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Effect of pruning regimes and fertilizer levels on quality and economics of guava (*Psidium guajava* L.)

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Abstract
The experiment framed was intended to find out the optimum level of pruning and economic dose of fertilizer for higher yield and quality production of guava fruits. The results of the present investigation indicated that, different pruning treatments and fertilizer levels produced significant effect on fruit quality of guava. Physical and chemical quality attributes were recorded better in 45 cm pruning level with application of 125% RDF (1000:500:500 g NPK/tree) treatment. The maximum net monetary returns (Rs. 4,97,933/ha.) with highest (2.95) B: C was also obtained with the application of the said treatment.

Keywords: Pruning regimes, fertilizer, economics, *Psidium guajava* L.

Introduction
Guava is considered as one of the exquisite nutritionally valuable and remunerative fruit crop. It excels most other fruit crops in productivity, hardiness, adaptability and nutritive value. Guava bears on current season's growth and flowers appears in the axils of new leaves, therefore, it responds well to pruning. Pruning of guava is one of the most important practices that influence the vigour, productivity and quality of the fruits. Pruning levels under high density planting is vital for building strong frame work of the trees in early years and for maintain vigor, yield, productivity and quality of fruits in later years. (Rupankar *et al.*, 2015) [11]. A light pruning is considered necessary to encourage new shoots after the harvest. Pruning is helpful in reducing the tree size and improving the fruit quality and provide opportunity to increase the number of tree per unit area and subsequently the higher yield (Kumar and Rattanpal, 2010) [8]. In guava, the flowers and fruits are borne on current season's growth a light pruning is considered necessary to encourage new shoots after harvest. Though guava being an evergreen fruit plant practically no attention has been paid towards its pruning. The technology also helps in maintaining the manageable tree height with open architecture and canopy shoots with outwardly growth facilitating and utilization of light. Yield and quality of guava fruits is significantly influenced due to adoption of improved pruning technology and use of inorganic fertilizers. Properly pruned and well nourished guava trees produce excellent quality fruits shown by various research workers. Guava is hardy to soil and agro-climatic conditions, but gives good response to maturing increasing fruit production and quality. Proper fertilization application is very essential for high yield and better quality of guava fruits. The present recommended fertilizer dose for guava crop is 800:400:400 g NPK/tree/year with the spacing 6 X 6m (Anon, 2018) [1] which accommodates 277 plants per hector. Pruning is effective to induce healthy current season shoots from older woods. The exact information on intensity of pruning and nutrient needs of guava crop is not available. In recent days, farmers as well as consumers are interested in quality production of fruits as high quality produce is fetching higher price in the local as well as export markets.

Materials and Methods
The experiment was conducted in a well established orchard of fifteen years age Sardar guava trees planted at 6.0 X 6.0 m spacing in FRBD design. The experiment was conducted at Research Farm, college of Agriculture, Latur during *Mrig* bahar 2019 on trees having uniform growth and vigor.

All the cultural and horticultural practices were followed as per the recommendation. The experimental trees were pruned as per treatments in the 2nd fortnight of May and fertilizer doses as per treatments were applied just before the onset of monsoon along with 20 kg FYM per tree in which half dose of N and full dose of P_2O_5 and K_2O was applied as basal dose and remaining half dose of N as per treatments was applied at fruit set stage.

Details of Treatments

Table 1: Factor A: Pruning intensity

Pruning treatment	Pruning intensity
P_0	No pruning
P_1	15 cm of past season growth
P_2	30 cm of past season growth
P_3	45 cm of past season growth

Table 2: Factor B: Fertilizer levels

Treatments	% RDF	N,P,K Dose (g/tree)
F_1	75%	600:300:300 (g/tree)
F_2	100%	800:400:400 (g/tree)
F_3	125%	1000:500:500 (g/tree)

Table 3: Treatment Combinations

Treatment	Details
P_0F_1	No pruning + 75% RDF
P_1F_1	15 cm of past season growth + 75% RDF
P_2F_1	30 cm of past season growth + 75% RDF
P_3F_1	45 cm of past season growth + 75% RDF
P_0F_2	No pruning + 100% RDF
P_1F_2	15 cm of past season growth + 100% RDF
P_2F_2	30 cm of past season growth + 100% RDF
P_3F_2	45 cm of past season growth + 100% RDF
P_0F_3	No pruning + 125% RDF
P_1F_3	15 cm of past season growth + 125% RDF
P_2F_3	30 cm of past season growth + 125% RDF
P_3F_3	45 cm of past season growth + 125% RDF

Results and Discussion

The results clearly showed that, pruning was influenced significant effect on phsio- chemical qualities of guava fruits. The data on physical and chemical attributes of guava fruits is presented in tables. Interaction effect of pruning and fertilizer application had recorded significant effect on physio-chemical properties of guava fruits. Maximum fruit length (6.92cm), fruit width (6.97cm), fruit volume (180.47ml), pulp weight (178.00g), ascorbic acid (246.49mg/100g),

T.S.S. (11.41%), reducing sugars (5.19%) and total sugars (8.41%) was recorded in 45 cm pruning with the application of 125% RDF (1000:500:500 g NPK/tree) (P_3F_3) treatment. Minimum acidity (0.45%) was also recorded in said treatment. The results of present research investigation showed that the as the severity of pruning increases the fruit quality parameters like T.S.S., Acidity, reducing sugars, non-reducing sugars, and total sugars recorded higher as per pruning intensities i.e. from light to severe pruning level which might be due to increased in concentration of metabolites synthesis. The increase in the ascorbic acid content of fruits increased with increase in severity of pruning intensity. The present findings are in agreement with the findings of (Kumar and Rattanpal, 2010) [8]. Maximum increase in quality parameters of guava fruits were recorded in severe pruning intensity (Prakash *et al.*, 2012) [10] Regarding the chemical properties of guava fruits Maximum T.S.S.(%), ascorbic acid content (mg/100g pulp), reducing sugars (%) and total sugars (%) was found higher in mostly severe pruned trees and minimum acidity (%) and non-reducing sugars (%) were found in severe pruning trees while maximum acidity (%) and non reducing sugars (%) present in un pruned trees. Improved soluble solids and sugars was found to be correlated with increase light intensity the increased rate of photosynthesis due to more light penetration into interior tree canopy increased the soluble solids in fruits of pruned trees. The decrease in acidity might be due to deposition of higher quantam acid that is synthesized in fruits during development (Rupankar *et al.*, 2015) [11] in guava.

Table 4: Effect of pruning regimes and fertilizer levels on physical parameters of guava fruits

Pruning Level	Fruit length (cm)	Fruit width (cm)	Fruit Volume (ml)	Pulp weight (g)	Weight of Seeds (g/fruit)	Pulp: Seed ratio
P_0	5.76	5.96	110.20	125.89	5.12	25.14
P_1	5.79	6.02	115.51	128.16	4.65	25.81
P_2	5.96	6.17	127.78	136.62	4.55	29.32
P_3	6.21	6.38	136.11	145.51	4.02	35.97
S.E.	0.12	0.13	5.98	5.71	0.13	2.93
C.D. at 5%	0.36	0.38	17.56	16.77	0.39	8.61
Fertilizer level						
F_1	5.52	5.74	92.75	113.07	4.70	22.09
F_2	5.82	6.09	119.55	129.79	4.58	28.02
F_3	6.45	6.57	154.90	159.28	4.47	37.08
S.E.	0.10	0.11	5.18	4.95	0.11	2.54
C.D. at 5%	0.31	0.32	15.20	14.52	NS	7.46
Interaction						
P_0F_1	5.39	5.60	90.47	107.53	5.48	19.14
P_1F_1	5.43	5.70	91.20	110.83	4.81	20.05
P_2F_1	5.61	5.78	93.80	116.30	4.50	24.41
P_3F_1	5.66	5.86	95.53	120.07	4.01	24.74
P_0F_2	5.67	5.90	100.87	120.97	4.84	26.06
P_1F_2	5.69	5.94	115.67	137.20	4.85	26.35
P_2F_2	5.84	6.21	129.33	140.93	4.84	29.59
P_3F_2	6.07	6.32	132.33	129.79	3.79	30.10
P_0F_3	6.21	6.37	139.27	150.07	5.04	30.23
P_1F_3	6.25	6.44	139.67	152.67	4.29	31.03
P_2F_3	6.41	6.50	160.20	156.37	4.30	33.96
P_3F_3	6.92	6.97	180.47	178.00	4.25	53.09

S.E.	0.21	0.22	10.37	9.90	0.23	5.08
C.D. at 5%	0.62	0.65	30.41	29.04	0.67	NS

The quality parameters of fruits are stimulated by cell division, cell elongation, increase in number and weight of fruit better development, better transportation of water, uptake and

Table 5: Effect of pruning regimes and fertilizer levels on chemical quality parameters of guava

Pruning Level	T.S.S. (%)	Acidity (%)	Reducing Sugars (%)	Non-reducing Sugars (%)	Total sugars (%)	Ascorbic acid (mg/100g)
P_0	10.10	0.60	3.87	3.04	6.79	219.57
P_1	10.22	0.58	4.20	2.96	6.88	222.13
P_2	10.40	0.57	4.30	2.70	7.00	225.65
P_3	10.61	0.54	4.50	2.59	7.49	229.01
S.E.	0.07	0.07	0.15	0.14	0.19	0.86
C.D. at 5%	0.23	0.02	0.44	0.41	0.56	2.54
Fertilizer level						
F_1	9.63	0.63	3.73	3.35	6.32	210.67
F_2	10.40	0.58	4.13	2.81	7.07	222.69
F_3	10.96	0.51	4.79	2.31	7.73	238.91
S.E.	0.06	0.06	0.13	0.12	0.16	0.75
C.D. at 5%	0.19	0.01	0.38	0.36	0.48	2.20
Interaction						
P_0F_1	9.38	0.65	3.30	3.53	6.13	206.63
P_1F_1	9.59	0.63	3.65	3.52	6.16	209.43
P_2F_1	9.72	0.62	3.87	3.27	6.19	212.98
P_3F_1	9.85	0.61	4.10	3.10	6.81	213.64
P_0F_2	10.18	0.60	4.03	2.97	6.85	217.21
P_1F_2	10.32	0.58	4.12	2.89	6.97	220.30
P_2F_2	10.55	0.58	4.14	2.69	7.20	226.35
P_3F_2	10.57	0.56	4.23	2.67	7.25	226.89
P_0F_3	10.74	0.54	4.29	2.62	7.39	234.87
P_1F_3	10.76	0.52	4.81	2.47	7.50	236.65
P_2F_3	10.92	0.51	4.89	2.13	7.63	237.62
P_3F_3	11.41	0.45	5.19	2.01	8.41	246.49
S.E.	0.13	0.01	0.26	0.24	0.33	1.50
C.D. at 5%	0.39	0.03	0.76	0.72	0.97	4.41

Increase in T.S.S. (%) can be explained by that increase in fertilizer application than that of recommended phosphorous enters into the composition of phospholipids and nucleic acids, the latter combines with proteins and results in the formation of nucleo-proteins which are the important constituents of the nuclei of cells potassium acts as a catalyst in the formation of more complex substances and in the acceleration of coenzymes are beneficial in the improvement of fruit quality and nitrogen enhances the uptake of phosphorous and potassium. Increase in sugars content of fruits by the more than that of recommended dose of NPK fertilizers might be due to the enhancement in uptake of nutrients which lead to increased in catalytic activities by which complex substances degrade into simple sugars and thereby improve the fruit quality. The present results are in accordance with the findings of (Dutta *et al.*, 2009), (Binepal *et al.*, 2013) [2], (Kaur and Kaur, 2017) [5] in guava. Acidity in guava fruits decreased with increasing in level of nitrogen. Potassium played a significant role in quality improvement of guava fruits the effect of potassium on fruit quality may be explained from the fact that potassium improved photosynthetic activity and also help in better translocation of metabolites from leaves to fruits (Kumar *et al.*, 2009) [7], (Maity *et al.*, 2006) [9]. Improvement in fruit quality might be due to continuous supply of nutrients, higher concentration of soil enzymes, rapid mineralization and transformation of plant nutrient in soil. The results of present study are in accordance with the finding of (Shivakumar, 2010) [12], (Singh *et al.*, 2010) [13] and (Yadav *et al.*, 2011) [15], (Tandel *et al.*, 2017) [14] in papaya.

Table 6: Effect of pruning and fertilizer levels on economics of guava

Treatment	Treatment details	Cost of cultivation (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	B: C ratio
P_0F_1	No Pruning + 75% RDF (600:300:300 g NPK/tree)	1,85,082.47	3,78,005.31	1,92,922.84	2.04
P_1F_1	15 cm Pruning + 75% RDF (600:300:300 g NPK/tree)	1,90,228.22	4,05,699.81	2,15,471.59	2.13
P_2F_1	30 cm Pruning + 75% RDF (600:300:300 g NPK/tree)	1,94,279.88	4,26,829.80	2,32,549.92	2.20
P_3F_1	45 cm Pruning + 75% RDF (600:300:300 g NPK/tree)	2,00,963.70	4,69,476.71	2,68,513.01	2.34
P_0F_2	No Pruning + 100% RDF (800:400:400 g NPK/tree)	2,08,587.22	4,88,804.71	2,80,217.50	2.34
P_1F_2	15 cm Pruning + 100% RDF (800:400:400 g NPK/tree)	2,11,616.18	5,10,158.49	2,98,542.32	2.41
P_2F_2	30 cm Pruning + 100% RDF (800:400:400 g NPK/tree)	2,13,841.91	5,21,604.86	3,07,762.96	2.44
P_3F_2	45 cm Pruning +100% RDF (800:400:400 g NPK/tree)	2,16,221.65	5,40,971.32	3,24,749.68	2.50
P_0F_3	No Pruning + 125% RDF (1000:500:500 g NPK/tree)	2,25,908.67	5,82,828.62	3,56,919.95	2.58
P_1F_3	15 cm Pruning +125% RDF (1000:500:500 g NPK/tree)	2,28,477.63	5,93,790.37	3,65,312.75	2.60
P_2F_3	30 cm Pruning +125% RDF (1000:500:500 g NPK/tree)	2,36,738.76	6,46,537.15	4,09,798.40	2.73
P_3F_3	45 cm Pruning + 125% RDF (1000:500:500 g NPK/tree)	2,55,001.81	7,52,935.48	4,97,933.67	2.95

Regarding the economics of guava cultivation pruning and fertilizer levels showed significant effect on economic parameters of guava cultivation. Maximum cost of cultivation (Rs. 2,55,001.81/ha.), gross monetary returns (Rs. 7,52,935.48/ha.), net returns (Rs. 4,97,933.67/ha.), and B: C ratio (2.95) was observed in 45 cm pruning level with application of 125% RDF (1000:500:500 g NPK/tree) treatment which was followed by 30 cm pruning level with application of 125% RDF (1000:500:500 g NPK/tree) treatment. In present studies the higher levels of pruning and fertilizer levels produced significant effect on economics of guava cultivation. The pruning intensity of 45 cm with fertilizer application of 125% RDF (P_3F_3) showed positive response on most of the economic attributes under the study. The maximum gross monetary returns in the potential treatments may be due to higher yield and good quality fruits with the application of higher levels of NPK. As the trees of the experimental orchard has attained full growth and age and may be due to low nutrient status of orchard soil might have responded for higher level of fertilizer application. Minimum net returns in the treatment of lowest level of NPK was observed. The highest B: C ratio may be due to more net returns. The present findings are in accordance with the findings of (Dhomane and Kadam 2013) [3] and (Kumar 2019) [6].

Conclusion

It can be concluded that, pruning of tertiary branches of guava at 45 cm level with the application of 125% RDF (1000:500:500 g NPK/tree) produced better physical and chemical attributes of fruits. The economics of guava cultivation under the influence of different treatments of pruning and NPK levels also showed that, highest gross, net monetary returns and B: C ratio was obtained with the application of said treatment.

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