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Studies on Canopy Management Practices on NPK Status of Leaves in High Density Planting of Guava (*Psidium guajava* L.) Cv. Hisar Safeda

Shashank Singh[1]*, Devi Singh[1], Jeet Ram Sharma[1], M.K. Rana[2], Nidhi Sharma[1] and H.M. Vijaya

[1]Department of Horticulture, [2]Department of Vegetable Science, Chaudhary Charan Singh Haryana Agriculture University, Hisar- 125004 (Haryana), India
**Corresponding author*

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A B S T R A C T

The field experiment was conducted on guava cv. Hisar Safeda planted under different plant density to study the changes in nutrient composition of leaves after pruning and pinching. A significant difference was observed in N, P and K content due to different pruning levels and pinching numbers at different planting density of guava during rainy season. The highest N, P and K content was recorded in leaves taken from plants subjected to severe pruning up to 60% removal of shoot followed by 40 and 20% removal of shoot as compared to leaves taken from unpruned plants irrespective to pinching and spacing. Regarding pinching, the maximum N, P and K content was recorded in leaves taken from plants pinched twice, which was followed by leaves taken from plants pinched one time and the minimum in leaves taken from control plants with no pinching irrespective to pruning and spacing, while irrespective of pruning and pinching spacing also significantly affected the leaves nutrient composition as highest N, P and K content was registered in leaves taken from plants at 5x5 m spacing, which was followed by leaves taken from plants at 5x4 and 5x3 m spacing and the minimum in leaves taken from plants at closer spacing (5x2 m). The interaction between pruning and spacing was significant in respect to nitrogen content of leaves during rainy season, while other interactions were non-significant. However, the interaction effect due to pruning levels, pinching numbers and spacing was non significant in respect to P and K content of leaves during rainy season.

Introduction

Guava (*Psidium guajava* Linn.) popularly known as poor man's apple of the tropics belongs to the family Myrtaceae. It is believed to have originated in an area extending from southern Mexico through parts of Central America. Today, the guava is grown throughout the tropics and subtropics. The fruit is in great demand in domestic as well as international markets and is traded in more than 60 countries. The introduction of high-density planting is one of the important technologies to achieve high productivity per unit area both in short duration crop and perennial crop. A strategy for high-density planting in horticultural crops would call for use of dwarfing scion verities, growth and canopy management through pruning and cultural practices. High-density planting in guava has been achieved by closer spacing and canopy management practices. There are several reasons for pruning perennial fruit trees and if done drastically may influences

several physiological processes directly or indirectly. These effects result from alteration in communication system within the tree. Low yield is generally associated with high concentration of mineral nutrients in the fruits because minerals absorbed by roots are readily available to the few fruits produced. Therefore, it is expected that any type of pruning that reduce yield should increase the mineral content of fruits (Mika, 1986). The nitrogen, potassium, and phosphorus contents are increased by dormant pruning (Olszewski and Slowik, 1982; Ibrahem- Ahmed *et al.*, 1983a, 1983b). The decrease in number of fruits caused by pruning is associated with an increase in leaves N, P, K in fruit (Ferree and Schupp, 2003). Therefore, nutritional status of shoots may play an important role in such context. Keeping in view of above mentioned facts, the present investigation was conducted to study how nutrient levels of leaves got changed after pruning and pinching under different spacing.

Materials and Methods

The experiment entitled "Studies on canopy management practices on leave tissue analysis for NPK content in high-density planting of guava (*Psidium guajava* L.) cv. Hisar Safeda" was conducted at Research Farm of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2014-15 and 2015-2016 in rainy season to find out the suitable pruning level, pinching number at different spacing to evaluate leave tissue analysis for NPK content in plants of guava. The cultivar used for the investigation was Hisar Safeda.

The treatments comprising four levels of pruning (*i.e.*, 20, 40, 60% removal of shoot and control plants with no pruning), three pinching numbers (*i.e.*, control plants with no pinching, one time pinching in first week of August and two times pinching in first week of August and first week of October) and four different spacing (*i.e.*, 5x2, 5x3, 5x4 and 5x5 m) were laid out in a randomized block design with three replications. Forty-eight treatment combinations were imposed in three replications with 48 plants per replication. The data recorded on leave tissue analysis, which were influenced by different levels of pruning, pinching numbers and spacing.

For determining leaves nutrient status, four to six month old healthy leaves samples from non-fruiting terminals were collected in month of October and washed with running tap water followed by 0.1% HCl and two washings through distilled water. The seventeen washed leaves samples were surface dried and then oven dried at 70ºC for 48 hours. The dried leaves samples were ground and sieved. The ground leaves sample (0.5 g) was taken in 50 ml conical flask and added 10 ml diacid mixture (H_2SO_4: $HClO_4$ in 9:1 ratio) in to the flask. Digestion on a hot plate was carried out as described by Jackson (1973) for determination of N, P, and K. The total volume of the aliquot was made to 50 ml. The data was analyzed with the help of a windows based computer package OPSTAT (Sheoran, 2004), which calculates the standard error of means (SEm), standard error of the difference in mean (SEd) and critical difference (CD) between the treatments at 5% level of significance.

Result and Discussion

The data presented in tables 1, 2 and 3 reveals that N, P and K content of guava leaves significantly influenced by different pruning levels, pinching numbers and spacing. There was a significant increase in N, P and K content of guava leaves with increasing pruning severity as compared to control plants with no pruning.

Table.1 Effect of pruning, pinching and spacing on nitrogen content of guava in rainy season (based on pooled data)

Pruning × Pinching × Spacing (P x B x S)												
Pruning →	**P_0**			**P_{20}**			**P_{40}**			**P_{60}**		
Pinching→ Spacing ↓	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**
S_1 (5×2 m)	1.44	1.50	1.55	1.45	1.51	1.56	1.48	1.54	1.59	1.51	1.57	1.62
S_2 (5×3 m)	1.45	1.51	1.56	1.47	1.52	1.57	1.50	1.55	1.60	1.53	1.58	1.63
S_3 (5×4 m)	1.47	1.52	1.58	1.48	1.53	1.59	1.51	1.56	1.62	1.54	1.59	1.65
S_4 (5×5 m)	1.49	1.54	1.59	1.50	1.55	1.61	1.53	1.58	1.64	1.56	1.61	1.67

Pruning x Pinching (P x B)				
Pinching → Pruning ↓	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**Mean (P)**
P_0	1.46	1.52	1.57	1.52
P_{20}	1.48	1.53	1.58	1.53
P_{40}	1.51	1.56	1.61	1.56
P_{60}	1.54	1.59	1.64	1.59
Mean (B)	**1.50**	**1.55**	**1.60**	

Pruning x Spacing (P x S)					
Spacing → Pruning ↓	**S_1 (5×2 m)**	**S_2 (5×3 m)**	**S_3 (5×4 m)**	**S_4 (5×5 m)**	**Mean (P)**
P_0	1.49	1.51	1.52	1.54	**1.52**
P_{20}	1.50	1.52	1.53	1.55	**1.53**
P_{40}	1.53	1.55	1.56	1.58	**1.56**
P_{60}	1.56	1.58	1.60	1.61	**1.59**
Mean (S)	**1.52**	**1.54**	**1.55**	**1.57**	

Pinching x Spacing (B x S)					
Spacing → Pinching ↓	**S_1 (5×2 m)**	**S_2 (5×3 m)**	**S_3 (5×4 m)**	**S_4 (5×5 m)**	**Mean (B)**
B_1	1.47	1.49	1.50	1.52	**1.50**
B_2	1.53	1.54	1.55	1.57	**1.55**
B_3	1.58	1.59	1.61	1.63	**1.60**
Mean (S)	**1.52**	**1.54**	**1.55**	**1.57**	

CD at 5% level of significance	
Pruning	0.02
Pinching	0.01
Spacing	0.02
Pruning× Pinching	NS
Pruning× Spacing	0.03
Pinching× Spacing	NS
Pruning× Pinching× Spacing	NS

Table.2 Effect of pruning, pinching and spacing on phosphorus content of guava in rainy season (based on pooled data)

Pruning × Pinching × Spacing (P x B x S)												
Pruning ➞	**P_0**			**P_{20}**			**P_{40}**			**P_{60}**		
Pinching➞ Spacing ↓	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**
S_1 (5×2 m)	0.12	0.16	0.23	0.14	0.19	0.26	0.15	0.20	0.27	0.16	0.21	0.28
S_2 (5×3 m)	0.13	0.18	0.24	0.15	0.20	0.27	0.16	0.21	0.28	0.17	0.22	0.29
S_3 (5×4 m)	0.15	0.20	0.26	0.17	0.22	0.29	0.18	0.23	0.30	0.19	0.24	0.31
S_4 (5×5 m)	0.16	0.21	0.28	0.18	0.23	0.31	0.19	0.24	0.33	0.20	0.25	0.34

Pruning x Pinching (P x B)				
Pinching ➞ Pruning ↓	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**Mean (P)**
P_0	0.14	0.19	0.25	**0.19**
P_{20}	0.16	0.21	0.28	**0.22**
P_{40}	0.17	0.22	0.29	**0.23**
P_{60}	0.18	0.23	0.30	**0.24**
Mean (B)	**0.16**	**0.21**	**0.28**	

Pruning x Spacing (P x S)					
Spacing ➞ Pruning ↓	**S_1 (5×2 m)**	**S_2 (5×3 m)**	**S_3 (5×4 m)**	**S_4 (5×5 m)**	**Mean (P)**
P_0	0.17	0.18	0.20	0.22	**0.19**
P_{20}	0.19	0.21	0.22	0.24	**0.22**
P_{40}	0.20	0.22	0.24	0.25	**0.23**
P_{60}	0.21	0.23	0.25	0.26	**0.24**
Mean (S)	**0.20**	**0.21**	**0.23**	**0.24**	

Pinching x Spacing (B x S)					
Spacing ➞ Pinching ↓	**S_1 (5×2 m)**	**S_2 (5×3 m)**	**S_3 (5×4 m)**	**S_4 (5×5 m)**	**Mean (B)**
B_1	0.14	0.15	0.17	0.18	**0.16**
B_2	0.19	0.20	0.22	0.24	**0.21**
B_3	0.26	0.27	0.29	0.31	**0.28**
Mean (S)	**0.20**	**0.21**	**0.23**	**0.24**	

CD at 5% level of significance	
Pruning	0.02
Pinching	0.02
Spacing	0.02
Pruning× Pinching	NS
Pruning× Spacing	NS
Pinching× Spacing	NS
Pruning× Pinching× Spacing	NS

Table.3 Effect of pruning, pinching and spacing on potassium content of guava in rainy season (based on pooled data)

Pruning × Pinching × Spacing (P x B x S)												
Pruning ➞	**P_0**			**P_{20}**			**P_{40}**			**P_{60}**		
Pinching➞ Spacing ↓	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**
S_1 (5×2 m)	1.13	1.19	1.26	1.16	1.21	1.25	1.18	1.24	1.30	1.20	1.26	1.33
S_2 (5×3 m)	1.15	1.20	1.28	1.17	1.23	1.30	1.19	1.24	1.32	1.21	1.27	1.34
S_3 (5×4 m)	1.16	1.22	1.30	1.19	1.25	1.32	1.21	1.27	1.34	1.23	1.29	1.36
S_4 (5×5 m)	1.18	1.25	1.32	1.20	1.27	1.34	1.22	1.29	1.36	1.24	1.31	1.39

Pruning x Pinching (P x B)				
Pinching ➞ Pruning ↓	**B_1 (Control)**	**B_2 (One time)**	**B_3 (Two time)**	**Mean (P)**
P_0	1.16	1.22	1.29	**1.22**
P_{20}	1.18	1.24	1.30	**1.24**
P_{40}	1.20	1.26	1.33	**1.26**
P_{60}	1.22	1.28	1.35	**1.29**
Mean (B)	**1.19**	**1.25**	**1.32**	

Pruning x Spacing (P x S)					
Spacing ➞ Pruning ↓	**S_1 (5×2 m)**	**S_2 (5×3 m)**	**S_3 (5×4 m)**	**S_4 (5×5 m)**	**Mean (P)**
P_0	1.19	1.21	1.23	1.25	**1.22**
P_{20}	1.21	1.23	1.25	1.27	**1.24**
P_{40}	1.24	1.25	1.27	1.29	**1.26**
P_{60}	1.26	1.27	1.29	1.31	**1.29**
Mean (S)	**1.23**	**1.24**	**1.26**	**1.28**	

Pinching x Spacing (B x S)					
Spacing ➞ Pinching ↓	**S_1 (5×2 m)**	**S_2 (5×3 m)**	**S_3 (5×4 m)**	**S_4 (5×5 m)**	**Mean (B)**
B_1	1.17	1.18	1.20	1.21	**1.19**
B_2	1.22	1.24	1.26	1.28	**1.25**
B_3	1.29	1.31	1.33	1.35	**1.32**
Mean (S)	**1.23**	**1.24**	**1.26**	**1.28**	

CD at 5% level of significance	
Pruning	0.03
Pinching	0.02
Spacing	0.03
Pruning× Pinching	NS
Pruning× Spacing	NS
Pinching× Spacing	NS
Pruning× Pinching× Spacing	NS

While irrespective of pinching and spacing severely pruned plants *i.e.*, 60% removal of shoot was recorded the highest N content of leaves (1.59%), which was followed by 40 (1.56%) and 20% removal of shoot (1.53%) and the minimum in leaves taken from control plants with no pruning (1.52%). The P content was recorded maximum in leaves taken from plants receiving 60% removal of shoot (0.24%), which was statically at par with 40% removal of shoot (0.23%) and 20% removal of shoot (0.22%) and the minimum in leaves taken from control plants with no pruning (0.19%), irrespective of pinching and spacing.

The K content of guava leaves also recorded highest in leaves of tree subjected to 60% removal of shoot (1.29%), which was statically at par with 40% removal of shoot (1.26%) and followed by 20% removal of shoot (1.24%) and the minimum in leaves taken from control plants with no pruning (1.22%).

In respect to pinching numbers, the highest N, P, and K content was recorded in leaves taken from plants pinched two times (1.60, 0.28 and 1.32% respectively), which was followed by leaves taken from plants pinched one time (1.55, 0.21 and 1.25% respectively) and the minimum in leaves taken from control plants with no pinching (1.50, 0.16 and 1.19% respectively) irrespective of pruning and spacing. The possible reasons for the above effect might be due to that severe pruning removes an ample amount of plant biomass, which would have utilized nutrients for its growth and development if it had not been pruned. Therefore, leaves of unpruned and lightly pruned trees contained low level of N, P and K content, while leaves of severely pruned tree showed a high level of N, P and K content. Similarly, Tahir and Hamid (2002) also found higher N, P and K content in leaves of guava subjected to complete thinning during summer. Khera and Chundawat (1977) observed that N content was higher in leaves of deblossomed guava tree cv. Banarsi Surkha. Adhikari (2009) reported highest NPK content with increasing pruning severity in guava.

Irrespective of pruning and pinching, spacing also significantly affected the N, P and K content during rainy season. The minimum N, P and K content was recorded in leaves taken from plants at 5x2 m spacing (1.52, 0.20 and 1.23% respectively) and the maximum in leaves taken from plants at 5x5 m spacing (1.57, 0.24 and 1.28% respectively), which was statically at par with leaves taken from plants at 5x4 (1.55, 0.23 and 1.26% respectively) and followed by 5x3 m (1.54, 0.21 and 1.24% respectively) spacing. The nitrogen, phosphorus and potassium content of leaves increased with decreasing plant density. The nitrogen, phosphorus, and potassium content were recorded maximum in leaves taken from plants at wider spacing and the minimum in leaves taken from plants at closer spacing, which might be due to wider spacing responsible for higher uptake and translocation of nutrient from soil to aerial part of the plants. These results are in line with previous findings of Kumar *et al.*, (2013) in apricot.

The interaction between pruning and spacing was significant in respect to nitrogen content of leaves during rainy season, while other interactions were non-significant. The maximum nitrogen content of leaves was recorded in leaves taken from plant with the combination of 60% removal of shoot at 5x5 m spacing (1.61%), which was statically at par with the combination of 60% removal of shoot at 5x4 m (1.60%) and 60% removal of shoot at 5x3 m (1.58%) spacing and the minimum in combination of control trees with no pruning at 5x2 m (1.49%) spacing, irrespective of spacing. However, the interaction effect due to pruning levels,

pinching numbers and spacing was non significant in respect to P and K content of leaves during rainy season.

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