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Evaluation of IPM practices on yield and quality attributes of guava cv. Taiwan white

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ABSTRACT

The present study was conducted in Dr. Y.S.R. Horticultural University on guava to evaluate the Integrated Pest Management practices against yield and quality parameters. Studies on the influence of IPM practices on yield attributes of guava were estimated on total fruit yield, infested fruit yield and marketable fruit yield. The mean total fruit yield recorded as 3.39 ± 0.13 kg per tree in IPM plot of guava as compared to 2.36 ± 0.23 kg per tree in control plots of guava. The mean fruit fly and fruit borer infested fruit yield was 0.17 ± 0.06 kg and 0.08 ± 0.04 kg per tree in IPM plot which was 50.04 and 60.51 per cent less than that of control plots. The mean marketable fruit yield was in IPM plot was 43.40 per cent more than that of control plot of guava. The impact of IPM practices on fruit quality parameters revealed that the biochemical content is higher in the fruits of IPM plot compared to that of control plots. The mean data of IPM plot shows Total soluble solids content (8.67 ± 0.18 o Brix), titratable acidity (0.56 ± 0.02 per cent), Total soluble solids/acid ratio (15.72 ± 1.03), total sugars content (7.29 ± 0.44 per cent) and ascorbic acid (252.89 ± 5.69) as higher while, it was recorded lower in the control plots.

Keywords: Guava cv. Taiwan, IPM plot, Control plot, Yield, Quality

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Introduction

Guava (*Psidium guajava* L.) belongs to the family Myrtaceae, which is universally called as “the apple of the tropics” and is one of the most important commercial fruits in India after mango, banana and citrus. In recent years, Taiwan guava is fetching popular every year amongst the guava growers for its consistent fruiting character with two harvest seasons every year and due to its size and sweetness. The high ascorbic acid content in the fruits makes this cultivar internally acclaimed and most sought after fruit in the international market fetching premium price for quality fruits as each fruit weighs around 250 -300 grams (Reddy, 2019) [1]. But this cultivar is seriously damaged by various insect pests, resulting in decline of yield and quality of fruits and vast number of insects occupies the status of major pests of guava. Amongst the various pests infesting the guava fruit, the main insects the infest Taiwan guava are fruit flies and fruit borers which cause loss up to 26,902 million rupees (Sharma *et al.*, 2011) [2]. The major sucking pest complex of guava viz., mealy bugs, rugose spiralling whitefly and tea mosquito bug are also the prime reason for major impediment for the guava cultivation which suck sap from twigs, leaves and flowers and the infested fruits will turn into uneven shapes with poor yield and quality (Amin *et al.*, 2019) [3]. IPM is the best cost effective practice in reducing the pest population below economic threshold level which significantly reduces crop losses and increases productivity and quality of fruit by maximizing economic benefits. The average benefit cost ratio for IPM farmers (2.9) was more than that of non-IPM farmers (Aker *et al.*, 2016) [4]. The total soluble solid concentration (12.33°Brix) and vitamin C concentration (162.14 mg 100 per g) of the guava fruit was reported high in bagged fruits compared to un-bagged fruits of guava (Rahman *et al.*, 2018) [5]. So in this investigation, implementation of IPM practices was done to control the pest damage and to evaluate the IPM practices against yield and quality attributes of guava fruits. Wrapping the fruits with transparent polypropylene bags results in no fruit fly damage with lowest yield loss (1.66% per cent), better fruit quality and highest market price with net profit (1.357 lakh/ha) (Mondal *et al.*, 2015) [6]. Maximum fruit firmness (84.1N) and high reducing sugars (3.45%), non-reducing sugars (3.03%) and total sugars (7.10%) are noticed in perforated polyethylene bagged fruit of guava than un-bagged fruits (Abbasi *et al.*, 2014) [7].

Material and methods

The present investigation was carried out during *rabi*, 2019- 2020 in two guava plots (IPM Plot and Control Plot) which is planted in square system and spacing of 2 m x 2 m between rows and plants respectively of Dr. Y.S.R. Horticultural University at Venkataramannagudem, West Godavari District of Andhra Pradesh.

1. IPM plot: Schedule of IPM practices against major insect pests of guava

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1. Raking or ploughing the soil around the tree to expose resting stages of insect at three days interval from November 2019 to February 2020.
2. Regular collection and destruction of fallen and infested fruits.
3. Pruning of intermingling excessive branches for the management of sucking pests at vegetative stages in the July – October 2019.
4. Soil application of *Metarrhizium anisopliae* @ 2 kg/acre to reduce the fruit flies and mealy bugs, respectively at first week of November 2019.
5. Installation of yellow sticky traps @ 6/ acre in guava field against sucking pests from December 2019 to February 2020.
6. Installation of light traps @ 1/ acre in guava field against lepidopteran pests at first week of November 2019.
7. Erection of bird perches @ 15/acre in guava field at first week of November 2019.
8. Bagging of fruits with paper bags to avoid infestation of borers at monthly intervals from November 2019 to February 2020.
9. Installation of methyl eugenol pheromone traps @ 10 / acre at fruit development stage to control fruit flies [methyl eugenol (0.1%) + malathion (0.1%)] at monthly intervals from November 2019 to February 2020.
10. Ant colonies in the orchard was destroyed at regular intervals as they encourage the sucking pests.
11. Need based spraying application of insecticide viz., NSKE 5% @ 3 ml/lit, Neem oil @ 3 ml/lit, *Bacillus thuringiensis* @ 1 gm/lit, Imidacloprid 17.8 SL @ 0.3 ml/lit, and Spinosad @ 0.25 ml/lit for the management of sucking and borer pests was carried out on the appearance of the pest and repeated at 15 days interval from November 2019 to February 2020.

1. Control plot:

No control measures were taken against insect pests.

2.

Yield attributes in IPM and control plots of guava

Total fruit yield per tree (Kg)

The weight of the total guava fruits harvested from the randomly selected five trees was recorded from IPM and control plots of guava at each harvesting and the average weight of total fruit yield per tree was calculated.

2. Fruit fly infested fruit yield per tree (kg)

The weight of the fruit fly infested fruits harvested from the randomly selected five trees was recorded in IPM and control plots of guava and the average weight of fruit fly infested fruit yield per tree was calculated.

3. Fruit borer infested fruit yield per tree (Kg)

The weight of the fruit borer infested fruits harvested from the randomly selected five trees were recorded in IPM and control plots of guava and the average weight of fruit borer infested fruit yield per tree was recorded.

4. Marketable fruit yield per plant (Kg)

The weight of the marketable guava fruits harvested from the randomly selected five trees was recorded in IPM and control plots of guava and the average weight of marketable fruit yield per tree was calculated.

5. Fruit diameter (cm)

Guava fruit diameter was measured for fully matured fruit per tree in IPM and control plots with the help of digital Vernier calipers at widest middle point where maximum girth was noticed. The average fruit girth was calculated and expressed in centimeters.

6. Fruit length (cm)

Fully matured guava fruit per plant was randomly selected from IPM and Control plots of guava. The fruit length was recorded by measuring the distance from the stalk end to the floral end of the fruit with the help of digital Vernier calipers. The average fruit length was calculated and expressed in centimeters.

3. Evaluation of fruit quality attributes in IPM and control plots of guava

The biochemical analysis of guava fruits was carried out in the Department of Biochemistry at Dr. Y.S.R. Horticultural University at Venkataramannagudem, A.P.

1. TSS (°Brix)

The total soluble solids were estimated from fully matured fruits in IPM and Control plots at each harvest with the help of pocket digital refractometer (Atago, Pal-α, made in Japan) by placing a drop of fruit juice on digital refractometer at room temperature. The average of total soluble solids in guava fruit pulp were calculated and expressed in degree brix.

2. Titratable acidity (%)

A quantity of 10 g grinded fruit sample from IPM and Control plot was taken into a 100 ml volumetric flask each and the volume was made up to the mark with distilled water. From this, an aliquot of 10 ml was pipetted into 100 ml conical flask, add two drops of phenolphthalein indicator and titrated against 0.1 N NaOH until a faint pink colour was obtained and persisted at least for 15 seconds as an end point by (Ranganna, 1986) [8] and record the titre value of two samples. The per cent acidity in guava fruit pulp of IPM and Control plots was calculated by using the following formula.

$$\text{Titrateable acidity (\%)} = \frac{\text{Titre value} \times \text{equivalent weight of acid} \times \text{Normality}}{\text{Weight of sample taken (g)} \times \text{Volume of aliquot taken (ml)}} =$$

Note: Equivalent weight of acid = 0.0064 (Citric acid)

3. TSS/acid ratio

TSS / Acid ratio was calculated by dividing the value of total soluble solid of guava fruit pulp by per cent acidity of guava fruit pulp from IPM and Control plot respectively.

4. Total Sugars (%)

A quantity of 50 ml of lead free filtrate was transformed into 100 ml volumetric flask 5 ml of diluted HCl (2:1) was added, mix well and leave it overnight at room temperature. The excess acid was neutralized with NaOH by using a drop of phenolphthalein indicator till the pink colour was persisted at least for few seconds. Finally, the volume was made up to 100 ml. The per cent total sugars in guava fruit pulp from IPM and Control plots were estimated by taking this solution into a burette and titrated against a mixture of standard Fehling's solution A and B (1:1) by using methyl blue as an indicator until the dark red colour precipitate was formed. Note down the titre value and calculate the per cent total sugars in guava fruit pulp of IPM and Control plots by using the following formula.

$$\text{Total sugars (\%)} = \frac{\text{Dilution factor} \times \text{volume made up (ml)}}{\text{Titre value} \times \text{weight of sample (g)}} \times 100$$

5. Ascorbic acid (mg/100g pulp)

Ten grams of guava fruit pulp from IPM and Control plots were blended with 3% meta-phosphoric acid and transferred into a 100 ml volumetric flask and the volume was made up to the mark with 3% meta-phosphoric acid. Five ml of 3% meta-phosphoric acid and the sample extract were transferred into a 100 ml conical flask and titrated with standard dye until the pink color was persisted at least for 15 seconds. The ascorbic acid content in guava fruit pulp of IPM and Control plots was calculated by using the following formula.

$$\text{Ascorbic acid} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up} \times 10}{\text{Vol. of sample extract taken (ml)} \times \text{weight of the sample (g)}}$$

$$\text{Dye factor} = \frac{0.5}{\text{Titre value}}$$

1.5. Statistical analysis

Yield and quality parameters of the IPM with control plots of guava cv. Taiwan white was compared using paired *t*-test with SPSS 12.0 version pioneered by W.S. Gosset (1908) and later on developed and extended by Prof. R.A. Fisher.

Results and discussion

Yield attributes in IPM and control plots of guava

The data reveals that total yield of guava fruits was maximum in IPM plot (30.47 kg per tree) in comparison to that of control plots (21.28 kg per tree). The data depicted the mean fruit fly infested fruit yield was 0.17 ± 0.06 kg per tree in IPM plot which was 50.04 per cent lower than that of control plots with mean infested fruit yield of 0.36 ± 0.11 kg per tree. The mean fruit borer infested fruit yield was lower in IPM plot (0.08 ± 0.04 kg per tree) which was 60.51 per cent less than that of control plots (0.23 ± 0.08 kg per tree). The fruit diameter in IPM plot was 8.52 ± 0.09 whereas; in control plots it was 6.60 ± 0.12 which is 22.57 times lower than IPM plot. The fruit length in IPM plot was 7.40 ± 0.17 whereas, in control plots it was 6.34 ± 0.13 which is 14.24 times lower than IPM plot (table 41).

The marketable fruit yield was 3.14 ± 0.16 kg per tree in IPM plot which was 43.40 per cent more than that of control plot (1.78 ± 0.28 kg per tree). The highest yield per tree and marketable yield per tree was recorded in IPM plot over control plots of guava cv. Taiwan white due to reduction in pest population and infestation. The present investigations are in accordance with the findings of Gandhi *et al.* (2006) [9], Ashfaq *et al.* (2016) [10] and Sruthi *et al.* (2018) [11] who recorded highest yield of marketable fruits in IPM plots in contrast to control plots and reported that the increase in yield due to adoption of IPM practices.

Evaluation of fruit quality attributes in IPM and control plots of guava

The data describes the TSS ($^{\circ}$ Brix) content in the fruit of IPM plot is 8.67 ± 0.18 $^{\circ}$ Brix which is 15.15 per cent higher than the fruits drawn from control plot (7.35 ± 0.16 $^{\circ}$ Brix). The titratable acidity (%) content in the fruit of IPM plot is 0.56 ± 0.02 per cent which is 12 per cent more than the fruit of control plot (0.49 ± 0.04 per cent). The

data indicates that, the fruits collected from IPM plot having higher TSS/acid ratio (15.72 ± 1.03) which is 7.83 times more than the fruits collected from the control plots (14.48 ± 1.06). Total sugars present in the fruits of IPM plot is 7.29 ± 0.44 per cent while the control plots is 6.64 ± 0.52 per cent. The ascorbic acid content in IPM plot fruit is 252.89 ± 5.69 mg per 100 g which is 11.27 times more than the control plots having 224.44 ± 10.77 mg per 100 g. The present study is according to Abbasi *et al.* (2014) [7] and Rahman *et al.* (2018) [5] who reported that the adoption of IPM practices like bagging of guava fruits resulted in reduction of pest damage and increase in ascorbic acid content total sugars, firmness and reduce the weight loss.

IPM is undoubtedly a practicable and acceptable tactic over the world in advocating an integration of all means of management. Henceforth, to evaluate the best insect management in terms of economics, the data was recorded on yield which includes total yield per tree, yield of infested fruit per tree and marketable fruits per tree. Pruning in first week of July coupled with adoption of IPM practices like raking or ploughing the soil around the tree, regular collection and destruction of fallen and infested fruits, soil application of *Metarrhizium anisopliae*, installation of yellow sticky traps, installation of light traps, erection of bird perches and methyl eugenol pheromone traps, bagging of fruits, application of NSKE, Neem oil, *Bacillus thuringiensis*, Imidacloprid and Spinosad were responsible for suppression of pest population in IPM plot and resulting in increased fruit yield per tree and quality of fruits than that of control plot.

Author contribution

1. Author 1 conceived research, conducted the experiment and analyzed data of research
2. Author 2 advised the technical programme of research and approved the manuscript

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Conflict of interest

All the co-authors have *no conflicts of interest* with this manuscript and they agree with the contents of the manuscript for the submission.



Pruning of intermingling branches Application of *M. anisopliae* in soil



Yellow Sticky Traps Solar Light Trap

Table 1. Yield and yield attributes in IPM and control plots of guava cv. Taiwan white

Harvesting Date	Total yield (Kg.)		Fruit fly infested fruit yield (Kg.)		Fruit borer infested fruit yield (Kg.)		Marketable fruit yield (Kg.)		Fruit diameter (cm)		Fruit length (cm)	
	IPM Plot	Control plot	IPM Plot	Control plot	IPM Plot	Control plot	IPM Plot	Control plot	IPM plot	Control plot	IPM plot	Control plot
15/11/2019	3.51	2.50	0.10	0.21	0.09	0.17	3.31	2.12	8.38	6.76	7.32	6.54
29/11/2019	3.39	2.76	0.11	0.43	0.13	0.20	3.15	2.13	8.69	6.48	7.41	6.18
13/12/2019	3.38	2.31	0.29	0.44	0.04	0.34	3.05	1.53	8.54	6.7	7.28	6.22
27/12/2019	3.33	2.14	0.21	0.36	0.08	0.12	3.04	1.66	8.43	6.67	7.3	6.21
10/1/2020	3.48	2.24	0.11	0.34	0.04	0.13	3.39	1.77	8.46	6.74	7.37	6.38
22/01/2020	3.28	1.98	0.17	0.30	0.04	0.26	3.07	1.42	8.54	6.55	7.3	6.3
04/02/2020	3.62	2.56	0.22	0.31	0.12	0.20	3.28	2.05	8.53	6.49	7.35	6.37
17/02/2020	3.18	2.34	0.15	0.57	0.11	0.31	2.91	1.46	8.56	6.42	7.4	6.33
28/02/2020	3.30	2.45	0.16	0.25	0.08	0.32	3.06	1.88	8.55	6.55	7.84	6.55
Mean + S.D	3.39 ± 0.13	2.36 ± 0.23	0.17 ± 0.06	0.36 ± 0.11	0.08 ± 0.04	0.23 ± 0.08	3.14 ± 0.16	1.78 ± 0.28	8.52 ± 0.09	6.60 ± 0.12	7.40 ± 0.17	6.34 ± 0.13
Total	30.46	21.28	1.52	3.20	0.72	2.05	28.25	16.03				

Table 2. Quality attributes of IPM and Control plots of guava cv. Taiwan white

Harvesting dates	TSS (° Brix)		Titratable acidity (%)		TSS/Acid ratio		Total sugars (%)		Ascorbic acid (mg/100g pulp)	
	IPM plot	Control plot	IPM plot	Control plot	IPM plot	Control plot	IPM plot	Control plot	IPM plot	Control plot
11/15/2019	8.62	7.34	0.6	0.56	13.82	13.23	6.93	6.12	249	214
11/29/2019	8.79	7.12	0.56	0.45	15.36	13.45	7.21	6.54	253	230
12/13/2019	8.69	7.56	0.53	0.43	17.00	13.65	6.59	6.1	263	245
12/27/2019	8.49	7.23	0.58	0.53	14.85	13.45	6.9	6.0	257	238
1/10/2020	8.43	7.6	0.56	0.51	15.39	14.78	8.07	7.56	251	216
1/22/2020	8.73	7.32	0.55	0.48	15.93	14.89	7.49	7	257	220
2/4/2020	8.5	7.45	0.57	0.52	15.69	14.98	7.49	6.87	244	218
2/17/2020	8.9	7.34	0.55	0.47	16.42	15.87	7.61	6.98	254	219
2/28/2020	8.9	7.23	0.54	0.49	17.04	15.98	7.29	6.56	248	220
Mean + S.D	8.67 ± 0.18	7.35 ± 0.16	0.56 ± 0.02	0.49 ± 0.04	15.72 ± 1.03	14.48 ± 1.06	7.29 ± 0.44	6.64 ± 0.52	252.89 ± 5.69	224.44 ± 10.77

(continued on next page)



Figure 1. Components used in IPM Plot of guava cv. Taiwan white

Bird perch Bagging of guava fruits Fruit fly trap

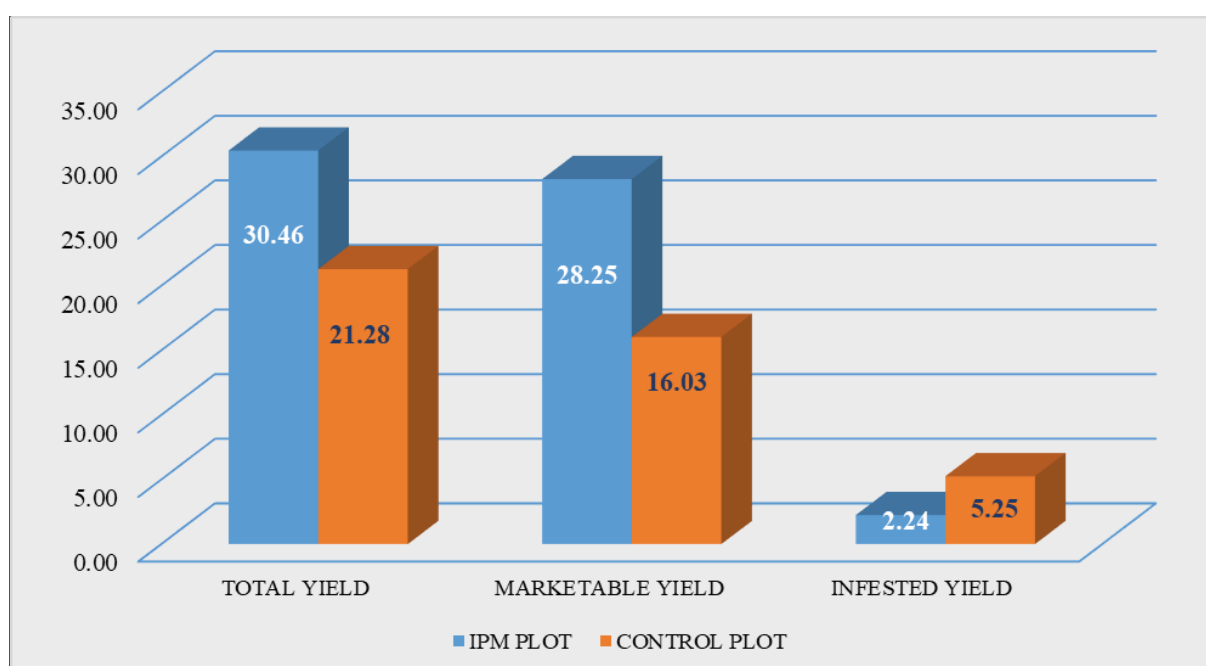


Figure 2. Comparison of total fruit yield, infested fruit yield and marketable fruit yield in

IPM and control plots of guava cv. Taiwan white

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