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Impact of Pruning Time on Shoot Sprouting and Yield Attributes of Guava (*Psidium guajava* L.) Genotypes

S. M. Choudhary[1]*, A. M. Musmade[2] and S. S. Kulkarni[3]
[1]Ph.D. Research Scholar, Department of Horticulture, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri- 413 722 India.
[2]Retired Professor, Department of Horticulture, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri- 413 722 India.
[3]Senior Horticulturist, Department of Horticulture, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri- 413 722 India.

(Corresponding author: S. M. Choudhary)*
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ABSTRACT: The present investigations were conducted on seven different genotypes such as RHR-Guv-58, RHR-Guv-60, RHR-Guv-14, RHR-Guv-16, RHR-Guv-3, RHR-Guv-6 and Sardar with five pruning time *i.e.* 15th May, 15th June, 15th July, 15th August, 15th September and no pruning (control). Guava trees bear terminally, that's why pruning influences more shoots sprouting, flowering, fruiting and consequently increase in guava yield. The results revealed that the significantly minimum time required for initiation of new shoots was observed in Sardar with 15th May pruning time. Similarly, a maximum number of sprouted shoots per plant was recorded in pruning time control and Sardar. The significantly maximum number of fruit was recorded in Sardar with 15th May pruning time. The significantly maximum length, diameter and weight were observed in RHR-Guv-14 genotype with 15th June pruning time. Pruning on 15th September was found to be better in escape of fruit fly infestation. 15th May pruning time, Sardar and interaction between them were found significantly better for total yield per plant but marketable yield free from fruit fly infestation were significantly recorded higher in 15th July pruning time and Sardar, followed by RHR-Guv-14 genotype.

Keywords: Guava, Pruning time, Sprouting shoot, Genotypes, Marketable yield.

INTRODUCTION

Guava (*Psidium guajava* L.) is the most valuable cultivated species of the Myrtaceae family popularly known as "poor man's fruit" or "apple of tropics" (Singh, 2013). Guava is native to tropical America stretching from Mexico to Peru and was introduced in India by the Portuguese during 17th century (Dinesh and Vasugi, 2010). Guava is the fourth most important fruit crop in India after Mango, Banana and Citrus (Nagar *et al.*, 2017). It is commercially important in India, China, Indonesia, South Africa, Florida, Brazil, Mexico, Colombia, West Indies, Hawaii, Egypt, Yemen, Cuba, Venezuela, New Zealand, Philippines, Vietnam and Thailand and also has good level of the dietary minerals, potassium, magnesium, and generally a broad, low-calorie profile of essential nutrients (Nimisha *et al.* 2013). The area under guava in India during 2018-19 was 270.0 thousand ha producing 4107.0 thousand MT with the productivity of 15.21 MT/ha. Guava contributes 4.0 % area of total fruit and 4.1 % of total fruit production in India (Anon., 2019). The flowering season for guava is summer, rainy and autumn with corresponding harvesting period rainy, winter and spring. The maximum production of guava obtains during the rainy season. The rainy season fruits are produced severely attacked by seasonal insect called fruit fly. Fruit flies infestation ranges from 20 to 46 per cent with crop loss of 16 to 40 per cent, which is matter of serious concern (Hasseb, 2007). Fruits harvested in autumn winter have different developmental and postharvest characteristics than the spring summer fruits (Silva *et al.* 1998). Pruning technique is used to minimize the disease and insect pest attack, mostly fruit fly infestation. Pruning is very important horticultural operation leads to regulate the crop with season. It increases the yield and quality of fruit it evades the flowering and fruiting of crop and gives the better canopy structure. Guava trees bear terminally, that's why pruning influences more shoots sprouting, flowering, fruiting and consequently increase in guava yield. The yield of winter season crop is less than rainy season crop. To overcome the problem of low yield during winter season pruning has been taken to regulate summer season flowering to minimize rainy season crop and increase that during the winter season (Dubey *et al.* 2002). Therefore, the major objective of the present research work is to standardize the pruning time for growth and yield of guava genotypes.

MATERIAL AND METHODS

The present investigation was conducted at the Instructional-cum-Research Farm, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2016 and 2017. The experiment was conducted on seven different genotypes such asSardar (G_1), RHR-Guv-58 (G_2), RHR-Guv-60 (G_3), RHR-Guv-14 (G_4), RHR-Guv-16 (G_5), RHR-Guv-3 (G_6) and RHR-Guv-6 (G_7) with five pruning time i.e. 15^{th} May (P_1), 15^{th} June (P_2), 15^{th} July (P_3), 15^{th} August (P_4), 15^{th} Sept (P_5) and no pruning (control) (P_6). The genotypes were pruned 75 per cent of current season growth of guava plantsat different timesto understand influence on growth, yield and fruit fly infestation of guava. Nine years old guava plants with 6 x 6 spacing were selected in the experiment. The experiment was laid out in FRBD with forty two treatments. It was replicated two times. Observations on growth attributes and yield parameters were recorded. The statistical analysis of the data was done as per the standard procedure (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

A. Time required for initiation of new shoots

The data on time required for initiation of new shoots are presented in Table 1. The minimum time required for initiation of new shoots (27.86 days) was observed in P_1 (15^{th} May pruning time) treatment, while the maximum (44.79 days) in P_5 (15^{th} September pruning time) treatment. Data regarding effect of genotypes indicated that, the minimum was recorded in G_1 genotype (31.42 days) and maximum (37.46 days) in G_3 genotype. Regarding interaction effect of pruning time and genotypes, significantly minimum (24.00 days) was noticed in P_1G_1 treatment combination. The results of conducted experiments revealed that the minimum days required for initiation of new shoots was noted in the pruning time of 15^{th} May (P_1) but later it was increased in number of days from June to September pruning time and also more or less in control treatments. The late commencement of initiation of new shoots in plant are subjected to time of pruning and active growth phase on the basis that such trees after pruning immediately put forth new vegetative growth and carbohydrates favour the flower bud formation or initiation. It might have been utilized in the vegetative growth, thereby delaying in new shoots formation. The pruning time also plays an important role in sprouting of buds. The earlier pruned trees required less days as compared to late pruning. The September pruning required maximum days in when the shoots were exposed to unfavorable climatic condition, whereas May pruning time favorable with monsoon climatic condition with active growth phase of plant leads to require minimum days for sprouting shoots (Nikumbhe 2014, Joshi*et al.,* 2017and Sah *et al.,* 2017).

B. Number of shoots sprouted per plant

Among the treatments (Table 1) As regards the pooled results of pruning time, significantly maximum number of sprouted shoots (100.04) were recorded in P_1 (15^{th} May) treatment and the minimum (83.07) in P_5 treatment. In case of genotypes maximum sprouted shoots (140.29) were noticed in G_1 (Sardar) and minimum in G_3 genotype (79.71). The results indicated that the maximum number of sprouted shoots was recorded in the pruning time of 15^{th} May (P_1) as compared to other treatments and control once. This might be due to the translocation of metabolites and favours the more sprouting in pruned matured shoots during the active growth phase of plant. It was also observed maximum number of sprouted shoots in the G_1 (Sardar) as compared to other genotypes. It might be due to the independent growth rate and habit of variety because Sardar plant having more sprouting habit compare to other genotypes. The results of present aspect were observed maximum number of sprouted shoots in pruned plants compared to un-pruned plants in guava. These results are also similar with the findings of Nikumbhe (2014), Thakre *et al.* (2016), Sah *et al.* (2017) and Lakpathi and Rajkumar (2018) in guava.

C. Number of fruit harvested per plant

The data in respect of number of fruits harvested per plant are presented in Table 1 and graphically depicted in Fig. 1. The significantly maximum number of fruit (171.57) was noted in P_1 treatment, which was superior over rest of treatments, while the minimum (85.36) in P_5 treatment in pooled results of pruning time. In case of genotypes, the highest number of fruits (214.08) was noted in G_1 genotype and minimum in G_7 genotype (121.17). Interaction effect among the various pruning time and genotypes were recorded maximum number of fruit (265.00) in P_1G_1 treatment, while the minimum (70.25) in P_5G_7 treatment combination. The results revealed that the maximum number of fruits in the pruning time of 15^{th} May (P_1) but later it was decreased from June (P_2) to September (P_5) pruning treatments and control also. This might be due to change in the weather conditions and C: N ratio in plant. Congenial climatic condition and C: N ratio leads to the more sprouting and fruiting and consequently increases in number of fruits. It was also observed that the maximum number of fruits was observed in G_1 (Sardar) as compared to others and this could be attributed to the characteristics of the genotype. Though, the number of branches was found to be more in control. The higher number of fruits was recorded in pruning treatments (P_1) irrespective of genotype. Similarly response of genotypes to pruning time was also noticed. However, G_1 (Sardar) having more sprouting ability to produce more number of fruits per shoot was superior over the rest of the genotypes. The results of this investigation are similar with the Singh *et al.* (2001) reported that, plants pruned in May and June recorded significantly maximum number of fruit per plant than un-pruned plants in guava.

Table 1: Effect of pruning time and genotypes on shoot initiation, shoot sprouting and yield parameters (Pooled data of 2 years- 2016 & 2017).

Treatments	Time required for initiation of new shoots	Number of shoots sprouted per plant	Number of fruit	Average length of fruit (cm)	Average diameter of fruit (cm)	Average weight of fruit (cm)	Average no. of seeds per fruit
P_1 - 15th May	27.86	100.04	171.57	7.78	7.40	231.39	271.43
P_2- 15th June	30.79	96.93	159.96	8.03	7.61	244.39	269.86
P_3- 15th May	34.79	92.54	153.32	7.86	7.44	233.75	263.29
P_4- 15th May	39.79	93.29	115.89	7.59	7.24	221.61	274.64
P_5- 15th May	44.79	83.07	85.36	7.46	7.18	213.68	266.04
P_6 (Control)	40.75	92.39	157.57	7.78	7.35	226.25	274.14
S.E. (±)	0.04	2.17	2.45	0.03	0.03	0.66	0.91
CD at 5 %	0.10	6.03	6.78	0.09	0.09	1.84	2.53
G_1- Sardar	31.42	140.29	214.08	6.83	6.53	162.00	322.83
G_2- RHR-Guv-58	37.08	89.92	127.96	7.80	7.48	237.29	247.67
G_3- RHR-Guv-60	37.46	79.21	131.25	8.00	7.77	243.46	252.54
G_4- RHR-Guv-14	37.08	87.83	135.08	8.48	7.83	251.04	271.71
G_5- RHR-Guv-16	37.33	84.46	125.00	7.61	7.26	233.88	282.54
G_6- RHR-Guv-3	37.42	87.42	129.75	8.00	7.43	241.67	253.38
G_7- RHR-Guv-6	37.42	82.17	121.17	7.53	7.29	230.25	258.63
S.E. (±)	0.04	2.35	2.64	0.04	0.04	0.72	0.99
CD at 5 %	0.11	6.51	7.32	0.10	0.10	1.99	2.73
P_1G_1	24.00	154.75	265.00	6.83	6.48	161.50	326.50
P_1G_2	28.50	94.75	158.00	7.95	7.68	240.75	249.75
P_1G_3	28.50	83.75	159.50	8.16	7.90	248.75	253.75
P_1G_4	28.50	89.25	163.50	8.58	7.83	250.75	272.50
P_1G_5	28.50	91.75	148.50	7.53	7.23	239.50	284.00
P_1G_6	28.50	97.25	159.75	7.95	7.45	241.75	257.50
P_1G_7	28.50	88.75	146.75	7.50	7.26	236.75	256.00
P_2G_1	26.50	143.50	247.50	6.93	6.70	166.50	323.00
P_2G_2	31.50	90.00	148.00	8.00	7.53	257.50	247.00
P_2G_3	31.50	84.75	150.75	8.20	8.10	258.75	253.50
P_2G_4	31.50	90.75	152.50	8.80	8.17	266.25	271.50
P_2G_5	31.50	85.50	136.25	8.00	7.65	252.50	282.00
P_2G_6	31.50	93.75	143.75	8.40	7.62	260.50	251.00
P_2G_7	31.50	90.25	141.00	7.90	7.49	248.75	261.00
P_3G_1	30.50	139.75	234.75	6.85	6.55	164.50	313.25
P_3G_2	35.50	91.50	138.75	7.93	7.61	245.25	242.50
P_3G_3	35.50	80.50	141.50	8.25	7.99	248.50	248.00
P_3G_4	35.50	84.50	146.50	8.65	8.02	253.50	265.50
P_3G_5	35.50	84.00	134.00	7.70	7.18	244.75	274.75
P_3G_6	35.50	89.50	141.25	8.05	7.43	244.75	247.50
P_3G_7	35.50	78.00	136.50	7.58	7.32	235.00	251.50
P_4G_1	35.50	131.25	168.25	6.85	6.53	161.00	327.25
P_4G_2	40.50	91.25	104.50	7.63	7.28	227.00	250.25
P_4G_3	40.50	79.50	109.50	7.75	7.50	236.50	253.25
P_4G_4	40.50	90.00	113.50	8.23	7.67	248.50	278.25
P_4G_5	40.50	89.75	109.00	7.35	6.96	222.50	288.25
P_4G_6	40.50	86.00	107.50	7.88	7.39	235.25	257.00
P_4G_7	40.50	85.25	99.00	7.43	7.34	220.50	268.25
P_5G_1	40.50	125.00	127.50	6.73	6.45	157.00	317.00
P_5G_2	45.50	79.25	76.75	7.40	7.35	221.75	245.50
P_5G_3	45.50	71.00	78.50	7.55	7.40	229.75	251.00
P_5G_4	45.50	81.25	84.75	8.25	7.52	237.25	265.50
P_5G_5	45.50	72.75	78.50	7.33	7.16	213.25	279.50
P_5G_6	45.50	77.75	81.25	7.75	7.28	225.00	252.00
P_5G_7	45.50	74.50	70.25	7.20	7.11	211.75	251.75
P_6G_1	31.50	147.50	241.50	6.81	6.50	161.50	330.00
P_6G_2	41.00	92.75	141.75	7.90	7.42	231.50	251.00
P_6G_3	43.25	75.75	147.75	8.08	7.75	238.50	255.75
P_6G_4	41.00	91.25	149.75	8.38	7.75	250.00	277.00
P_6G_5	42.50	83.00	143.75	7.78	7.37	230.75	286.75
P_6G_6	43.00	80.25	145.00	7.95	7.40	242.75	255.25
P_6G_7	43.00	76.25	133.50	7.55	7.25	228.75	263.25
S.E. (±)	0.09	5.75	6.47	0.09	0.09	1.75	2.41
CD at 5 %	0.26	NS	17.93	0.25	0.24	4.86	NS

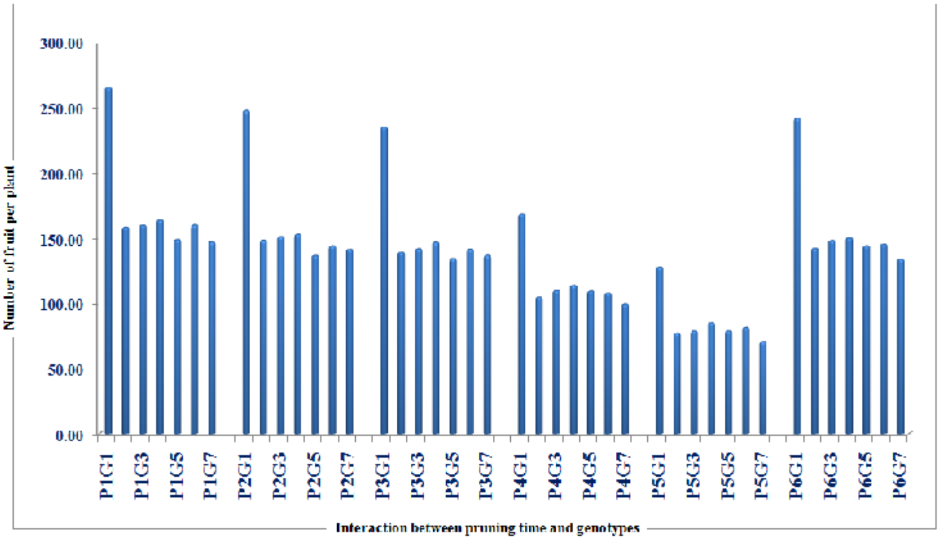

Fig. 1. Effect of pruning time and genotypes on number of fruits per plant.

These results are also similar with the findings of Singh *et al.* (2001), Shabhan and Haseeb (2009), Pilania *et al.* (2010), Mehta *et al.* (2012), Prakash *et al.* (2012), Ali *et al.* (2014), Nikumbhe (2014) and Mali *et al.* (2016), in guava.

D. Average length, diameter and weight of fruit

Data regarding on length, diameter and weight of fruit are presented in Table 1. Significantly maximum length of fruit (8.03 cm), diameter of fruit (7.61 cm) and weight of fruit (244.39 g) was recorded by P_2 (15^{th} June) pruning time treatment. In case of genotype maximum length of fruit (8.48 cm),diameter of fruit (7.83 cm) and weight of fruit in (251.04 g) was observed in G_4 (RHR-Guv-14) genotype in pooled results. Regarding interaction, maximum length of fruit (8.80 cm), diameter of fruit (8.17 cm) and weight of fruit (266.25 g) was noticed in P_2G_4 treatment combination in pooled data. The results revealed that, time of pruning does not affect too much on fruit length and diameter; G_4 genotypes has maximum length, diameter and weight of fruit and minimum in G_1 as well as in control ones. Pruned plants were recorded maximum fruit diameter than control plants. This might be due to pruning effect causes shifting of metabolites in sprouted shoots, fruit buds and variation in genetic make-up of the genotype which leads to increase in vegetative and reproductive growth in plants and due to which length of fruit is increased. The results of present studies are in consonance with those of Pilania *et al.* (2010), Ali *et al.* (2014), Nikumbhe (2014), Thakre *et al.* (2016), Sah*et al.* (2017) and Lakpathi and Rajkumar *et al.* (2018) in guava, who also obtained increased fruit size in pruned as compared to control plants. The production of large size fruits by trees subjected to pruning might be due to more nutrient supply to the limited number of fruits and lesser crop load per tree and. Similar results was reported by Mehta *et al.* (2012), Nikumbhe (2014), Raut *et al.* (2016) and Lakpathi and Rajkumar *et al.* (2018) in guava as they obtained an increment in fruit weight in pruned than un-pruned plants.

E. Average number of seeds per fruit

Data presented Table 1 indicated that the significant minimum average number of seeds per fruit (263.29) was observed in P_3 (15^{th} July) treatment. In case of genotype, the minimum average number of seeds per fruit (247.67) was observed in G_2 (RHR-Guv-58) genotype. In interaction effect of pruning time and genotypes indicated that, the minimum average number of seeds per fruit (242.50) was observed in P_3G_2 treatment combination. There was not such effect of pruning time on number of seeds per fruit. Similar findings have been reported by Nikumbhe (2014) in guava and Joshi *et al.* (2017) in custard apple.

F. Yield of fruit per plant

Data regarding on yield of fruit per plant with fruit fly infestation are presented in Table 2. Pruning time of pooled results revealed that significantly maximum yield of fruit per plant (38.70 kg) was recorded in P_1 (15^{th} May) treatment and minimum in P_5 (15^{th} September) treatment (17.93 kg). As regards to genotypes, significantly maximum yield (34.81 kg) was observed in G_1 (Sardar) and it was at par with G_4 (RHR-Guv-14) genotype (34.18 kg). Interaction effect of pruning time and genotypes of pooled data indicated that, significantly highest yield of fruit (42.80 kg) was noted in P_1G_1 treatment, which was at par with P_2G_1 (41.20 kg) treatment and lowest in P_5G_7 treatment combination (14.92 kg). The results revealed that, maximum yield of fruit per plant with fruit fly infestation was recorded in pruning time of 15^{th} May (P_1) treatment. This may be attributed to the proper balance between the vegetative and reproductive growth of the plants and availability of stored food material in pruned plant as compared to other treatments. Since un-pruned plant got exhausted because of the heavy crop load during the previous season, they produced less number of flower buds for winter season. This might have exposed the plants for compensation point unit production of photosynthesis and subsequently lower yield in winter compare to pruned ones.

Table 2: Effect of pruning time and genotypes on yield per plant, marketable yield per plant and marketable yield per ha (Pooled data of 2 years- 2016 & 2017).

Treatments	Yield per plant (kg)	Marketable yield per plant (kg)	Marketable yield per ha (t)
P_1 - 15th May	38.70	21.33	5.91
P_2- 15th June	38.03	23.04	6.38
P_3- 15th May	34.97	29.53	8.18
P_4- 15th May	25.31	22.32	6.18
P_5- 15th May	17.93	16.17	4.48
P_6 (Control)	34.89	18.16	5.03
S.E. (±)	0.22	0.16	0.04
CD at 5 %	0.62	0.43	0.12
G_1- Sardar	34.81	24.35	6.75
G_2- RHR-Guv-58	30.70	20.89	5.79
G_3- RHR-Guv-60	32.27	22.23	6.16
G_4- RHR-Guv-14	34.18	24.06	6.66
G_5- RHR-Guv-16	29.60	19.95	5.53
G_6- RHR-Guv-3	31.68	21.88	6.06
G_7- RHR-Guv-6	28.24	18.95	5.25
S.E. (±)	0.24	0.17	0.05
CD at 5 %	0.67	0.47	0.13
P_1G_1	42.80	24.31	6.73
P_1G_2	38.15	20.83	5.77
P_1G_3	39.79	21.49	5.95
P_1G_4	41.11	23.32	6.46
P_1G_5	35.65	19.00	5.26
P_1G_6	38.66	21.62	5.99
P_1G_7	34.76	18.77	5.20
P_2G_1	41.20	25.82	7.15
P_2G_2	38.11	22.94	6.35
P_2G_3	39.19	23.67	6.56
P_2G_4	40.73	25.47	7.06
P_2G_5	34.45	20.32	5.63
P_2G_6	37.50	22.64	6.27
P_2G_7	35.04	20.39	5.65
P_3G_1	38.64	33.13	9.18
P_3G_2	34.04	28.72	7.96
P_3G_3	35.15	29.76	8.24
P_3G_4	37.14	31.60	8.75
P_3G_5	32.92	27.25	7.55
P_3G_6	34.75	29.45	8.16
P_3G_7	32.14	26.81	7.43
P_4G_1	27.13	24.02	6.65
P_4G_2	23.84	20.78	5.76
P_4G_3	26.02	23.06	6.39
P_4G_4	28.33	25.35	7.02
P_4G_5	24.47	21.36	5.92
P_4G_6	25.40	22.58	6.26
P_4G_7	21.95	19.08	5.29
P_5G_1	20.02	18.27	5.06
P_5G_2	17.07	15.30	4.24
P_5G_3	18.04	16.31	4.52
P_5G_4	20.29	18.39	5.09
P_5G_5	16.74	15.03	4.16
P_5G_6	18.45	16.54	4.58
P_5G_7	14.92	13.33	3.69
P_6G_1	39.05	20.56	5.70
P_6G_2	32.98	16.77	4.65
P_6G_3	35.41	19.08	5.29
P_6G_4	37.49	20.25	5.61
P_6G_5	33.35	16.74	4.64
P_6G_6	35.30	18.44	5.11
P_6G_7	30.63	15.31	4.24
S.E. (±)	0.59	0.41	0.11
CD at 5 %	1.64	1.14	0.32

Maximum yield and fruit fly infested fruits was observed early pruning due to favourable condition for fruit yield and infestation, while minimum fruit yield and fruit fly infested fruits in late pruning due to unfavourable condition for fruit fly infestation. These findings are in accordance with Singh and Saxena (2008), Dubey *et al.* (2002), Basu *et al.* (2007), Nimbalkar *et al.* (2010), Pilania *et al.* (2010), Prakash *et al.* (2012), Mali *et al.* (2016), Nikumbhe (2014) and Sah *et al.* (2017) as they obtained an increment in fruit yield per plant by pruning in guava during winter season. It also observed that, maximum yield of fruit per plant with fruit fly infestation was recorded in G_1 (Sardar) and G_4 (RHR-Guv-60) genotype. It might be attributed to the characteristics of the Sardar having more sprouting ability to produce more number of fruits per shoot and genotype G_4 (RHR-Guv-60) having more fruit weight consequently increases yield (Nikumbhe, 2014).

G. Marketable yield of fruit

Data presented in Table 2 showed that the significantly maximum marketable yield of fruit per plant (29.53 kg) and per ha (8.18 t) was recorded in P_3 (15th July time of pruning) treatment. Pooled results of genotypes indicated that, significantly highest marketable yield per plant (24.35 kg) and per ha (6.75 t) was noted in G_1 (Sardar) genotype and it was at par with G_4 (RHR-Guv-14) genotype (24.06 kg and 6.66 t, respectively). Regarding interactions, maximum yield per plant (33.13 kg) and per ha (9.18 t) was recorded in P_3G_1 treatment and it was followed by P_3G_4 (31.60 kg per plant and 8.75 t per ha) treatment combination.

Results of pooled data showed that, the maximum marketable yield of fruit per plant was recorded in 15th July (P_3) treatment and genotype G_1 (Sardar) and G_4 (RHR Guva-60). Marketable yield is a major concern in production. This is due to the change in the fruiting time and harvesting by pruning operation and indirectly climatic influence cause unfavorable conditions of emerging fruit fly consequently less infestation of fruits and increase the marketable yield (Brar *et al.* 2008 and Mali *et al.*, 2016). Increase in the marketable yield of moderate pruned plants as compared to un-pruned guava plants (Shirsath, 2013). It also observed that the maximum marketable yield of fruit was recorded in G_1 (Sardar) and G_4 (RHR Guva-60) genotype. It might be attributed to the characteristics of the genotype with less infestation of fruit fly (Nikumbhe, 2014).

CONCLUSION

The results of present investigation, it can be concluded that pruning on 15th July was best to obtain maximum marketable yield. The genotype RHR-Guv-14 is better in large fruit size, more fruit weight and yield, thus it can be evaluated for cultivation as *mrigbhar* crop.

FUTURE SCOPE

The genotype RHR-Guv-14 may evaluate for cultivation as *hast bhar* crop.

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