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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 659-663

www.thepharmajournal.com
Received: 16-01-2023
Accepted: 19-02-2023

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Enhancing chemical quality through pruning time, pruning intensity and fruit bagging in Mrig bahar Guava cv. Lucknow-49

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Abstract
A field experiment was carried out at Garden of Department of Horticulture Kalyanpur, Kanpur, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur-208002 during the tenure of 2020-2021 and 2021-2022 to evaluate the fruit quality and yield through different pruning time, intensity and bagging of fruit in Mrig bahar Guava cv. Lucknow-49.The experiment was conducted in a Randomized block design (Factorial) with three replications. The treatment combination comprise of 3 factors *viz*. 3 pruning time, 2 pruning intensity and 2 bagging levels. Based on the experimental results it can be concluded that result obtained from the present investigation, among different pruning time (15th June), pruning intensity (50%) and fruit bagging (30 DAFS) was found most effective in improving chemical parameters of guava fruit. The results showed that application of $T_3P_2D_2$ (15 June + Pruning of 50% of the annual growth + Bagging at 30 DAFS) has resulted in the maximum TSS (16.83 and 17.05 0Brix), vitamin-c (409.00 and 415.04 mg), reducing sugar (4.33 and 4.46%), non-reducing sugar (2.40 and 2.49%), total sugars (6.76 and 6.95%),), pectin content (1.18 and 1.21%), with minimum titratable acidity (0.15 and 0.15%) during both the year of observation. Pruning of guava trees in the second week of June with 50 per cent pruning intensity give maximum return for guava growers of Central-Western part of the state of Uttar Pradesh.

Keywords: Pruning time, pruning intensity, bagging, TSS, acidity, vitamin-C, total sugar, pectin content

Introduction
Guava (*Psidium guajava* L.) also known as “apple of tropics” or “poor man’s apple” is one of the most popular fruit crops of tropical and sub-tropical climate. It belongs to the Myrtaceae family having chromosome number 2n= 22 and is native to Tropical America, extending from Mexico to Peru**.** The plant was introduced by the Portuguese to the Indian subcontinent in the early 17th century but at present, the major guava producing countries are India, China, Thailand, Pakistan, Mexico, Indonesia, Brazil, Bangladesh. However, due to its easy availability, a rich source of nutrients, and inexpensiveness of the fruit to the common man; it seems to be an Indian fruit**.**

Guava is the fifth most important fruit in respect of area and production after banana, mango, citrus, and papaya in India. The area under guava in India is about 2.65 million hectares, producing 4.05 million tones, and productivity of 1.52million tones/hectare (NHB Database, 2017-18). In India, largest area and highest production under guava fruit is in Uttar Pradesh and highest Productivity in Andhra Pradesh. It grows everywhere in India in the homestead gardens, even without or little care, but it is commercially cultivated in the states of Uttar Pradesh, Bihar, Madhya Pradesh, West Bengal, Punjab, Gujarat, Maharashtra, Karnataka, and Andhra Pradesh.

The chemical composition of guava fruits varies widely with cultivars, stage of maturity and season. The total soluble solids content in fruit varies from 8.2 to 10.5 ^{0}Brix.The total sugar content ranges between 4.9 and 10.1%. Out of which fructose (59%), glucose (36%) and sucrose (5%) are the predominant sugars in ripe guava while sucrose is the main constituent in fully ripe fruits. The ascorbic acid content ranges from 75 to 260 mg/100 g, which varies with cultivar, season, location and stage of maturity (Singh, 1988, Das *et al.*, 1995; Ghosh and Chattopadhyay, 1996) [17, 5, 8]. Pink-fleshed cultivars are poorer in ascorbic acid content than the white fleshed ones. In general, the fruits harvested during winter season are superior in quality to rainy season fruits. Guava fruits are a good source of pectin which ranges between 0.5 and 1.8%.

The pectin content also varies with cultivars and stage of maturity and there is no specific trend in pectin content between pink and white fleshed cultivars/hybrids. Citric and malic acids are the predominant organic acids present in fruits. Several volatile compounds have been reported to be responsible for the characteristic flavour of guava that includes hydrocarbons, alcohols, and carbonyls. The pink flesh colour of some cultivars is due to the presence of lycopene.

Materials and Methods

The experimental site is located at Garden of Department of Horticulture Kalyanpur, Kanpur, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur-208002 during the tenure of 2020-2021 and 2021-2022. Kanpur having an even topography with adequate irrigation and proper drainage facilities. Geographically district Kanpur city of Uttar Pradesh falls under subtropical climate zone and is situated between the latitude 25.260 and 26.280 North and longitude 79.310 and 80.340 East and at an altitude of 125.90 meter above mean sea level in the alluvial belt of Gangatic plains located in the central part of Uttar Pradesh. Kanpur is characterized by sub-tropical climate with hot dry summer and cold winters. The annual rainfall is about 800-880 mm. The major portion of rain is received between July to September, with scattered shower in winter from the North-East monsoon. The maximum temperature ranges from 24 to 46 °C and minimum 7.0 to 24.8 °C with relative humidity from 32 to 98% in different months of the year. The soil was sandy loam, good in fertility with belt of Central-Western part of the state of Uttar Pradesh.

Results and Discussion

1.1 Effect of pruning time, pruning intensity and bagging on total soluble solid (^{0} Brix)

The interaction effect among different time of pruning, Pruning intensity and Bagging gave the highest TSS under $T_3P_2D_2$ (15 June+50%+30 days after fruit set) during both the years. The lowest Number of TSS was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. However the effect of treatment on control was also found significant during both the years. Dhaliwal and Kuar (2003) [6] observe the highest TSS content was recorded for pruning at 30 cm on 10 April. Brar *et al.* (2007) [3] reported the total soluble solids were higher in the fruits of pruned trees as compared to the unpruned ones. Bhagawati *et al.* (2015) [2] observe bio-chemical properties of fruits, total soluble solids and total sugar were found to increase with enhanced pruning severity and least in case of no pruning. Jayswal *et al.* (2017) [9] reported, highest TSS in pruning at 40 cm, while the minimum was observed in unpruned plants. The results of the study revealed that among the various pruning treatments the pruning of 30 cm of apical shoots on 15th May proved to be the best in improved the fruit quality by increasing TSS, of guava fruits (Singh *et al*. 2020) [15].

1.2 Effect of pruning time, pruning intensity and bagging on titrable Acidity (%)

The Interaction effect among different time of pruning, Pruning intensity and Bagging give minimum titratable acidity in $T_3P_2D_2$ (15 June+50%+30 days after fruit set) during both the years. The maximum titratable acidity was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. Overall, the treatments were found significant over control during 2022. Kumar and Rattanpal (2010) [12] observed, fruit acidity was low with the pruning treatment, ½ removal of vegetative growth of plants and Bhagawati *et al.* (2015) [2] reported the acidity was found to be highest with no pruning and decreased with increase in pruning intensity.More acidity was observed in fruits from unpruned trees and a gradual decrease was observed when the pruning intensity of pruning were increased (Kumar and Srivastava 1983) [11]. The maximum acidity was obtained with heavy pruning and minimum with light pruning treatment (Singh and Chauhan 1998) [16].

1.3 Effect of pruning time, pruning intensity and bagging on Vitamin C (mg/100 g pulp)

Interaction effect among different time of pruning, Pruning intensity and Bagging gave highest Vitamin-c in $T_3P_2D_2$ (15 June+50%+30 days after fruit set) during both the years. The lowest Vitamin-C was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. Meena *et al.* (2017) [13] analysis on fruit quality showed that pruning in May at 45 cm length from shoot tip also produced superior quality fruits in term of higher TSS and vitamin C. Kumar and Rattanpal (2010) [12] found that, TSS and vitamin C (mg/100 g fruit pulp) and low acidity was the best in pruning treatment by 1/2 removal of vegetative growth in guava fruit crop. Contrary this, pruning of 30 cm of apical shoots on 15th May proved to be the best in increasing the ascorbic acid guava fruit Singh *et al*. (2020) [15].

1.4 Effect of pruning time, pruning intensity and bagging on reducing sugar (%)

Interaction effect among different time of pruning, Pruning intensity and Bagging gave highest reducing sugar in $T_3P_2D_2$ (15 June+50%+30 days after fruit set) during both the years. The lowest reducing sugar was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. Jayswal *et al.* (2017) [9] reported the highest Reducing Sugar was recorded in pruning at 40 cm, while the minimum was observed in unpruned plants. Sawant *et al.* (2018) [14] significant increase with respect to quality parameter i.e maximum reducing sugars when guava plants were pruned 50 per cent of secondary branches. The pruning of 30 cm of apical shoots on 15th May proved to be the best in increasing of guava fruit (Singh *et al*. 2020) [15].

1.5 Effect of pruning time, pruning intensity and bagging on non-reducing sugar (%)

The Interaction effect among different time of pruning, pruning intensity and Bagging gave highest Non-reducing sugar in $T_3P_2D_2$ (15 June+50%+30 days after fruit set) during both the years. The lowest Non-reducing sugar was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. Jayswal *et al.* (2017) [9] recorded highest Non-Reducing Sugar was recorded in pruning at 40 cm, while the minimum was observed in unpruned plants. In guava among the various pruning treatments the pruning of 30 cm of apical shoots on 15th May proved to be the best in increasing the non-reducing sugar of guava fruit (Singh *et al*. 2020) [15].

1.6 Effect of pruning time, pruning intensity and bagging on total sugars (%)

Higher amount of invert and total sugars content with the

Interaction effect among different time of pruning, Pruning intensity and Bagging gave highest Total sugar in $T_3P_2D_2$(15 June+50%+30 days after fruit set) during both the years. The lowest Number of Total suagr was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. Basu *et al.* (2007) [1] found that pruning had a significant effect on the quality of guava fruits and time of pruning distinctly influenced fruit quality. The total sugar was found higher. El-Souda (2005) [7] observed that in guava fruit total sugars were increased by pruning treatments compared to control trees without significant differences. Total sugar content of all treatments was higher than the control. Singh and Chauhan (1998) [16] observed highest sugar content with heavy pruning which was closely followed by medium level pruning in peach variety July Elberta. The total sugars were also affected significantly by different pruning intensities.

1.7 Effect of pruning time, pruning intensity and bagging on Pectin content (%)

The Interaction effect among different time of pruning, Pruning intensity and Bagging gave highest pectin content in $T_3P_2D_2$ (15 June+50%+30 days after fruit set) during both the years. Whreas the lowest pectin content was recorded in $T_1P_1D_1$ (15 May+25%+20 days after fruit set) during both the years. Thus there is increase in pectin due to water content of fruits during growth and development. The enzymatic conversions of pectin substances are the cause of increase or decrease in different fractions of pectin. The increase in total Pectin in fruit development is an implication of galacturonic acid synthesis. Similar results of higher pectin content in mature than in the ripe fruit of guava as reported by (Chayan *et al*., 1992) [4].

Table 1: Interaction effect among different time of pruning, pruning intensity and bagging on Total Soluble Solid (^{0}Brix)

Treatment Combinations	Total Soluble Solid (TSS) (^{0}Brix)						Titratable acidity (%) (2021)					
	2021						2021					
	T_1 (15 May)		T_2 (30 May)		T_3 (15 June)		T_1 (15 May)		T_2 (30 May)		T_3 (15 June)	
	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)
	2021						2021					
D_1 (20 Days After Fruit Set)	13.36	13.53	13.76	14.36	15.06	14.83	0.27	0.24	0.22	0.21	0.19	0.16
D_2 (30 Days After Fruit Set))	13.70	14.00	13.53	14.33	15.50	16.83	0.24	0.22	0.22	0.20	0.18	0.15
Factors	A	B	C		AXBXC		A		B	C	AXBXC	
SE (m)±	0.14	0.12	0.12		0.29		0.00		0.00	0.00	0.00	
C.D	0.43	0.35	0.35		NS		0.01		0.00	0.00	NS	
	2022						2022					
D_1 (20 Days After Fruit Set)	12.65	13.55	13.45	13.56	14.67	16.51	0.27	0.25	0.23	0.22	0.20	0.17
D_2 (30 Days After Fruit Set))	13.45	13.54	13.65	14.18	15.17	17.05	0.26	0.24	0.22	0.21	0.19	0.15
Factors	A	B	C		AXBXC		A		B	C	AXBXC	
SE (m)±	0.07	0.06	0.06		0.15		0.00		0.00	0.00	0.00	
C.D	0.22	0.18	0.18		0.44		0.00		0.00	0.00	NS	

Table 2: Interaction effect among different time of pruning, pruning intensity and bagging on vitamin-C (mg/100gm) and reducing sugar (%)

Treatment Combinations	Vitamin-C (mg/100gm)						Reducing sugar (%)					
	2021						2021					
	T_1 (15 May)		T_2 (30 May)		T_3 (15 June)		T_1 (15 May)		T_2 (30 May)		T_3 (15 June)	
	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)
	2021						2021					
D_1 (20 Days After Fruit Set)	273.43	282.80	291.63	303.93	324.30	385.43	3.20	3.31	3.67	3.78	4.15	4.28
D_2 (30 Days After Fruit Set))	276.26	287.40	287.90	324.13	361.13	409.00	3.40	3.53	3.71	3.93	4.23	4.33
Factors	A	B	C		AXBXC		A		B	C	AXBXC	
SE (m)±	2.27	1.85	1.85		4.54		0.02		0.02	0.02	0.05	
C.D	6.66	5.44	5.44		13.33		0.08		0.06	0.06	NS	
	2022						2022					
D_1 (20 Days After Fruit Set)	283.10	292.38	298.73	317.46	334.33	391.40	3.30	3.37	3.77	3.87	4.24	4.38
D_2 (30 Days After Fruit Set))	286.48	296.12	307.60	322.10	371.35	415.04	3.52	3.61	3.76	3.99	4.23	4.46
Factors	A	B	C		AXBXC		A		B	C	AXBXC	
SE (m)±	2.07	1.69	1.69		4.15		0.02		0.01	0.01	0.04	
C.D	6.09	4.97	4.97		NS		0.06		0.05	0.05	NS	

Table 3: Interaction effect among different time of pruning, pruning intensity and bagging on non-reducing sugar (%) and total sugar (%)

Treatment Combinations	Non-reducing sugar (%)						Total sugar (%)					
	2021						2021					
	T_1 (15 May)		T_2 (30 May)		T_3 (15 June)		T_1 (15 May)		T_2 (30 May)		T_3 (15 June)	
	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)
	2021						2021					
D_1 (20 Days After Fruit Set)	2.06	2.16	2.23	2.26	2.30	2.40	5.26	5.40	5.86	6.03	6.43	6.63
D_2 (30 Days After Fruit Set))	2.26	2.16	2.20	2.26	2.30	2.40	5.66	5.66	5.86	6.20	6.46	6.76
Factors	A	B	C		AXBXC		A		B	C	AXBXC	
SE (m)±	0.01	0.01	0.01		0.03		0.03		0.02	0.02	0.06	
C.D	0.05	0.04	0.04		NS		0.09		0.08	0.08	NS	
	2022						2022					
D_1 (20 Days After Fruit Set)	2.18	2.27	2.51	2.34	2.36	2.52	5.43	5.65	6.28	5.93	6.51	6.81
D_2 (30 Days After Fruit Set))	2.35	2.24	2.29	2.35	2.41	2.49	5.91	5.88	6.18	6.66	6.62	6.95
Factors	A	B	C		AXBXC		A		B	C	AXBXC	
SE (m)±	0.03	0.03	0.03		0.07		0.07		0.05	0.05	0.14	
C.D	0.10	0.10	0.10		NS		0.21		0.16	0.17	0.42	

Table 4: Interaction effect among different time of pruning, pruning intensity and bagging on pectin content (%)

Treatment Combinations	Pectin content (%)					
	2021					
	T_1(15 May)		T_2(30 May)		T_3(15 June)	
	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)	P_1 (25% Pruning)	P_2 (50% Pruning)
D_1 (20 Days After Fruit Set)	0.82	0.85	0.93	0.96	1.05	1.14
D_2 (30 Days After Fruit Set))	0.84	0.89	0.93	1.01	1.11	1.18
Factors	A	B	C		AXBXC	
SE (m)±	0.00	0.00	0.00		0.01	
C.D	0.01	0.01	0.01		NS	
	2022					
D_1 (20 Days After Fruit Set)	0.85	0.89	0.97	1.02	1.07	1.16
D_2 (30 Days After Fruit Set))	0.88	0.94	0.97	1.04	1.12	1.21
Factors	A	B	C		AXBXC	
SE (m)±	0.00	0.00	0.00		0.01	
C.D	0.01	0.01	0.01		NS	

Conclusion

The result obtained from the present investigation, it can be concluded that among different pruning time 15th June, Pruning intensity, 50% and bagging 30 days after fruit set was found most effective in improving chemical parameters of guava fruit. Thus, pruning of guava trees on 15th June following 50 per cent pruning intensity of annual shoot growth and bagging 30 days after fruit set can be recommended to obtain higher quality of fruit, and maiming the return for guava growers of Northern Gangetic plains of India.

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