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Effect of fruit thinning on growth, and quality of rainy season crop of guava (*Psidium guajava* L.)

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Abstract
A field trial was conduct at Horticulture Research Center, Patharchatta, Pantnagar, Department of Horticulture, GBPUAT, Pantnagar india during 2017-2018 to evaluate the effect of fruit thinning on growth, yield and quality of rainy season crop of guava *cv.* pant prabhat. There were five different fruit thinning treatments *viz.* 10%, 20%, 30%, 40% 50% fruit thinning and one control (without thinning) planted in single hedge row system (4x8m). The treatment T_5 (50% fruit thinning) gave maximum increase in plant height, spread, fruit diameter and plant volume whereas, lowest increment of growth was found in case of treatment T_6 control (without thinning treatment). In case of total number of fruits per plant and yield per plant were found maximum in T_6 control (No fruit thinning) but better quality and bigger size, fruits was found with the thinning of 50% fruit. From the study it can be concluded that for getting better quality and bigger size, fruits in rainy season crop of guava under single hedge row planting in *tarai* condition of Uttarakhand 50% fruit thinning can be recommend in first week of June.

Keywords: Fruit thinning, guava, pant prabhat, single hedge row

1. Introduction
Guava (*Psidium guajava* L.) also known as 'apple of the tropics' is an important cultivated fruit grown throughout the world. It is famous as "poor man's fruit" and belongs to the family Myrtaceae. Guava is considered as one of the most exquisite, rich nutritionally and remunerative fruit crop. It excels most other fruit crops in productivity, hardiness, adaptability and nutritive value. Guava tree is not only year round producer but also has high nutritive values and excellent taste (Zamir *et al*., 2003 and Rahman *et al*., 2003) [21, 13]. It is considered as one of the legendry, nutritionally valuable and remunerative fruit because of its hardy and prolific bearing nature even in marginal lands as it can be grown in all types of soils having pH ranging from 4.5-8.2 (Negi and Rajan, 2007 and Wilson, 1980) [10, 20]

Three flowering seasons are common in *tarai* region *i.e.* April-May, July-August and October-November. The April–May flowering produces rainy season crop and July-August flowering produces winter season crop. In *tarai* condition, guava tree produces 90% crop in rainy season, 8-9% in winter season and 1-2% in spring season. The rainy season crop is poor in quality, less nutritive and infested by many insect, pest and disease (Lal, 1992) [8]. On the other hand winter season guava fruits are superior in quality with respect to nutrition and taste (Rathore, 1976) [14]. In India number of diabetic patients is increasing day by day. Guava is one of the fruit that is suitable for a diabetic patient. So there is a need to improve the quality of rainy season fruits so that the rainy season crop may also be remunerative.

The crop loads is one of the most important factor influencing the relationship of source and sinks. The high crop load of fruit trees led to the weakness of tree vigor and affects the development of leaves which resulted in the fruit trees senescence at later growth stage. Additionally, high crop load reduced trees storage nutrition, which significantly affected the vegetative growth and flower bud differentiation in the second year. Fruit thinning is most effective method to maintain the vegetative and reproductive growth of the plant, which ensures high yield quality in fruit trees by adjusting the relationship between source and sink which influence the transportation and distribution of photosynthates. Another reason for the poor quality of rainy season crop is that the fruit trees have a tendency to set excessive numbers of fruits irrespective to its capacity and leaf area, which results in small size and poor quality fruits development, this it also reduces the shelf life of produce and their market price. Thinning of fruits and flowers as to prevent excessive fruiting which leads to production of bigger size fruits with better quality. Thinning process serves to increase the plant's ability to form flower buds for the next year.

2. Materials and Method

2.1 Experimental site

The investigation was conducted at Horticulture Research Center (HRC), Patharchatta of Department of Horticulture of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar district Udham Singh Nagar (Uttarakhand) during the year 2017- 2018. Pantnagar is situated at the foothills of the Shivaik range of Himalayas at 29˚ North latitude and 79.3˚ East longitude. The altitude of the place is 243.84 m above the mean sea level. Experimental site classified as humid sub-tropical climatic zone (locally known as the *tarai* region), has hot summers and cool winters. A total 150 cm rainfall per annam received out of which about 80-90% is fall from June to September and 10-20% during November to March. The soil of the experimental field was sandy clay loam in texture having neutral pH (7.2), medium in organic carbon (0.68%), low in available nitrogen (262 kg ha^{-1}), high in available phosphorus (25.2 kg ha^{-1}) ad available potassium (301 kg ha^{-1}).

2.2 Experimental Materials

The study was conducted on seven years old guava trees cv. Pant Prabhat under single hedge row planting system (4 m × 8 m). Plants of uniform growth and vigour were planted during the September, 2010. There were six treatment including control under study. Four replication of each treatment were taken. The total number of trees under experiment was twenty four. All experiment trees were maintained under uniform cultural practices during the entire period of investigation.

2.3 Treatment details

The experiment was consisted of five different levels of fruit thinning *viz*. 10, 20, 30, 40 and 50 per cent with one treatment as control (no thinning). Thinning was done during first week of June. Each treatment was replicated four times. The details of the treatments are present in table 1.

Table 1: Treatment Details of the guava experiment

S. No.	Treatments/fruit Thinning	Symbol
1	10% Fruit thinning	T_1
2	20% Fruit thinning	T_2
3	30% Fruit thinning	T_3
4	40% Fruit thinning	T_4
5	50% Fruit thinning	T_5
6	Control	T_6

2.4 Observations recorded

Observation like plant height, trunk diameter, plant spread, plant volume, terminal and lateral shoot growth were recorded in filed and total soluble solids, acidity, ascorbic acid, reducing sugar, non- reducing sugar and total sugar were analysed in laboratory following standard methods and procedures.

2.5 Statistical analysis

The experiment was laid out in Randomized Block Design (RBD). The data was statistically analyzed for analysis of variance according to Snedecor and Cochran (1968) for Randomized Block Design (RBD). The significance of variation among treatment was observed by applying "F" test and critical difference (C.D.) at 5% level of significance was calculated to compare the mean values of the treatments.

3. Result and Discussion

3.1 Efect of fruit thinning on growth parameters

It was observed from the finding that all the thinning treatments significantly increase the plant height, trunk diameter plant spread and plant volume (Table 2). The maximum plant height, (0.73 m), trunk diameter (1.38 cm) plant spread (0.82 m) and plant volume (0.255 m^3) was recorded in 50% thinning treatment followed by 40% thinning treatment and minimum growth was recorded in control treatment. As a result the maximum increase in plant height, spread, diameter and volume was observed in treatment T_5 (50% fruit thinning) which was the heaviest manual fruit thinning level. In this study, the increase in growth and vigour of plant under the above treatments can be attributed to more availability of nutrients and photosynthates for vegetative growth. Similarly, increase in vegetative growth with the increase in the intensity of fruit thinning has been reported by Sefick and Ridley (1988) [16], Saini *et al*. (2001) [15], Myers *et al*. (2002) [9], Bal *et al*. (2004) [3] and Ashour (2003) [2].

The shoot growth was found to be significantly affected by the different treatment. It was found that the shoot lengths considerably increased with increase in percent of fruit thinning. Highest terminal shoot length (54.89 cm) was recorded in treatment T_5 followed by treatment T_4 (51.32 cm). The lowest terminal shoot length (34.99 cm) was recorded in treatment T_6 (control).

Similarly the terminal shoot lengths the lateral shoot lengths were also found to increase with increase in percent of fruit thinning. Highest lateral shoot length was observed in treatment T_5 (27.74 cm) followed by treatment T_4 (23.19 cm).

3.2 Effect of fruit thinning on physical parameters of guava fruit

All the fruit thinning treatments significantly increased the fruit weight compared to control (T6). The fruit weight was increased with the increase in intensity of fruit thinning. The maximum fruit weight (121.10 g) was found with 50% fruit thinning (T5) which was statistically at par with (T4) 40% fruit thinning (115.25 g). Minimum fruit weight from the control tree was associated with the heavy crop load which creates more competition among the growing fruits for the food supply. Increase in the fruit weight in T_5 might be due to the reduction in the number of fruits per tree thereby increasing the leaf to fruit ratio which resulted in increased availability of photosynthates and lesser nutritional competition among the developing fruits, thus improving the fruit weight. These results are support by the findings of Chahill *et al.* (1980) [5], Islam *et al.* (1992) [7] and Sharifuzzaman (1996) [17].

All the fruit thinning treatments significantly increased fruit length and diameter as compared to control. There was progressive increased in fruit length and diameter with the increase of fruit thinning intensity. Maximum fruit length (5.81 cm) was found with 50% fruit thinning (T5) which was *at par* with T3 (5.46 cm) and T4 (5.69 cm). Increase in the fruit size could be attributed to increase in leaf to fruit ratio as a result of thinning, thus increasing the availability of photosynthates and nutrients to the remaining fruits thereby increasing the length and diameter of individual fruits. The result is in accordance with the finding of Davarynejad *et al*. (2008) [6] and Singh and Bajwa (1965) [18].

3.3 Effect of fruit thinning on chemicals parameters

It was found that the total soluble solids, reducing sugars, non- reducing sugar and total sugar were increased with increasing fruit thinning percentage. Amongst all fruit thinning treatments the maximum increase in total soluble solids (10.35^0 Brix), ascorbic acid (181.14^0 Brix), reducing sugar (5.01%) non reducing sugar (3.66%) and total sugar (8.51%) was recorded with 50% fruit thinning. Improvement in total soluble solids ascorbic acid, reducing sugar, non-reducing sugars and total sugar might be attributed to reduced crop load due to thinning, consequently increasing the leaf to fruit ratio, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits, thus improving the non reducing sugars of the guava fruits. Similar results have been reported by Rab *et al*. (2012) [12]. Whereas increase in total sugars had also been reported by Bhullar *et al.* (2008) [4]

The percent of fruit thinning treatments significantly affected titratable acidity during the rainy season. The decrease in total titratable acidity was observed with increased per cent of fruit thinning. Maximum total titratable acidity (0.140%) was found with treatment control (no thinning) followed by 10% fruit thinning (0.139%). However, minimum total titratable acidity (0.132%) was recorded with 50% fruit thinning. The fruit acidity decreased with a concomitant decrease in pH as the fruit advances in maturity. Thinning seems to delay the maturation process by slowing down decrease in acidity of guava fruits. The results are in accordance with the findings of Thakur and Chandel (2004) [4] and Abeer and Mohsen (2010) [1].

The maximum ascorbic acid content (181.14 mg/100g pulp) was recorded with T_5(50% fruit thinning) which is at par (177.96 mg/100g pulp) with treatment T_4 and the minimum was recorded with T_6 (167.84 mg/100g pulp) in control. Similar result has been reported by Thakur and Chandel (2004) [4] and Rab *et al*. (2012) [12].

Table 2: Effect of fruit thinning on increase in plant height, plant spread, trunk diameter and plant volume of guava

Treatments	Increase in plant height (m)	Increase in trunk diameter(cm)	Increase in plant spread(m)	Increase in Plant volume(m^3)
T_1 (10% fruit thinning)	0.35	1.08	0.45	0.038
T_2 (20% fruit thinning)	0.45	1.13	0.55	0.071
T_3 (30% fruit thinning)	0.56	1.23	0.67	0.128
T_4 (40% fruit thinning)	0.64	1.32	0.71	0.165
T_5 (50% fruit thinning)	0.73	1.38	0.82	0.255
T_6 (Control)	0.32	0.95	0.37	0.022
CD (5%)	0.087	0.063	0.072	0.039
SEm ±	0.029	0.021	0.024	0.013

Table 3: Effect of fruit thinning on increase in terminal and lateral shoot length of guava

Treatments	Increase in terminal shoot length (cm)	Increase in Lateral shoot length (cm)
T_1 (10% fruit thinning)	38.86	15.14
T_2 (20% fruit thinning)	42.67	19.13
T_3 (30% fruit thinning)	47.09	21.11
T_4 (40% fruit thinning)	51.32	23.19
T_5 (50% fruit thinning)	54.89	27.74
T_6 (Control)	34.99	12.48
CD (5%)	2.730	3.281
SEm ±	0.898	1.079

Table 4: Effect of fruit thinning on average fruit weight, average fruit length, and average fruit diameter of guava

Treatments	Average fruit weight(g)	Average fruit length(cm)	Average fruit diameter(cm)
T_1 (10% fruit thinning)	86.55	5.14	5.75
T_2 (20% fruit thinning)	100.25	5.26	5.87
T_3 (30% fruit thinning)	102.17	5.46	5.96
T_4 (40% fruit thinning)	115.25	5.69	6.18
T_5 (50% fruit thinning)	121.10	5.81	6.39
T_6 (Control)	72.15	4.97	5.66
CD (5%)	8.648	0.416	0.385
SEm ±	2.843	0.137	0.127

Table 5: Effect of fruit thinning on total soluble solids (TSS), acidity and ascorbic acid of guava fruits

Treatments	T.S.S (%)	Acidity (%)	Ascorbic acid (mg/100g pulp)
T_1 (10% fruit thinning)	6.85	0.139	170.98
T_2 (20% fruit thinning)	7.67	0.137	172.49
T_3 (30% fruit thinning)	8.27	0.136	175.32
T_4 (40% fruit thinning)	9.15	0.133	177.96
T_5 (50% fruit thinning)	10.35	0.132	181.14
T_6 (Control)	6.25	0.140	167.84
CD (5%)	0.283	0.003	5.717
SEm ±	0.093	0.001	1.880

Table 6: Effect of fruit thinning on reducing, non-reducing and total sugar content of guava of guava

Treatments	Reducing Sugar (%)	Non reducing Sugar (%)	Total Sugar (%)
T_1 (10% fruit thinning)	3.23	2.26	5.48
T_2 (20% fruit thinning)	3.41	2.61	6.03
T_3 (30% fruit thinning)	3.80	2.80	6.73
T_4 (40% fruit thinning)	4.16	3.01	7.22
T_5 (50% fruit thinning)	5.01	3.66	8.51
T_6 (Control)	3.02	1.52	4.70
CD (5%)	0.080	0.750	0.230
SEm ±	0.026	0.247	0.076

4. Conclusion

On the basis of the present investigation on fruit thinning in guava cv. Pant Prabhat, it can be concluded that, for getting better quality and bigger size fruits in rainy season crop of guava under single hedge row planting in *tarai* condition of Uttarakhand 50% fruit thinning in 1st week of June can be recommended.

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