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Effect of Pruning Intensities on Tree vigour, Flowering and Fruiting of Guava cv. Khaja under Alluvial zone of West Bengal, India

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A B S T R A C T

An experiment was conducted at BCKV, Gayeshpur Farm, West Bengal to study the effect of different pruning intensities on tree vigour flowering and fruiting in guava. 7 year old guava trees were headed back at 1m, 2m and 3m height from the ground level in the month of April and May with no heading back (control) in 2012 (T_1- 1m heading back in April, T_2- 2m heading back in April, T_3- 3m heading back in April, T_4- 1m heading back in May, T_5- 2m heading back in May, T_6- 3m heading back in May, T_7- control). Sub-treatment was given to the headed back trees (S_1- No pruning (Control), S_2: Pinching of 3 month shoot, S_3: 50% pruning of 3 month shoot, S_4: 50% pruning of 4 month shoot, S_5: One leaf pair pruning of 3 month shoot). It was observed that 2m heading back in April followed by 50% pruning of 3 month shoot (T_2S_3) proved to be beneficial for increasing number of flowers per shoot (62.39), obtaining higher fruit set (83.33%) and higher number of fruits per shoot (54.14) ultimately increasing the yield per shoot (4.98 kg/shoot).

Introduction

Guava (*Psidium guajava* L.) is one of the most common fruits in India, belongs to the family Mytraceae. It is originated in Tropical America and was introduced to India during 17th century by Portuguese (Menzel and Paxton, 1985). The plant has wider adaptability in various environmental conditions. The crop has gained considerable importance in the country as well as in West Bengal on account of its high nutritive value, pleasant aroma, good flavour and comparatively low cost of cultivation. In West Bengal, guava is commercially grown in the districts of Murshidabad, Nadia and 24-

Parganas (North and South) where the soils are fertile (alluvial) and having high water table. Crop regulation for production of more winter season crop has been standardized with different measures like spraying of higher concentrations of urea, application of growth regulators, etc., however these are cumbersome, laborious and uneconomical. Defoliation with urea to induce flowering for winter crop is almost ineffective in West Bengal, may be due to high humidity. For reducing rainy season crop the regulators like NAA (300 ppm) and NAD (50 ppm) were found effective as flower thinner but these results are not so conspicuous to adopt commercially. Pruning the current season's growth of spring flush was advocated to avoid rainy season crop and to get a subsequent winter crop (Gaur, 1996).

In general, pruning of trees is practiced to reduce the amount of growth on the plant and to maintain vegetative, reproductive balance, to develop plant form with good light distribution, small in size and easy to manage and to regulate the bearing of the trees and to influence the size of the fruit. There is variation in pruning requirements among different species and among the trees of same species in different environments. We need to understand the growth behaviour and bearing habit of the trees to decide about the pruning levels and test the general response of trees or trees parts to the pruning practices before it is advocated. As in guava the fruit buds are formed on current season's growth, pruning emerges new growth and thereby flowering (Reddy and Bhagwan, 2014).Interventions with foresaid technologies are successful in low height trees. Recoupment of canopy is quicker in guava after drastic pruning. Hence, management of canopy can keep the trees at low height. Accordingly, it is proposed to heading back the trees during spring and early summer before exhaustion of reserve food and to study the capacity of emerging shoots in producing floral buds for winter season crop in successive periods. In new alluvial soils of West Bengal the guava plants grow very tall, dense and overcrowding, trees bears more fruits in rainy season as compared to winter season. The developing and deploying appropriate technology to manage such senile orchards in order to attain the competitive edge in commercial production is necessary. Various technologies like one leaf-pair pruning, removal of certain extent of vegetative growth during different periods at different location have been advocated. Very precise information regarding the impact of such techniques under West Bengal is not available. Hence, it is proposed to develop technique to keep the trees with manageable canopy in order to get maximum quality fruits. Keeping the above in view, the present investigation was undertaken to study the effect of pruning intensities on tree vigour, flowering and fruiting during winter and rainy season.

Materials and Methods

Research was conducted at Regional Research Station, Gayeshpur, Nadia, West Bengal. The Soil chemical properties of the experiment site Soil pH-6.3, Available Nitrogen (kg/ha)-182.00, Available P_2O_5 (Kg/ha)-45.00, Available K_2O (Kg/ha)-275.00. Experiment was laid out in Split-Plot Design with 7 main treatment and 5 sub treatment and 3 replications. Main treatment comprised of T_1: Heading back at 1m height (April), T_2: Heading back at 2m height (April), T_3: Heading back at 3m height (April), T_4: Heading back at 1m height (May), T_5: Heading back at 2m height (May), T_6: Heading back at 3m height (May) T_7: No heading back (Control) and Sub treatment comprised of **S_1:** No pruning (Control), **S_2:** Pinching of 3 month shoot, **S_3:** 50% pruning of 3 month shoot, **S_4:** 50% pruning of 4 month shoot, **S_5:** One leaf pair pruning of 3 month

shoot. In Heading back (main-treatment) operation Trees were pruned 1m, 2m and 3m from the ground level in the month of April, 2012 and 1m, 2m and 3m from the ground level in the month of May, 2012 following randomization with the help of pruning saw. After pruning copper oxychloride was pasted on cut surface of pruned branches to check the microbial infection. Multiple new shoot emerges out from the pruned trees after few days. These multiple shoots are thinned out and only few healthy and well spaced shoot are retained covering all the directions to form a proper architecture for trees. These sprouts are allowed to grow for 3-4 months before imposing sub-treatments. When the newly emerged shoots from headed back trees were 3 or 4 months old, sub –treatments viz., pinching (removal of the apical portion) twice at 30 days interval, 50% pruning of 3 month shoot, 50% pruning of 4 month shoot and one leaf pair pruning of 3 month shoot were imposed as per sub treatment. For the control treatment the shoots were kept unpruned. Sub-treatments were also imposed to trees that did not receive heading back (T_7). Observation were recorded on Vegetative characteristic such as Tree height, Sprout emergence, Number of sprouts, Sprout emergence (days after sub treatment), Shoot length (cm) at monthly interval, Length of new shoots at one year interval and Flowering characteristics such as Flowering date, Duration of flowering (days), Number of flowers/ shoots. Statistical analysis of data was done by following the fisher's Analysis of Variance (ANOVA) as given by Rangaswamy (2002). The level of significance used in 'F' and 't' test was p=0.05.

Result and Discussion

Tree growth characteristics

Before imposing the treatment of heading back the selected trees for the experimentation showed variation numerically with regard to tree height and spread which was due to overcrowding of the trees (Table 1). After imposing the treatments maximum tree height was recorded in T_7 (No heading back) whereas minimum tree height was recorded in T_1 (heading back at 1m in April) and T_4 (heading back at 1m in May) during 2013 and during the year 2014, maximum tree height was recorded in T_7 (No heading back) whereas minimum tree height was recorded in T_1 (heading back at 1m in April) and T_4 (heading back at 1m in May). As heading back was performed at different heights i.e.1m, 2m and 3m, the trees headed back to 1m height from ground level had least tree height due to the loss of the extensive vegetative growth. Similar results were obtained by Kumar and Rattanpal (2010) and Mishra *et al.*, (2014). Tree spread (N-S) was maximum in T_7 (No heading back) in winter 2012 and in rainy 2013, whereas tree spread was minimum in T_1 (heading back at 1m in April) for 2013 and 2014 respectively. Also, maximum tree spread (E-W) was recorded in T_7 whereas minimum tree spread was recorded in T_1 (during 2013 to 2014 respectively). It may be ascribed to the fact that heading back at 1m left only the stumps which ultimately affected tree spread even in other heading back treatments there was only four-five scaffold branches with no shoots or few shoots. The topping operation had severely restricted the height and tree spread even after recoupment by virtue of which trees remained manageable. Teotia and Singh (1971) registered a reduction in the tree canopy by pruning in guava cv. Allahabad Safeda. However, Aravindakshan (1953), Dhaliwal and Singh (2004) observed increased in tree canopy volume. Heading back at 2m height in the month of April took minimum days for sprout emergence whereas Heading back at 2m height in the month of May took maximum days for sprout emergence. It might be due to more reserve food materials available to individual vegetative bud (Syamal

and Rajput, 1989) and more light interception in trees headed back at 2m height resulting in early sprouting of vegetative bud as opined by Lakpathi *et al.,* (2013). Similar findings were reported by Jadhav *et al.,* (2002), Suleman Mohammad *et al.,* (2006), Basu *et al.,* (2007).

Total number of sprouts was maximum in T_6 whereas minimum number of sprouts was recorded in T_4 (3 months after heading back treatment) (Table 2). Trees headed back at 1m had least sprouts. It might be due to less number of vegetative buds left on the severe pruned branches and comparative less rejuvenate capacity of the aged branch that had resulted in less number of sprouts.

After 3 months of heading back shoot length was highest in trees headed back at 2m in the month of April which was at par with trees headed back at 2m in the month of May (Table 3). Significantly lowest tree height was observed in trees headed back at 1m height in the month of April. Maximum shoot length was found with severely pruned trees earlier by Bajpai *et al.,* (1973), Jadhav *et al.,* (2002) and Shaban and Haseeb (2009).

The increase in shoot length might be attributed to less number of shoots and more food reserves available to individual shoots (Lakpathi *et al.,* 2013). These findings were also in agreement with the findings of Syamal and Rajput (1989) in ber. Differential light interception within the tree canopies might have resulted differential shoot growth.

Table.1 Effect of heading back on tree height and tree spread of guava

Treatments	Tree height (m)			Tree spread (m) (N-S)			Tree spread (m) (E-W)		
	Before heading back (2012)	2013	2014	2012	2013	2014	2012	2013	2014
T_1	9.08	2.44	3.43	8.12	1.42	2.35	8.07	1.28	2.50
T_2	8.65	3.35	4.78	9.17	2.78	4.32	8.87	2.95	4.37
T_3	8.77	4.31	5.56	7.37	3.05	4.32	7.47	3.12	4.03
T_4	7.82	2.53	3.85	7.32	2.40	3.25	7.03	2.67	3.37
T_5	8.10	3.90	5.21	8.53	2.62	3.83	7.95	2.63	3.48
T_6	7.60	4.30	5.80	8.35	3.62	4.90	8.90	4.13	5.07
T_7	8.77	9.00	9.10	9.17	9.53	9.73	8.85	9.10	9.20
SEm(±)	**0.42**	**0.19**	**0.18**	**0.45**	**0.27**	**0.30**	**0.38**	**0.30**	**0.31**
CD@5%	**1.29**	**0.57**	**0.56**	**1.39**	**0.85**	**0.92**	**1.18**	**0.93**	**0.97**

Table.2 Sprout emergence and number of sprouts as influenced by heading back and pruning (sub-treatment)

Treatments	Sprout emergence (DAHB)	Number of Sprouts (3MAHB)	Axillary sprout emergence (DAST)
T_1	11.33	87.00	44.33
T_2	10.00	269.00	39.67
T_3	12.00	268.67	32.67
T_4	17.67	73.33	33.00
T_5	21.00	231.33	36.00
T_6	18.67	281.67	40.33
T_7	-	-	38.61
SEm(±)	**0.20**	**2.34**	**0.50**
CD@5%	**0.65**	**7.37**	**1.58**

Table.3 Effect of heading back on shoot length at monthly interval.

Treatments	1 month after heading back	2 month after heading back	3 month after heading back
T_1	11.93	24.24	43.05
T_2	15.69	22.38	67.54
T_3	14.93	39.31	55.67
T_4	11.66	22.08	45.05
T_5	10.44	31.63	48.49
T_6	15.75	36.40	55.45
T_7	-	-	-
SEm (±)	**0.17**	**0.35**	**0.67**
CD@5%	**0.55**	**1.10**	**2.10**

Table.4 Effect of heading back on date and duration of flowering for both winter and rainy season crop

Treatments	Winter season crop		Duration of flowering (days)	Rainy season crop		Duration of flowering (days)
	Start	End		Start	End	
T_1	5th September	5th October	31	15th March	30th April	45
T_2	28th August	1st October	34	15th March	2nd May	43
T_3	21st August	26th October	35	9th March	16th May	46
T_4	11th September	13th October	33	21st March	3rd May	43
T_5	24th August	1st October	38	13th March	28th April	44
T_6	19th August	28th September	39	13th March	27th April	41
T_7	12th August	12th October	30	24th February	15th April	50
SEm(±)	**-**	**-**	**0.48**	**-**		**0.64**
CD@ 5%	**-**	**-**	**1.48**			**1.97**

Table.5 Effect of heading back and shoot pruning on number of flowers per shoot

Treatment combinations	Winter season crop 2012	Rainy season crop 2013	Pooled	Winter season crop 2013	Rainy season crop 2014	Pooled
$T_1 S_1$	1.40	32.33	16.87	10.21	40.33	25.27
T_1S_2	2.22	34.66	18.44	20.43	39.67	30.05
T_1S_3	3.16	40.33	21.75	24.31	51.67	37.99
T_1S_4	2.50	36.17	19.34	20.57	49.00	34.79
T_1S_5	2.18	31.13	16.66	14.33	31.67	23.00
T_2S_1	5.20	46.23	25.72	25.63	86.00	55.82
T_2S_2	5.80	45.75	25.78	29.47	76.66	53.57
T_2S_3	7.98	54.63	31.31	23.62	101.15	62.39
T_2S_4	4.28	50.15	27.22	22.67	70.66	46.67
T_2S_5	3.68	47.83	25.76	21.43	78.33	49.88
T_3S_1	6.70	48.17	27.44	16.51	85.33	50.92
T_3S_2	6.32	47.79	27.06	27.39	81.35	54.37
T_3S_3	9.64	69.40	39.52	19.67	91.66	55.67
T_3S_4	7.78	68.40	38.09	14.17	89.33	51.75
T_3S_5	8.22	51.66	29.94	18.23	88.00	53.12
T_4S_1	1.28	30.13	15.71	15.13	64.41	39.77
T_4S_2	3.18	31.36	17.27	21.45	80.33	50.89
T_4S_3	4.10	36.35	20.23	16.33	72.18	44.26
T_4S_4	3.58	31.31	17.45	9.15	51.34	30.25
T_4S_5	2.62	28.39	15.51	16.22	62.64	39.43
T_5S_1	5.34	45.16	25.25	17.17	55.61	36.39
T_5S_2	6.14	44.63	25.39	21.23	61.65	41.44
T_5S_3	8.12	52.66	30.39	19.89	75.34	47.62
T_5S_4	5.98	50.33	28.16	15.21	72.61	43.91
T_5S_5	6.02	46.53	26.28	11.33	46.84	29.09
T_6S_1	7.10	47.67	27.39	19.25	86.34	52.80
T_6S_2	6.62	48.19	27.41	21.53	95.94	58.74
T_6S_3	8.98	54.16	31.57	25.45	97.67	61.56
T_6S_4	8.12	52.13	30.13	19.03	82.62	50.83
T_6S_5	7.80	50.13	28.97	16.49	73.31	44.90
T_7S_1	17.13	40.31	28.72	14.19	96.67	55.43
T_7S_2	16.16	46.37	31.27	14.31	90.21	52.26
T_7S_3	20.23	26.33	23.28	16.41	72.32	44.37
T_7S_4	15.42	31.25	23.34	14.67	85.36	50.02
T_7S_5	21.31	41.66	31.49	11.39	92.32	51.86
SEm (±) (sxm)	**0.21**	**0.84**	**0.53**	**0.37**	**1.47**	**0.91**
CD@5% (sxm)	**0.28**	**1.60**	**0.94**	**0.70**	**2.73**	**1.70**
SEm (±) (mxs)	**0.13**	**0.62**	**0.38**	**0.27**	**1.06**	**0.66**
CD@5% (mxs)	**0.38**	**1.82**	**1.10**	**0.79**	**3.11**	**1.94**

Table.6 Interaction effect of heading back and pruning on per cent fruit set

Treatment combinations	Winter season crop	Rainy season crop	Pooled	Winter season crop	Rainy season crop	Pooled
	2012	2013		2013	2014	
$T_1 S_1$	23.80 (20.18)	74.64 (59.75)	49.22 (37.64)	69.64 (56.55)	77.44 (61.63)	75.48 (60.31)
T_1S_2	45.05 (42.14)	75.48 (60.30)	60.26 (50.90)	63.00 (52.51)	65.82 (54.20)	64.41 (53.36)
T_1S_3	47.78 (43.71)	84.83 (67.07)	66.31 (54.50)	70.46 (57.06)	74.49 (59.65)	72.48 (58.34)
T_1S_4	44.80 (42.00)	70.11 (56.85)	57.46 (49.27)	64.12 (53.19)	72.69 (58.50)	68.41 (55.79)
T_1S_5	46.33 (42.88)	82.43 (65.19)	64.38 (53.34)	52.13 (46.20)	59.39 (50.39)	55.76 (48.29)
T_2S_1	41.35 (40.00)	75.77 (60.50)	58.56 (49.91)	67.58 (55.27)	83.36 (65.92)	75.47 (60.29)
T_2S_2	34.66 (36.05)	75.96 (60.63)	55.31 (48.03)	75.84 (60.55)	81.58 (64.59)	78.71 (62.52)
T_2S_3	38.97 (38.61)	84.24 (66.69)	61.61 (51.70)	77.77 (61.90)	88.88 (70.71)	83.33 (65.96)
T_2S_4	50.00 (44.98)	70.73 (57.23)	60.36 (50.96)	68.20 (55.65)	79.89 (63.35)	74.05 (59.35)
T_2S_5	34.24 (35.80)	82.65 (65.38)	58.44 (49.84)	62.95 (52.49)	80.93 (64.10)	71.94 (58.00)
T_3S_1	38.21 (38.16)	75.81 (60.52)	57.01 (49.01)	58.15 (49.67)	83.70 (66.18)	70.93 (57.35)
T_3S_2	34.18 (35.76)	77.32 (61.53)	55.75 (48.28)	67.21 (55.03)	80.36 (63.67)	73.79 (59.18)
T_3S_3	51.66 (45.93)	85.33 (67.46)	68.50 (55.84)	74.83 (59.87)	82.60 (65.33)	78.72 (62.51)
T_3S_4	58.10 (49.64)	60.28 (50.91)	59.19 (50.28)	63.87 (53.03)	84.19 (66.55)	74.03 (59.34)
T_3S_5	43.31 (41.13)	77.86 (61.91)	60.58 (51.09)	65.94 (54.27)	82.72 (65.42)	74.33 (59.54)
T_4S_1	25.78 (21.00)	74.41 (59.59)	50.10 (41.57)	65.23 (53.85)	77.86 (61.91)	71.55 (57.74)
T_4S_2	47.48 (43.54)	75.32 (60.19)	61.40 (51.57)	67.46 (55.20)	82.60 (65.32)	75.03 (60.00)
T_4S_3	29.76 (33.04)	80.28 (63.69)	55.02 (47.87)	74.22 (59.20)	85.85 (68.05)	80.04 (63.51)
T_4S_4	60.34 (50.95)	73.97 (59.30)	67.15 (55.01)	72.57 (58.39)	79.53 (63.01)	76.05 (60.68)
T_4S_5	79.77 (63.25)	75.87 (60.56)	77.82 (61.88)	67.14 (55.00)	77.12 (61.40)	72.13 (58.11)
T_5S_1	58.24 (49.72)	71.32 (57.60)	64.78 (53.58)	67.33 (55.12)	79.12 (62.80)	73.23 (58.82)
T_5S_2	42.51 (40.68)	74.52 (59.68)	58.52 (49.89)	62.69 (52.34)	77.42 (61.63)	70.06 (56.81)
T_5S_3	38.42 (38.30)	80.73 (63.95)	59.57 (50.50)	80.14 (63.52)	86.79 (68.70)	83.47 (65.98)
T_5S_4	35.95(36.81)	69.92 (56.72)	52.94 (46.66)	65.42 (53.97)	81.74 (64.70)	73.58 (59.07)
T_5S_5	51.83 (46.03)	82.27 (65.10)	67.05 (54.95)	65.14 (53.79)	78.76 (62.55)	71.95 (58.01)
T_6S_1	34.51 (35.96)	74.28 (59.51)	54.39 (47.50)	78.13 (62.10)	81.23 (64.32)	79.68 (63.19)
T_6S_2	32.48 (34.73)	74.62 (59.73)	53.55 (47.02)	61.87 (51.85)	77.89 (61.94)	69.88 (56.69)
T_6S_3	40.53 (39.52)	81.76 (64.76)	61.15 (51.43)	77.64 (61.80)	85.98 (68.10)	81.81 (64.80)
T_6S_4	50.74 (45.41)	69.33 (56.35)	60.03 (50.77)	70.52 (57.09)	71.42 (57.66)	70.97 (57.38)
T_6S_5	32.56 (34.78)	76.98 (61.31)	54.77 (47.72)	51.97 (46.11)	67.37 (55.15)	59.67 (50.56)
T_7S_1	73.20 (58.81)	72.34 (58.26)	72.77 (58.53)	65.12 (53.78)	80.40 (63.73)	72.76 (58.53)
T_7S_2	71.53 (57.75)	42.23 (40.51)	56.88 (48.94)	60.80 (51.22)	77.15 (61.46)	68.98 (56.15)
T_7S_3	78.55 (62.40)	76.76 (61.16)	77.65 (61.78)	72.03 (58.05)	85.36 (67.51)	78.70 (62.50)
T_7S_4	85.08 (67.28)	74.82 (59.87)	79.95 (63.39)	64.49 (53.40)	75.15 (60.08)	69.82 (56.66)
T_7S_5	73.30 (58.87)	69.76 (56.61)	71.53 (57.73)	65.06 (53.74)	75.11 (60.05)	70.09 (56.82)
SEm (±) (sxm)	**1.01 (0.66)**	**1.34 (0.92)**	**1.18 (0.70)**	**1.27 (0.80)**	**1.49 (1.13)**	**1.45 (0.42)**
CD@5% (sxm)	**1.60 (0.98)**	**2.70 (1.93)**	**2.15 (1.24)**	**2.50 (1.61)**	**2.89 (2.27)**	**2.81 (1.29)**
SEm (±) (mxs)	**0.66 (0.42)**	**1.02 (0.72)**	**0.84 (0.49)**	**0.95 (0.61)**	**1.11 (0.86)**	**1.07 (0.24)**
CD@5% (mxs)	**1.95 (1.23)**	**2.98 (2.10)**	**2.47 (1.44)**	**2.78 (1.79)**	**3.24 (2.51)**	**3.15 (0.69)**

Table.7 Effect of heading back (main treatment) on number of fruits per shoot

Treatments	Winter season crop	Rainy season crop	Pooled	Winter season crop	Rainy season crop	Pooled
	2012	2013		2013	2014	
T_1	0.99	27.31	14.15	11.55	30.05	20.80
T_2	2.13	38.35	20.15	17.40	68.80	43.10
T_3	3.56	45.04	23.19	12.76	72.10	42.43
T_4	1.46	23.98	12.72	10.80	53.52	32.16
T_5	2.82	36.29	19.56	11.63	50.67	31.15
T_6	2.98	38.08	20.53	14.02	67.44	40.73
T_7	13.74	28.41	19.01	9.33	68.51	38.92
SEm (±)	**0.07**	**0.28**	**0.18**	**0.11**	**0.53**	**0.32**
CD@5%	**0.21**	**0.87**	**0.54**	**0.35**	**1.64**	**1.00**

Table.8 Effect of pruning (sub treatment) on number of fruits per shoot

Treatments	Winter season crop	Rainy season crop	Pooled	Winter season crop	Rainy season crop	Pooled
	2012	2013		2013	2014	
S_1	3.35	30.70	17.02	11.39	59.48	35.44
S_2	3.29	30.04	16.66	14.77	58.92	36.85
S_3	4.73	41.71	22.08	15.69	68.17	41.93
S_4	4.19	32.61	17.80	11.03	55.80	33.42
S_5	4.17	34.56	18.72	9.61	51.27	30.44
SEm (±)	**0.02**	**0.16**	**0.09**	**0.06**	**0.29**	**0.18**
CD@5%	**0.06**	**0.45**	**0.26**	**0.18**	**0.83**	**0.51**

Flowering characteristics

The commencement of flowering was delayed in trees headed back at 1m height during both the seasons (Table 4). In rainy season crop, the control trees flowered on 24th February, 2013 and flowering ceased on 15th April, 2013 with the duration of flowering being (50 days). On the contrary, trees headed back at 1m in May initiated flowering on 21st March, 2013 and flowering ceased on 3rd May, exhibiting a flowering duration of 43 days. Similar results were observed in case of winter season crop, where also the severely pruned trees showed a delay in commencement of flowering. The late commencement of flowering in headed back trees in comparison to the control ones maybe explained on the basis that pruned trees put forth new vegetative growth immediately after pruning and almost the entire amount of carbohydrate which otherwise favour the flower-bud formation/initiation, might have been utilized in the vegetative growth of the tree, thereby delaying the flower bud formation. Further flower bud in untopped trees might have differentiated earlier than the emergence of new shoots in topped trees. These findings are in conformity with the result obtained by Dhaliwal and Singh (2004). In control trees the number of flowers per shoot was maximum for the winter season 2012 while trees headed back at 1m height in April and May had minimum number of flowers per shoot (2.29) and (2.95) (Table 5).

The minimum number of flowers per shoot in headed back trees maybe due to the fact that as the heading back operation was performed in April and May this lead to profuse vegetative growth in the following month and the carbohydrates reserved for the next flowering season was utilized for the sprouting of lateral buds and growth of the shoots. The upright branches generally remain vegetative and vigorous. Horizontal branches are generally more fruitful. In headed back trees initially many tiller like upright shoots developed which utilized maximum nutrients that may have caused the delay in fruit bud differentiation. However, during second year trees pruned at 2m or 3m had numbers of flower than control trees. This is in accordance with findings of Dhaliwal *et al.,* (2000) in guava.

However, in the winter season crop 2013, maximum number of flower per shoot was observed in trees headed back at 2m height in April.

This might be due to the production of new fruiting shoots after heading back that might have lead to maximum number of flower per shoot. After 3 months of heading back, pruning (sub treatment) was performed on the headed back trees along with the no heading back trees. Maximum number of flowers per shoot was observed in the shoots which where pruned to 50% of its length and these trends were observed in all the season 2013 and rainy season of 2014. The interaction effect of treatment in pooled data showed that during both the year maximum number of flower per shoot was recorded in heading back at 3 month and 50% pruning of shoots showing the superiority of 50 % pruning over other pruning treatments. In absolute control trees (T_7S_1) the flower per shoot did not make much difference. Since flowering in guava occurs on current season growth, therefore pruning helped in getting new fruiting units and thus increases the number of flower per shoot. Similar findings were reported by Pilania *et al.,* (2010).

Fruit characteristics

Fruit set was observed maximum in T_2 (76.70 %), S_3 (79.79 %) and minimum in T_1 (67.31 %), S_5 (67.68 %) among the heading back and pruning respectively. In the interaction effect, maximum fruit set was recorded in T_5S_3 (83.47 %) which was found to be statistically on par with T_2S_3 (83.33 %), T_6S_3 (81.81 %) and T_4S_3 (80.04 %) while significantly minimum fruit set was recorded in T_1S_5 (55.76 %) (Table 6).

With regard to number of fruits per shoot, T_2 (43.10), S_3 (41.93) recorded maximum while T_1 (20.80) S_5 (30.44) recorded minimum among the heading back and pruning treatment respectively (Table 7 & 8). T_2S_3 recorded highest number of fruits per shoot (54.14) while T_1S_5 recorded lowest number of fruits per shoot (13.14) in the interaction effect.

Heading back in April followed by 50% pruning of 3 month shoot (T_2S_3) proved to be beneficial for increasing number of flowers per shoot (62.39), obtaining higher fruit set (83.33%) and higher number of fruits per shoot (54.14).

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