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Varietal Performance of Guava under Meadow System of Ultra High Density Planting

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ABSTRACT: High density planting in guava is gaining popularity among Indian guava growers due to its highly remunerative nature. However, the return from high density guava orchards is genotype and environment dependent. Therefore, to find out potential guava varieties suitable for ultra high density for commercial cultivation in Southern Rajasthan, a field experiment was conducted to evaluate the performance of different varieties *viz.*, Allahabad Safeda, Red Fleshed, Sardar (L-49), Pant Prabhat, Lalit, and Shweta with relation to growth, flowering, physiological, yield and qualitative attributes in a meadow orchard system. The results revealed that the var. Shweta recorded significantly higher canopy volume, plant spread (E-W direction) and girth of primary branches, while maximum plant height and leaf area were recorded in cv. L-49 and Lalit, respectively. Shweta also recorded maximum fruit diameter, fruit retention, fruit weight, carbon assimilation rate and total chlorophyll content, similarly cv. Lalit recorded the maximum number of flowers per shoot, per cent fruit set, number of fruits, yield per plant and estimated yield per ha. It is concluded that the varieties Lalit, Shweta and L-49 performed better in meadow orcharding system and could be recommended for maximizing land use and enhancing productivity.

Keywords: Guava varieties, Growth, Yield, Quality, Meadow orcharding.

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the important fruit crops of India. It is popular due to its adaptability to diverse soil and Agro-climatic conditions, low cost of cultivation, higher nutritive value, prolific bearing and thus highly remunerative (Reddy *et al*., 1999). The fruit is a good source of vitamin 'C' (212 to 250 mg/100 g) and minerals such as calcium (12.68mg/100g), magnesium (7.22) potassium (38.23) and iron (3.66) (Ali *et al*., 2014). Guava is the fourth most important fruit crop after mango, banana and citrus covering an area of 2.65 lakh hectares with a total fruit production of 40.54 lakh tones (Anonymous, 2018). At present, guava is cultivated largely through a traditional system, under which it is difficult to achieve desired levels of productivity because large trees provide low production per unit area and needs higher labour and input requirements (Mohammed *et al*., 1984; Singh, 2002). Various studies revealed the possibility of increased yield in guava per unit area by increasing the plant population (Mitra *et al*., 1984; Pandey *et al*., 2007). Ultra high density planting system is one of such recent and novel concepts of increasing productivity without affecting the fruit quality of both annual and perennial horticultural crops (Singh *et al*., 2007; Subedi *et al*., 2020). This system of planting not only provides higher yield but also provides higher net economic returns per unit area in the initial years and also facilitates more efficient use of inputs (Reddy, 2004). The meadow orchard or ultra high density planting system is one of the most efficient modern systems which accommodates about 5000 plants ha^{-1} (2 m × 1 m) coupled with regular topping and hedging. The performance of any variety of any crop depends upon its genetic makeup expressed under given set of environments as environment affects physiological adaptability of the variety in that region. In India, a handful of varieties are ruling the market. However, with the changing climate and the horticultural production system, identifying suitable varieties for ultra high density planting system is quintessential to enhancing productivity. Keeping the above in view, the present study was carried out to find out the performance of different guava varieties under ultra high density system of planting.

MATERIALS AND METHODS

The performance of three years old guava varieties *viz*., Allahabad Safeda, Red Fleshed, Sardar (L-49), Pant Prabhat, Lalit (CISH G-3), and Shweta (CISH G-4) were evaluated at Horticulture Farm, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan) during 2009-10 and 2010-11. The experiment was carried out in a randomized block design (RBD) at the spacing of 2 m × 1 m (5000 plants ha^{-1}) with five replications. The plants were maintained under there commended package of practices during the entire period of investigation. The plants of uniform growth were chosen in each variety and were pruned twice a year in February and September to achieve fruiting during July-August (*Ambe bahar*) and March-April (*Hastha bahar*), respectively. The data on tree height (m), plant spread (from N-S & E-W) (m) and girth of primary branches (cm), were recorded using ameter scale and Vernier-caliper. Canopy volume (m^3) was calculated as the method described by Samaddar and Chakrabarti (1988). Leaf area (cm^2) was measured with the help of leaf area meter (Mac-Systronics). Flowering and fruiting parameters *i.e.*, number of flowers per shoot, per cent fruit set and per cent fruit retention were recorded on randomly selected five branches from all directions of the plant and the average was calculated during both years. C- assimilation rate (μ-mol-$m^{-2}s^{-1}$) was measured by CIRAS-2 Portable photosynthesis system at 10 AM to 12 Noon under natural radiation and total chlorophyll content in leaves (mg g^{-1}fresh weight) was estimated by the method as suggested by Arnon (1947).

The physiologically matured fruits were harvested during the entire fruiting season *i.e.*, from 2nd October to the end of December. Physico-chemical characters were recorded from acomposite sample of ten fruits for all the cultivars. The number of fruits per plant was counted and weight after each harvest for fruit yield per plant. Average fruit weight (g) was obtained by weighing the fruits on an electronic balance from each cultivar. The fruit breadth was measured at the highest rounded portion of the fruits. Similarly, fruit length was measured from fruit base to calyx base. The yield of fruits per hectare was calculated by multiplying the fruit yield per plant with the number of plants per hectare (5000 plants).TSS was measured by Erma Handheld Refractometer (0-32°B). Chemical components like acidity, ascorbic acid and total sugar content were estimated as per standard methods suggested by AOAC (1980). The data obtained on various variables were subjected to RBD analysis and the interpretation of the data was carried out in accordance with Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Among the guava varieties evaluated under uniform cultural and environmental conditions, variety Shweta recorded maximum E-W plant spread (2.01m), girth of primary branches (2.35 cm) and canopy volume (0.70 m^3) followed by L-49 and minimum in Allahabad Safeda, while maximum leaf area (63.12 cm) was recorded in Lalit, which was at par with L-49 and Shweta (Table 1). This might be due to the genetic makeup of the different varieties expressed under given set of environment. As far as flowering and physiological parameters were concerned var. Lalit showed the maximum number of flowers $shoot^{-1}$ (42.30) and per cent fruit set (48.69%), while var. Shweta exhibited maximum fruit retention (45.40%), C- assimilation (4.54 μ mol $m^{-2}s^{-1}$) and total chlorophyll content (2.25 mg g^{-1} fresh weight) (Fig. 1). This is probably due to better physiological adaptability of this variety in this region and productivity of any crop depends on the process of photosynthesis, which in turn depends on the chlorophyll content of leaves in plants involved in photosynthesis thereby, helps in uptake and translocation of sugar in the plant system. The CO_2 assimilation rate in Shweta might be high due to the high chlorophyll content in the leaves. Further, a higher leaf area having high total chlorophyll content in leaves and a higher CO_2 assimilation rate led to a higher photosynthesis rate in Shweta. An increase in carbon assimilation could be strongly relevant in the photosynthetic acclimation capacity and in the avoidance of chloroplast photo-oxidative stress in trees (Adams *et al*., 2013). In the current study, as far as vegetative growth attributes to concern Shweta outperformed other varieties under investigation might be due to a higher photosynthesis rate. Under adverse environmental conditions that restrict the rate of photosynthesis (Calzadilla *et al*., 2019) variety Shewta might perform better and offer better resilience to climate change. Further, apart from the genetic makeup of plants, higher vegetative vigour of variety Shweta could be one of the explanations for low flowering intensity and fruit set. A negative relationship between vegetative growth and flowering intensity and fruit set is a well-established fact and confirmed by Kumawat *et al*. (2017). Furthermore, among the different varieties under investigation Shweta retains the highest number of fruits might be due to low crop load (low flowering intensity and low fruit set). The present results are in accordance with the results obtained by Khan *et al*. (2007) in citrus, Kumar and Jaiswal (2003) in mango, Shete and Karale (2000) in aonla and Singh and Misra (2010) in ber.

Table 1: Vegetative growth characteristics of different guava varieties under ultra high density system of planting.

Treatment	Plant height (m)	Plant spread (m)		Girth of primary branches (cm)	Leaf area (cm^2)	Canopy volume (m^3)
		E-W	N-S			
Allahabad Safeda	1.71	1.60	1.54	2.09	53.38	0.30
Red Fleshed	1.77	1.67	1.64	2.11	59.48	0.41
L-49	1.89	1.75	1.64	2.14	61.03	0.61
Pant Prabhat	1.84	1.69	1.58	2.13	52.98	0.48
Lalit	1.86	1.75	1.64	2.15	63.12	0.58
Shweta	1.83	2.01	1.67	2.35	60.94	0.70
S.Em.±	0.03	0.04	0.05	0.04	1.49	0.02
C.D. (P = 0.05)	0.08	0.11	NS	0.12	4.25	0.07

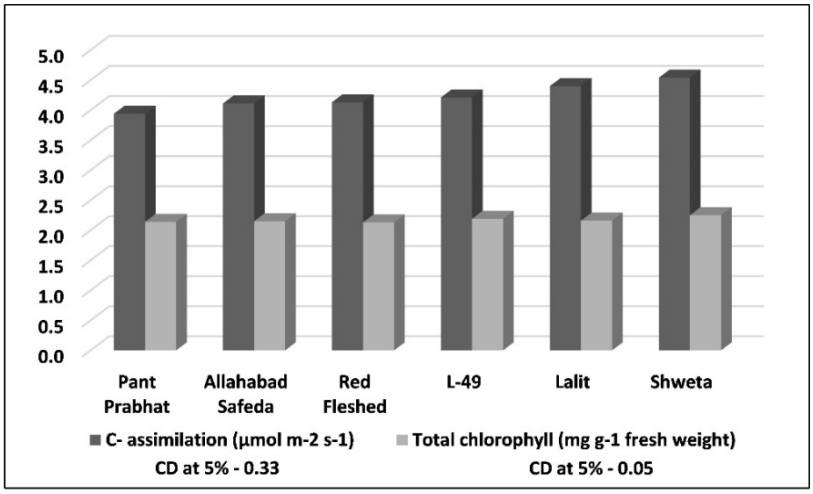

Fig. 1. C-assimilation (µ mol m^{-2} s^{-1}) and total chlorophyll (mg g^{-1} fresh weight) of guava varieties.

There was a significant difference among evaluated guava varieties for yield attributes and yield during both years (Table 2). The maximum polar fruit diameter (6.18 cm), seed weight (6.71) and seed index (1.37) was noticed in Red Fleshed, while equatorial fruit diameter (6.14 cm), average fruit weight (156.50 g) and pulp weight (130.70 g) were maximum in Shweta. Shweta produces higher quality fruits in terms of fruit size and weight might be due to the low crop load on trees. The results are in accordance with earlier research findings which confirmed that a reduction in crop load significantly improves fruit size in apples (Isarangkoo *et al*., 2019). Apart from low crop load, larger fruit size in Shweta may be attributed to enhanced photosynthetic efficiency due to high vegetative vigour, large leaves with higher chlorophyll content, and high carbon assimilation. Among the six varieties, the maximum number of fruit $plant^{-1}$, yield $plant^{-1}$ and estimated yield ha^{-1} was obtained in var. Lalit (62.10, 6.54 kg $plant^{-1}$ and 32.69 t ha^{-1}, respectively), while, the minimum number of fruits were obtained in Shweta (35.70) and minimum yield $plant^{-1}$, estimated yield ha^{-1} was obtained in Allahabad Safeda (4.66 kg $plant^{-1}$ and 23.32 t ha^{-1}, respectively), which was at par with Pant Prabhat and Red Fleshed. From the viewpoint of guava growers yield is the most important aspect and the yield of any crop variety depends upon the genetic makeup of the variety and environmental interaction. Variety Lalit not only produced more flowers, but it also set a higher percentage of fruits. As a result, there are more fruits on the plants (62.10 fruit $plant^{-1}$) than in other varieties (35.7 to 43.4 fruit $plant^{-1}$). However, the fruit weight was the lowest of all varieties investigated, but due to a higher number of fruits per plant, it provided a better yield than the other varieties studied. These results are in conformity with the findings of Pandey *et al.* (2007).

Among the six varieties, maximum TSS (14.31°Brix) and total sugar (9.62%) and minimum acidity (0.31%) were recorded in Allahabad Safeda which was at par with Shweta (13.78°Brix; 9.49% & 0.35%, respectively) while, maximum ascorbic acid content (232 mg 100 g^{-1} pulp) and pulp/seed ratio (24.73) were recorded in Shweta and minimum ascorbic acid content was found in Pant Prabhat (154.70 mg 100 g^{-1} pulp). Taste is a complex character, which is contributed to a greater extent by TSS (Athani *et al*., 2007). The maximum sugar content in Allahabad Safeda might be due to the high total soluble solids content of the fruit. These results are in accordance with Athani *et al*. (2007); Babu *et al.* (2007); Pandey *et al*. (2007); Patel *et al.* (2007); Singh *et al*. (2008) in guava fruit.

Table 2: Yield attributes and yields of different guava varieties under ultra high density system of planting.

Treatments	No. of flowers shoot^{-1}	Per cent fruit set	Per cent fruit retention	Fruit diameter (cm)		Av. fruit weight (g)	Pulp weight (g)	Av. seed weight fruit^{-1} (g)	No. of fruits plant^{-1}	Yield	
				Polar	Equatorial					kg plant^{-1}	t ha^{-1}
Allahabad Safeda	29.10	41.96	40.95	4.63	5.50	108.10	93.16	4.80	43.20	4.66	23.32
Red Fleshed	31.10	45.98	42.07	6.18	5.53	116.08	98.27	6.71	41.30	4.77	23.83
L-49	29.93	42.94	43.01	5.37	6.04	127.80	110.00	5.66	41.80	5.33	26.63
Pant Prabhat	28.30	41.88	41.20	5.21	5.73	111.50	101.47	5.53	43.40	4.83	24.16
Lalit	42.30	48.69	42.10	4.58	5.45	105.50	92.29	6.49	62.10	6.54	32.69
Shweta	25.10	39.30	45.40	5.53	6.14	156.50	130.70	5.29	35.70	5.59	27.97
S.Em.±	0.90	1.12	1.23	0.14	0.15	3.03	2.66	0.15	1.54	0.16	0.80
C.D. (P = 0.05)	2.57	3.20	NS	0.39	0.43	8.66	7.61	0.43	4.40	0.46	2.28

Table 3: Quality parameters of different guava varieties under ultra high density system of planting.

Treatment	Pulp: seed ratio	Seed index (g)	TSS (°B)	Acidity (%)	Ascorbic acid (mg/100g pulp)	Total sugar (%)
Allahabad Safeda	19.43	1.03	14.31	0.31	212.20	9.62
Red Fleshed	14.66	1.37	12.12	0.52	204.66	8.23
L-49	19.44	1.13	13.52	0.40	221.80	9.20
Pant Prabhat	18.35	1.06	13.67	0.43	154.70	9.31
Lalit	14.21	1.17	12.21	0.53	204.90	8.27
Shweta	24.73	1.11	13.78	0.35	232.00	9.49
S.Em.±	0.28	0.01	0.20	0.01	1.71	0.11
C.D. (P = 0.05)	0.79	0.04	0.57	0.01	4.90	0.31

CONCLUSIONS

Guava cultivars, Lalit, Shweta and L-49 performed better in the ultra high density system of planting under Southern Rajasthan conditions in comparison to other tested cultivars. Shweta produced superior quality fruits with the second-highest fruit yield, whereas Lalit produced the highest fruit yield. Furthermore, based on the physiological indicators, Shweta seems to be more resilient to climate change. L-49 is still a preferred cultivar of guava among consumers and it also produces economically viable fruit yield next to Lalit and Shweta.

FUTURE SCOPE

The research work can be helpful to horticulturists for further study and also may be useful to guava growers for the selection of suitable varieties for the meadow orcharding system.

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Conflicts of Interest. None.

REFERENCES

Adams, W. W., Muller, O., Cohu, C. M. and Demmig-Adams, B. (2013). May photoinhibition be a consequence, rather than a cause, of limited plant productivity? *Photosynth. Res.*, *117,* 31–44.

Ali, D. O. M., Ahmed, A. R. and Babikir, E. B. (2014). Physicochemical and nutritional value of red and white guava cultivars grown in Sudan. *J. Agri-Food Appl. Sci.*, *2*(2), 27-30.

Anonymous (2018). Horticulture Statistics at a Glance, pp. 9.

AOAC (1980). Official Methods of Analysis of the Association of Official Analytical Chemist, Washington D C., pp.60-70.

Arnon, D. I. (1947). Copper enzymes in isolated chloroplasts. Polyphenol oxidase in *Beta vulgaris. Plant physiol*., *24,* 1-15.

Athani, S. I., Patil, P. B., Swamy, G. S. K., Sabarad, A. I. and Gorabal, K. R. (2007). Studies on growth parameters and fruit characters in guava cultivars. *Acta Hortic*., *735,* 271-275.

Babu, K. D., Patel, R. K. and Yadav, D. S. (2007). Comparative evaluation of guava selections under north eastern region of India. *Acta Hortic*., *735,* 99-103.

Calzadilla, P. I., Vilas, J. M., Escaray, F. J., Unrein, F., Carrasco, P. and Ruiz, O. A. (2019). The increase of photosynthetic carbon assimilation as a mechanism of adaptation to low temperature in *Lotus japonicas*. *Sci. Rep*., 1-15.

Isarangkoo, S., Ayutthaya, N., Kawphaitoon, S. and Techawongstien, S. (2019). Effect of crop load on fruit size and nutrients in fruit parts of mango 'NumDok Mai Sithong'. *Acta Hortic.*, *1244*, 101-108.

Khan, M. A., Idrees, M. And Shahab, D. (2007). Chlorophyll content in some *Citrus* species. *Vegetos*, *20,* 7-8.

Kumar, N. and Jaiswal, U. S. (2003). Bearing behaviour of some West and South Indian mangoes. *Haryana J. of Hort. Sci.*, *32,* 154-156.

Kumawat, K. L., Sarolia, D. K., Kaushik, R. A. and Jodha, A. S. (2017). Effect of irrigation and fertigation scheduling on growth, flowering, yield and economics of guava cv.

Lalit under ultra high density planting system. *Indian J. Hort.*, *74*(3), 362-668.

Mitra, S. K., Sen, S. K., Maiti, S. C. and Bose, T. K. (1984). Effect of plant density on growth, yield and fruit quality in guava. *Bangladesh Hort*., *12,* 7-9.

Mohammed, S., Wilson, L. A. and Prendergast, N. (1984). Guava meadow orchard: Effect of ultra high density plantings and growth regulators on growth, flowering and fruiting. *Tropical Agri.*, *61,* 297-301.

Pandey, D., Shukla, S. K., Yadav, R. C. and Nagar, A. K. (2007). Promising guava (*Psidium guajava* L.) cultivars for North Indian conditions. *Acta Hortic*., *735*, 91-94.

Panse, V. G. and Sukhatme, P. V. (1985). In: Statistical method for Agriculture workers. ICAR-New Delhi, pp. 145-155.

Patel, R. K., Yadav, D. S., Babu, K. D., Singh, A. and Yadav, R. M. (2007). Growth, yield and quality of various guava (*Psidium guajava* L.) hybrids/cultivars under mid hills of Meghalaya. *Acta Hortic*., *735,* 57-59.

Reddy, B. M. C. (2004). High density planting in horticultural crops. *First Indian Horticulture Congress,* 6-9 Nov., New Delhi, 36.

Reddy, N. N., Gangopadhyay, K. K., Rai, M. and Ram K. (1999). Evaluation of guava cultivars under rainfed sub-humid region of Chhotanagpur plateau. *Indian J. of Hort.*, *56*(2), 135-140.

Samaddar, H. N. and Chakarbati, U. (1988). Effect of different root stocks on Himsagar and Langra mango. *Acta Hortic*., *231*, 220-224.

Shete, M. B. And Karale, A. R. (2000). Studies on extent of fruiting in aonla cultivars. *J. of Maharashtra Agric. Univ.*, *24,* 322-323.

Singh, A. K., Mishra, S. K. and Singh, A. (2008). Studies on physico-chemical characters of different guava (*Psidium guajava* L.) cultivars. *Plant Arch.*, *8*, 453-455.

Singh, G. (2002). High density planting and crop regulation in guava. In: R. P. Shukla, R. K. and B.P. Kapoor (eds.). Mannual of summer school on recent advances in production, protection and post-harvest management of sub-tropical fruits, CISH, Lucknow, pp. 1-7.

Singh, G., Singh, A. K. and Mishra, D. (2007). High Density Planting in Guava. *Acta Hortic*., *735*, 235-242.

Singh, R. and Misra, K. K. (2010). Floral and yield characteristics of ber (*Zizyphus mauritiana* Lamk.) genotypes.*Environment and Eco., 28,* 2542-2545.

Subedi, G. D., Atreya, P. N., Gurung, C. R., Giri, R. K. and Gurung, Y. R. (2020). High Density Cultivation of Major Fruit Crops: Opportunities and Challenges in Nepal. *Proceeding of 11th National Horticulture Seminar*, p 94-107.

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