (*Passiflora edulis* f. *flavicarpa* Deg.) and Giant granadilla (*Passiflora quadrangularis* L.) are commonly cultivated. Passion fruit is a woody, perennial vine that bears a delicious fruit. It is a vigorous, climbing vine that clings by tendrils to almost any support. Passion fruit is known in Hawaii as lilikoi, golden passion fruit in Australia, maracuja peroba in Brazil, and yellow granadilla in South Africa. The name "Passion fruit" does not refer to any aphrodisiac properties of the fruit, but was given by a Spanish Catholic missionary who saw the flower as a symbol of Christ's passion, where "Passus" means "suffering" and "Flos" means "flower."

The purple passion fruit (*P. edulis* f. *edulis*) is adapted to the cooler subtropics or at high altitudes in the tropics, while the golden passion fruit (*P. edulis* f. *flavicarpa*) is more suited to the tropical low land conditions. Brazil, Venezuela, South Africa, New Zealand, Australia, Papua, New Guinea, Fiji, Hawaii, Taiwan and Kenya account for 80-90% of the world's passion fruit production. In India both purple and yellow passion fruits are grown commercially (Sema and Maiti, 2006) and its cultivation is confined to Kerala, Nilgiri hills and Kodaikanal of Tamil Nadu, Coorg region of Karnataka as well as Himachal Pradesh and North Eastern States viz., Meghalaya, Mizoram, Manipur, Nagaland and Sikkim. The purple passion fruit is adapted to subtropical conditions and endures a few degrees of winter frost without injury, while the yellow passion fruit is more suited to tropical low land conditions (Roy *et al.*, 2012) and it is tolerant to several diseases and pests. The optimum temperature for the cultivation is 20 to 30°C. Passion fruit vines grow in a variety of soil types, but light to heavy sandy loams of medium texture with a pH of 5.5 to 6.5 are ideal. Once established, it can reach a height of 15 to 20 feet per year.

Passion fruit stands out not only for its exotic and unique flavour and aroma but for its amazing nutritional and medicinal properties. Its fruits are used for fresh consumption and processing purpose. People like this fruit due to its pleasant aroma, rich flavour, prolific bearing habit and highly remunerative nature even without much care and has capacity to suite to hill farming system. Passion flower's ability to reduce anxiety makes it useful for asthma, palpitations, and other cardiac rhythm abnormalities, high blood pressure, insomnia, neurosis, nervousness, pain, and other conditions (Chevallier, 1996; Bruneton, 1995). It contains plant sterols, which help in lowering the levels of cholesterol. Passion fruit is a reservoir of Vitamin C, Vitamin A and Potassium. The juice of passion fruit is found to reduce cancer cell growth. The phenolic acids and flavonoids present in fruit are thought to have heart-protective properties. Passion fruit is a good source of antioxidants, both water soluble and fat soluble ones. The fruit is quite high in carbohydrates and simple sugars, which improves athletic performance. It is said to have somniferous properties, which when taken before going to bed, help the person to relax and have a restful sleep. The fruit is consumed alone or in fruit salads, sherbets, ice cream, jams, cool drinks and as concentrates.

Passion fruit is one of Kerala's most promising fruit crops. Passion fruit is gaining commercial importance in Kerala due to its adaptability to humid tropical climates (Sulladmath *et al.*, 2012) Progressive farmers have begun commercial production of passion fruit due to its increasing popularity and adaptation to the climatic conditions of Kerala. Because of its nutritional and market worth, as well as its short maturity period, passion fruit is an excellent crop for small-scale producers.

Proper canopy management and balanced nutrition plays a vital role in plant growth, yield and fruit quality of Passion fruit. Reducing vigour of crop after few years of growing is a major problem in passion fruit cultivation. But proper canopy management and nutrition helps in exploiting the full potential of the crop even after the crop loses its vigour due to its exhaustive fruiting in early periods.

Generally, the passion fruit vines are most productive till four or five years of age, after which they lose their vigour and will become less productive; but regular pruning after one year of planting can overcome this situation and will improve the vigour and productivity of the plant. It is also necessary to prevent diseases and mechanical damage to fruits. The yellow variety does not respond well to pruning as the purple one, and this operation should thus be restricted to the purple type. Flower and fruit development of passion fruit takes place only on the current season's growth; hence all vines older than one year are unfruitful. Therefore pruning of old and dead branches that have already born fruit is necessary practice. As passion fruit vine does not store a large amount of food reserves like grapevine, severe pruning is not recommended. A light pruning is recommended after harvest in warm winter climates and in areas with cool winters pruning in early spring or in late winter when they are not actively growing.

Passion fruit is a highly nutrient responsive crop. So along with pruning, foliar application of nutrients helps in rejuvenation of the crop and it will also increase the fruit yield. Foliar feeding of nutrients is an effective tool for reducing the quantum of soil applied nutrients and thereby enhancing the nutrient use efficiency. Foliar spray of nutrients has many advantages like low application rates, uniform distribution of fertilizers and sudden and effective response from plant. However, no systematic attempts have been made to study these aspects. Keeping this in view, the present study is aimed to find out the effect of different pruning intensities and rejuvenation through foliar nutrition on growth, yield and quality of passion fruit.

Review of Literature

2. REVIEW OF LITERATURE

Passionfruit (*Passiflora edulis*) is a perennial, vigorous, climbing, woody vine that produces edible round or ovoid fruit with many small seeds. It belongs to the family Passifloraceae, which includes 500 species of Passiflora and is indigenous to southern Brazil, Paraguay, and northern Argentina. It is a high value export oriented crop. Passion fruit stands out not only for its exotic and unique flavour and aroma but also for its amazing nutritional and medicinal properties. Because of the growing popularity of this crop, as well as its adaptation to our climatic circumstances, progressive farmers have begun commercial cultivation in Kerala. Passion fruit vine has a vigorous growth habit and it consumes considerable amount of water and nutrients. Canopy size determines how effectively the plant can access light, water and nutrients. Hence proper canopy management is important as it helps to maximize the quality of the plant's micro-climate, thereby proper growth and production. Pruning is necessary to maintain appropriate production of passion fruits because they are borne on shoots from the current season. It is also necessary to prevent diseases and mechanical damage to fruits. In general, passion fruit vines are most productive until they are four or five years old, after which they lose vigour and become less productive; however, regular pruning after one year of planting can overcome this situation and improve the plant's vigour and productivity. Immediately after pruning there is a temporary loss of vigour of vines. Passion fruit is a highly nutrient responsive crop. So along with pruning, foliar application of nutrients helps in rejuvenation of the crop and it will also increase the fruit yield. Foliar feeding of nutrients is an effective tool for reducing the quantum of soil applied nutrients and thereby enhancing the nutrient use efficiency

The current experiment was carried out for studying the response of pruning and foliar nutrition of primary and micronutrients application on the biometric characters, yield characters, quality characters etc of the passion fruit variety 134P. The review of literature highlights the following aspects.

Biometric characters

Yield characters

Quality characters

Shelf life

Plant analysis

Fruit analysis

Incidence of pest and diseases

Economic analysis

2.1 BIOMETRIC CHARACTERS

The size of the canopy determines how effectively the plant can access light, water, and nutrients (Abasi *et al.*, 2018)

Akamine *et al*. (1974) reported that, in commercial plantings in Australia and New Zealand, purple passion fruit vines are typically pruned to facilitate spraying or to encourage new growth.

Pruning affects hormonal conditions and results in reduction of vegetative buds and an increase in the growth of new shoots, increased number of new shoots and canopy structure with enhanced nutritional translocation (Tyagi *et al*., 2017)

According to Abasi *et al*. (2018), vines that have been severely pruned are more likely to produce excessively vigorous shoots because only a small number of the parent vine's and root's growing points have access to all of the energy that has been stored in the parent vine.

According to Skinkis (2013), overcrowding reduces vine vigour (rate of shoot growth) and vine size (pruning weight). Abasi *et al*. (2018) opined that severe pruning of a dormant or relatively inactive vine can result in a severe setback or even the vine's death.

Senthilkumar *et al*. (2015) stated that, the most effective way to maintain the right balance between growth and production is to prune the vines for optimal cropping according to their vigour. Increased pruning severity will result in vigorous individual shoots at the expense of the crop's overall growth.

Flower and fruit development in passion fruit occurs only on current season's growth; thus, all vines older than one year were unfruitful. Pruning old and dead branches that have already produced fruit is therefore a necessary practise. Since passion fruit vine does not store as much food as grapevine, severe pruning is not advised (Deshmukh *et al*., 2017)

Passion fruit vines are vigorous climbers that attach to virtually any structure with their tendrils. Once established, it can grow up to 15 to 20 feet per year (Deshmukh *et al*., 2017)

The timing of pruning can alter the phenology of flowering and fruiting, since temperature, light, and plant vigour helps to induce flowering (Oliveira *et al*., 2004)

Reduced croploads led to earlier fruit maturity in apple (Palmer *et al*., 1997) and peach (Siham *et al*., 2005)

Kohale *et al.* (2013) discovered that pruning time and intensity had a significant impact on cane length in grape cv. Sharad Seedless. Edson *et al.* (1993) noticed that increasing crop load per vine reduced shoot growth in 'Seyval' grape plants.

According to Chalak (2008), as the pruning intensity increased, the cane diameter also increased in grape cv. Tas-A-Ganesh.

Velu (2001) found that in grape cv. 'Muscat,' where the pruning level was extreme (pruning 67% of the canes to 5 bud level and 33% to 2 bud level), it took less time (40.06 days) for bud sprouting. According to Palma *et al.* (2000), in the grape cv. Victoria, increased bud loads per vine caused a delay in bud sprouting when compared with lower bud load treatments. In 'Beauty Seedless' grapes, Godara *et al*. (1977) found that vines that had been severely pruned needed fewer days to sprout buds and blossom than vines that had been lightly pruned.

According to Bailey *et al*. (2021), the best time for fertilizer application in passion fruit is after pruning.

Mehta *et al.* (2016) reported that, application of 250:125:125g NPK+1.2g boron resulted in the greatest plant girth in passion fruit.

Increased K dosages of up to 600 g K2O plant^{-1} have been found to increase pseudostem girth in banana (Sindhu, 1997). According to Geetha (1998), increasing the amount of nitrogen applied in banana up to 190 g plant^{-1} enhanced plant girth substantially.

Aiyelaagbe and Abiola (2008) noticed that compared to non-fertilized crops, plants that received 4.2 t ha^{-1} of inorganic fertiliser flowered earlier and produced more flowers in passion fruit.

Joy and Anjana, (2017) noticed that passion fruit takes 10 - 14 days from flower bud initiation to full bloom; 70 days from full bloom to fruit ripening and 80 - 84 days from flower bud initiation to fruit ripening and harvest. Fischer *et al.* (2018) stated that the ideal harvest time in passion fruit is 63 days after anthesis. According to Bailey *et al*. (2021) the average number of days from flowering to harvest is 70–75.

Deshmukh *et al.,* 2017 reported that passion fruit takes around 80–90 days from flowering to fruit maturity. May to June and September to October are the two main seasons for purple passion fruit availability.

Mehta (2012) discovered that combining boron with NPK fertilisers resulted in vigorous plant growth, a larger number of fruits, earlier flowering, and fruiting in passion fruit.

Beena and Beevy (2016) reported that flowering in *P. edulis* var. *edulis* began in April and lasted until September. According to Tripathi (2018), passion fruit flowers all year if conditions are favourable.

According to Dutta (2004), among micronutrients, boron plays a significant role in governing numerous physiological and biochemical processes in plants, and foliar treatment of boron (0.5%) promoted early flowering in passion fruit.

According to Borges *et al.* (2007), potassium deficit in passion fruit delayed flowering and lowered production, including fruit size. The duration to fruit maturity was reduced by around 25 days when the K concentration was raised to 8 mmol L^{-1} (Fischer *et al*., 2018).

In a study conducted by Chapagain and Wiesman (2004), it was discovered that greater P application increased days to maturity in tomato.

According to Mehta *et al*. (2016), applying 250g N:125g P_2O_5:125g K_2O coupled with 1.2g boron reduced the number of days required for flower initiation and fruit maturity in passionfruit.

Foliar treatment of Zn EDTA + $MnSO_4$ + $CuSO_4$ + Borax results in early inflorescence emergence and shortened the time between blooming and harvesting in banana cultivar Grand Naine (Yadav *et al.*, 2010).

Modi *et al*. (2012) conducted an experiment in papaya cv. Madhu Bindu and found that, foliar treatment of zinc and boron led to early flower bud initiation and the shortest possible time between fruit set and the first harvest.

In papaya cv. Washington, Shekhar *et al*. (2010) found that foliar treatment of $MnSO_4$ 0.25%+ $CuSO_4$ 0.25%+ borax (0.1%) reduced the days to blooming (186.33 days) compared to control (208 days).

Yadav *et al*. (2017) discovered that foliar treatments of Boric acid (0.4%) and Zinc sulphate (0.4%) resulted in the shortest number of days to harvest in Strawberry Cv. Winter Dawn (59.26 days and 59.15 days, respectively) when compared to the control (62.10 days).

2.2 YIELD PARAMETERS

The amount of pollen deposited on the stigma determines the fruit set, number of seeds, weight of the fruit, and fruit yield (Akamine and Girolami, 1959)

According to Tripathi (2018), passion fruit can yield 10-12 tonnes per hectare per year on an average. The vines are perennial and can yield for 10 to 15 years, with a maximum yield up to six years.

Tripathi *et al*.(2014) stated that, passion fruit vines can only produce fruit during the current growing season, and systematic pruning of the vines promotes new growth, which leads to a more consistent and prolific fruit production. Also they stated that, a dormant or inactive vine may experience a growth setback and a decrease in yield if it is pruned arbitrarily and severely.

Schoneberg *et al.* (2020) stated that pruning is done with horticultural objectives in mind, such as better fruit quality and quantity, plant vigour, and production efficiency.

According to Tyagi *et al.* (2017) in old mango orchards with high population densities, pruning treatment seems to be an alternative approach to improve production and quality.

According to Abasi *et al*. (2018), moderate pruning may be the most suited because it reduces dieback incidence and improves optimum yield. According to Joy (2017) light pruning does not decrease yield since fruiting occurs on young wood.

Mendoca *et al*. (2016) noticed that high pruning intensity enhances vine vigour while decreasing yield amount, making the procedure unfavourable.

According to Skinkis (2013), even if the vine seems to be matured, stored starch reserves in vines stressed by overcropping can be so low that the next year's vegetative development and fruit yield will be substantially diminished.

Crop load decreased as the severity of pruning increased. Fruit weight and diameter were found to be strongly associated with crop load; the lower the crop load, the higher the rise in fruit weight and diameter (Bound and summers, 2000)

According to Vance and Skinkis, (2013) Vines with large canopies and excessive vegetative growth in comparison to crop levels can result in poor bud fruitfulness as well as reduced cold hardiness, fruit set, yield, and quality at harvest.

Borges *et al.* (2006) found that the development of fruits is impaired by insufficient light.

Growing yellow passion fruits with varying number of reproductive branches (40, 30, 24, 20 and 14 branches plant^{-1}) demonstrated that a smaller number of tertiary branches reduced production (number of fruits plant^{-1}), productivity (kgha^{-1} of fruits), and juice yield, but increased the average fruit weight without changing the internal qualities of organs (Hafle *et al.*, 2009).

According to Knight and Winters, (1962) seed development is directly correlated to juice content.

Cavalcante *et al.* (2007) reported a rind thickness of 0.60-0.70 cm, whereas Ferreira *et al.* (2010) reported a rind thickness of 0.71 cm in passion fruit.

According to Ghosh *et al.* (2017) purple types have an average fruit diameter of 3-5 cm

Kannan (2010) reported that foliar nutrition proved effective in rectifying nutrient deficits, which was critical for production maximisation.

Foliar nutrients increased crop yield and quality in commercial crops while causing no harm to the flora or fauna (Geetha, 2019).

According to PRS (2015), in the absence of phosphorus, passionfruit growth is reduced, affecting the quantity of dry matter, root growth and fruit production.

Olermo *et al.* (2017) discovered that removing N from the NPK treatment lowered passion fruit production by 57% to the same level as the control, while reductions in fruits without P and K were 38% and 7%, respectively. Furthermore, fruit weight losses due to non-application of N, P_2O_5 and K_2O were 63%, 40%, and 6%, respectively

Aiyelaagbe *et al*. (2005) found that the application of N 60-480 kg ha^{-1} to passion fruit plants considerably increased the dry weight of the leaves, stems, and entire plant when compared to control.

According to Kumar *et al*. (2006), spraying Allahabad Safeda guava leaves with 1% KNO_3 considerably improved fruit size. K_2SO_4 foliar sprays of 1 and 2 percent significantly enhance total and reducing sugars in the guava cultivar Lucknow-49 (Singh and Chauhan, 1982). Kumar *et al.* (2006) found that applying K to guava cultivar Lucknow-49 resulted in higher vitamin C levels in fruits.

Araujo *et al*. (2006) studied the effects of different K concentrations in the nutrient solution of passion fruit and discovered that 6 mmol L^{-1} of K produced fruits with larger weight and yield/plant, also the thickness and relative water content of the pericarp along with concentration of vitamin C increases with dose of K(from 0 to 8 mmol L^{-1}).

Natal *et al*. (2004) demonstrated that foliar applications of Zn (0.5%) and Boron (0.25%) increased fruit yield, fruit weight, and quality in passion fruit.

According to Ebeed *et al.* (2001), foliar spraying of Fe+Zn+Mn improved tree production, fruit weight, pulp weight, and pulp/fruit weight in mango cv. Mesk

Ghanta and Dwivedi (1993) found that foliar applications of zinc, boron, and copper resulted in the maximum fruit yield, individual fruit weight, and fruit size in banana cv. Giant Governor.

Anjali *et al*. (2013) found that foliar applications of $ZnSO_4$ + $FeSO_4$ + $CuSO_4$ + H_3BO_3 increased bunch weight, individual finger weight, yield per plant, and yield per hectare when compared to the control in banana cv. Grand Naine

According to Ashoori *et al.* (2013), foliar spraying of urea, Zn, and Fe improved the size of the fruit in grape vine.

According to Weber *et al.* (2017), fruit weight accumulation involves competition for photosynthesis-derived compounds, and a smaller fruit number increases the assimilates that are readily available for fruit filling.

As per a study by Freitas *et al.* (2006) on the effects of macronutrient deficiencies and boron (B) on yellow passion fruit, Magnesium(Mg),Nitrogen(N), phosphorus (P), and sulphur (S) deficiencies in the nutrient solution resulted in the fewest fruits per plant (each producing 0, 2, 3, and 4 fruits, respectively) when compared to the control (10 fruits).

A study was carried out by Mayorga (2016) to compare sweet passion fruit cultivated at different altitudes. According to the study, passion fruit planted at higher altitudes (2498 m MSL, 14.9°C) had larger and heavier fruits than passion fruit grown at lower altitudes (2006 m MSL, 17.9°C).

According to Joy and Anjana (2017), among the 14 types evaluated in the study, the maximum juice production of 937 kg ha^{-1} was recorded by the type 134P followed by 890 kg ha^{-1} (142P), 704 kg ha^{-1} (143P) as the mean of two years. Hence the type 134P was selected as the best type in terms of the ultimate yield, that is, the maximum juice production.

2.3 QUALITY CHARACTERS

The quality of any produce is influenced by the factors such as variety genetics, environmental conditions, genotype-environment interaction, and crop management practices (Wyckhuys *et al.*, 2012)

The physiological processes of the plant, including photosynthesis, transpiration, respiration, the translocation of assimilates, and finally metabolism, are all impacted by environmental conditions, and these processes collectively determine the fruit's quality (Ladaniya, 2008).

Singh and Saini (2013) reported that 50% pruning of fruitful shoots and removal of dead and diseased wood, along with fruit thinning, stimulates new growth and provides essential light distribution throughout the tree for the formation of strong fruit buds and acceptable fruit quality and yield in Peach cv. Shan-I- Punjab.

According to Schoneberg *et al*. (2020) in addition to microclimate factors like light penetration, temperature, and humidity, canopy architecture also had an impact on fruit quality and yield.

Fruit quality can be affected by crop canopy microclimate, particularly light penetration, temperature, and humidity (Edgley *et al.*, 2019)

In order to promote the synthesis of antioxidants that increase the nutritional content of the fruits, some UV radiation must penetrate them as they mature (Fischer *et al*., 2016).

According to Nascimento *et al*. (2003) and Ripardo (2010), soluble solids, titratable acidity, and the ratio of soluble solids to titratable acidity may all be directly impacted by environmental conditions like temperature and solar radiation as well as cultural techniques like fertiliser doses.

According to Sherman and Beckman (2002), high intensity of sunlight during ripening is required for many fruits to develop high fruit sugar levels.

Kurtural *et al*. (2006) found that the TSS of grapevine cv. Chambourcin increased linearly with an increase in the intensity of pruning. According to Senthilkumar *et al*. (2015), fruits with low TSS and high fruit acidity are produced by vines that bear heavily. According to Tyagi *et al*. (2017) TSS content in ber was higher in fruits with severe and medium pruning.

Chalak (2008) found that TSS and the TSS to acid ratio declined as pruning intensity decreased.

Balakrishnan and Rao (1963) discovered that the total soluble solids and reducing sugar content improved with the intensity of pruning. According to Chadha and Kumar (1970), the amount of reducing sugar and total soluble solids increased as the intensity of pruning increased.

Joon and Singh (1983) discovered that as pruning intensity reduced in the grape cv. Delight, the TSS: acid ratio decreased considerably. In cv. Thompson Seedless, TSS was found to increase as pruning intensity was increased, according to Sehrawat *et al.* (1998)

According to Fischer *et al.* (2018), plant nutrition is one of the most important aspects for the development of the characteristic fruit quality.

Fertilizers have an impact on both the internal and external properties of passion fruit, including the percentage of juice, the amount of soluble solids, and the acid index (Aular *et al*., 2014)

According to Aular *et al*. (2014), potassium and nitrogen were needed in greater amounts for passion fruit, followed by calcium, sulphur, phosphorus, and magnesium. Fertilizers influenced the internal features, such as the percentage of juice, the amount of soluble solids, and the acid index, as well as the external qualities, such as fruit weight, fruit size, and rind thickness.

Fischer *et al.* (2018) found that TSS were lower in fruits with lower levels of N, P, and K, while ascorbic acid concentration decreased with lower levels of N, K, and S in the nutrient solution.

According to Reis *et al.* (2018), the acidity of purple type was 2.83 percent, compared to 9.06 percent for yellow type.

Shiomi *et al*. (1996) opined that, In the case of purple passion fruit, the reduction in acidity is primarily responsible for the improvement in consumption quality.

According to Pongener *et al*. (2014), the qualitative characteristics of purple passion fruit were higher when they were harvested after the breaker stage, when the fruits had gained 50% of its purple coloration.

Mehraj *et al.* (2015) reported that the maximum total soluble solids were observed under the foliar treatment of boron and zinc, while the lowest value was observed under control in strawberry.

Song *et al.* (2015) reported that Zinc sulphate applied as a foliar spray on grapevine cv. Merlot improved total soluble solids accumulation while lowering titrable acidity levels.

According to Rawat *et al.* (2010), foliar spraying of zinc sulphate enhanced TSS, total sugars, sugar-acid ratio, and lowered acidity in guava. The amount of pectin and vitamin C (ascorbic acid) in guava cv Lucknow-49 considerably enhanced after boron application.

Tamboli *et al*. (2015) found that foliar application of $FeSO_4$ + $ZnSO_4$ + borax coupled with the recommended fertiliser dosage resulted in the maximum TSS, lowering sugar, and minimal acidity in fig cv. Deanna.

According to Verma *et al*. (2016), the foliar spray of $ZnSO_4$ + Borax was the most efficient for inducing the quality attributes like total sugar, ascorbic acid, and TSS in aonla cv. NA -7. Singh *et al*. (2001) reported that, spraying 0.5% $ZnSO_4$, 0.2% borax, and 0.4% $CuSO_4$ together significantly increased TSS, sugars, and ascorbic acid content of aonla cv. Francis.

According to Venu *et al.* (2014), the interaction impact of zinc, boron, and iron was shown to be most important when it came to quality-related characteristics including total soluble solids, ascorbic acid with lowest acidity, reducing sugars, non-reducing sugars, and total sugars in Kagzi Lime.

Tyagi *et al.* (2017) observed that K application increased the photosynthesis, which lead to accumulation of carbohydrates and increased fruit yield and quality. Kumar *et al.* (2006) reported that the application of potassium enhanced the TSS level (10.1° Brix) in the papaya pulp since it is known to assist translocation of sugar in plants.

In the Ratnagiri district of Maharashtra where soil is deficient in K (due to heavy rainfall, 5000 mm per year), it was clearly demonstrated that potassium application is necessary to produce quality fruits with attractive colour (Kumar *et al.,* 2006)

Bakshi *et al*. (2013) reported in strawberry cv. Chandler, treatment of 0.6 percent $ZnSO_4$ resulted in the greatest TSS, ascorbic acid TSS/acid ratio, and lowest acidity.

Arshad and Ali (2016) observed that in guava, foliar Zn treatment resulted in greater TSS, Vitamin C levels, and firmness with decreased acidity.

According to Paul and Nair (2015), foliar application of $ZnSO_4$ + $FeSO_4$ + $CuSO_4$ + H_3BO_3 + $(NH_4)_2MoO_4$ resulted in the greatest total sugar, reducing sugar, and lowest non-reducing sugar in banana cv. Nendran.

Shibuya (1997) claimed that passion fruit's acidity decreased as nitrogen application increased. According to research by Rao *et al.* (2014), TSS was shown to rise as nitrogen levels raised; nevertheless, the results are statistically on par when 100 and 150 g of nitrogen per hectare are applied to the Purple Passion fruit variety.

According to Borges *et al.* (2007), potassium deficiency in passion fruit delayed flowering and declined production, including reduction in fruit size. As a result, the quality of the fruit and juice is affected.

According to Freitas *et al.* (2006), fruits with low levels of N, P, and K content had minimal TSS. Also deficiency of N, K & S in nutritional solution causes reduction in Ascorbic acid content in passion fruit.

Charan *et al.* (2018) reported that, the ascorbic acid content of passion fruit ranges from 16.98 to 30.50 mg $100g^{-1}$ and the total carotenoids ranges from 1.07 to 2.81 mg $100g^{-1}$.

According to Oliveira *et al*. (2011), the yellow passion fruit's average seed yield was 4.23 percent. Coelho *et al*. (2011) reported an 11.50 percent seed yield. They claimed that the size and shape of the fruits in yellow passion fruit didn't influence seed yield.

According to Silva *et al.* (2008), the pulp yield in yellow passion fruit ranges between 31.44 and 41.28 percent. As reported by Silva *et al*. (2015) the average pulp yield of yellow passion fruit is 44.43 percent.

2.4 SHELF LIFE OF FRUITS

Fruit with thicker skins are more suited for long-distance transportation because they minimise physical damage-related postharvest losses (Suassuna *et al*., 2011)

According to Tyagi *et al*. (2017) high N concentration decreases post-harvest life due to increased vulnerability to mechanical damage, physiological problems, and decay.

Optimized fertilization is crucial for the marketability of fruits after harvest since it has a substantial impact on how much different bioactive components are present in fruits due to nutrition management and organic fertilization in fruit crops (Tyagi *et al*., 2017)

Kumar *et al*. (2006) reported that, K application improves storage and shipping quality and extends shelf life in fruit crops

2.6 PLANT ANALYSIS

Joy (2010) discovered that zinc and B are the micronutrients that the passion fruit plant absorbs the most, followed by Mn and Fe.

According to Hariprakasarao *et al*. (1988), increasing N, P, and K application levels led to greater leaf N, P, and K statuses during the blooming stage of passion fruit.

Deshmukh *et al*. (2017) opined that although passion fruit vines are heavy feeders, over-fertilization will harm the roots and possibly kill the plant.

Mc. Artney and Ferree (1999) found that petiole N was inversely correlated with the number of shoots per vine.

Senthilkumar *et al.* (2015) found that plants with higher bud loads in 'Perlette' grapes had lower petiole N, P, and K contents.

According to Borges *et al*. (2003) passion fruit requires more potassium than nitrogen.

The index leaves (youngest fully developed leaf plus the next 9 older leaves) of the passion fruit had a N content of 1.5–7.98%. Growth and productivity were improved when the N content in the index leaves was 4.5–5.5% (Menzel *et al.*, 1991).

Boaretto *et al.* (2002) reported that foliar fertilization of Zn enhanced leaf Zn concentration to optimun range in orange plants.

Menzel *et al.* (1993) stated that 0.15 to 0.25 percent P concentration was ideal for maintaining good productivity in passion fruit plants.

Kondo and Higuchi (2013) stated that for optimum yield in passion fruit, a leaf P concentration of 0.21 percent is recommended.

Fe, Zn, and B content in leaves of pomegranates were considerably raised by foliar application of $FeSO_4$ (0.4%), $ZnSO_4$ (0.25%), and borax (0.2%) alone or in combination (Afria *et al.*, 1999).

Dutta and Dhua (2002) observed that application of Zn (0.1 and 0.2%) enhanced the nitrogen and zinc status of mango leaf tissue.

2.7 FRUIT ANALYSIS

The quality of the fruit is significantly impacted by fertilisation. For optimum nutrient uptake and to get a consistently high yield of better-quality passion fruit, suitable manures and fertilisers must be applied (Fischer *et al*., 2018)

Due to the limited generation of dry matter, Haag *et al.* (1973) found that the absorption of nutrients in passion fruit was low until the 7th to 8th months. After the fruits emerge (8th and 9th months), growth becomes exponential, increasing the uptake of N, K, and Ca.

Patel (2015) reported that foliar sprays of $ZnSO_4$ (0.5%), $FeSO_4$ (0.5%), and Borax (0.2%) resulted in 6.36% zinc content and 1.56% boron content in mango cv. Amrapali compared to the control (4.40% and 0.95%, respectively).

Among, the nutrients removed in the harvested fruits in passion fruit , the largest quantity was that of K followed by N (Haag *et al.*, 1973).

Application of micronutrients to guava plants significantly increased the mineral content of fruit (Fe, Mn, and Zn) (El-Sisy, 2011).

2.8 PEST AND DISEASE

Pruning passionfruit vines is done to prevent pests and diseases and to promote new vine growth (Joy, 2010)

A variety of insect pests, mites, nematodes, and bacterial, viral and fungal plant infections afflict the passion fruit, which can seriously injure the plants and fruit (Bailey *et al.*, 2021)

According to Abasi *et al.* (2018), higher pruning intensity resulted in less dieback disease, whereas lower pruning intensity resulted in a higher incidence of dieback disease. Low pruning intensity allows for a dense canopy, which fosters a disease-friendly environment. As a result, moderate pruning may be the best option because it reduces dieback and encourages maximum yield.

If neglected, fresh vine growth may eventually cover older vine growth that has lost its leaves, creating a thatch-like canopy of decomposing leaves. This could be a source of fungi diseases that impair the quality of new leaves and fruit (Bailey *et al*., 2021)

Cushnie (2011) claims that moderate pruning results in an optimum canopy density that permits proper aeration and creates an environment that is unfavorable for the incidence of dieback.

Skinkis (2013) reported that low pruning intensity allows for a dense canopy, which encourages a disease-friendly environment.

Tripathi *et al.* (2014) reported that brown spot is the major disease in passion fruit, followed by root rot.

According to Yadav and Patel (2004), purple varieties are more prolific and grew at higher elevations, but they are sensitive to collar rot and nematodes.

Zhang *et al.*, 2018 opined that pruning should be carried out in late winter or early spring to considerably reduce the risk of infection.

According to Tyagi *et al*. (2017), poor fertilizer management will promote physiological disorders in fruit crops due to mineral deficiencies of some or increases of other resulting in toxicity.

Tyagi *et al.* (2017) stated that Zn deficiency is most prevalent in fruit crops, and foliar spraying of zinc sulphate 0.5% increased overall plant health and reduced leaf chlorosis and dieback in kinnow mandrins.

2.9 ECONOMIC ANALYSIS

Lokesh *et al*. (2004) evaluated the economics of passion fruit growing in the Gonikoppa district of Karnataka and indicated 5-6 years as the economic life of a passion fruit orchard. They discovered that ₹ 71,500 was spent on the establishment of the orchard. The vine begins fruiting in the second year, yielding 200 quintals per hectare in the third and following years, with a net return of ₹ 81,125 per hectare and a benefit cost ratio of 2.17.

A study conducted by Hafle *et al.* (2010) to investigate the economic profitability of yellow passion fruit in various plant formations revealed that, more severe pruning techniques (20 and 14 branches per plant) resulted in greater production costs and decreased productivity, as well as higher economic and operational expenditures. For systems with fewer tertiary branches, the net income was negative (T_4 and T_5). Less severe pruning led to systems with positive net income ranging from R$ 1,861.06/ha in T3 to R$ 3,895.74/ha (2006/2007) in T_2.

According to Senthilkumar *et al. (*2015), adopting judicious pruning techniques could assure a high net return in grapes with higher productivity.

Reddy (2010) reported that in papaya cv. Sunrise Solo, net returns were best in the treatment where plants were sprayed with boron 0.2 percent, which gave 3.28 lakh compared to 0.08 lakh in the control.

According to Patel *et al.* (2010), foliar treatment of $ZnSO_4$ + $FeSO_4$ on banana cv. Basarai led to a greater Benefit-Cost ratio.

Materials and Methods

3. MATERIALS AND METHODS

The present study on “Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.) for enhancing growth, yield and quality” was conducted at the Department of Fruit Science, College of Agriculture, Vellayani . The Field experiment was conducted at RARS Ambalavayal, during 2020-2021. The objective of the experiment was to standardise the effects of various levels of pruning and foliar nutrition on growth, yield, and quality of passion fruit. The details of experimental site as well as materials and methods adopted are discussed in this chapter.

3.1 EXPERIMENTAL SITE

The experimental site is located 974 metres above mean sea level at 8.5 degrees North latitude and 76.9 degrees East longitude. Laterite is the most common type of soil. The soil at the test site has a pH of 5.1 and is sandy clay loam in texture.

3.2 EXPERIMENTAL MATERIALS

The experiment was conducted in one year old standing crop of passion fruit variety 134P at RARS, Ambalavayal.

3.3 EXPERIMENTAL DETAILS

One year old plants were pruned and basal dose of fertilizers were applied to the plants. Application of different treatments were started one month after pruning in the main field.

Details of various treatments imposed

A: Pruning intensity(P)

P_1. - Removing quarter portion (25%) of current fruiting branch

P_2.-Removing half portion (50%) of current fruiting branch

P_3. - Removing three quarter portion (75%) of current fruiting branch

P_4.- No pruning (control)

B. Rejuvenation of pruned vines through foliar nutrition (F)

F_1.- 19:19:19 @ 1 %

F_2.-19:19:19 @ 1 % + Sampoorna KAU micronutrient mixture @1 %

F_3.- Water spray (control)

Treatment Combinations

T_1:P_1F_1

T_2: P_1F_2

T_3: P_1F_3

T_4: P_2F_1

T_5:P_2F_2

T_6: P_2F_3

T_7:P_3F_1

T_8: P_3F_2

T_9:P_3F_3

T_{10}: P_4F_1

T_{11}:P_4F_2

T_{12}:P_4F_3

Manuring of plants was done after pruning. Ad hoc Package of Practice Recommendation of passion fruit (80 N: 30 P_2O_5: 60 K_2O (g vine^{-1}) and FYM 10 kg vine^{-1} (Joy, 2010) were given uniformly to all treatments as soil application. Dead and diseased vines was removed as and when it was noticed. Rejuvenation of vines using foliar nutrition was done at three times- one month after pruning, at time of flowering and fruiting. Observations were recorded up to one year after pruning.

EXPERIMENTAL DETAILS

Design	: RBD
Number of treatments	: 12
Number of replications	: 3
Number of plants per plot	: 7
Spacing	: 4×4m
Plot size	: $112m^2$
Number of observational plants	: 5

3.4 OBSERVATIONS

3.4.1 **Biometric observations**

3.4.1.1 Number of newly emerged branches per vine

Number of newly emerged branches per vine was counted and recorded in each plant and average was worked out.

3.4.1.2 Days taken for emergence of new branches

Number of days from pruning to emergence of new branches was recorded and average was worked out.

3.4.1.3 Length of Plant

The length of the plants were measured in centimetres from the soil level to the tip of the plant at monthly intervals, and average was calculated.

3.4.1.4 Girth of Plants

Girth of the stem was measured above 5 cm from the ground level and expressed in centimeters.

3.4.1.5 Number of flowers produced per vine per month

The number of flowers found in each vine was counted and recorded, and average was calculated.

3.4.1.6 Days taken for first Flowering

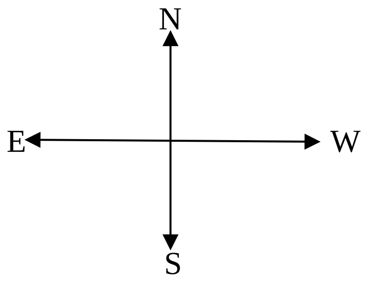
The number of days between pruning and the opening of the first flower was recorded using tagging, and average was calculated.

3.4.1.7 Days taken for first fruiting

The number of days between pruning and the first fruit set was recorded and average was taken.

3.4.1.8 Total flowers production per vine

The total number of flowers found in each vine was counted and recorded from the first to the last flowering, and average was calculated.



R_1T_4	R_2T_3	R_3T_4
R_1T_{11}	R_2T_6	R_3T_7
R_1T_2	R_2T_{11}	R_3T_5
R_1T_5	R_2T_2	R_3T_{10}
R_1T_6	R_2T_{10}	R_3T_3
R_1T_8	R_2T_{12}	R_3T_2
R_1T_{12}	R_2T_4	R_3T_8
R_1T_7	R_2T_7	R_3T_{12}
R_1T_{10}	R_2T_9	R_3T_1
R_1T_1	R_2T_1	R_3T_{11}
R_1T_9	R_2T_5	R_3T_6
R_1T_3	R_2T_8	R_3T_9

Fig.1 Lay out of the experimental plot

Plate 1. General field view

Plate 2. Pruning operation at the field

25% pruning 50% pruning 75% pruning

Plate 3. Different levels of pruning

Plate 4. Field after pruning

Plate 5. Different flowering stages of passion fruit

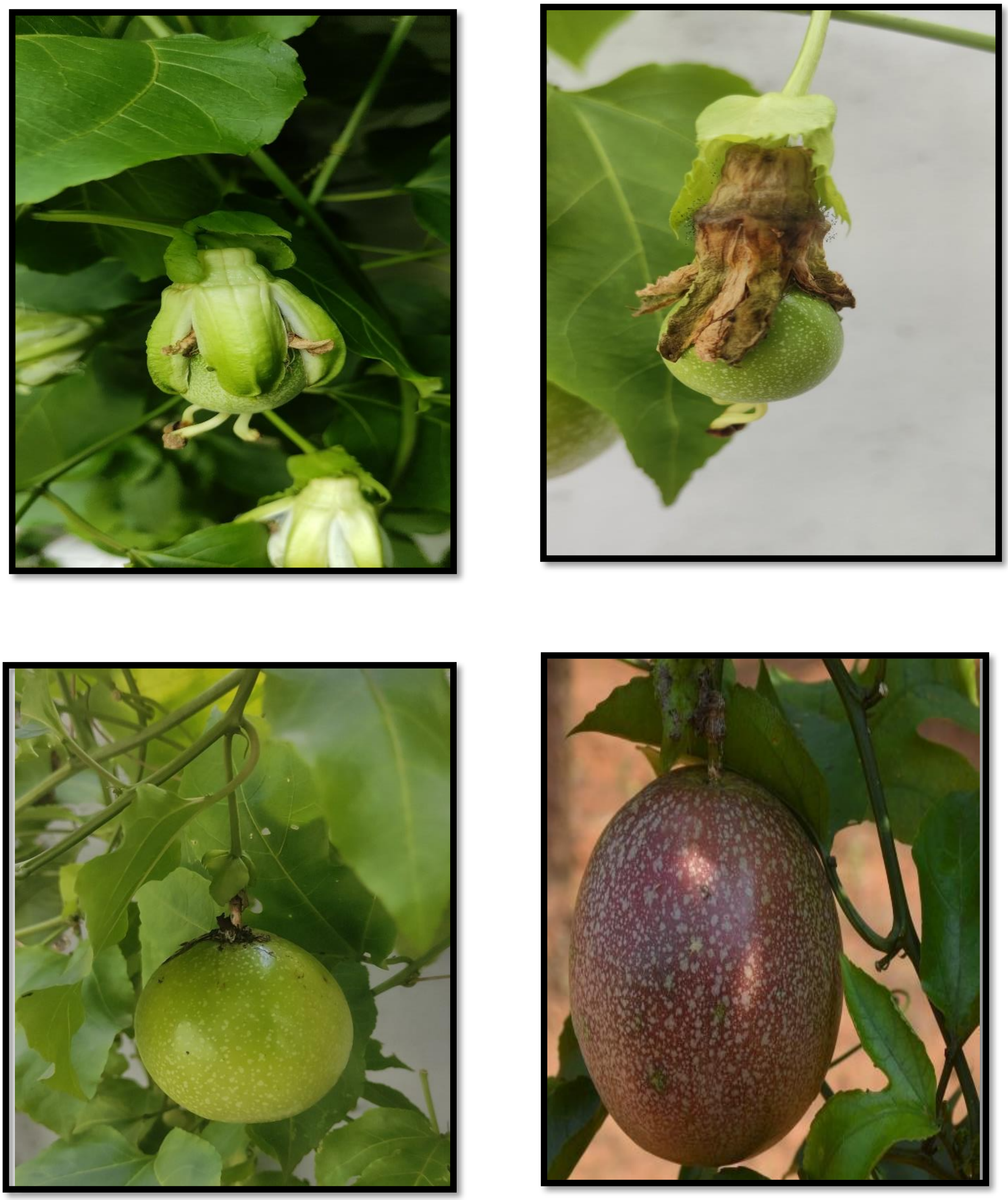


Plate 6. Different fruiting stages of passion fruit

Plate 7. Fruit bearing stage at the field

3.4.1.9 Flowering to harvest duration (Days)

The number of days from blossoming to the first fruit harvest was observed and recorded, and an average was calculated.

3.4.2 Yield characters

3.4.2.1 Number of fruits per vine per month

The number of fruits found in each vine was counted and recorded, and average was calculated.

3.4.2.2 Total fruits production per vine

The fruits were weighed and recorded at each harvest from each plant, and average was determined.

3.4.2.3 Rind color

Rind color was expressed as different intensity of purple color based on the external appearance of the fruit.

3.4.2.4 Pulp color

Pulp color was visually identified with the help of Universal Color Language (UCL). The Universal Color Language was defined by the Inter-society Color Council, National Bureau of Standards in 1946

3.4.2.5 Fruit diameter

Fruit diameter was measured with a thread and scale, and the measurement was expressed in centimetres.

3.4.2.6 Fruit weight

The weight of ten fruits was taken with a weighing balance, and the average was calculated and expressed in grams.

3.4.2.7 Pulp weight

The weight of the pulp from ten fruits was measured with a weighing balance, and the average values were calculated and expressed in grams.

3.4.2.8 Rind weight

Rind from ten fruits were weighed using a weighing balance, and average values were calculated and represented in grams.

3.4.2.9 Juice weight

The juice extracted from ten fruits in each treatment was weighed using a weighing balance and average was calculated.

3.4.2.10 Seed weight

Seeds were collected from the pulp, seed weight was measured with a weighing balance, and average values were calculated.

3.4.2.11 Rind thickness

Fruit rind thickness was measured with a vernier caliper, and the average was taken and stated in centimetres.

3.4.2.12 100 Seed weight

The weight of the hundred seeds from each fruit was measured using a weighing balance, and average values were taken and expressed in grams.

3.4.3 Quality characters

3.4.3.1 Total soluble solids

TSS was measured immediately using a digital refractometer and expressed in degree Brix.

3.4.3.2 Acidity

The titrable acidity of the fruit pulp was evaluated using the A.O.A.C. method (1998) and expressed as a percentage of anhydrous citric acid.

3.4.3.3 Total carotenoids

The total carotenoid present in the fruit was analyzed using Jensen's (1978) method and expressed as a percentage.

3.4.3.4 Ascorbic acid content

The ascorbic acid concentration was determined using the A.O.A.C. technique (1998) and expressed as mg per 100 gram of pulp.

3.4.3.5 Total sugar

Total sugar was estimated on a fresh weight basis using the A.O.A.C. technique (1975) and expressed in percentage.

3.4.3.6 Sugar /Acid ratio

The sugar acid ratio was calculated by dividing total sugar by titrable acidity.

3.4.3.7 Reducing sugar

According to the technique recommended by the A.O.A.C. method (1998), the reducing sugar content on a fresh weight basis was calculated and reported in percentage.

3.4.3.8 Non- reducing sugar

The non-reducing sugar content of the fruit was calculated by subtracting the value of reducing sugars from the total sugar value (Ranganna, 1997).

3.4.4 Organoleptic evaluation

A panel of judges from various age groups evaluated the quality of passion fruit using a 9-point hedonic scale to assess its appearance, colour, flavour, texture, taste, and overall acceptability (Amerine *et al*., 1965). A mark of 5.5 or higher was regarded as acceptable.

3.4.5 Shelf life of fruits at ambient conditions (days)

Fruits' shelf life under ambient conditions was calculated as the number of days from ripening to the point at which the fruit skin shrank and became unfit for consumption.

3.4.6 Plant analysis

3.4.6.1 NPK Content of leaf

Tissue samples (leaf petiole) were collected from the 4th leaf from the apex (index leaf).
Nitrogen content was estimated by Modified kjeldahl method (Jackson, 1973).
Phosphorus content was estimated using spectrophotometer and Flame Photometric method (Piper, 1966) was used in the estimation of K content in the leaf petiole.

3.4.6.2 Micro nutrient content (B, Zn,) of leaf

The plant sample is digested using nitric-perchloric acid (9:4) digestion mixture and absorbance value was recorded using Atomic Absorption Spectrometer (Jackson, 1973)

3.4.7 Fruit analysis

Fruits were taken from each replication and analysed for total N, P, K, and micronutrients (B and Zn) using steps described by Ranganna (1997) after drying in a hot air oven at 65°C.

3.4.8 Pest and disease incidence

The frequency of pest and disease incidence was regularly examined in the plants.

3.4.9 Economic analysis

3.4.9.1 Net Income

The economics of cultivation of the crops was worked out
Net income (₹ ha^{-1}) = Gross income – Cost of cultivation

3.4.9.2 B: C ratio

$$BCR = \frac{\text{Gross income}(₹\ ha^{-1})}{\text{Cost of cultivation}(₹\ ha^{-1})}$$

3.4.10 STATISTICAL ANALYSIS

Analysis of variance was used to evaluate for significance after the experiment data were statistically examined using a Randomized Block Design (Panse and Sukhatme, 1985).

The Kruskal-Wallis test was used for organoleptic analysis to get the mean rank values for all the treatments from the various scores provided by the 10 judges of the sensory panel (Sidney,1988)

Results

4. RESULTS

The current study to find out the effect of pruning and foliar application of primary and micronutrients for enhancing growth, yield and quality of passion fruit was conducted at the Regional Agricultural Research Station, Ambalavayal during 2019-2021. The results of the study are presented below.

4.1 Biometric characters

4.1.1 Number of newly emerged branches per vine

The data on the influence of pruning and foliar nutrition on number of newly emerged branches per vine are presented in Table 1.

The pruning and foliar nutrition given to the plants had shown significant variation among the different treatments in terms of number of newly emerged branches per vine. The highest number of newly emerged branches per vine was recorded for the treatment T_8 (119.16) which was on par with T_7 (116.27), T_5 (110.83) followed by T_4 (102.93) which was on par with T_6 (99.13). The lowest number of newly emerged branches per vine was observed in T_{12} (72.17) which was on par with T_{10} (78.83) and significantly different from other treatments.

4.1.2 Days taken for emergence of new branches

The data on the influence of pruning and foliar nutrition on number of newly emerged branches per vine are presented in Table 1.

The pruning and foliar nutrition given to the plants had shown significant variation among the different treatments in terms of number of newly emerged branches per vine. The least number of days was recorded for T_8 (7.40 days) which was on par with T_7 (7.73 days), T_5 (8.53days) followed by T_9 (9 days) which was on par with T_4 (9.07 days), T_6 (9.60days). The longest duration for emergence of new branches was recorded for T_{12} (15.73days) which was significantly different from other treatments.

4.1.3 Length of plant

Data of vine length influenced by combination of pruning and foliar nutrition are presented in Table 2:

The length of the plants was taken regularly at bimonthly intervals from 1 month after pruning to 12 months after pruning**.** The significant variation in the length of the plants was observed in different treatments at bimonthly observations from 1 MAP to 12 MAP.

At 2 months after pruning, the treatment means were not significantly different

At 4 months after pruning, the longest vine was produced in the treatment T_5 (10.58 m) which was on par with the treatments T_4 (9.64 m) and T_8 (9.56 m) followed by the treatment T_2 (9.34 m) which was on par with the treatments T_7 (9.14 m) and T_{12} (8.55 m). The shortest vine was produced in the treatment T_3 (7.44 m) which was on par with the treatments T_{10} (7.84 m), T_6 (8.16 m), T_1 (8.22 m), T_9 (8.26 m) and T_{11} (8.36 m)

At 6 months after pruning, the longest vine length was recorded in the treatment T_5 (11.88 m) which was significantly different from other treatments followed by T_4 (10.94 m) which was on par with the treatments T_8 (10.86 m), T_2 (10.64 m) and T_7 (10.44 m). The shortest vine length was recorded in the treatment T_3 (8.53 m) which was on par with the treatments T_{10} (9.14 m) and T_{12} (9.02 m).

Observation recorded at 8 months after pruning showed that, T_5 (12.28 m) recorded the longest vine length, which was significantly different from other treatments, followed by T4 (11.34 m), T_8 (11.26 m), T_2 (7.04 m) and T_7 (10.84 m). The treatment T_3 (8.95 m) recorded the shortest vine length which was on par with the treatments T_{12} (9.40 m), T_6 (9.52 m) and T_{10} (9.54 m).

Observation recorded at 10 months after pruning showed that, treatment T_5 (12.88 m) records the longest vine length which was on par with the treatment T_4 (12.34 m), followed by T_8 (11.86 m) which was on par with T_2 (11.64 m) and T_7 (11.44 m). The treatment T_3 (9.55 m) recorded the shortest vine length which was on par with T_{12} (9.93 m), T_6 (10.12 m) and T_{10} (10.14 m)

At 12 months after pruning, the longest vine length was recorded in the treatment T_5 (13.48 m) which was on par with T_4 (13.11 m) followed by T_8 (12.46 m) which was on par with the treatments T_2 (12.24 m) and T_7(12.04m). The shortest vine length was

Table 1. Effect of pruning and foliar nutrition on number of newly emerged branches per vine and days taken for emergence of new branches

Treatments	Number of newly emerged branches per vine	Days taken for emergence of new branches
T_1	92.60	12.27
T_2	93.60	12.67
T_3	88.00	13.60
T_4	102.93	9.07
T_5	110.83	8.53
T_6	99.13	9.60
T_7	116.27	7.73
T_8	119.17	7.40
T_9	94.83	9.00
T_{10}	78.83	13.80
T_{11}	87.67	13.87
T_{12}	72.17	15.73
S.Em	3.68	0.42
CD(0.05)	10.81	1.24

recorded in the treatment T_3 (10.15 m) which was on par with treatments T_{12} (10.31 m) and T_6 (10.61m).

4.1.4 Girth of the plant (cm)

Data of plant girth influenced by combination of pruning and foliar nutrition are presented in Table 3:

The girth of the plants were taken regularly at bimonthly intervals from 2 month after pruning to 12 month after pruning**.**

Observation noted at 2 month after pruning showed that, treatment T_5 (14.70 cm) recorded highest plant girth which was on par with the treatments T_4 (13.90 cm) and T_8 (13.70 cm).The lowest plant girth was recorded in treatment T_{10} (7.95 cm) which was on par with treatments T_6 (8.50 cm),T_9 (9.08 cm) , T_{11} (9.52 cm) and T_{12} (10.20 cm)

At 4 months after pruning, the treatment T_5 (15.83 cm) records highest plant girth which was on par with the treatments T_4 (15.03 cm) and T_8 (14.67 cm) followed by T_1 (12.60 cm) which was on par with the treatments T_3 (12.33 cm), T_7 (11.73 cm), T_{12} (11.93 cm), T_2 (11.47 cm), T_9 (10.31 cm) and T_6 (9.73 cm). The lowest plant girth was recorded in the treatment T_{10} (9.18 cm)

At 6 months after pruning, the treatment means were not significantly different

At 8 months after pruning, treatment T_5 (17.33 cm) recorded highest plant girth which was on par with the treatments T_4 (16.53 cm) and T_8 (16.37 cm). The lowest plant girth was recorded for the treatment T_{10}(10.62 cm) which was on par with the treatments T9 (11.82 cm), T_{11}(12.15 cm) and T_{12} (12.91 cm).

At 10 months after pruning, treatment T_5 (17.93 cm) which was on par with treatments T_4 (17.13 cm) and T_8 (16.97 cm).The lowest plant girth was recorded for the treatments T_{10} (11.44 cm) which was on par with the treatments T_6 (11.93 cm),T_9 (12.42 cm) , T_{11} (12.75cm) and T_{12} (13.74cm)

At 12 months after pruning, the treatment means were not significantly different

Table 2. Effect of pruning and foliar nutrition on length of the plant (m)

Treatments	2 months after pruning	4 months after pruning	6 months after pruning	8 months after pruning	10 months after pruning	12 months after pruning
T_1	7.32	8.22	9.52	9.92	10.52	11.21
T_2	8.44	9.34	10.64	11.04	11.64	12.24
T_3	6.54	7.44	8.53	8.95	9.55	10.15
T_4	8.74	9.64	10.94	11.34	12.30	13.11
T_5	9.35	10.58	11.88	12.28	12.88	13.48
T_6	8.26	8.16	9.46	9.52	10.12	10.61
T_7	8.24	9.14	10.44	10.84	11.44	12.04
T_8	8.67	9.56	10.86	11.26	11.86	12.46
T_9	7.57	8.26	9.47	9.63	10.23	10.83
T_{10}	7.94	7.84	9.14	9.54	10.14	10.74
T_{11}	7.46	8.36	9.66	10.06	10.66	11.26
T_{12}	7.86	8.55	9.02	9.40	9.93	10.31
S.Em	0.50	0.37	0.31	0.21	0.20	0.19
CD(0.05)	NS	1.08	0.92	0.61	0.59	0.56

Table 3. Effect of pruning and foliar nutrition on girth of the plant in passion fruit (cm).

Treatments	2 months after pruning	4 months after pruning	6 months after pruning	8 months after pruning	10 months after pruning	12 months after pruning
T_1	11.40	12.60	13.40	14.10	14.70	14.97
T_2	10.30	11.47	12.27	12.97	13.98	14.57
T_3	11.10	12.33	13.13	13.83	14.43	14.73
T_4	13.90	15.03	15.83	16.53	17.13	17.23
T_5	14.70	15.83	16.63	17.33	17.93	18.13
T_6	8.50	9.73	10.63	11.43	11.93	12.27
T_7	10.57	11.73	12.53	13.23	13.83	14.03
T_8	13.70	14.67	15.67	16.37	16.97	17.23
T_9	9.08	10.31	11.12	11.82	12.42	12.75
T_{10}	7.95	9.18	9.92	10.62	11.44	11.38
T_{11}	9.52	10.65	11.45	12.15	12.75	12.95
T_{12}	10.20	11.10	12.02	12.81	13.74	14.27
S.Em	1.67	1.85	1.64	1.47	1.51	1.44
CD(0.05)	2.67	3.12	NS	2.38	2.44	NS

NS-Non significant

4.1.5 Number of flowers produced per vine per month

Data on the effect of pruning and foliar nutrition on number of flowers produced per month is depicted in Table 4.

Flower production started from 2 months after pruning. The significant variations in the number of flowers produced per month were observed in different treatments at monthly observations.

Results of data on number of flowers produced per vine per month at 2 months after pruning showed that the highest number of flowers recorded in T_5 (7.83) which differed significantly from all other treatments followed by T_2 (5.83). which was on par with T_1 (5.5), T_4 (5.17), T_{10} (4.17), T_6 (4.17) and differed significantly from all other treatments. The number of flowers found to be lowest for T_9 (1.50) which was on par with T_7 (1.83), T_8 (2.50) and T_{12} (2.50).

At 3 months after pruning, treatment T_5(14.95) which was on par with T_4 (14.42), T_1 (13.52), T_2 (13.40) recorded the maximum number of flowers and differed significantly from all other treatments. This was followed by T_6 (10.15) which was on par with T_{11} (9.29), T_8 (9.16), T_3 (8.49), and differed significantly from all other treatments. The lowest number of flowers was recorded in T_9 (5.82) which was on par with T_{12} (6.16), T_{10} (6.73) and T_7 (7.21).

At 4 months after pruning, the mean flower production was found to be the highest for T_5 (25.11) which differed significantly from all other treatments followed by T_4 (20) which was on par T_1 (18.70) and followed by T_2 (16.56) which was on par with all other treatments. Absolute control, T_{12} (9.82) recorded the lowest number of flowers which was on par with T_{10} (11.14), T_9 (11.15) and T_7 (11.18)

At 5 months after pruning, the treatment means were not significantly different

At 6 months after pruning, the highest number of flowers per plant was observed for T_5 (40.55) which was significantly different from all other treatments followed by T_4 (35.07) which was on par with T_2 (35.06), T_1 (31.19) and followed by T_{11} (25.48). The lowest number of flowers was observed for absolute control treatment. T_{12} (19.16) which was on par with T_9 (20.16), T_{10} (21.20), T_7 (21.89) and T_8 (22.37)

At 7 months after pruning, the mean flower production was found to be the highest for T_5 (21.57) which differed significantly from all other treatments followed by T_2 (15.26) which was on par with T_4 (14.92) followed by T_8 (12.55). Absolute control, T_{12} (8.12) recorded the lowest number of flowers which was on par T_{10} (8.75), T_{11} (9.71), T_7 (9.91) and T_9 (10.04).

At 8 months after pruning, the treatment means are not significantly different

At 9 months after pruning, the mean flower production was found to be the highest for T_5 (8.98), which was on par with T_2 (7.41) and differed significantly from all other treatments followed by T_4 (7.20) which was on par with T_1 (6.46), T_7 (6.11), T_8 (5.97) and T_3 (5.74). Absolute control, T_{12} (3.43) recorded the lowest number of flowers which was on par with T_{10} (4.15) and T_{11} (4.27)

4.1.6 Days taken for first flowering

The data regarding the days taken for first flowering is inscribed in Table no 5.

Results of the statistical analysis showed that number of days taken for first flowering in passion fruit showed significant difference on the levels of pruning and foliar nutrition applied to the vine. Least number of days for first flowering was observed in treatment T_5 (64.67days), which was on par with T_2 (67.67days) followed by T_1 (70days) which was on par with T_4 (70.67days) and T_8 (71.33days). The highest number of days for first flowering was observed for T_{12} (86.00days) absolute control which was significantly different from other treatments.

4.1.7 Days taken for first fruiting

The data regarding the days taken for first fruiting is inscribed in Table no 5.

Results of the statistical analysis showed that number of days taken for first fruiting in passion fruit showed significant difference on the doses of secondary and micronutrients applied to the vine. Least number of days for first fruiting was observed in treatment T_5 (73.83 days), which differed significantly from all other treatments. This was followed by T_4 (82.83 days) which was on par with T_2 (83.17 days), T_1 (85.17 days) and the longest number of days for first flowering was observed for T_{12} (102.5 days) which differed significantly from other treatments.

Table 4. Effect of pruning and foliar nutrition on number of flowers produced per month in passion fruit.

*MAP-Months after pruning

Treatments	2 MAP	3 MAP	4 MAP	5 MAP	6 MAP	7 MAP	8 MAP	9 MAP
T_1	5.50	13.52	18.71	11.48	31.19	12.29	10.48	6.46
T_2	5.83	13.40	16.56	13.08	35.06	15.26	11.08	7.41
T_3	3.83	8.49	13.15	13.49	23.18	11.82	9.49	5.74
T_4	5.17	14.42	20.00	10.28	35.07	14.92	8.28	7.20
T_5	7.83	14.95	25.11	12.49	40.55	21.57	10.49	8.98
T_6	4.17	10.15	13.07	11.74	25.10	11.42	9.74	5.27
T_7	1.83	7.21	11.18	12.83	21.89	9.91	10.83	6.11
T_8	2.50	9.16	12.75	12.81	22.37	12.55	12.48	5.97
T_9	1.50	5.82	11.15	11.85	20.16	10.04	9.85	5.56
T_{10}	4.17	6.73	11.14	10.25	21.20	8.75	8.25	4.15
T_{11}	3.50	9.29	14.23	12.49	25.48	9.71	10.49	4.27
T_{12}	2.50	6.16	9.82	9.29	19.16	8.12	7.29	3.43
S.Em	0.64	0.97	0.94	1.43	1.34	0.85	1.33	0.57
CD(0.05)	1.89	2.85	2.74	NS	3.92	2.49	NS	1.69

NS-Non significant

4.1.8 Flowering to harvest duration (days)

It is evident from the data in Table 5 that there was considerable influence of pruning and foliar nutrition on flowering to harvest duration.

Significant variation in number of days was seen from flowering to harvest duration in passion fruit. Least number of days from flowering to harvest duration was observed in treatment T_5 (63.00 days), which was on par with T_4 (64.15 days), T_8 (65.35 days) and highest number for days from flowering to harvest was noted in T_{12} (82.22 days) which was on par with T_{10} (81.09 days) which also differed significantly from other treatments.

4.1.9 Total flower production per vine

The different combinations of treatments applied had significant influence on the total number of flowers produced per vine in passion fruit (Table No 6).

The pruning and foliar nutrition given to the plants had shown significant variation among the different treatments in terms of total flowers vine^{-1}. The highest flowers vine^{-1} was recorded for T_5 (152.18 flowers) which was significantly different from all other treatments followed by T_4 (137.53 flowers) which was on par with T_2 (135.31 flowers) and T_1 (128.28 flowers). The total flowers produced vine^{-1} was the lowest for T_9 (87.91 flowers) which was on par with T_{12} (90.61 flowers), T_{10} (94.12 flowers) and T_3 (97.52flowers).

Table 5. Effect of pruning and foliar nutrient application on days for first flowering, first fruiting and flowering to harvest days in passion fruit.

Treatment	Days taken for first flowering	Days taken for first fruiting	Flowering to harvest duration (Days)
T_1	70.12	85.17	70.08
T_2	67.67	83.17	69.67
T_3	78.00	95.67	74.46
T_4	70.67	82.83	64.15
T_5	64.67	73.83	63.00
T_6	76.33	92.33	72.04
T_7	74.33	90.21	75.35
T_8	71.33	87.67	65.35
T_9	79.33	95.17	68.77
T_{10}	81.12	96.83	81.09
T_{11}	78.67	89.50	74.92
T_{12}	86.00	102.50	82.21
S.Em	1.6	1.32	1.10
CD(0.05)	3.39	3.87	3.23

Table 6. Effect of pruning and foliar nutrition on total flowers produced per vine in passion fruit (number)

Treatments	Total flower production per vine (number)
T_1	135.31
T_2	128.28
T_3	97.52
T_4	137.53
T_5	152.18
T_6	113.43
T_7	104.35
T_8	117.40
T_9	87.91
T_{10}	94.12
T_{11}	105.75
T_{12}	90.61
SEm(±)	3.97
CD(0.05)	11.64

4.2 Yield characteristics

4.2.1 Number of fruits produced per vine per month

The different doses of pruning and foliar nutrition combination applied had significant influence on the number of fruits produced per month per vine in passion fruit (Table No 7).

Fruit production was started from 5 months after pruning and significant variations in the number of fruits produced per month were observed in different treatments from 5 months after pruning to 10 months after pruning.

At 5 months after pruning, the mean fruit production was highest for T_5 (7.83) which differed significantly from all other treatments followed by T_2 (6.17) which was on par with T_4 (6.17) followed by T_1 (4.50). T_9 (1.17) recorded the lowest number of fruits in passion fruit plants which differed significantly from all other treatments followed by T_{12} (7.03) which was on par with all other treatments except T_5,T_2,T_4,T_1

At 6 months after pruning, the mean fruit production was highest for T_5 (12.67) and was on par with T_2(11.67) which differed significantly from all other treatments, this was followed by T_4 (11.00) and T_1 (9.33). T_9 (4.17) recorded the lowest number of fruits for passion fruit plants and differed significantly from other treatments, this was followed by T_{12}(5.83) which was on par with T_7 (6.00), T_3 (6.17), T_{10} (6.50) and T_8 (6.67)

Results of data on number of fruits at 7 month after pruning showed that, the highest number of fruits was recorded in T_5 (11.17) which differed significantly from all other treatments followed by T_4 (8.83) which was on par with T_2 (8.50) which also differed significantly from all other treatments followed by T_8 (6.33) which was on par with T_1 (6.00) and T_{11} (5.50). The number of fruits was found to be lowest for T_{12} (3.17) which was on par with T_9 (3.67), T_{10} (4.00), T_6 (4.50), T_7 (4.67), T_3 (4.67) and differed significantly from other treatments.

At 8 months after pruning, the mean fruit production was highest for T_5 (18.67) which differed significantly from all other treatments followed by T_2 (14.33) and T_4 (12.00) which was on par with T_1 (11.67) and T_8 (10.67). T_{12} (7.50) recorded the lowest number of fruits in passion fruit plants which was on par with T_9 (7.83), T_{10} (8.17), T_7 (8.33), T_6 (8.83) and T_3 (8.83).

At 9 months after pruning, the mean fruit production was found to be the highest for T_5 (21.67) which differed significantly from all other treatments followed by T_4 (18.33) followed by T_2 (16.00) which is on par with T_8 (15.17), T_1 (14.67) and T_7 (14.00). T_{12} (10.08) recorded the lowest number of fruits for passion fruit plants. which was on par with T_{10} (10.42), T_9 (10.92), T_3 (11.75), T_6 (12.25) and T_{11} (12.33)

At 10 months after pruning, the mean fruit production was highest for T_2 (4.83) which was on par with T_5 (4.80) which differed significantly from all other treatments and followed by T_4 (4.00) which was on par T_1 (3.83), T_8 (3.67). T_{12} (2.17) recorded the lowest number of fruits for passion fruit plants which was on par with T_9 (2.50), T_7 (2.50), T_6 (2.83) and T_3 (2.83)

4.2.2 Total fruit production per vine

The data on the influence of pruning and foliar nutrition on total fruits produced per vine are presented in Table No 7.

The pruning and foliar nutrition given to the plants had shown significant variation among the different treatments in terms of total fruit production. The maximum fruits produced per vine was recorded for T_5 (6.49 kg vine^{-1}) which was significantly different from other treatments and followed by T_4 (5.94 kg vine^{-1}) which was on par with T_2 (5.48 kg vine^{-1}). The total fruits produced per vine was the lowest for T_9 (2.62 kg vine^{-1}) which was on par with T_{12} (3.10 kg vine^{-1}) and differed significantly from other treatments.

Table 7. Effect of pruning and foliar nutrition on number of fruits produced per month in passion fruit.

Treatments	5 MAP	6 MAP	7 MAP	8 MAP	9 MAP	10 MAP
T_1	4.50	9.33	6.00	11.67	14.67	3.83
T_2	6.17	11.67	8.50	14.33	16.00	4.83
T_3	2.67	6.17	4.67	8.83	11.75	2.83
T_4	6.17	11.00	8.83	12.00	18.33	4.00
T_5	7.83	12.67	11.17	18.67	21.67	4.80
T_6	2.50	7.17	4.50	8.33	12.25	2.83
T_7	2.83	6.00	4.67	8.33	14.00	2.50
T_8	3.17	6.67	6.33	10.67	15.17	3.67
T_9	1.17	4.17	3.67	7.83	10.92	2.50
T_{10}	2.83	6.50	4.00	8.17	10.42	3.17
T_{11}	2.83	7.33	5.50	9.67	12.33	3.17
T_{12}	2.33	5.83	3.17	7.50	10.08	2.17
SEm(±)	0.39	0.43	0.55	0.67	0.78	0.30
CD(0.05)	1.15	1.27	1.62	1.97	2.30	0.79

*MAP- months after pruning

Table 8. Effect of pruning and foliar nutrition on total fruits produced per vine in passion fruit (Kg vine^{-1}).

Treatments	Total fruit production per vine (Kg vine^{-1})
T_1	5.20
T_2	4.48
T_3	3.37
T_4	5.94
T_5	6.49
T_6	3.65
T_7	3.14
T_8	3.52
T_9	3.10
T_{10}	3.30
T_{11}	4.09
T_{12}	2.62
SEm(±)	0.17
CD(0.05)	0.49

4.2.3 Rind colour

The data on rind colour of pulp influenced by pruning and foliar nutrition is presented in Table No 8.

The rind colour of the fruit was found to be deep purple with white specks for T_2, T_5, T_8. Purple with white specks for T_1,T_3,T_4,T_6,T_7,T_9,T_{11} and light purple with white specks for T_{10}, T_{12}

4.2.4 Pulp colour

The data on pulp colour of passion fruit for different treatments is presented in Table No 8.

The pulp colour was analyzed using Universal Colour Language (UCL).

4.2.5 Fruit diameter

Fruit diameter as influenced by different combinations of pruning and foliar nutrition are presented in Table 9.

The fruit diameter recorded from the different treatment's combination showed significant difference in passion fruit. The highest fruit diameter was recorded for T_5 (7.13cm) which was on par with T_8 (6.95 cm) and significantly different from all other treatments, followed by T_7 (6.90 cm) which was on par with T_4 (6.74 cm.), T_2 (6.66 cm.), also differed significantly from other treatments. The lowest fruit diameter was reported for control T_{12} (5.60 cm) which differed significantly from other treatments and on par with T_{10} (5.71 cm.) and T_{11} (5.82 cm.).

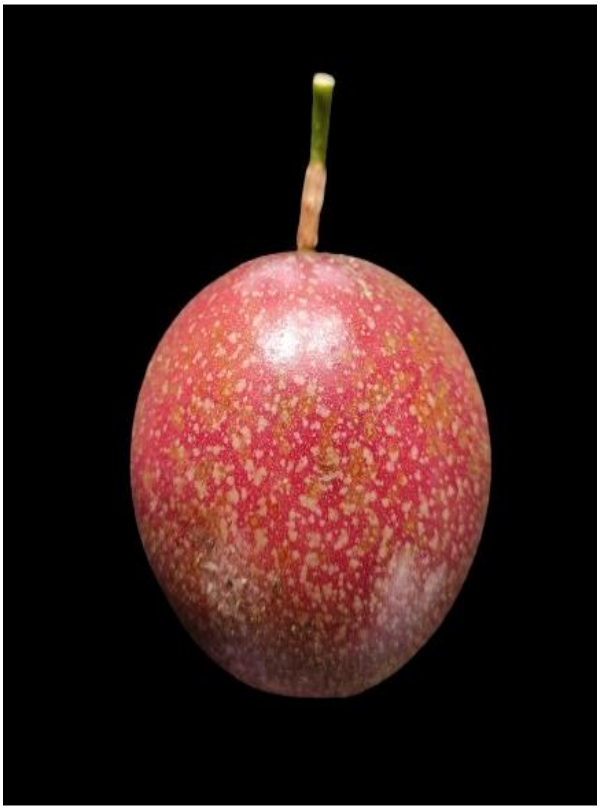
4.2.6 Fruit weight

Fruit weight as influenced by different treatment combinations of pruning and foliar nutrition are presented in Table 10.

The fruit weight recorded from different treatment combination showed significant difference in passion fruit. The highest fruit weight was recorded for T_5 (131.16 g) which was on par with T_8 (123.27g) and differed significantly from all other treatments, followed by T_2 (116.91 g) which is on par with T_7 (109.87g). The lowest

Table 9. Effect of pruning and foliar nutrition on rind and pulp color in passion fruit.

Treatments	Rind colour	Pulp colour
T_1	Purple with white specks	Vivid Yellow(9B)
T_2	Deep purple with white specks	Bright Orangish Yellow(21B)
T_3	Purple with white specks	Brilliant Greenish Yellow(4A)
T_4	Purple with white specks	Vivid Orangish Yellow(21A
T_5	Deep purple with white specks	Vivid Orangish Yellow(21A
T_6	Purple with white specks	Brilliant Greenish Yellow(4A)
T_7	Purple with white specks	Vivid Yellow(9B)
T_8	Deep purple with white specks	Vivid Orangish Yellow(21A)
T_9	Purple with white specks	Brilliant Greenish Yellow(6A)
T_{10}	Light Purple with white specks	Light Greenish Yellow(5C)
T_{11}	purple with white specks	Brilliant Greenish Yellow(2B)
T_{12}	Light Purple with white specks	Light Greenish Yellow(5C)

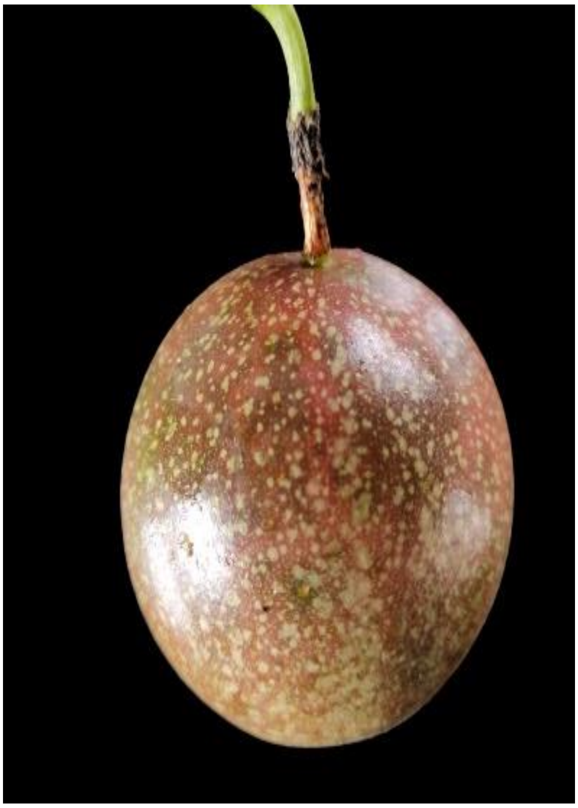


Fruit of T_5

50% pruning+

19:19:19@1%+

Sampoorna @1%

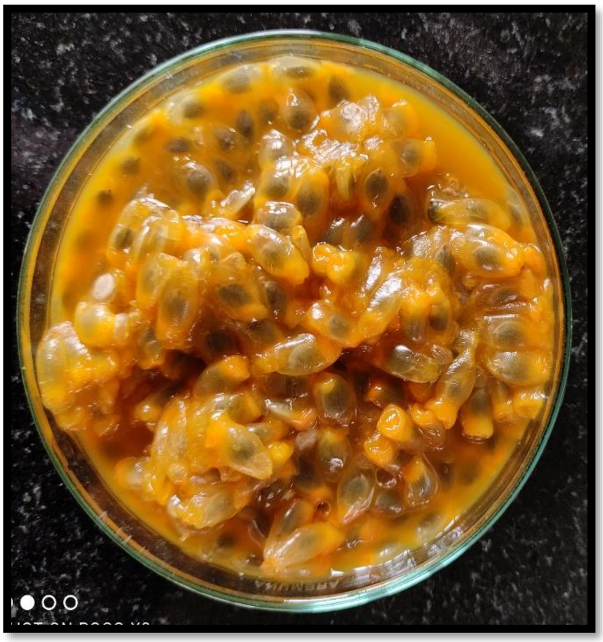


Fruit of T_{12}

No pruning and foliar

nutrition

Plate 8. Fruits of best treatment and control



Fruit pulp (T_5)

50% pruning+19:19:19@1%+Sampoorna @1%

Fruit pulp(T_{12})

No pruning and foliar nutrition

Plate 9. Fruit pulp of best treatment and control

fruit weight was reported for T_{12} (82.46g) which was on par with T_3 (86.61g), T_{10} (89.44g) and differed significantly from other treatments.

4.2.7 Pulp weight

Pulp weight as influenced by different treatment combination of pruning and foliar nutrition are presented in Table No 10.

The data recorded for pulp weight indicated that the highest pulp weight was obtained for T_5 (55.48 g) which was on par with T_8 (52.78 g) and significantly different from all other treatments, followed by T_2(47.66 g) which was on par with T_4 (47.16 g). The lowest pulp content was noticed with T_3 (31.31 g) which was on par with T_{12} (32.35 g.) and significantly different from other treatments.

4.2.8 Rind weight

Rind weight influenced by different treatment combination of pruning and foliar nutrition are presented in Table No 10.

The rind weight recorded from the different treatment combination showed significant difference in passionfruit. The highest rind weight was recorded for T_5 (63.93 g) which was on par with T_8 (59.13 g), T_2 (58.23 g) which were differed significantly from all other treatments. The lowest rind weight was reported for control T_{12} (40.44 g) which was on par with T_{10} (43.14 g), T_3 (44.57 g), T_6 (45.03g) and T_9 (45.47 g) which differed significantly from other treatments.

4.2.9 Juice weight

Juice weight influenced by treatment combination of pruning and foliar nutrients are presented in Table No 10.

The juice weight recorded from the different treatment combination showed significant difference in passion fruit. The highest juice weight was recorded for T_5 (40.61 g) which was on par with T_8 (35.93 g) and was significantly different from other treatments followed by T_2 (34.41 g), T_7 (33.78 g), T_4 (32.74 g), T_1 (31.62 g) and T_{11} (31.47 g). The lowest juice weight was recorded for T_{12} (25.31 g) which was on par with T_9 (27.41 g), T_6 (28.21 g), T_{10} (28.27 g) and T_3 (29.16 g)

Table 10. Effect of pruning and foliar nutrition on fruit diameter and rind thickness in passion fruit(cm).

Treatments	Fruit diameter (cm)	Rind thickness (cm)
T_1	6.56	0.57
T_2	6.66	0.53
T_3	5.91	0.47
T_4	6.74	0.63
T_5	7.13	0.67
T_6	6.40	0.47
T_7	6.90	0.57
T_8	6..95	0.60
T_9	5.86	0.53
T_{10}	5.71	0.43
T_{11}	5.82	0.53
T_{12}	5.60	0.43
SEm(±)	0.04	0.08
CD(0.05)	0.25	0.13

4.2.10 Total Seed weight

Seed weight as influenced by pruning and foliar nutrient treatment is presented in Table No 10.

The seed weight recorded from the different treatment combination showed significant difference in passionfruit. The highest seed weight was recorded for T_5 (11.75 g) which was on par with T_4 (11.36 g) and differed significantly from other treatments followed by T_8 (11.36 g) which was on par with T_7 (11.21 g). The lowest seed weight was reported for T_{12} (9.67 g) which was on par with T_{10} (9.97 g) and differed significantly from other treatments.

4.2.11 Rind thickness

Rind thickness as influenced by treatment combination of pruning and foliar nutrients are presented in Table No 9.

The different combination of pruning and foliar nutrition given to passion fruit plant had significant effect on rind thickness recorded. The thickness was found to be highest for T_5 (0.67 cm) which was on par with T_4 (0.63 cm), T_8 (0.60 cm), T_1 (0.57 cm) and T_7 (0.57 cm) but significantly differed from other treatments the rind thickness was found to be least in T_{12} (0.43 cm) which was on par with T_{10} (0.43cm), T_6 (0.46 cm), T_3 (0.46 cm) and T_9 (0.53 cm).

4.2.12 100 Seed weight

100 seed weight as influenced by different treatment combinations are presented in Table No 10.

The 100 seed weight recorded from the different treatment combination showed significant difference in passion fruit. The highest 100 seed weight was recorded for T_5 (4.98 g), T_4 (4.81 g), T_8 (4.65 g) and T_7 (4.53 g) which were significantly different from all other treatments, followed by T_2 (4.33 g) which was on par with T_3 (4.02 g). The lowest 100 seed weight was reported from T_{12} (2.97 g) which was on par with T_{10} (3.30 g), T_9 (3.49 g) and differed significantly from other treatments.

Table 11. Effect of pruning and foliar nutrient application on fruit weight, pulp weight, rind weight, seed weight and 100 seed weight

Treatments	Fruit weight (g)	Pulp weight (g)	Rind weight (g)	Juice weight (g)	Total Seed weight (g)	100 seed weight (g)
T_1	100.32	38.44	53.29	31.62	10.26	3.63
T_2	116.91	47.66	58.23	34.41	11.03	4.87
T_3	86.61	31.31	44.57	29.16	10.73	3.96
T_4	106.65	47.16	48.97	32.74	11.52	4.50
T_5	131.16	55.48	63.93	40.61	11.75	4.56
T_6	95.08	39.79	45.03	28.21	10.28	3.68
T_7	109.87	43.07	55.56	33.78	11.21	4.06
T_8	123.27	52.78	59.13	35.93	11.36	3.81
T_9	98.84	42.56	45.47	27.41	10.21	3.46
T_{10}	89.44	36.15	43.14	28.27	9.98	3.95
T_{11}	96.02	35.94	49.81	31.47	10.28	3.45
T_{12}	82.46	32.35	40.44	25.31	9.67	3.33
SEm(±)	2.90	1.24	2.09	2.06	0 .11	0.23
CD(0.05)	8.51	3.64	6.12	6.04	0.34	0.68

4.3) Quality characters

4.3.1 TSS

The data regarding the TSS as influenced by pruning and foliar nutrition are depicted in the Table 11.

The pruning and foliar nutrients applied to the plants in different combinations had shown significant difference in TSS of the fruits. The treatment T_5 (20.47°brix) recorded the highest TSS, which was significantly different from other treatments followed by T_4 (19.30°brix) which was on par with T_2 (18.77°brix.). The lowest TSS was observed for T_{12} (15.20°brix) and differed significantly from other treatments.

4.3.2 Acidity

Data on acidity of fruit influenced by pruning and foliar nutrition application is inscribed in Table No 11.

Pruning and foliar nutrients applied at different combinations had significant effect on acidity of passion fruits. The lowest value for acidity was recorded for T_4 (1.04 %) which was on par with T_2 (1.12%), T_5 (1.13%), T_7 (1.23%) and differed significantly from other treatments. The fruits were found to be highly acidic in T_{12} (2.60%) which was on par with T_{11}(2.36%) which differed significantly from other treatments followed by T_{10} (2.28 %) which was on par with T_9 (2.23 %) and T_3 (2.11%).

4.3.3 Sugar acid ratio

The sugar acid ratio of passion fruit was significantly influenced by different combinations of pruning and foliar nutrients applied. Sugar acid ratio was found to be maximum for T_4 (14.61) and was on par with T_5 (14.59) which was significantly different from other treatments followed by T_7(12.27) which was on par with T_2 (10.90). The lowest amount of sugar acid ratio was recorded for T_{12} (4.27) which was on par with T_{11} (4.88), T_{10} (5.54), T_3 (5.61) and significantly different from other treatments.

4.3.4 Ascorbic acid

Data on ascorbic acid on fruit influenced by pruning and foliar nutrient application is inscribed in Table No 11.

The ascorbic acid content in passion fruit was noticed to be highest in T_5 (34.11mg 100 g^{-1}) which was on par with T_2 (31.54 mg 100 g^{-1}), T_4 (28.42) and significantly differ from all other treatments followed by T_8 (26.64 mg 100 g^{-1}), which was on par with T_1 (26.35 mg 100 g^{-1}) ,T_{11} (24.80 mg 100 g^{-1}) ,T_7 (23.97 mg 100 g^{-1}) ,T_3 (23.25 mg 100 g^{-1}) and T_{10} (21.70 mg 100 g^{-1}). The least mean value of ascorbic acid was recorded for T_9 (17.05 mg 100 g^{-1}) which was on par with T_{12} (20.15 mg 100 g^{-1}), T_6 (20.58 mg 100 g^{-1}) and T_{10} (21.70 mg 100 g^{-1}) which is significantly different from all other treatments.

4.3.5 Total Carotenoids

Data on total carotenoid of fruit influenced by pruning and foliar nutrients application is inscribed in Table No 11.

Carotenoid content in pulp of passion fruit were the highest for T_5 (2.89 mg 100 g^{-1}) which was on par with T_4 (2.80 mg 100 g^{-1}) followed by T_8 (2.73 mg 100 g^{-1}) which was on par with T_2 (2.62 mg 100 g^{-1}). The least value for carotenoid content in pulp was recorded for T_{12} (1.43 mg 100 g^{-1}**)** followed by T_{10} (1.89 mg 100 g^{-1}) which was on par with T_{11} (2.02 mg 100 g^{-1}) and differed significantly differed from other treatments**.**

Table 12. Effect of pruning and foliar nutrition on, TSS, acidity, total carotenoids, ascorbic acid and sugar/; acid ratio in passion fruit.

Treatments	TSS (°brix)	Acidity (%)	Total Carotenoids(mg100g^{-1})	Ascorbic acid (mg100g^{-1})	Sugar/acid ratio
T_1	18.03	1.44	2.51	26.35	9.09
T_2	18.77	1.12	2.62	31.54	10.90
T_3	17.47	2.11	2.11	23.25	5.61
T_4	19.30	1.04	2.80	28.42	14.61
T_5	20.47	1.13	2.89	33.44	14.59
T_6	18.67	1.51	2.80	20.58	8.12
T_7	17.30	1.23	2.56	23.97	12.27
T_8	18.70	1.65	2.73	26.64	7.58
T_9	16.43	2.23	2.15	17.05	6.48
T_{10}	16.20	2.28	1.89	21.70	5.34
T_{11}	16.37	2.36	2.02	24.80	4.88
T_{12}	15.20	2.60	1.43	20.15	4.28
SEm(±)	0.20	0.15	0.06	2.01	0.59
CD(0.05)	0.60	0.11	0.13	5.89	1.73

4.3.6 Total sugar

Data on total sugar content on fruit influenced by different combination of pruning and foliar nutrition is inscribed in Table No 12.

The total sugar content of passion fruit was significantly influenced by different treatments. Total sugar was found to be maximum for T_5 (16.27 %) which was on par with T_4 (15.14%) and significantly different from all other treatments followed by T_2 (14.95 %) which was on par with T_8 (14.77 %), T_7 (14.51 %) and T_1 (14.42 %). The lowest amount of total sugar content was recorded for T_{12} (10.25 %) which was on par with T_9 (10.77 %) and differ significantly from all other treatments.

4.3.7 Reducing sugar

Data on reducing sugar content of fruit as influenced by different combination of pruning and foliar nutrient application is inscribed in Table No 12.

Reducing sugar was highest in T_5 (11.78 %) which was significantly different from all other treatments followed by T_2 (10.36%) which was on par with T_4(9.65%) and T_1 (9.48%). The lowest amount of reducing sugar content was reported in T_9 (5.64 %) which was on par with T_{12} (6.16%) and differed significantly from other treatments

4.3.8 Non reducing sugar

Data on non-reducing sugar content on fruit as influenced by different combinations of pruning and foliar nutrient application is inscribed in Table No 12.

Non-reducing sugar content was the lowest for treatment T_3 (3.18 %) which was on par with T_{11} (3.78%), T_6 (3.78%), T_{10}(3.96%) and T_{12} (4.09%) and differed significantly different from other treatments. Highest amount of non-reducing sugar content was reported in T_8 (6.54 %) which was on par with T_7 (6.07%), T_4 (5.49%) and had significant difference from all other treatments.

Table 13. Effect of pruning and foliar nutrition on total sugars, reducing sugars and nonreducing sugar in passionfruit.

Treatments	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)
T_1	14.42	9.48	4.95
T_2	14.95	10.36	4.59
T_3	11.79	8.61	3.18
T_4	15.14	9.65	5.49
T_5	16.27	11.78	4.48
T_6	12.25	8.56	3.78
T_7	14.51	8.44	6.07
T_8	14.77	8.23	6.54
T_9	10.78	5.64	5.13
T_{10}	12.22	8.26	3.96
T_{11}	11.55	7.77	3.78
T_{12}	10.25	6.16	4.09
SEm(±)	0.40	0.32	0.38
CD(0.05)	1.16	0.95	1.10

4.4 Shelf life of fruits at ambient conditions

Shelf life of passion fruit as influenced by combination of pruning and foliar nutrition is presented in Table No 14.

The different combination of pruning and foliar nutrition given to passion fruit plant had significant effect on the shelf life of fruits. The data recorded for shelf life indicated that the longest shelf life was recorded for the treatment T_5 (7.13 days) which is on par with T_4 (6.53days), T_8 (6.13days) and significantly different from all other treatments, followed by T_6 (6.03days) which was on par with T_7 (5.87 days), T_2 (5.67 days), T_1(5.53 days), T_{11} (5.47 days). The lowest shelf life was recorded in control T_{12} (4.27 days) which was on par with T_9 (4.80 days), T_3 (4.93 days), T_{10} (5.13 days), and differed significantly from other treatments.

4.5 Plant analysis

4.5.1 Plant NPK content

The data on total NPK content of plant tissue as influenced by different treatment combinations of pruning and foliar nutrition are inscribed in Table 15.

The statistical report on plant analysis showed that, in the leaf of passion fruit, concentration of nitrogen was found to be the highest in treatment T_5 (5.85%) which was on par with T_4 (5.78%), T_2 (5.52%) and T_1 (5.48%) and was significantly different from all the other treatments, followed by T_{11} (5.34%) which was on par with T_{10} (5.26 %), T_8 (4.40%) and T_7 (5.06 %) followed by T_8 (4.49 %). The lowest content of nitrogen in leaf tissue was observed in T_{12} (3.72 %) which was on par with T_9 (3.80 %), T_3 (4.02 %), T_6 (4.05%) and differed significantly from other treatments.

Leaf phosphorous content in index leaf was highest for T_5 (0.52%) which was on par with T_4 (0.51%) and differed significantly from other treatments followed by T_2 (0.41%) which was on par with T_1 (0.40%), T_{10} (0.38%) followed by T_8 (0.36%). The control recorded lowest content of phosphorous T_{12} (0.23%) and was on par with T_6 (0.25%) and differed significantly from all other treatments.

Table 14. Effect of pruning and foliar nutrition on shelf life of passionfruit at ambient conditions.

Treatments	Shelf life of fruit (days)
T_1	5.53
T_2	5.67
T_3	4.93
T_4	6.53
T_5	7.13
T_6	6.03
T_7	5.87
T_8	6.13
T_9	4.80
T_{10}	5.13
T_{11}	5.47
T_{12}	4.27
SEm(±)	0.37
CD(0.05)	1.09

The potassium content was highest for T_5 (3.14 %) which was on par with T_4 (2.60%) and differed significantly from all other treatments followed by T_2 (2.42 %) which was on par with T_{10} (2.38 %), T_1 (2.36 %). The lowest potassium value was noted for T_{12} (1.16 %) which was on par with T_9 (1.21 %), T_6 (1.31 %) and T_3 (1.34 %) and differed significantly from other treatments.

4.5.2 Plant micronutrient content

The data on micronutrient (B, Zn) content of plant tissue as influenced by different treatment combinations are inscribed in Table No 18.

The zinc content in leaf tissue was the highest for T_5 (128.89ppm) and was significantly different from other treatments. It was followed by T_2 (117.13ppm) followed by T_8 (106.20ppm) which was on par with T_{11} (103.81ppm). The lowest zinc content was recorded for T_{12} (70.22 ppm) which was on par with T_7 (75.92 ppm) followed by T_9 (78.83ppm) which was on par with T_3 (81.69ppm), T_6 (83.62ppm) and T_{10} (83.63ppm)

The boron content in leaf tissue was the highest for T_2 (4.42ppm) which was on par with T_5 (4.36ppm) and was significantly different from other treatments. It was followed by T_8 (4.09 ppm) which was on par with T_{11} (4.03ppm) followed by T_4 (3.56ppm) The lowest zinc content was recorded for T_{12} (1.53ppm) and differed significantly from other treatments, followed by T_9 (1.83ppm) and T_3 (1.99ppm)

4.6 Fruit analysis

4.6.1 Fruit NPK content

The data on the total fruit NPK content as influenced by pruning and foliar nutrition are inscribed in the Table No 19.

The fruit analysis revealed the highest nitrogen content in T_5 (5.35%) which was on par with T_4 (5.28%), T_2 (5.02%) and T_1 (4.98%) showed statistically significant difference from others and was followed by T_{11} (4.84%) which was on par with T_7 (4.76 %). The lowest nitrogen content was recorded for T_{12} (3.22 %) which was on par T_9 (3.30%), T3 (3.52%), T_6 (3.55%) and differed significantly from other treatments.

Table 15. Effect of pruning and foliar nutrition on nitrogen, phosphorus and potassium content of passionfruit (%)

Treatments	Nitrogen(%)	Phosphorous(%)	Potassium(%)
T_1	5.48	0.40	2.36
T_2	5.52	0.41	2.42
T_3	4.02	0.30	1.34
T_4	5.78	0.51	2.60
T_5	5.85	0.52	3.14
T_6	4.05	0.25	1.31
T_7	5.06	0.34	1.66
T_8	4.49	0.36	1.96
T_9	3.80	0.32	1.21
T_{10}	5.26	0.38	2.38
T_{11}	5.34	0.32	2.00
T_{12}	3.72	0.23	1.16
SEm(±)	0.14	0.015	0.19
CD(0.05)	0.42	0.04	0.56

Table 16. Effect of pruning and foliar nutrition on zinc and boron content in leaf of passion fruit(ppm).

Treatments	Zinc (ppm)	Boron (ppm)
T_1	88.65	2.93
T_2	117.13	4.42
T_3	81.69	1.99
T_4	89.43	3.56
T_5	128.89	4.36
T_6	83.62	2.71
T_7	75.92	2.88
T_8	106.20	4.09
T_9	78.83	1.83
T_{10}	83..63	2.74
T_{11}	103.81	4.03
T_{12}	70.22	1.53
SEm(±)	2.76	0.04
CD(0.05)	8.11	0.13

The fruit phosphorus content was highest in treatment T_5 (0.68%), which was on par with T_4 (0.66%) and differed significantly from other treatments followed by T_1 (0.62%) which was on par with T_2 (0.60%) followed by T_7 (0.51%) which was on par with T_{10} (0.50%), T_{11} (0.48%). The lowest fruit phosphorus content was registered for T_9 (0.28%) which was on par with T_{12} (0.28%), T_3 (0.31%) and T_6 (0.32%) and differed significantly from all other treatments.

The potassium content in fruit was highest for T_5 (1.01%), which was on par with T_4 (0.96%), T_2 (0.91%) and significantly different from all other treatments. This was followed by T_1 (0.87%) and was on par with T_{11} (0.83%), T_{10} (0.77%) and differed significantly from other treatments. The lowest potassium value in fruit was noted for T_{12} (0.49%) which was on par with T_3 (0.53%), T_6 (0.54%), T_9 (0.60%) and differed significantly from other treatments.

4.6.2 Micronutrient content in fruit

The data on total fruit micronutrient content as influenced by pruning and foliar nutrition are inscribed in the Table No 20.

The zinc content in fruit was highest for T_5 (9.64 ppm) which was on par with T_2 (8.97ppm) and was significantly different from other treatments. It was followed by T_8 (8.16 ppm) which was on par with T_{11} (8.07ppm) followed by T_4 (7.03ppm) and was on par with T_3 (6.72ppm) and T_1 (6.44ppm), which differed significantly from other treatments. The lowest zinc content was recorded for T_{12} (5.52 ppm) which was on par with T_9 (5.86ppm), T_{10} (5.87ppm), T_6 (6.04ppm) and T_7 (6.04ppm).

The boron content in fruit was highest for T_5 (1.93 ppm) and was significantly different from other treatments. It was followed by T_2 (1.53 ppm), T_8 (1.43 ppm) and T_{11}(1.23) ppm. The lowest zinc content was recorded for T_{12} (0.68 ppm) which was on par with T_{10} (0.72ppm), T_7 (0.73 ppm) and T_6 (0.76ppm) and had significant difference from other treatments.

Table 17. Effect of pruning and foliar nutrition on nitrogen, phosphorus and potassium content in passion fruit

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)
T_1	4.98	0.62	0.87
T_2	5.02	0.60	0.91
T_3	3.52	0.31	0.53
T_4	5.28	0.66	0.96
T_5	5.35	0.68	1.01
T_6	3.55	0.31	0.54
T_7	4.56	0.51	0.72
T_8	3.99	0.43	0.72
T_9	3.30	0.28	0.60
T_{10}	4.78	0.50	0.77
T_{11}	4.84	0.48	0.83
T_{12}	3.22	0.28	0.49
S.Em	0.14	0.02	0.04
CD(0.05)	0.42	0.06	0.12

Table 18. Effect of pruning and foliar nutrition on zinc and boron content in passion fruit

Treatments	Zinc(ppm)	Boron(ppm)
T_1	6.44	0.85
T_2	8.97	1.53
T_3	6.72	0.83
T_4	7.03	0.90
T_5	9.64	1.93
T_6	6.04	0.76
T_7	6.04	0.73
T_8	8.16	1.43
T_9	5.86	0.79
T_{10}	5.87	0.72
T_{11}	8.07	1.23
T_{12}	5.52	0.68
SEm(±)	0.30	0.029
CD(0.05)	0.89	0.085

4.7 PEST AND DISEASE INCIDENCE

There was no severe incidence of pest and disease in the field. The Brown spot caused by *Alternaria passiflorae* and scab caused by *Cladosporium oxysporum* was noticed with less than 1 per cent incidence.

4.8 ECONOMIC ANALYSIS

The data on net income and B: C ratio as influenced by pruning and foliar nutrition are presented in Table No 21.

4.8.1 Net income

The effect of combination of pruning and foliar nutrient application in passion fruit exhibited notable difference in the net income. The highest net income was obtained for treatment T_5 (₹ 275625 ha^{-1}) and was significantly different from other treatments. This was followed by T_2 (₹ 219187.5 ha^{-1}) which was on par with T_4 (₹ 246487.5 ha^{-1}). The lowest net income was recorded for treatment T_{12} (₹ 67937.5 ha^{-1}) which was on par with T_9 (₹ 89175 ha^{-1}).

4.8.2 B: C ratio

The effect of pruning and foliar nutrient application on B: C ratio in passion fruit showed that T_5(3.68) recorded the highest B: C ratio which was on par with T_2 (3.34) and it differed significantly from all other treatments. This was followed by T_4 (3.06) which was on par with T_1 (2.72). The minimum B: C ratio was observed with T_{12} (1.40) and had significant difference from other treatments followed by T_9 (1.86) which was on par with T_3 (1.98) and T_7 (2.02).

Table 19. Effect of pruning and foliar nutrition on Net come and B:C ratio in passionfruit

Treatments	Net income	B:C ratio
T_1	205237.5	2.72
T_2	219187.5	3.34
T_3	110312.5	1.98
T_4	246487.5	3.06
T_5	275625	3.68
T_6	126062.5	2.60
T_7	102312.5	2.02
T_8	108937.5	2.22
T_9	89175	1.86
T_{10}	112175	2.53
T_{11}	154812.5	2.51
T_{12}	67937.5	1.40
SEm(±)	9661.69	0.12
CD(0.05)	28336.77	0.35

Discussion

5. DISCUSSION

Passion fruit is a prominent member of the family Passifloraceae with 600 species. They are mostly vines distributed in tropical and subtropical regions. Passion fruit is gaining commercial importance in Kerala due to its adaptability to humid tropical climates. Because of its nutritional and market worth, as well as its short maturity period, passion fruit is an excellent crop for small-scale producers. Proper canopy management and balanced nutrition plays a vital role in plant growth, yield and fruit quality of Passion fruit. Reducing vigour of crop after few years of growing is a major problem in passion fruit cultivation. But proper canopy management and nutrition helps in exploiting the full potential of the crop even after the crop losses its vigour due to its exhaustive fruiting in early periods. Passion fruit is a highly nutrient responsive crop. So along with pruning, foliar application of nutrients helps in rejuvenation of the crop and it will also increase the fruit yield. Hence there is need to improve and standardize the pruning level and foliar nutrition of vines through primary and micronutrients for growth, yield and quality of passion fruit. Keeping with these views, the experiment was conducted and experimental results regarding the growth, yield, quality, plant and fruit analysis, pest and disease incidence and economical status are analyzed and discussed below

5.1 BIOMETRIC CHARACTERS

5.1.1 Number of newly emerged branches per vine and days taken for emergence of new branches

The present study indicated that 75% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1% resulted in highest number of newly emerged branches per vine in passion fruit.

Results of the present study is in accordance with the findings of Tyagi *et al*. (2017). They observed that, Pruning affects hormonal conditions and results in a reduction of vegetative buds and an increase in the growth of new shoots, increased number of new shoots and canopy structure with enhanced nutritional translocation in passion fruit.

Abasi *et al*. (2018) observed that, vines that have been severely pruned are more likely to produce excessively vigorous shoots because only a small number of the parent vine's and root's growing points have access to all of the energy that has been stored in the parent vine.

The current study is in accordance with the study of Senthilkumar *et al*. (2015). He stated that, the most effective way to maintain the right balance between growth and production is to prune the vines for optimal cropping according to their vigour. Increased pruning severity will result in vigorous individual shoots at the expense of the crop's overall growth.

Nitrogen is crucial for the production of proteins, amino acids, and chlorophyll, which enhances the transfer of metabolites to the growth sites (Mahatao *et al*., 2014).

Mehta (2012) discovered that combining boron with NPK fertilisers resulted in vigorous plant growth in passion fruit.

5.1.2 Length and Girth of plant

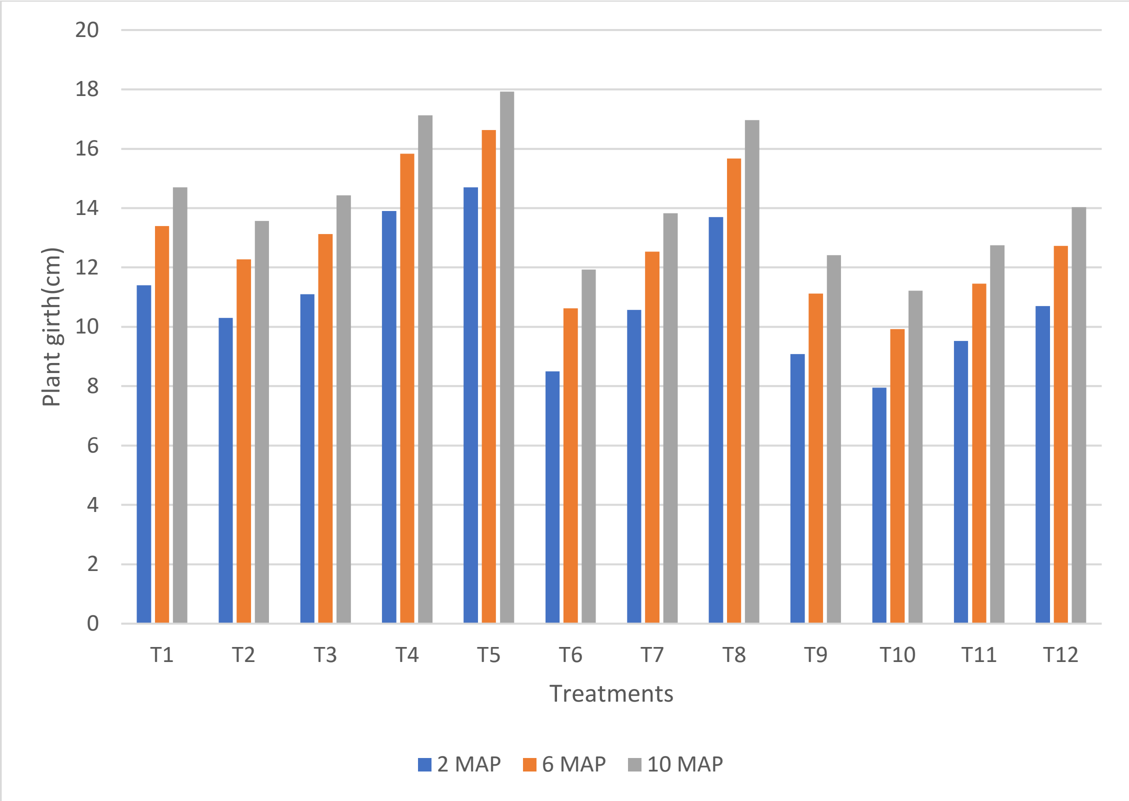
The present study indicated that 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1% resulted in longest plant for all months except for 2 months after pruning. Regarding plant girth the treatments received 50 % ,75% pruning along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1% and 50% pruning along with 19:19:19 @ 1% showed highest values.

According to Chalak (2008), as the pruning intensity increased, the vine diameter also increased in grape cv. Tas-A-Ganesh.

Mehta *et al.* (2016) reported that, application of 250:125:125g NPK+ 1.2g boron resulted in the greatest plant girth in passion fruit.

Increased K dosages up to 600 g K_2O plant^{-1} have been found to increase pseudostem girth in banana (Sindhu, 1997). According to Geetha (1998), increasing the amount of nitrogen applied in banana up to 190 g plant^{-1} enhanced plant girth substantially.

Fig. 2. Effect of pruning and foliar nutrition on girth of the plant in passion



Intake of nutrients, particularly nitrogen, increased height and girth, which may be related to the synthesis of complex molecules that aid in tissue development (Nalina, 2002)

The process of cell expansion and pulp growth were accelerated by the steady increase in nitrogen treatment, which led to increase in length and girth of the plants (Al-Harthi and Al-Yahyai, 2009).

The contribution of potassium to the stimulation of numerous enzymes as well as cell growth was explained by Nandan *et al.* (2011).

5.1.3 Number of flowers produced vine^{-1}month^{-1}

The present study indicated that 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1% resulted in highest number of flowers produced per vine per month. 50% pruning and foliar nutrition of primary and micronutrients had a significance influence in increasing number of flowers produced per vine month at all stages of growth except for 5 months and 8 months after pruning.

The increased number of flowers might be attributed to boron's impact on indigenous florigenic substances and promotion of flower initiation behaviour (Reddy, 2010)

Increased metabolic activities such as glucose translocation, nitrogen metabolism, respiration, cell wall construction, and RNA synthesis by boron and zinc would eventually result in more flowers, continuous flowering, and early fruit maturity (Ding *et al*., 1991).

Nalina, (2002) observed that, potassium is a metabolic accelerator because it speeds up the process of respiration, increases photosynthesis, and favours the early emergence of inflorescence.

5.1.4 Days taken for first flowering and first fruiting

The current experiment recorded a significant reduction in days taken for first flowering for the plants treated with 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1%

Daniel and Rao (1969) discovered a 3 to 4 day delay in bud sprouting in the least severe pruning compared to the moderate or severe pruning in grape cv Anab-e-Shahi. Similar results were obtained by Godara *et al.* (1977) and Senthilkumar *et al.* (2015) in 'Beauty Seedless' grapes

Velu (2001) found that in grape cv. 'Muscat,' where the pruning level was extreme (pruning 67% of the canes to 5 bud level and 33% to 2 bud level), it took less time (40.06 days) for bud sprouting. According to Palma *et al.* (2000), in the grape cv. Victoria, increased bud loads per vine caused a delay in bud sprouting when compared with lower bud load treatments. In 'Beauty Seedless' grapes, Godara *et al.* (1977) found that vines that had been moderately pruned needed fewer days to sprout buds and blossom than vines that had been lightly pruned.

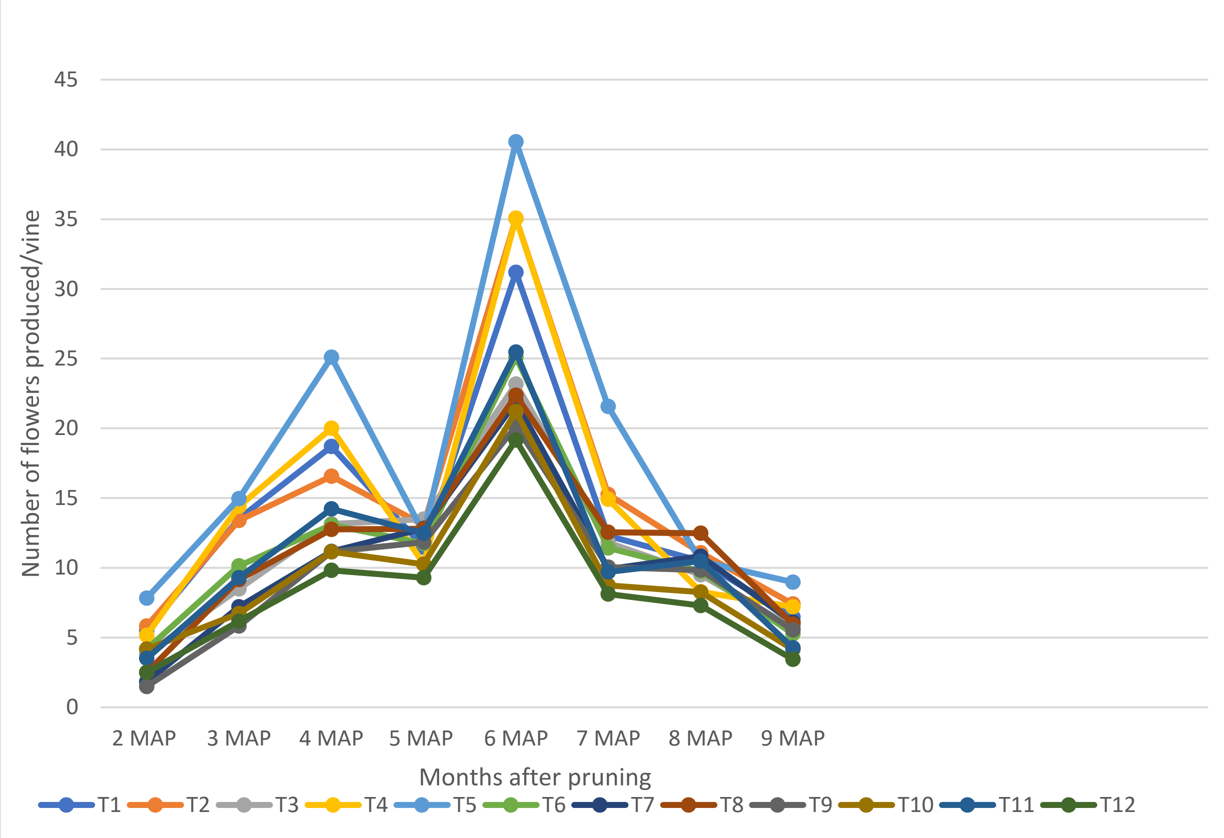
The treatments with severe pruning (75% pruning of current fruiting branch) recorded longest days for first flowering and fruiting compared to light pruning(25% pruning of current fruiting branch) and moderate pruning (50% pruning of current fruiting branches). The late commencement of flowering in most severely pruned vines (75% pruning) compared to unpruned vines may be attributed to the fact that pruned vines produce new vegetative growth immediately after pruning, and almost all of the carbohydrates that would otherwise favour flower bud formation/initiation may have been used in the vine's vegetative growth, delaying flowering. Jannoyer (2009) found similar results in mango.

Borges *et al.* (2007), found that potassium deficit in passion fruit delayed flowering and lowered production, including fruit size.

The findings of current study are in consistent with those of Mehta *et al.* (2016), who discovered that applying 250:125:120g NPK combined with 1.2g boron to passion fruit reduced the number of days required for flower initiation and fruit development.

Sajid *et al*. (2010) also discovered that foliar sprays of Zinc and Boron had an influence on days to flowering in sweet orange. Sarolia *et al.* (2007) obtained similar results in guava.

Fig. 3. Effect of pruning and foliar nutrition on number of flowers produced/vine/month



According to Dutta (2004), among micronutrients, boron plays a significant role in governing numerous physiological and biochemical processes in plants, and foliar treatment of boron (0.5%) promoted early flowering in passion fruit. Boron foliar spray promoted flowering by stimulating cell division and elongation.

Shekhar *et al*. (2010) reported that the days to blooming were shortened (186.33 days) in papaya cv. Washington following foliar application of $MnSO_4$ 0.25%+ $CuSO_4$ 0.25%+ borax (0.1%) compared to control (208 days).

Zinc and boron treatment led to earlier fruit set, which might be due to zinc and boron's impact on increased metabolite synthesis. They also aid in leaf development and chlorophyll creation, which allows the plants to have higher absorption and early metabolite synthesis. Boron also contributes to the formation of early flower buds, blossoming, and the generation of indigenous chemicals. Boron is primarily involved in pollen germination, pollen tube development, fertilisation, and glucose metabolism. Zinc aids in hydrocarbon transport and metabolism.

5.1.5 Total flower production per vine

The current study revealed that the highest total flower production per vine was observed in the treatment with 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1%. Severely pruned vines (75% pruning) and unpruned vines recorded the lowest total flower production.

Similar findings were made by Sajid *et al.* (2010), who found that spraying zinc and borax onto the leaves of the sweet orange cultivar Blood Red hastened flowering.

Increased flower production may be attributable to the effect of micronutrients on blooming through auxin biosynthesis (Veena and Lavania, 1989)

According to Gopikrishna (1979), the loss of potential bearing wood of plant may be the cause of the reduced quantity of flowers on branches that have been severely pruned.

5.1.6 Flowering to harvest duration (days)

The present study clearly shows that least number of days from flowering to harvesting was obtained in the treatment combination of 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1%.

In Strawberry Cv. Winter Dawn, Yadav *et al.* (2017) found that foliar treatments with Boric acid (0.4%) and Zinc sulphate (0.4%) led to the fewest number of days to harvest (59.26 days and 59.15 days, respectively) compared to control (62.10 days).

According to Borges *et al.* (2007), potassium deficit in passion fruit delayed flowering and lowered production, including fruit size. The duration to fruit maturity was reduced by around 25 days when the K concentration was raised to 8 mmol L^{-1} (Araujo *et al*., 2006).

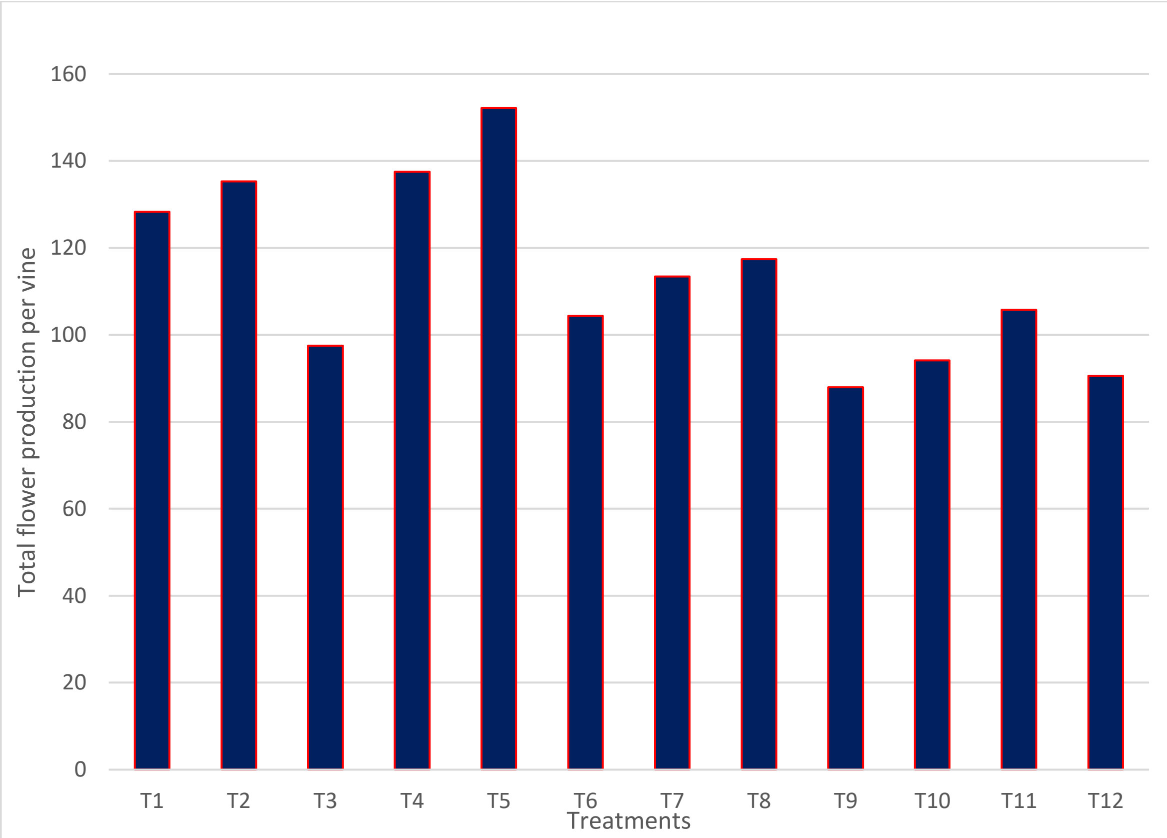
Deshmukh *et al.*, 2017 reported that passion fruit takes around 80–90 days from flowering to fruit maturity

According to Mehta *et al*. (2016), applying 250g N:125g P2O5:125g K2O along with 1.2g boron reduced the number of days required for flower initiation and fruit maturity in passionfruit.

Yadav *et al.* (2010) reported similar findings as current study that, foliar treatment of Zn EDTA + $MnSO_4$ + $CuSO_4$ + Borax results in early inflorescence emergence and shortened the time between flowering and harvesting in banana cultivar Grand Naine. Similar results were also obtained by Shekhar *et al*. (2010) in Papaya cv. washigton

Modi *et al*. (2012) conducted experiment in papaya cv. Madhu Bindu and found that, foliar treatment of zinc and boron led to early flower bud initiation and the shortest possible time between fruit set and the first harvest.

Fig. 4. Effect of pruning and foliar nutrition on total flower production/vine



Yield Characters

5.2.1 Number of fruits per vine per month and total fruit production per vine

The results of this study showed that the treatment combination with 50% pruning of the current fruiting branch and foliar applications of 19:19:19 at 1% and Sampoorna KAU Micronutrient mix at 1% produced the largest number of fruits per month and the highest total fruit yield per vine.

These results are supported by Singh *et al*. (2004), who noted that trees that have started to lose vigour, productivity, or fruit size require pruning in order to improve their health. According to the results of the current experiment, cut back of old, unwanted branches encouraged the growth of fresh shoots, which resulted in fresh fruiting wood. So, compared to plants that weren't pruned, pruned trees produced more fruits.

Joon and Singh (1983) studied pruning effect in grapes cv. Delight and observed that with a reduction in pruning intensity, the average yield per vine increased. The trees with moderate amounts of pruning produced the most fruits per tree (Singh, 2007)

In the present study the severly pruned vines (75 % pruning) along with foliar application recorded lowest fruit production among the treatments followed by unpruned vines. The result was supported by Gopu *et al.* (2014) who reported that, elimination of the young shoots that may have been capable of synthesising food may have caused poor fruit set in severely pruned trees. In general, a better source is necessary for a better sink, which is significantly more assured in moderate pruning than in severe pruning. The poor performance of unpruned trees could be attributed to photosynthetic limitations.

This decrease in overall fruit yield is likely to be the result of a decrease in the need for photo assimilates as a result of fewer drains in the plant. This may enhance photo assimilates partitioning and increase the quantity of photo assimilates accessible to the fruits, increasing fruit weight and longitudinal diameter (Cruz *et al.*, 2010; Silva *et al.*, 2009).

Olermo *et al.* (2017) discovered that removing N from the NPK treatment lowered passion fruit production by 57% to the same level as the control, while reductions in fruits without P and K were 38% and 7%, respectively

According to Keller *et al*. (1998), yield is mostly affected by N availability at the bloom stage. The inadequate N supply during bloom impaired fruit set in the grape cultivar Cabernet Sauvignon. The result was confirmed by Senthilkumar *et al*. (2017).

The addition of K enhanced photosynthesis, which resulted in the accumulation of carbohydrates and improved fruit quality and yield (Tyagi *et al.*, 2017)

Foliar sprays with added micronutrients when used during flowering, it has been demonstrated to enhance the yield of fruits (Whiley *et al.*, 1996).

Increase in fruit set percentage might be due to the effect of boron on stimulating the production of pollen and increase pollen viability (Madani *et al.,* 2013). Boron enhances pollen germination, pollen tube growth and fertilization process (Youzhi and John, 1995)

The promotion of processes in plants like enhanced starch synthesis and quick transfer of carbohydrates by micronutrients like zinc and boron is well known. Additionally, zinc is involved in the production of auxin in plants, which raises fruit retention, lowers fruit drop, and ultimately increases the overall fruit yield. Foliar treatment speeds up the physiological process, which increases the amount of fruit produced (Gurjar *et al.*, 2015). Increased fruit production and weight, as well as a decrease in fruit drop, may result in higher yield (Shekher *et al*., 2010)

More fruit production is possible as a result of the presence of more flowers and a high fruit set. Larger protein and IAA synthesis as mediated by zinc (Jeykumar *et al.,* 2001) or greater fruit setting, fruit retention, fruit growth and development (Shekher *et al.,* 2010) results in more fruit number.

Involvement of zinc and boron in fruit setting and fruit retention leads to an increase in fruit yield as a result of their activity. Zn and Boron are connected in numerous physiological processes, including hormone metabolism, photosynthesis, and auxin

Fig. 5. Effect of pruning and foliar nutrition on number of fruits/vine/month

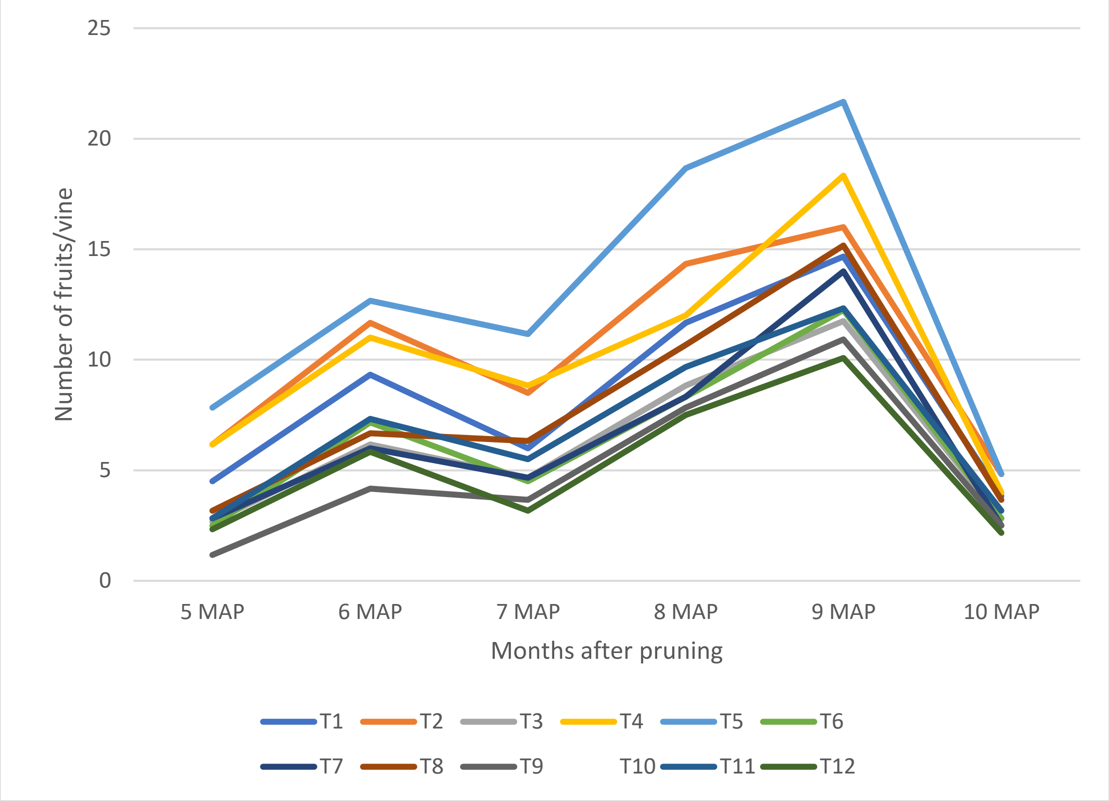
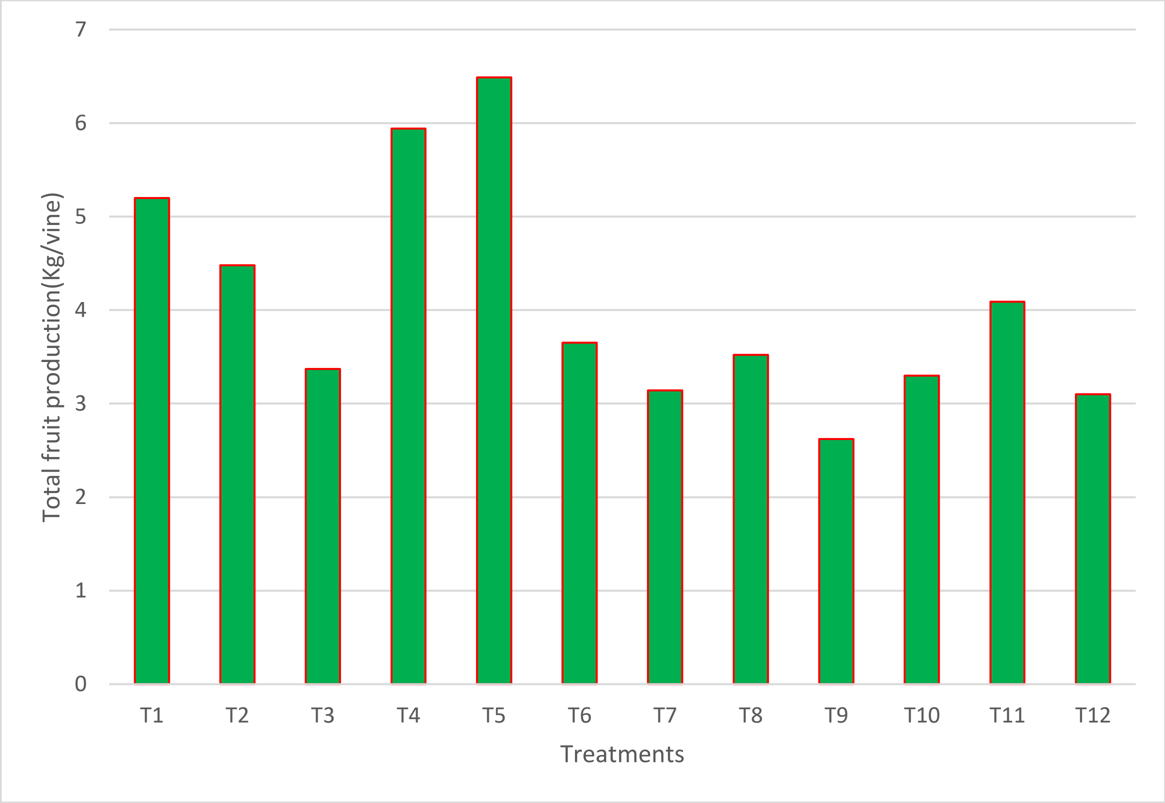


Fig. 6. Effect of pruning and foliar nutrition on total fruit production(Kgvine^{-1})



production, which is essential for flower initiation, fruit set, and fruit development (Rajkumar *et al*., 2014).

When leaf Zn concentration rose, Garcia *et al.* (1984) observed less fruit drop.

Boron decreases abscisic acid activity (Veena and Lavania, 1989) due to their indirect halted action in auxin production, which delays the establishment of the abscission layer in the early fruit development stage (Guardiola and Garcia, 2000).

5.2.2 Rind and pulp colour

The present study clearly indicates that, 50% pruning of the current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1% improved rind colour and pulp colour in passion fruit.

These results are also confirmed by Singh *et al*. (2004), who found that citrus fruit's colour development is enhanced by sunlight as a result of pruning. Similar findings are obtained by Ahmed *et al*. (2006) in Kinnow fruit.

Studies by Sites and Reitz (1949) concluded that increased light intensity throughout plant canopy by proper pruning was correlated with higher soluble solids concentrations and better rind colour and pulp colour in fruit crops

5.2.3 Fruit Diameter (cm)

The results of the current investigation showed that the treatment combination of 50% pruning of the current fruiting branch, foliar application of 19:19:19 @1%, and Sampoorna KAU Micronutrient mix @1% produced the fruits with increased diameter.

Ghosh *et al*. (2017) reported an average diameter of 3-5 in purple varieties of passion fruit.

It is well established that in many species, a decrease in fruiting wood is likely to result in increased fruit size (Gurnah *et al.,* 1980). Buel (1956) reported that this was true with passion fruit also.

According to Kumar *et al*. (2006), spraying Allahabad Safeda guava leaves with 1% KNO_3 considerably improved fruit size

Senthilkumar *et al.* (2017) concluded that, the average diameter of the fruit was positively influenced by potassium.

Litchi fruit diameter and length increased after foliar treatment of zinc at 100 ppm (Sharma *et al.*, 2005)

Increase in fruit length, fruit diameter, and volume may be caused by the accumulation of more dry matter in the fruit through the translocation of carbohydrates from the leaf to fruit and rapid protein synthesis in the developing fruits, both of which are controlled by zinc and boron (Singh *et al.,* 2000 and Singh *et al.*, 2010). Alternatively, more water may move into fruits through semi-permeable cell membranes, which is also controlled by zinc, leading to an increase in fruit size (Bhalerao and Patel, 2015).

5.2.4 Fruit weight

The current investigation found that the treatment combination with 50% pruning of the currently fruiting branch and foliar applications of 19:19:19 at 1% and Sampoorna KAU Micronutrient mix at 1% produced the maximum fruit weight.

The results were similar to the findings of Ferree and Palmer (1982) and Norton (2001) who reported that with severe pruning, the quantities of photosynthates available for fruit growth should be higher, which likely explains the increased fruit growth reported during the reporting period.

Berry weight decreased as pruning intensity decreased, indicating that the two variables are proportional to one another (Palanichamy *et al.,* 2004)

Fruit weight accumulation, according to Weber *et al.* (2017), includes competition for photosynthesis-produced compounds, and a smaller fruit number increases the available assimilates for fruit filling.

Pruning is expected to improve microclimate, vegetative and reproductive behaviour, and photosynthetic rates (Singh *et al.*, 2009), which explains the increased fruit weight and volumes in severely and moderately pruned trees.

The findings are consistent with those of Mahmoodi *et al*, 2017, and may be attributed to the fact that nitrogen is one of the essential nutrients that aids in increasing photosynthetic efficiency and is a component of amino acids, which form an important component of the protein system, and thus could have contributed to the production of a large amount of biomass (Khan *et al*, 2019).

Study by Olermo *et al.* (2017) revealed that, fruit weight losses due to non-application of N, P_2O_5, and K_2O were 63 percent, 40%, and 6%, respectively in passion fruit. Kundu *et al.* (2007), reported that fruit weight of guava increased with high levels of P application.

Study of Senthilkumar *et al.* (2017) revealed that the addition of potassium in the fertiliser enhanced the average fruit weight. Foliar spraying Allahabad Safeda guava with 1% KNO_3 improved fruit size considerably (Singh *et al.*, 1982).

Araujo *et al*. (2006) studied the effects of different K concentrations in the nutrient solution of passion fruit and discovered that 6 mmol L^{-1} of K produced fruits with larger weight and yield $plant^{-1}$.

According to Ashoori *et al.* (2013), foliar spraying of urea, Zn, and Fe improved the size of the fruits in grape vine.

Natal *et al*. (2004) demonstrated that foliar applications of Zn (0.5%) and Boron (0.25%) increased fruit yield, fruit weight, and quality in passion fruit. According to Ebeed *et al*. (2001), foliar spraying of Fe+Zn+Mn improved tree production, fruit weight, pulp weight, and pulp/fruit weight in mango cv. Mesk. Ghanta and Dwivedi (1993) and Anjali *et al*. (2013) reported similar findings in banana cv. Giant Governer and Grand naine respectively.

5.2.5 Pulp weight and juice weight

According to the results of this study, the treatment combination that produced the maximum pulp weight and juice weight included 50% pruning of the current fruiting branch, foliar applications of 19:19:19 at 1% and Sampoorna KAU Micronutrient at 1%. This might be because pruning promotes water absorption and mineral mobilisation in the pruned region. These findings support the findings of Bruno and Evelyn (2001) in custard apple, Adhikari and Kandel (2015) in guava, and Singh and Bal (2008) in ber tree.

The result of current study was in agreement with Gurnah *et al*., (1980) who reported that, fruit from the unpruned treatment had less juice content than those from the pruned treatments in passion fruit.

Dugger, 1983 confirmed that, Boron treatment, either alone or in combination, aided in increasing pulp weight by accelerating photosynthates.

Foliar application of boric acid @1500 ppm increased the pulp weight and pulp seed ratio in 'Shahany' date palm (Khayyat *et al*. 2007).

Zinc application has increased juice content because it has regulated the water relation in plants (Tyagi *et al.,* 2017)

Study of Ebeed *et al.* (2001) found that, foliar spraying of Fe+Zn+Mn improved tree production, fruit weight, pulp weight, and pulp/fruit weight in mango cv. Mesk

According to Silva *et al.* (2008), the pulp yield in yellow passion fruit ranges between 31.44 and 41.28 percent. As reported by Silva *et al.* (2015) the average pulp yield of yellow passion fruit is 44.43 percent.

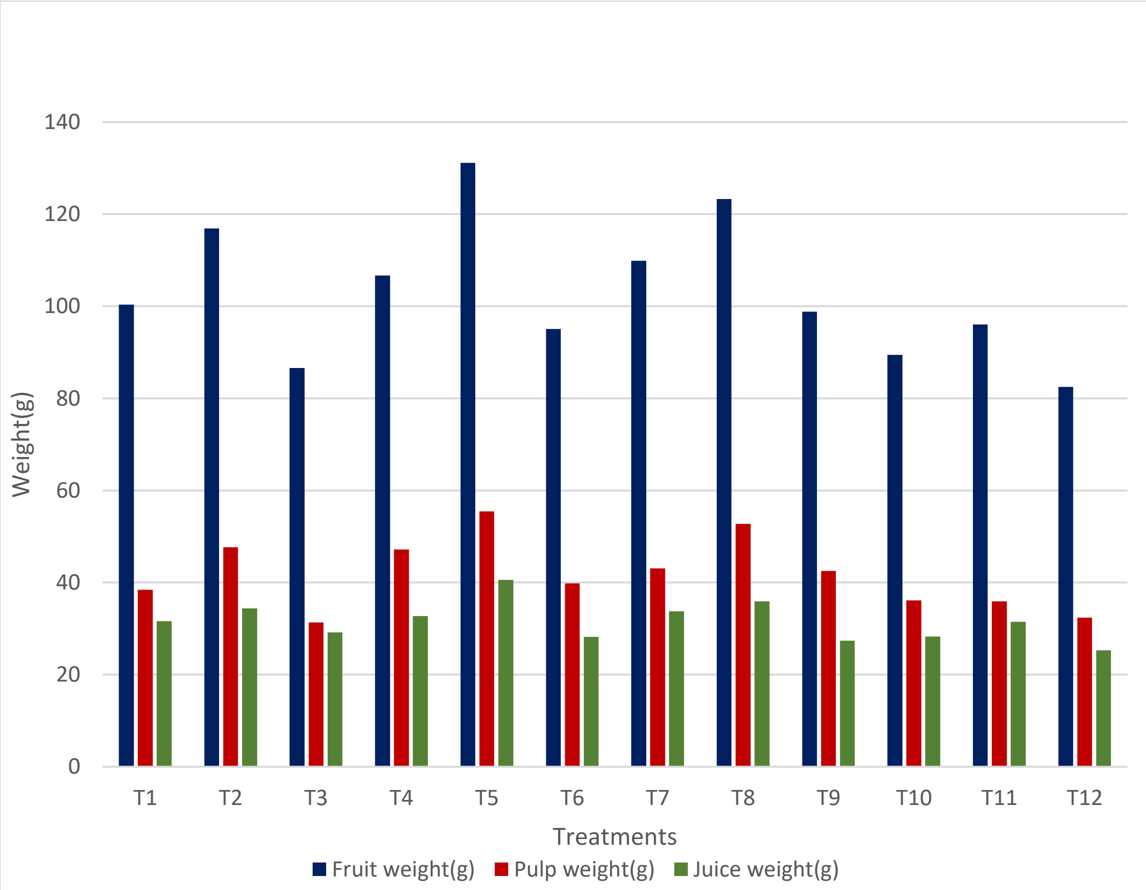
5.2.6 Rind weight , Seed weight , Rind thickness and 100 seed weight

The present study revealed that 25%, 50% and 75% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1% improved rind weight, seed weight, rind thickness and 100 seed weight in passion fruit.

The result of the present study is in similarity with Gurnah *et al.* (1980) who revealed that the rind weight of passion fruit were higher in light, medium and severe pruning treatments compared to the unpruned treatment.

Cavalcante *et al.* (2007) reported a rind thickness of 0.60-0.70cm, whereas Ferreira *et al.* (2010) reported a rind thickness of 0.71 cm in passion fruit.

Fig. 7. Effect of pruning and foliar nutrition on fruit weight, pulp weight and Juice weight in passion fruit



Araujo *et al*. (2006) found that K application at 6 mmol L^{-1} increased rind thickness in passion fruit compared to the control.

The passion fruit plants treated with 250-50-80 kg ha^{-1} NPK produced the most number of seeds per fruit (Olermo *et al*., 2017).

Souza *et al*. (2004) revealed that there is a significant correlation between seed weight and fruit weight in passion fruit.

5.3 QUALITY CHARACTERS

5.3.1 TSS

Highest TSS was recorded for the treatment combination with 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient mix @ 1%.

The result was in accordance with Khan *et al.* (1992) who reported that, Fruits with severe and moderate pruning contained higher TSS in ber. Chalak (2008) found that TSS and the TSS to acid ratio declined as pruning intensity decreased.

Kurtural *et al*. (2006) found that the TSS of grapevine cv. Chambourcin increased linearly with an increase in the intensity of pruning. According to Tyagi *et al*. (2017) TSS content in ber was higher in fruits with severe and medium pruning. Similar results were obtained by Balakrishnan and Rao (1963) and Chadha and Kumar (1970).

Studies by Sites and Reitz (1949) concluded that Increased light intensity throughout plant canopy by proper pruning was correlated with higher soluble solids concentrations and better rind colour in fruit crops.

High TSS (Total soluble solids), TSS/acid ratio in severely pruned vines may be attributed to decreased competition for metabolites among the limited number of bunches per vine, availability of more photosynthates as a result of improved vigour and physiological activities. (Gopu *et al.*, 2014). Similar findings are obtained by Sehrawat *et al*. (1998) ; Chougule *et al.* (2004) ; Somkuwar and Ramteke (2006)

Adhikari *et al*. (2015) noted that, compared to the control, pruned trees had a larger leaf-to-fruit ratio, which may have boosted the TSS concentration by allowing more metabolites to be produced

Findings of Tyagi *et al*. (2017) is in accordance with the current study where, the enzymes involved in converting polysaccharide into simple sugars, which raises the TSS of fruits, would have been triggered by zinc and potassium, which regulate the enzymatic activity in plants.

Kumar *et al.* (2006) reported that the application of potassium enhanced the TSS level (10.1° Brix) in the papaya pulp since it is known to assist translocation of sugar in plants. According to Jeyakumar *et al*. (2001), foliar spray of $ZnSO_4$@ 0.5% and H_3BO_3 @ 0.1% a resulted in increased TSS in papaya cv. CO_5

Mehraj *et al*. (2015) reported similar findings that, the foliar treatment of boron and zinc resulted in the highest total soluble solids, whereas the control resulted in the lowest total soluble solids in strawberry. Similar findings are obtained by Song *et al.* (2015) in grapevine, Rawat *et al.* (2010) in guava, Verma *et al*. (2016) in aonla

Higher total soluble solids in fruits may be the consequence of enhanced production of metabolites, translocation of minerals and photosynthates into developing fruits, which are promoted by zinc and boron (Jeykumar *et al*., 2001).

5.3.2 Titratable acidity and ascorbic acid content

The present experiment revealed that lowest titratable acidity and highest ascorbic acid content in passion fruit was recorded in treatment combination of 50% pruning of current fruiting branch along with foliar application of 19:19:19 @1 % and Sampoorna KAU Micronutrient @ 1%.

The current study's results agree with Shibuya's (1997) findings in Passion fruit, in which acidity decreased as the amount of N fertiliser increased.

Kumar *et al.* (2006) found that applying K to guava cultivar Lucknow-49 resulted in higher vitamin C levels in fruits. Similar findings were obtained by Araujo *et al*. (2006) in passion fruit.

The reduction in titrable acidity may result from the activity of boron and zinc during the glycolytic pathway or respiration, or both, in converting acids into sugars and their derivatives (Singh *et al*., 2010).

Reddy (2010) discovered that papaya cv Sunrise solo had higher ascorbic acid, and reduced acidity as a result of boron foliar treatment. Reduced acidity is also aided by the accumulation of total sugar from the breakdown of starch into sugar, the neutralisation of physiologically essential organic acids by boron, and the synthesis of protein (Reddy, 2010). Similar findings were obtained in papaya by Veena and Lavania (1989), Madani *et al.* (2012), Modi *et al*. (2012), Meena (2013), and Bhalerao and Patel (2015).

After conducting research on Strawberry cv. Chandler, Bakshi *et al*. (2013) reported that the plants treated with 0.6% $ZnSO_4$ had the lowest acidity (0.716%) and the maximum ascorbic acid content (60.88 mg 100 g^{-1}). Arshad and Ali (2016) got similar result in guava.

Zinc treatment enhanced the ascorbic acid content because more total soluble solids accumulated or because more metabolites were available for ascorbic acid production (Kumar and Shukla, 2005).

The increased ascorbic acid level in papaya fruits may result from the influence of boron and zinc on the conversion of carbohydrates into ascorbic acid (Kavitha *et al*., 2000). The acidity of fruits reduced following the application of zinc sulphate which can be related to higher buildup of total soluble solids. Due to the availability of metabolites necessary for ascorbic acid production, zinc treatment also resulted in an increase in ascorbic acid.

5.3.3 Total sugar and reducing sugar

According to the results of the current investigation, the treatment that received 50% pruning of the current fruiting branch together with foliar applications of 19:19:19 @1% and Sampoorna KAU Micronutrient @1% had considerably greater levels of total sugars and reducing sugars in passion fruit.

The result of the study was in accordance with Singh *et al.* (2010) who found that in moderately pruned trees of mango, the percentage of total sugar and reducing sugar were higher

Reduced competition between metabolites, fewer bunches per vine, and the availability of more photosynthates as a result of better vigour and physiological activity induced in them where source-sink relationships were well balanced may all contribute to the accumulation of high reducing and total sugars in balanced pruning of vegetative and reproductive growth (Gopu *et al.,* 2014; Mohanakumaran *et al.,* 1964; Singh and kumar, 1980).

In Custard apple, Kadam *et al.* (2018) found that the total sugar and reducing sugar were highest in pruned tress compared to control. These findings are supported by Sheikh and Rao (2002) in pomegranate, Lakpathi *et al.* (2013) in guava, and Kumar *et al*. (2014) in ber.

K_2SO_4 foliar sprays of 1 and 2 percent significantly enhance total and reducing sugars in the guava cultivar Lucknow-49 (Singh and Chauhan, 1982).

According to Verma *et al*. (2016), the foliar spray of $ZnSO_4$ + Borax was the most efficient for inducing the quality attribute like total sugar in aonla cv. NA -7. According to Paul and Nair (2015), foliar application of $ZnSO_4$ + $FeSO_4$+ $CuSO_4$ + H_3BO_3 + $(NH_4)_2MoO_4$ resulted in the highest total sugar, reducing sugar in banana cv. Nendran. Similar results are obtained by Venu *et al.* (2014) in Kagzi lime.

More total sugar accumulation may be caused by carbohydrate conversion, hexokinase activity, and starch breakdown into sugar due to the role of zinc, which catalyses the oxidation-reduction process in plants (Bhalerao and Patel, 2015).

According to Singh *et al.* (2001) and Singh *et al*. (2010), foliar spraying of zinc and boron increased the sugar fraction, which may be attributable to their presence as well as to their involvement in the translocation of sugars from one part of the plant to another part that is still developing and in the photosynthesis of metabolites.

5.3.4 Non-reducing sugar

Maximum non-reducing sugar was recorded in the treatment combination of 75% pruning of the current fruiting branch together with foliar applications of 19:19:19 @1% and Sampoorna KAU Micronutrient @1%

The result is in accordance with Daulta *et al.* (1986) who reported that non-reducing sugar increases with severity of pruning in peach cv. Sharbathi. These findings are supported by Sheikh and Rao (2002) in pomegranate, Lakpathi *et al.* (2013) in guava, and Kumar *et al.* (2014) in ber.

Sugar deposition may increase as a result of carbohydrate conversion, hexokinase activity by the action of zinc, which catalyses oxidation-reduction events in plants (Bhalerao and Patel, 2015). The findings are quite consistent with those of Makhmale *et al.* (2016) who studied custard apples. Waskela *et al.* (2013) observed similar findings in guava.

5.3.5 Sugar acid ratio

The sugar acid ratio of the passion fruit was significantly increased by pruning 50% of the current fruiting branch along with foliar application of 19:19:19 @ 1% and Sampoorna KAU Micronutrient @ 1%.

Joon and Singh (1983) discovered that when pruning intensity reduced in the cv. Delight grape, the TSS: acid ratio declined considerably.

Kondo and Higuchi (2011) reported that, sugar/acid ratio which influence the eating quality of passion fruit increased dramatically as fruit load reduced, due to reduction in fruit acidity.

Rumee and Baruah (2006) found that the increase in sugar acid ratio with the higher levels of potassium as the total sugar content rises and reduces the acidity levels

The results are in similarity with Premalatha and Suresh, (2019) who reported that application 3% micronutrient mixture increases sugar/acid ratio in banana. Similar results are obtained by Nehete *et al*. (2011) in mango, Yadav *et al.* (2010) in banana cv. Grand Naine, Kavitha *et al*. (2000) in papaya, Patel *et al*. (2010) in banana cv. Basrai. These findings are supported by ElShewy and Abdel-Khalek (2014) who revealed that foliar application of combinations of different micronutrients has increased the sugar acid ratio in peach cv. Florida prince and Desert red.

The rise in TSS and sugar acid ratio due to micronutrient application might be related to an increase in photosynthetic activity, sugar translocation from source to sink, and polysaccharide conversion to simple sugars, all of which are attributable to enhanced enzyme activities by zinc.

5.3.6 Total Carotenoids (mg per 100g)

The current study found that treatment combination includes pruning 50% of the current fruiting branch along with foliar application of 19:19:19 @ 1% and Sampoorna KAU Micronutrient @ 1% recorded highest total carotenoids in passion fruit.

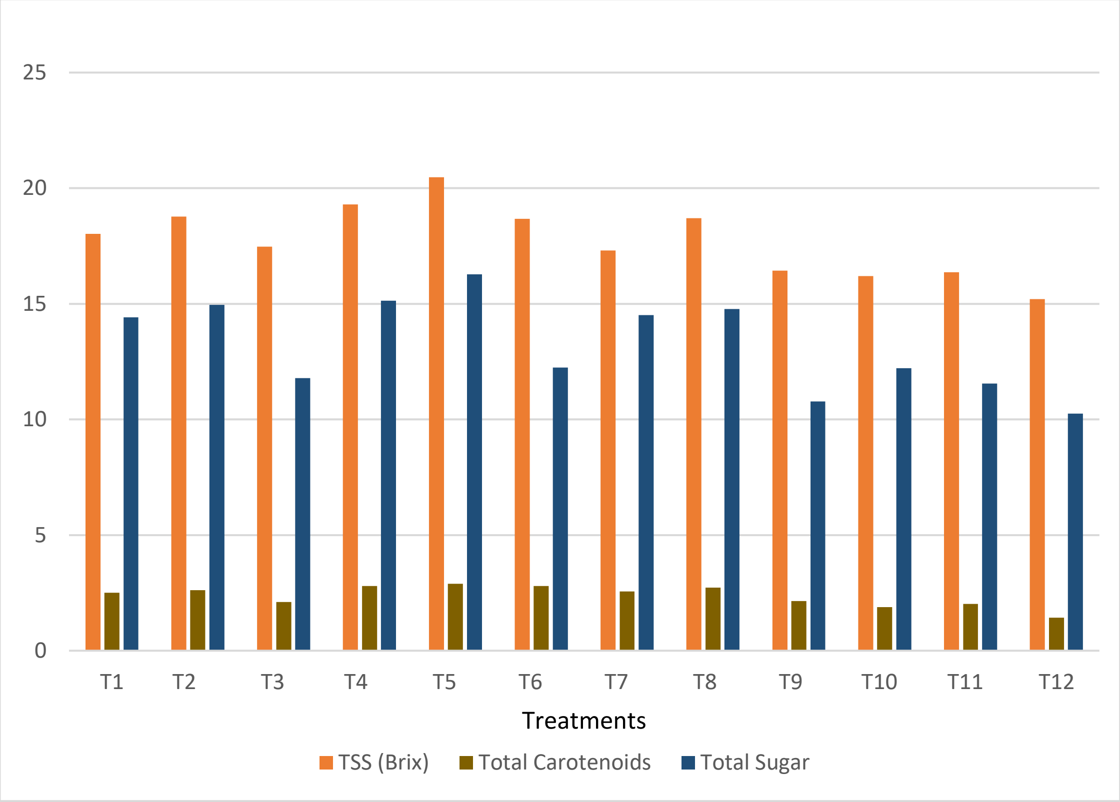
When $ZnSO_4$ @ 4% is applied to kinnow mandarin, similar results were obtained by Zaman *et al*. (2019), showing an elavation in total carotenoids.

Total carotenoids concentration was favourably influenced by pruning severity and was greatest in trees that had been moderately pruned (Singh *et al*. 2010)

According to Rodrigo and Zacarias (2010), zinc sulphate at a concentration of 4-6% raised the carotenoid content of *Citrus sinensis* and *Citrus reticulata*. Zaman *et al. (*2019) found similar result in Kinnow mandrin.

The foliar application of micronutrient may increase the carotene content of passion fruit by improving the carotene synthesis

Fig. 8. Effect of pruning and foliar nutrition on TSS, carotenoids and total sugar



5.4 Organoleptic evaluation of fruits for sensory quality

Pruning 50% of the current fruiting branch along with foliar application of 19:19:19 @ 1% and Sampoorna KAU Micronutrient mix @ 1% resulted in highest mean score for organoleptic characters like appearance, colour, flavour, taste and overall acceptability in passion fruit.

The highest ratings for taste in fruits during organoleptic evaluation were achieved due to the addition of potassium sources, which balances the sugar acidity levels in plants (Patil and Patil, 2017)

Similar results were found by Bhoyar and Ramdevputra (2016), who found that adding 0.5% Zn SO_4 and 0.5% $FeSO_4$ to guava increased its aroma, taste, flavour, texture, and overall acceptance.

Along with playing a critical part in the production of auxins, which are essential to plants, zinc is engaged in a variety of enzymatic processes. A lot of enzymatic processes also use it as a catalyst. As a result, complex sugars are converted into simple sugars, such as starch is converted into glucose or fructose. the formation of flavoproteins being connected to iron. Additionally, zinc's effect on zymohexose is responsible for its involvement in hexokinase activity, the production of cellulose, and the modification of sugars (Dutta and Dhua, 2002).

5.5 SHELF LIFE OF FRUITS AT AMBIENT CONDITIONS (DAYS)

A significant increase in the shelf life of passion fruit was obtained in the treatment with 50% pruning of the current fruiting branch along with foliar application of 19:19:19 @1% and Sampoorna KAU Micronutrient.

The trees treated with ZnSO4 0.5%+ 0.5% FeSO4 + 0.3% B in sapota had the longest shelf life (Thirupathaiah, 2017). It is attributed to an increase in photosynthetic activity throughout development, and optimal levels simulate cell wall integrity. Similar outcomes were obtained by Pathak and Mitra, (2008) Kumar *et al*. (2006) reported that, K application improves storage and shipping quality and extends shelf life in fruit crops.

5.6 Plant analysis

In the current study , pruning 50% of the current fruiting branch along with foliar application of 19:19:19 @ 1% and Sampoorna KAU Micronutrient mix @ 1% increased leaf nitrogen , phosphorus , potassium, zinc and boron content in passion fruit.

Pruning reduces the vegetative buds and increase the development of new shoot and attributes to altered hormonal conditions better nutritional translocation in a greater number of new shoots and leaves (Tyagi *et al.*, 2017)

Senthilkumar *et al.* (2015) found that plants with higher bud loads in 'Perlette' grapes had lower petiole N, P, and K contents. This result is in similarity with current study as unpruned vines with no foliar nutrient treatment (control) records lowest leaf NPK content.

The maximum amount of nitrogen that the plant could absorb was increased by applying more nitrogen doses (Babu and Sharma, 2005).

In passion fruit cv.Kaveri, plants treated with 100% NPK had the maximum N and K content in leaf tissue (Pongener and Alila, 2015).

According to Hariprakasarao *et al*. (1988), increasing N, P, and K application levels led to greater leaf N, P, and K statuses during the blooming stage of passion fruit.

Nitrogen had a substantial impact in increasing potassium uptake, which could be attributed to nitrogen's harmonising influence on potassium (Hazarikka and Mohan, 1992).

The highest phosphorus content may result from higher phosphorus metabolism, higher phosphorus uptake by leaves, and greater phosphorous translocation into the plant.

Boaretto *et al.* (2002) reported that foliar fertilization of Zn enhanced leaf Zn concentration to optimum range in orange plants. Similar result is obtained by Kaur *et al.* (2015) in Kinnow mandrins

Fig. 9. Effect of pruning and foliar nutrition on organoleptic characters in passion fruit

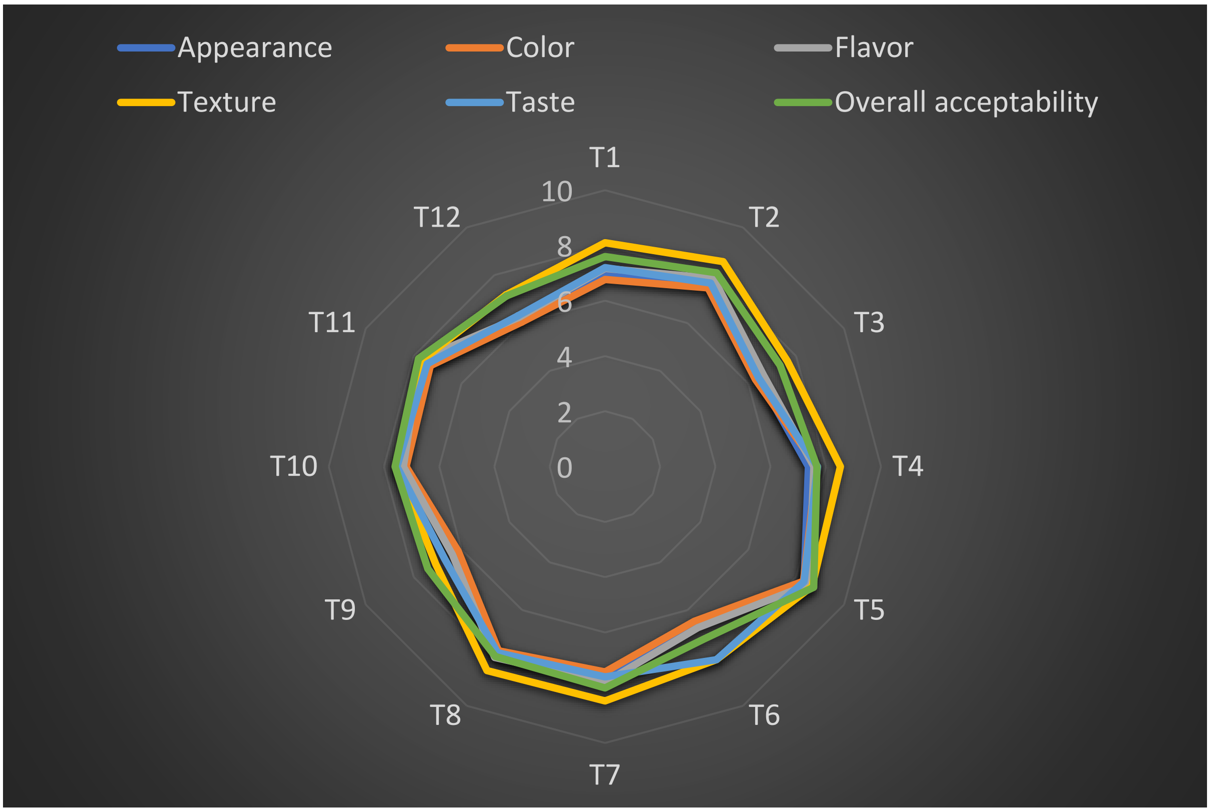
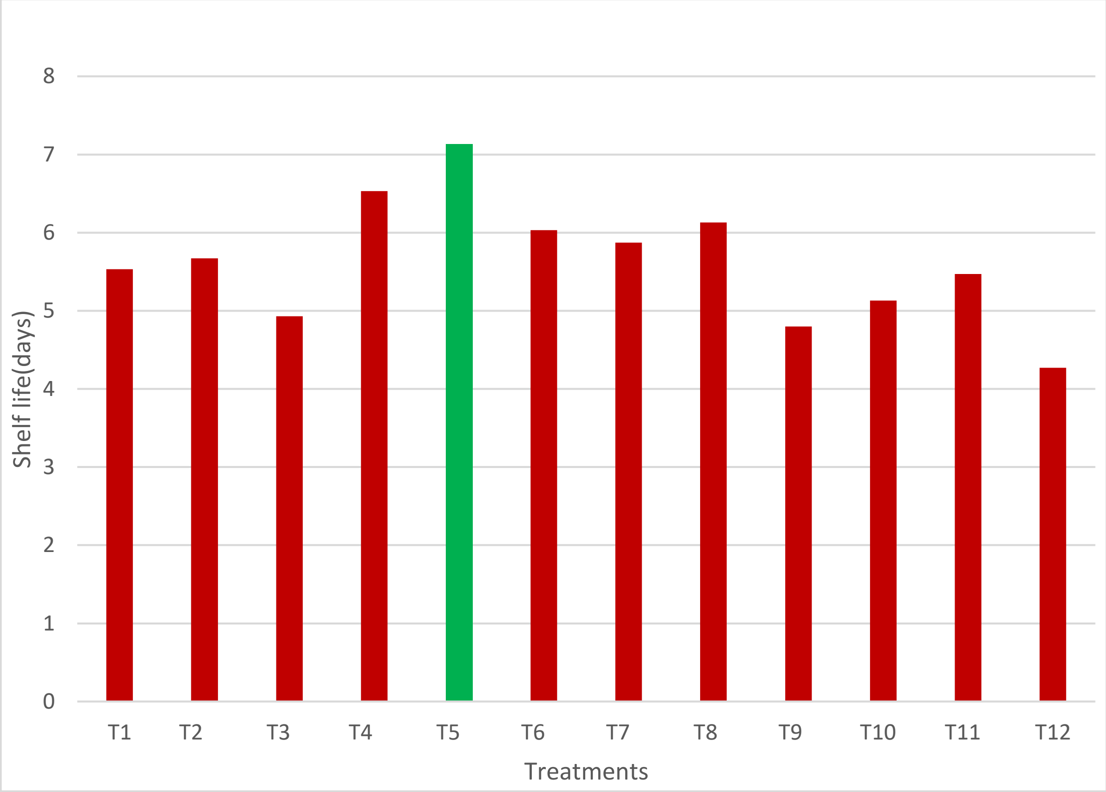


Fig. 10. Effect of pruning and foliar nutrition on shelf life of passion fruit



Fe, Zn, and B content in leaves of pomegranates were considerably raised by foliar application of $FeSO_4$ (0.4%), $ZnSO_4$ (0.25%), and borax (0.2%) alone or in combination (Afria *et al.*, 1999).

According to Pandey and Sinha (2006), boron stimulates leaf nitrogen content or increases nitrate absorption from the soil. Kumar and Shukla (2005) discovered that boron treatment reduced the activity of the nitrate reductase enzyme. Boron and zinc aid in nitrogen metabolism, resulting in increased nitrogen uptake. (Meena, 2013).

5.7 Fruit analysis

Data on fruit analysis indicated that 50% pruning of the current fruiting branch along with foliar application of 19:19:19 @ 1% and Sampoorna KAU Micronutrient mix @ 1% increased fruit nitrogen, phosphorus, potassium, zinc and boron content.

Results are in conformity with Pongener and Alila,(2015) who observed that when NPK fertilizers were used, there were noticeable changes in the N, P, and K content in fruit tissues, with passion fruit cv. Kaveri.

Patel (2015) reported that foliar sprays of $ZnSO_4$ (0.5%), $FeSO_4$ (0.5%), and Borax (0.2%) resulted in 6.36% zinc content and 1.56% boron content in mango cv. Amrapali compared to the control (4.40% and 0.95%, respectively).

Application of micronutrients to guava plants significantly increased the mineral content of fruit (Fe, Mn, and Zn) (El-Sisy, 2011).

Zinc application increased leaf nitrogen and zinc levels (Dutta and Dhua, 2002). Higher leaf nutrient concentration will result in higher fruit nutrient content due to translocation.

5.8 Pest and disease incidence

There were no serious pest and disease incidences observed in the field.

Results obtained by Gurnah *et al*. (1980) revealed that pruning reduces disease incidence in passion fruit. Similar results were obtained by Wangungu *et al*. (2014); Abasi *et al*. (2018); Joy and Sherin, (2016) According to Abasi *et al.* (2018), higher pruning intensity resulted in less dieback disease, whereas lower pruning intensity resulted in a higher incidence of dieback disease in passion fruit. Low pruning intensity allows for a dense canopy, which fosters a disease-friendly environment. As a result, moderate pruning may be the best option because it reduces dieback and encourages maximum yield.

Similar results were obtained by Cushnie (2011) who claims that moderate pruning results in an optimum canopy density that permits proper aeration and creates an environment that is unfavourable for the incidence of dieback.

Asrey *et al*. (2013) observed that, in pruned trees of mango, the percentage of anthracnose and stem-end rot diseases are found to be less.

Tyagi *et al.* (2017) stated that Zn deficiency is most prevalent in fruit crops, and foliar spraying of zinc sulphate 0.5% increased overall plant health and reduced leaf chlorosis and dieback in Kinnow mandrins. Similar results were obtained by Khorsandi *et al.* (2009), (Dikshit, 1961) and Kanwar *et al*., 1963). In addition, Alam (1989) noted that applying micronutrients including zinc, iron, copper, and manganese to citrus trees reduced the occurrence of interveinal chlorosis, little leaf, and dieback.

5.9 Economic analysis

The present investigation revealed that 50% pruning of the current fruiting branch along with foliar application of 19:19:19 @ 1% and Sampoorna KAU Micronutrient mix @ 1% resulted in highest net income and B:C ratio.

The result was in conformity with the study of Hafle *et al.* (2010) who studied the profitability of yellow passion fruit in various plant formations revealed that, more severe pruning techniques (20 and 14 branches per plant) resulted in greater production costs and decreased productivity, as well as higher economic and operational expenditures. For systems with fewer tertiary branches, the net income was negative (T_4 and T_5). Less severe pruning led to systems with positive net income ranging from R$ 1,861.06/ha in T3 to R$ 3,895.74/ha (2006/2007) in T2.

According to Senthilkumar *et al. (*2015), adopting judicious pruning techniques could assure a high net return in grapes with higher productivity.

Reddy (2010) reported that in papaya cv. Sunrise Solo, net returns were best in the treatment where plants were sprayed with boron 0.2 percent, which gave 3.28 lakh compared to 0.08 lakh in the control.

Pathak *et al.* (2011) reported that, the highest B:C ratio in banana cv Martman was obtained with the foliar application of Zn and Fe at proper intervels. Similar results was obtained by Patel *et al*. (2010) in banana cv. Basarai

The highest net income and B:C ratio obtained may be attributed to the higher fruit yield, fruit weight and production of quality fruits by proper canopy management and timely application of primary and micronutrients as foliar application to the plants.

Summary

6. SUMMARY

The research work on “Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.)” for enhancing growth, yield and quality was conducted with the objective to standardize the different pruning intensities and rejuvenation through foliar nutrition on growth, yield and quality of passion fruit. The study was conducted in purple passion fruit variety 134P. The investigation was carried out during 2020 December to 2021 December at the Department of Fruit Science, College of Agriculture, Vellayani. The salient findings of this study are summarized as follows.

The field experiment was laid out in RBD with 12 treatments and 3 replications. Treatments were T_1- Removing quarter portion (25%) of current fruiting branch + 19:19:19 @ 1 % , T_2 - Removing quarter portion (25%) of current fruiting branch + 19:19:19 @ 1 % + Sampoorna KAU micronutrient mixture @1 % T_3 - Removing quarter portion (25%) of current fruiting branch + Water spray (control) T_4 – Removing half portion (50%) of current fruiting branch +19:19:19 @ 1 % T_5 – Removing half portion (50%) of current fruiting branch +19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 % T_6 – Removing half portion (50%) of current fruiting branch + Water spray (control) T_7- Removing three quarter portion (75%) of current fruiting branch +19:19:19 @ 1 T_8 - Removing three quarter portion (75%) of current fruiting branch + 19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 % T_9 –Removing three quarter portion (75%) of current fruiting branch + Water spray (control). T_{10} – No pruning (control) + 19:19:19 @ 1 T_{11}- No pruning (control) + 19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 % and T_{12} –No pruning (control) + Water spray (control). Pruning was done in the month of December and foliar nutrient application was done at three times- one month after pruning, at time of flowering and fruiting. As per Ad hoc recommendation organic manure (10 Kg FYM plant^{-1}) and NPK (80: 30: 60 g plant^{-1} year^{-1}) were given uniformly to all treatments as soil application.

In the current study biometric parameters like number of newly emerged branches vine^{-1}, days taken for emergence of new branches, length of plant, girth of plant, number of flowers/vine/months, days taken for first flowering, days taken for first fruiting, total flower production/vine and flowering to harvest duration (days) were taken at monthly/bi monthly intervals from 1-12 months after pruning.

From the present investigation, it was observed that treatment combination of 75% pruning of current fruiting branch followed by application of 19:19:19@1% +Sampoorna KAU micronutrient mixture at one month after pruning at the time of flowering and fruiting increased the biometric characters like number of newly emerged branches per vine and reduced the days taken for emergence of new branches.

Observation on plant length and girth showed a significant increase throughout the growth period of plant due to the treatment combination of 50% pruning of current fruiting branch followed by application of 19:19:19@1% + Sampoorna KAU micronutrient mixture at one month after pruning at the time of flowering and at the time of fruiting

The study revealed that pruning and foliar nutrition had a positive response with respect to number of flowers produced/vine/month, days taken for first flowering, days taken for first fruiting, flowering to harvest duration and total flower production per vine.

Treatment combination with 50% pruning of current fruiting branch followed by application of 19:19:19@1% + Sampoorna KAU micronutrient mixture at one month after pruning at the time of flowering and at the time of fruiting increases number of flowers produced per vine per month, total number of flower production and decreases days taken for first flowering, days taken for first fruiting and flowering to harvest duration.

The result reveals that yield characters such as fruit weight, pulp weight, fruit girth, fruit diameter, rind weight, seed weight, rind thickness, number of fruits per vine and total fruit per vine were highest with the combined application of 50% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient @1%.100 seed weight was highest for treatment combination of 25% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient @1%

A positive response was seen in the qualitative characters like TSS, total sugar, reducing sugar, non-reducing sugar, sugar/acid ratio, ascorbic acid and total carotenoids with combined application of pruning and foliar nutrition of primary and micro nutrients. Combined application of 50% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient @1% reduced the titrable acidity and recorded maximum TSS, total sugar, reducing sugar, ascorbic acid, carotenoid whereas control plants reported lowest values for these characters. Rind and pulp color also improved in this treatment. Highest non-reducing sugar was recorded in the treatment which received 75% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient @1%

Organoleptic qualities of fruits varied significantly with the application of pruning and foliar nutrition of primary and micronutrients in passion fruit. 50% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient @1% increased the organoleptic qualities like appearance, colour, taste, flavour and overall acceptability. Shelf life of fruits were longer with the same treatment.

According to data from the plant analysis, nitrogen, phosphorous, potassium, zinc content was highest with the treatment combination which includes 50% pruning of current fruiting branch and foliar application of 19:19:19 @ 1% + Sampoorna KAU micronutrient mixture @ 1%. Similarly data from fruit analysis showed that nitrogen, phosphorous, potassium, boron and zinc content was highest with the treatment combination which includes 50% pruning of current fruiting branch and foliar application of 19:19:19 @ 1% + Sampoorna KAU micronutrient mixture @ 1%

Regarding pest and disease infestation, the Brown spot caused by *Alternaria passiflorae* and scab caused by *Cladosporium oxysporum* was noticed in the field with less than 1 per cent incidence rate. Also termite infestation was noticed in four plants. The pest and disease incidence were controlled by taking appropriate remedial measures as and when noticed

The pruning of current fruiting branch along with foliar spray of primary and micronutrients on passion fruit had shown a significant influence on net income and B:C ratio. The highest net income and benefit cost ratio was observed with treatment combination which includes removing half portion (50%) of current fruiting branch +19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 %.

From the above findings, it was concluded that removing half portion (50%) of current fruiting branch and foliar application of 19:19:19 @ 1 % + Sampoorna KAU micronutrient mixture @1 % at 1 month after pruning, at the time of flowering and fruiting along with the application of organic manure (10 kg FYM $plant^{-1}$) and NPK (80: 30: 60 g $plant^{-1}$ $year^{-1}$) had increased the growth, yield and quality characteristics of passionfruit and it was economically viable too.

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PRUNING AND FOLIAR NUTRITION FOR REJUVENATION IN PASSION FRUIT (*Passiflora edulis* f. *edulis* Sims.) FOR ENHANCING GROWTH, YIELD AND QUALITY

by

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ABSTRACT OF THE THESIS

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ABSTRACT

Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.) for enhancing growth, yield and quality

The study entitled "Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.) for enhancing growth, yield and quality" was conducted in the Department of Fruit Science, College of Agriculture, Vellayani, from 2020 December to 2021 December. Micronutrients and secondary nutrients play a major role in crop production due to their essentiality in plant metabolism and adverse effect that manifest due to their deficiency. The present work was undertaken to assess the effect of pruning and foliar nutrition on growth, yield and quality of passionfruit.

The field experiment was laid out in Randomized Block Design (RBD) with 12 treatments and 3 replications. The purple passion fruit variety 134P was selected for the research purpose. Treatments were T_1- Removing quarter portion (25%) of current fruiting branch + 19:19:19 @ 1 % , T_2 - Removing quarter portion (25%) of current fruiting branch + 19:19:19 @ 1 % + Sampoorna KAU micronutrient mixture @1 % T_3 - Removing quarter portion (25%) of current fruiting branch + Water spray (control) T_4 – Removing half portion (50%) of current fruiting branch +19:19:19 @ 1 % T_5 – Removing half portion (50%) of current fruiting branch +19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 % T_6 – Removing half portion (50%) of current fruiting branch + Water spray (control) T_7- Removing three quarter portion (75%) of current fruiting branch +19:19:19 @ 1 T_8 - Removing three quarter portion (75%) of current fruiting branch + 19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 % T_9 –Removing three quarter portion (75%) of current fruiting branch + Water spray (control) . T_{10} – No pruning (control) + 19:19:19 @ 1 T_{11}- No pruning (control) + 19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 % and T_{12} –.- No pruning (control) + Water spray (control). Pruning was done in the month of December and foliar nutrient application was done at three times- one month after pruning, at time of flowering and at the time of fruiting. As per Ad hoc recommendation organic manure

(10 kg FYM plant^{-1}) and NPK (80: 30: 60 g plant^{-1} year^{-1}) were given uniformly to all treatments as soil application.

Treatment combination with 75% pruning of current fruiting branch followed by application of 19:19:19@1% + Sampoorna KAU micronutrient mixture at one month after pruning at the time of flowering and at the time of fruiting increased the biometric characters like number of newly emerged branches per vine and reduces the days taken for emergence of new branches. Treatment combination with 50% pruning of current fruiting branch followed by application of 19:19:19@1% + Sampoorna KAU micronutrient mixture at one month after pruning at the time of flowering and at the time of fruiting increased the biometric characters like length of vine, girth of the vine, number of flowers produced per vine per month, total number of flower production and decreased the days taken for first flowering, days taken for first fruiting and flowering to harvest duration.

The results revealed that yield characters such as fruit weight, pulp weight, fruit girth, fruit diameter, rind weight, seed weight, rind thickness, number of fruits per vine and total fruit per vine were the highest with the combined application of 50% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient mixture @1%.100 seed weight was highest for treatment combination of 25% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient mixture @1%

Each character among the qualitative ones examined varied significantly. Combined application of 50% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient mixture @1% reduced the titrable acidity and recorded maximum TSS, total sugar, reducing sugar, ascorbic acid, carotenoid whereas control plants reported lowest values for these characters. Rind and pulp color also improved in this treatment. Highest non-reducing sugar was recorded in the treatment which received 75% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient @1%

50% pruning and foliar nutrition of 19:19:19@1% + Sampoorna KAU micronutrient mixture @1% increased the organoleptic qualities like appearance, colour, taste, flavour and overall acceptability. Shelf life of fruits were longer with the same treatment.

According to data from the plant analysis, nitrogen, phosphorous, potassium, zinc content was highest with the treatment combination which includes 50% pruning of current fruiting branch and foliar application of 19:19:19 @ 1% + Sampoorna KAU micronutrient mixture @ 1%. Similarly data from fruit analysis showed that nitrogen, phosphorous, potassium, boron and zinc content was highest with the treatment combination which includes 50% pruning of current fruiting branch and foliar application of 19:19:19 @ 1% + Sampoorna KAU micronutrient mixture @ 1%

The Brown spot caused by *Alternaria passiflorae* and scab caused by *Cladosporium oxysporum* was noticed in the field with less than 1 per cent incidence rate. Also termite infestation was noticed in four plants. The pest and disease incidence were controlled by taking appropriate remedial measures as and when noticed

The highest net income and benefit cost ratio was observed with treatment combination which includes removing half portion (50%) of current fruiting branch +19:19:19 @ 1 + Sampoorna KAU micronutrient mixture @1 %.

From the above findings, it was concluded that removing half portion (50%) of current fruiting branch and foliar application of 19:19:19 @ 1 % + Sampoorna KAU micronutrient mixture @1 % at 1 month after pruning, at the time of flowering and at the time of fruiting along with the application of organic manure (10 kg FYM plant^{-1}) and NPK (80: 30: 60 g plant^{-1} year^{-1}) had increased the growth, yield and quality characteristics of passionfruit and it was economically viable too.

സംഗ്രഹം

"വളർച്ച, വിളവ്, ഗുണമേന്മ എന്നിവ വർധിപ്പിക്കുന്നതിന് പാഷൻഫ്രൂട്ടിലെ(*Passiflora edulis* f. *edulis* Sims.) പുനരുജ്ജീവനത്തിനായുള്ള പ്രൂണിങ്ങും, ഇലകളുടെ പോഷകാഹാരംവും" എന്ന തലക്കെട്ടിലുള്ള പഠനം വെള്ളായണി കാർഷിക കോളേജിലെ ഫ്രൂട്ട് സയൻസ് വിഭാഗത്തിൽ 2020 ഡിസംബർ മുതൽ 2021 ഡിസംബർ വരെ നടത്തി. സൂക്ഷ്മപോഷകങ്ങളും ദ്വിതീയ പോഷകങ്ങളും വിള ഉൽപാദനത്തിൽ ഒരു പ്രധാന പങ്ക് വഹിക്കുന്നു കാരണം, സസ്യങ്ങളുടെ ഉപാപചയ പ്രവർത്തനത്തിലെ അവശ്യതയും അവയുടെ അഭാവം മൂലം പ്രകടമാകുന്ന പ്രതികൂല ഫലവുമാണ്. പാഷൻ ഫ്രൂട്ടിന്റെ വളർച്ച, വിളവ്, ഗുണമേന്മ എന്നിവയിൽ പ്രൂണിങ്ങും ഇലകളുടെ പോഷണത്തിനും ഉള്ള സ്വാധീനം വിലയിരുത്തുന്നതിനായാണ് ഇപ്പോഴത്തെ പ്രവർത്തനം ഏറ്റെടുത്തിരിക്കുന്നത്.

12 ട്രീട്മെൻറുകളും 3 പകർപ്പുകളും ഉപയോഗിച്ച് റാൻഡമൈസ്ഡ് ബ്ലോക്ക് ഡിസൈനിൽ (RBD) ഫീൽഡ് പരീക്ഷണം തയ്യാറാക്കി. പർപ്പിൾ പാഷൻ ഫ്രൂട്ട് ഇനമായ 134 പിയെ ഗവേഷണ ആവശ്യത്തിനായി തിരഞ്ഞെടുത്തു. T_1 ട്രീട്മെന്റിൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ കാൽ ഭാഗം (25%) നീക്കം ചെയ്യുകയും 19:19:19 1% മിശ്രിതം തളിക്കുകയും ചെയ്യുന്നു, T_2 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ കാൽ ഭാഗം (25%) നീക്കംചെയ്യുകയും 19:19:19 1% മിശ്രിതവും സമ്പൂർണ കെ.എ.യു. മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതവും 1 % തളിക്കുന്നു. T_3 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ കാൽ ഭാഗം (25%) നീക്കം ചെയ്യുകയും വാട്ടർ സ്പ്രേ (നിയന്ത്രണം)

കൊടുക്കുകയും ചെയ്യുന്നു. T_4 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ പകുതി ഭാഗം (50%) നീക്കംചെയ്യുകയും 19:19:19 1 % തളിക്കുകയും ചെയ്യുന്നു . T_5 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ പകുതി ഭാഗം (50%) നീക്കംചെയ്യുകയും 19:19:19 1% ഉം സമ്പൂർണ KAU മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതം 1% ഉം തളിക്കുന്നു. T_6 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ പകുതി ഭാഗം (50%) നീക്കം ചെയ്യുകയും വാട്ടർ സ്പ്രേ (നിയന്ത്രണം) കൊടുക്കുകയും ചെയ്യുന്നു. T_7 ൽ നിലവിലുള്ള കായ്ക്കുന്ന ശാഖയുടെ മുക്കാൽ ഭാഗം(75%) നീക്കം ചെയ്യുകയും 19:19:191% തളിക്കുകയും ചെയ്യുന്നു. T_8 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ മുക്കാൽ ഭാഗം (75%) നീക്കം ചെയ്യുകയും 19:19:19 1% ഉം സമ്പൂർണ KAU മൈക്രോന്യൂട്രിയന്റ് മിശ്രിതം 1% ഉം തളിക്കുന്നു. T_9 ൽ നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ മുക്കാൽ ഭാഗം (75%) നീക്കം ചെയ്യുകയും വാട്ടർ സ്പ്രേ (നിയന്ത്രണം) കൊടുക്കുകയും ചെയ്യുന്നു. T_{10} ൽ പ്രൂണിംഗ് ഇല്ല (നിയന്ത്രണം) + 19:19:19 1% കൊടുക്കുന്നു. T_{11} ൽ പ്രൂണിംഗ് ഇല്ല (നിയന്ത്രണം) + 19:19:19 1% ഉം സമ്പൂർണ KAU മൈക്രോന്യൂട്രിയന്റ് മിശ്രിതം 1 % ഉം കൊടുക്കുന്നു. T_{12} ൽ പ്രൂണിംഗ് ഇല്ല (നിയന്ത്രണം) + വെള്ളം സ്പ്രേ (നിയന്ത്രണം) കൊടുക്കുന്നു. പ്രൂണിംഗ് ഡിസംബർ മാസത്തിൽ നടത്തുകയും ഇലകളിൽ പോഷകങ്ങൾ മൂന്ന് തവണ പ്രയോഗിക്കുകയും ചെയ്തു - പ്രൂണിംഗ് കഴിഞ്ഞ് ഒരു മാസം കഴിഞ്ഞ്, പൂവിടുമ്പോൾ, കായ്ക്കുന്ന സമയത്ത്. അഡ്ഹോക്ക് ശുപാർശ പ്രകാരം ജൈവവളവും (10 കി.ഗ്രാം എഫ്.വൈ.എം. പ്ലാന്റ്$^{-1}$), എൻ.പി.കെ.യും (80:30:60 ഗ്രാം ഒരു ചെടിക്ക് ഒരു വർഷത്തിൽ) മണ്ണ് പ്രയോഗമായി എല്ലാ സംസ്കരണങ്ങൾക്കും ഒരേപോലെ നൽകി.

നിലവിലുള്ള കായ്ക്കുന്ന ശാഖയുടെ 75% പ്രൂണിങ്ങും 19:19:19 1% ഉം സമ്പൂർണ കെ.എ).യു മൈക്രോന്യൂട്രിയന്റ് മിശ്രിതം 1%ഉം പൂവിടുന്ന സമയത്തും കായ്ക്കുന്ന സമയത്തും പ്രയോഗിച്ച് ഒരു മാസത്തിനുള്ളിൽ ബയോമെട്രിക് പ്രതീകങ്ങളുടെ എണ്ണം വർദ്ധിപ്പിച്ചു. ഒരു വള്ളിയിൽ പുതുതായി ഉയർന്നുവരുന്ന ശാഖകൾ, പുതിയ ശാഖകൾ ഉണ്ടാകാൻ എടുക്കുന്ന ദിവസങ്ങൾ കുറഞ്ഞു. നിലവിലുള്ള കായ്ക്കുന്ന ശാഖയുടെ 50% പ്രൂണിങ്ങും 19:19:19 1% ഉം സമ്പൂർണ കെ.എ).യു മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതം 1% ഉം പൂവിടുന്ന സമയത്തും കായ്ക്കുന്ന സമയത്തും പ്രയോഗിച്ചുള്ള ട്രീട്മെന്റ് സംയോജനം ചെടിയുടെ നീളം വർധിപ്പിക്കുകയും വള്ളിയുടെ ചുറ്റളവ്, ഒരു വള്ളിയിൽ നിന്ന് പ്രതിമാസം ഉൽപ്പാദിപ്പിക്കുന്ന പൂക്കളുടെ എണ്ണം, മൊത്തം പൂക്കളുടെ എണ്ണം, ആദ്യത്തെ പൂവിടാൻ എടുത്ത ദിവസങ്ങൾ, ആദ്യം കായ്ക്കുന്ന ദിവസങ്ങൾ, വിളവെടുപ്പ് കാലയളവ് എന്നിവയിൽ കാര്യമായ മാറ്റമുണ്ടാക്കി.

ഫലങ്ങളുടെ തൂക്കം, പൾപ്പ് തൂക്കം, പഴത്തിന്റെ ചുറ്റളവ്, പഴത്തിന്റെ വ്യാസം, പുറംതൊലിയുടെ തൂക്കം, വിത്തിന്റെ തൂക്കം, പുറംതൊലി കനം, ഒരു വള്ളിയിലെ കായ്കളുടെ എണ്ണം, ഒരു വള്ളിയിൽ ആകെയുള്ള കായ് എന്നിങ്ങനെയുള്ള വിളവ് പ്രതീകങ്ങൾ 50% പ്രൂണിങ്ങും പ്രൂണിങ്ങും 19:19:19 1% ഉം സമ്പൂർണ കെ.എ).യു മൈക്രോന്യൂട്രിയന്റ് മിശ്രിതം 1%ഉം സംയോജി പ്പിച്ചപ്പോൾ ഏറ്റവും ഉയർന്നതാണെന്ന് ഫലങ്ങൾ വെളിപ്പെടുത്തി.

50% പ്രൂണിങ്ങും 19:19:19 1% ഉം സമ്പൂർണ കെ.എ).യു മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതം 1%ഉം സംയോജിപ്പിച്ചാൽ അസിഡിറ്റി കുറയ്ക്കുകയും പരമാവധി TSS, മൊത്തം പഞ്ചസാര,

റെഡ്യൂസിങ് പഞ്ചസാര, അസ്കോർബിക് ആസിഡ്, കരോട്ടിനോയിഡ് എന്നിവ കൂടുന്നതായും കണ്ടെത്തി. ഈ ട്രീട്മെന്റിൽ തൊലിയുടെയും പൾപ്പിന്റെയും നിറവും മെച്ചപ്പെട്ടു.

50% പ്രൂണിങ്ങും 19:19:19 1% ഉം സമ്പൂർണ കെ.എ).യു മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതം 1%ഉം രൂപം, നിറം, രുചി, രസം, മൊത്തത്തിലുള്ള സ്വീകാര്യത തുടങ്ങിയ ഓർഗാനോലെപ്റ്റിക് ഗുണങ്ങൾ വർദ്ധിപ്പിച്ചു. ഇതേ ട്രീട്മെന്റിൽ പഴങ്ങളുടെ സംഭരണ കാലാവധിയും കൂടുതലായിരുന്നു.

ചെടിയുടെ വിശകലനത്തിൽ നിന്നുള്ള വസ്തുത അനുസരിച്ച്, നൈട്രജൻ, ഫോസ്ഫറസ്, പൊട്ടാസ്യം, സിങ്ക് എന്നിവയുടെ അളവ് ഉയർന്നതായി കാണപ്പെട്ടു. അതുപോലെ, പഴങ്ങളുടെ വിശകലനത്തിൽ നിന്നുള്ള വസ്തുതയിൽ നിന്നു നൈട്രജൻ, ഫോസ്ഫറസ്, പൊട്ടാസ്യം, ബോറോൺ, സിങ്ക് എന്നിവയുടെ അളവും ഉയർന്നതായി കാണപ്പെട്ടു.

ആൾട്ടർനേറിയ പാസിഫ്ലോറ മൂലമുണ്ടാകുന്ന ബ്രൗൺ സ്പോട്ടും ക്ലോഡോസ്പോറിയം ഓക്സിസ്പോറം മൂലമു ണ്ടാകുന്ന ചുണങ്ങും ഒരു ശതമാനത്തിൽ താഴെ രോഗബാധ ശ്രദ്ധയിൽപ്പെട്ടു. കൂടാതെ നാല് ചെടികളിൽ ചിതൽബാധയും ശ്രദ്ധയിൽപ്പെട്ടു. ശ്രദ്ധയിൽപ്പെട്ടപ്പോൾ ഉചിതമായ പരിഹാരമാർ ഗങ്ങൾ സ്വീകരിച്ച് കീടബാധയും രോഗബാധയും നിയന്ത്രിച്ചു.

നിലവിലെ കായ്ക്കുന്ന ശാഖയുടെ പകുതി ഭാഗം (50%) നീക്കം ചെയ്യുന്നതും 19:19:19 1% ഉം സമ്പൂർണ കെഎ)യു മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതം 1% ഉം ഉൾപ്പെടെയുള്ള ട്രീട്മെന്റ്

സംയോജനത്തിൽ ഉയർന്ന അറ്റവരുമാനവും, ആദായ:ചിലവ് അനുപാതവും നിരീക്ഷിക്കപ്പെട്ടു.

മേൽപ്പറഞ്ഞ കണ്ടെത്തലുകളിൽ നിന്ന്, നിലവിലുള്ള കായ്ക്കുന്ന ശാഖയുടെ പകുതി ഭാഗം (50%) നീക്കം ചെയ്യുകയും, 19:19:19 @ 1 % ഉം സമ്പൂർണ KAU മൈക്രോ ന്യൂട്രിയന്റ് മിശ്രിതം 1 % ഉം എന്ന തോതിൽ പ്രൂണിങ് കഴിഞ്ഞു ഒരു മാസവും, പൂവിടുന്ന സമയത്തും കായ്ക്കുന്ന സമയത്തും പ്രയോഗം നടത്തുകയും ജൈവവളം (10 കി.ഗ്രാം എഫ്.വൈ.എം. പ്ലാന്റ്$^{-1}$), എൻ.പി.കെ (80: 30: 60 ഗ്രാം ചെടി$^{-1}$ വർഷം$^{-1}$) എന്നിവ ചേർക്കുന്നതും പാഷൻഫ്രൂട്ടിന്റെ വളർച്ചയും വിളവും ഗുണമേന്മയും വർധിപ്പിച്ചു, അത് സാമ്പത്തികമായും ലാഭകരമായിരുന്നു.

Appendices

APPENDIX I

Weather data during the period of study (October 2020 to December 2021)

Months	Maximum Temperature(ºC)	Minimum Temperature (ºC)	Relative Humidity (%)	Total Monthly Rainfall (mm)
Oct-20	26.5	18.2	83.4	127.0
Nov-20	27.0	18.1	86.1	115.2
Dec-20	26.4	16.9	82.8	30.6
Jan-21	26.6	17.0	76.0	65.9
Feb-21	28.6	16.6	65.1	27.0
Mar-21	30.4	18.4	68.0	34.3
Apr-21	29.5	18.7	77.8	112.7
May-21	27.4	17.2	84.8	215.0
Jun-21	26.1	16.2	83.7	224.2
Jul-21	24.9	15.7	90.3	504.9
Aug-21	25.1	16.2	92.1	225.5
Sep-21	25.9	15.9	87.0	140.1
Oct-21	26.2	16.5	88.2	325.1
Nov-21	24.7	17.1	90.2	187.4
Dec-21	26.6	15.5	78.3	10.9

APPENDIX II

COLLEGE OF AGRICULTURE VELLAYANI

Department of Fruit Science

Score card for assessing the organoleptic qualities of passion fruit cv. 134P.

Title: Pruning and foliar nutrition for rejuvenation in passion fruit (*Passiflora edulis* f. *edulis* Sims.) for enhancing growth, yield and quality

Criteria	Samples									
	1	2	3	4	5	6	7	8	9	10
Appearance										
Colour										
Flavour										
Texture										
Taste										
Overall Acceptability										

Score (9 point hedonic scale)

Like extremely-9

Like very much-8

Like moderately-7

Like slightly-6

Neither like nor dislike-5

Dislike slightly-4

Dislike moderately-3

Dislike verymuch-2

Dislike extremely-1

Name

Date: Signature