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Evaluation of physical characters of fruit, yield and cost economics under different crop regulation practices in Guava (*Psidium guajava* L.) Variety Sardar

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Abstract
A field experiment was carried out at KRC college of Horticulture, Arabhavi (Karnataka) during 2014-15 to study influence of pruning and different plant bio regulators in relation to physical characters of fruit, yield and cost economics of guava cv. Sardar. Different crop regulation practices like Pruning (P_2) and five bio regulators namely NAA 250ppm (T_2), Urea 15% (T_3), Ethrel 500ppm (T_4) and CCC 50ppm (T_5) were used at different concentrations, contributed favourable effects on fruit character, yield and B:C ratio. The maximum fruit length (7.13cm) and fruit weight (160.2g) were recorded in combination of pruning and ethrel treatment (P_2T_4). Fruit diameter (6.78cm) found maximum in combination of pruning and urea treatment (P_2T_3), higher fruit volume (165cc) was recorded in combination of pruning and cycocel treatment (P_2T_5). Less no. of seeds (180.75), less seed weight (2.91g) and where as maximum pulp weight (139.44g), pulp to seed ratio (48.76), yield (1.92 t/ha) and there by higher B:C ratio (1.71) were recorded in pruned plants with 250 ppm NAA treatment over control (P_1T_1).

Keywords: guava, crop regulation, pruning and bio regulators, fruit physical character, yield, cost economics

Introduction
Guava (*Psidium guajava* L.) belongs to the family Myrateace, is native of tropical America and is one of the most important tropical and subtropical fruit. In India, it is ranked as fifth major fruit after mango, banana, citrus and apple. Its cultivation in India is as early as 17th century (Mitra and Bose, 1990) [12]. In northern India, winter season crop is preferred because of its superior quality as compared to monsoon crop (Pandey *et al*., 1980) [15]. The orchardists suffer considerable financial loss due to the reduction in yield of marketable fruit on account of this malady. Moreover, rainy season fruits are small in size, inferior in quality due to temperature and humidity leads to highly susceptible to pest and disease infestation. Subsequent winter season crop load is also less and delayed ripening. The best remedy to this problem would be to eliminate the rainy season crop and thereby to induce a good winter crop. There were earlier works in this line by avoiding monsoon crop through half shoot pruning, hand deblossming, foliar sprays of urea and growth regulators at full bloom and pre bloom stages which correspondingly induce a reasonably good winter season crop (Singh *et al*., 1992; Lal *et al.*, 2000; Tiwari and Lal, 2007) [20, 11, 23-25]. The pruning of guava has not received much attention, when we see its economic importance, it can be justified. Lal (1983) [10] indicated that the yield of guava cv Sardar was improved by pruning. Urea or NAA or Ethephon has been applied to guava trees in a vigorous vegetative state of growth to change yield patterns (Shigeura *et al.*, 1975; Singh *et al.*, 1991) [18, 20] Keeping in view, the studies were thus planned to see the influence of pruning and spraying NAA, Urea, ethephon and Cycocel on inducing physical fruit character, yield and cost economics of guava.

Materials and Methods
The present investigation was conducted during the year 2014-2015 at Kittur Rani Channamma College of Horticulture, Arabhavi (University of Horticultural Sciences, Bagalkot), Gokak taluk of Belgaum district, Karnataka. The experimental material consisted of ten- year-old uniform trees of guava variety Sardar.

The treatment consisted of two pruning levels, *i.e*. no pruning (P_1), pruning (P_2) and five bio regulators treatment, *i.e*. control = T_1, NAA 250 ppm = T_2, Urea 15% = T_3, Ethrel 500 ppm = T_4 and Cycocel 50 ppm = T_5 all treatments were applied as foliar spray at 50% flowering stage. There were ten treatment combinations each replicated four times in factorial randomized block design. Shoot pruning of current season's growth was done at 10-20 cm of shoot length. It was performed in the first week of May. In order to study the Observations were recorded on yield/ ha in tonnes, average fruit weight, weight of pulp and weight of seeds in grams, length of fruit and diameter of fruit in centimetre. Fruit volume was determined by the conventional water displacement method of water displaced on immersion of the fruit and expressed in milli litre. Pulp to seed ratio was calculated by following formula:

$$\text{Pulp or seed per cent age} = \frac{\text{Pulp or seed weight per fruit}}{\text{Average fruit weight}} \times 100$$

Profitability of various treatments was also calculated. Statistical analysis was performed using web agri stat package (WASP) Version 2.0 (Jangam and Thali, 2010).

Results and Discussion

The results obtained from the present investigation are summarized below:

Effect of pruning and bio regulator treatment on physical fruit characters in guava (Table.1 & 2)

Data highlighted that pruning had significant effect on fruit length, fruit diameter and average fruit weight (Plate 1). The maximum average fruit length (6.11cm), fruit diameter (6.38 cm) and fruit weight (161.40 g) were noticed in pruned plants (P_2). The results obtained by Singh and Bal (2006) [21], Singh and Singh (2001) [19] in guava are in agreement with the results of present investigation.

Among bio regulator maximum value for fruit length (6.5 cm), fruit diameter (5.90 cm) and fruit weight (137.60 g) were noticed in T_4 treatment. Whereas interaction revealed that maximum values for fruit length (7.13 cm) and fruit weight (160.29 g) were noticed in P_2T_4, Increase in fruit size and weight may be attributed to the increased supply of nutrient and photosynthates to the developing fruits at the expense of restricted vegetative growth by ethrel (Brar *et al*. 2012) [5]. While maximum fruit diameter (6.78 cm) was noticed in P_2T_3 treatment.

The trend of results of present investigations with respect to fruit volume as influenced by pruning showed significant differences. The interpretation of results indicated that the fruit volume was considerably high (161.40) in pruned plants compared to unpruned plants. Pruning decreased the fruit load and as the number of fruits were less, the available food material reached the individual fruit in sufficient quantity (Naira and Moieza, 2013) [14].

With respect to bio regulator treatment, there was a significant effect observed. Maximum fruit volume of 163.13 was recorded in T_5. On contrary Jain and Dashora (2011) [7] reported higher fruit volume in PBZ and NAA treatments. The interaction effect revealed significant differences for fruit volume, high values for fruit volume (165.00) was recorded in P_2T_5 treatment combination.

Data highlighted that pruning had significant effect on number of seeds per fruit and seed weight. The maximum number of seeds per fruit (260.00) and seed weight (4.46g) was noticed in P_1 and minimum in P_2. Among bio regulator treatment the minimum seed number (227) and seed weight (3.67g) was observed in NAA treatment. Reduction in seed number in fruits treated with chemicals may be due to adverse effect on pollen germination on the stigma. On contrary Brar *et al.* (2012) [5] recorded minimum seeds in ethephon treatment. Whereas interaction revealed that maximum number of seeds per fruit (290.25) and seed weight (5.55g) recorded in control.

The maximum pulp weight and pulp to seed ratio as influenced by pruning was observed in P_2 (115.64 and 30.66) respectively. However, significantly maximum values for pulp weight (137.76) and pulp to seed ratio (39.80) as influenced by bio regulator recorded in NAA treatment compared to control. These results are in same line with Kundu and Mitra (1997) [9] who reported high pulp weight and pulp to core ratio compare to control. Agnihotri *et al*. (2013) [2] recorded high pulp to seed ratio in urea 15% treatment. Among the interaction, the maximum value for pulp weight (139.44g) and pulp to seed ratio (48.76) was observed with P_2T_2 treatment combination.

Effect of pruning and bio regulator treatment on yield and cost benefit ratio in guava (Table.3)

Pruning, bio regulators and their interaction had significant effect on yield per hectare. As compared to unpruned plants pruned plants got yield per hectare (1.52). This performance of plants may be because light pruning which might have increased the reproductive growth compared to unpruned plants which gave rise to more vegetative growth, Further there is possibility that the zone of flowering/fruiting buds in guava may be located at this length of shoot (10-15 cm from tip of shoot) thereby resulting in more flowering and fruit set in these plants.

Among the bio regulator treatment, highest yield per hectare (1.83) was recorded in T_2. Exogenous application of auxins maintains the ongoing physiological and biochemical functions which influence the pattern of organ differentiation that may change uptake translocation and accumulation of mineral nutrient in plant. Mohammed *et al*. (2006) [13], Abbas *et al* (2014) [1] also reported similar results.

Among interaction of pruning and bio regulator showed significant variation with respect to yield per hectare (1.92) was recorded in P_2T_2 plants which were highest compared to other treatment combinations. It may be due to the fact that control trees were exhausted because of heavy crop load during rainy season resulting into poor yield in winter (Tiwari and Lal, 2007) [23-25]. The findings of Tiwari *et al*. (1992) [26] have given support to the findings of this investigation. They reported that significantly higher yield in winter season (64.8 Kg) was recorded in the trees subjected to hand-deblossoming and it was followed by half-shoot pruning (54.0 kg) and 1000 ppm NAA (49.6 Kg). Serrano *et al.* (2008) [16] reported that the light pruning increased the number of productive branches and number of fruits per branch of guava cv. Paluma. Similar results were also given by Bajpai *et al.* (1973) [3], Gopikrishna (1979) [6] in guava.

The results of cost economics are furnished in Table 3 indicated that maximum net returns (9,943 Rs./ha) and B:C ratio (1.49) was recorded in pruned plants because of higher yield per plant and unit area. Minimum net profit and B:C ratio (7,055 Rs. /ha and 1.35 respectively) in not pruned plants due to lower yield compared to pruned pruned plants. Similar findings were also reported by Tiwari and Lal (2007)

[23-25], who reported that one leaf pruning is beneficial for regulating the crop in guava.

With respect to bio regulators, maximum Net returns and B:C ratio (14,945 Rs. /ha and 1.69 respectively) was recorded in NAA 250 ppm treated plants. These findings are in close conformity with the observations recorded by Tiwari and Lal (2007) [23-25], Sharma *et al.* (2013) [17] who reported that NAA 800ppm recorded higher net profit compared to control. Mohammed *et al.* (2006) [13] also reported maximum profit (Rs. 1,42,600/ha) was obtained with NAA 600 ppm followed by 15 per cent urea. The maximum net profit per plant due to crop regulation in NAA (200 ppm) was recorded by Bikash Das *et al.* (2007) [4].

The results of cost economics with respect to interaction, higher net returns and B:C ratio (16,033Rs. /ha and 1.71 respectively) was noticed in P_2T_2 treatment combination (Pruned plants treated with NAA 250ppm).

Plate 1: Effect of pruning and bio regulators on fruit characters of guava

Table 1: Effect pruning and bio regulator treatment on Physical characters of guava fruits

Treatments	Fruit weight (g)	Fruit diameter (cm)	Fruit length (cm)	Fruit volume (ml)
Pruning				
P_1 (No pruning)	111.09	4.89	5.55	143.25
P_2 (Pruning)	130.00	6.38	6.11	161.40
S.Em±	2.09	0.13	0.09	2.93
CD at 5%	6.05	0.38	0.27	8.51
Bio regulator treatments				
T_1 (Control)	91.52	5.00	5.05	141.63
T_2 (NAA 250 ppm)	127.54	5.79	6.04	150.62

T_3 (Urea 15%)	113.84	5.61	5.50	151.25
T_4 (Ethrel 500 ppm)	137.60	5.90	6.50	155.00
T_5 (Cycocel 50 ppm)	132.20	5.89	6.09	163.13
S.Em±	3.30	0.21	0.15	4.64
CD at 5%	9.57	0.60	0.42	13.46
Interactions				
P_1T_1	90.73	4.02	4.73	120.00
P_1T_2	113.91	5.49	6.00	137.50
P_1T_3	107.88	4.43	5.18	147.50
P_1T_4	114.90	5.22	5.85	150.00
P_1T_5	128.03	5.30	6.01	161.25
P_2T_1	92.32	5.99	5.37	163.25
P_2T_2	141.18	6.09	6.08	163.75
P_2T_3	119.82	6.78	5.82	155.00
P_2T_4	160.29	6.58	7.13	160.00
P_2T_5	136.37	6.47	6.17	165.00
S.Em±	4.67	0.29	0.21	6.56
CD at 5%	13.54	0.85	0.60	19.04
CV (%)	7.74	10.40	7.09	8.61

Pruning followed at 10-20 cm of shoot length

Table 2: Effect of pruning and bio regulators on seed number, seed weight and pulp weight of guava

Treatments	Number of seeds per fruit	Seed weight (g)	Pulp weight (g)	Pulp : seed ratio
Pruning				
P_1 (No pruning)	260.00	4.46	107.67	25.43
P_2 (Pruning)	244.10	4.05	115.64	30.66
S.Em±	2.06	0.11	1.88	0.90
CD at 5%	5.98	0.33	5.45	2.60
Bio regulator treatments				
T_1 (Control)	320.38	5.16	77.69	15.43
T_2 (NAA 250 ppm)	227.75	3.67	137.76	39.80
T_3 (Urea 15%)	239.38	4.50	98.79	22.15
T_4 (Ethrel 500 ppm)	233.88	4.26	133.10	31.81
T_5 (Cycocel 50 ppm)	238.88	3.68	110.92	31.04
S.Em±	3.26	0.18	2.97	1.42
CD at 5%	9.45	0.53	8.62	4.11
Interactions				
P_1T_1	290.25	5.55	72.78	13.15
P_1T_2	274.75	4.43	136.08	30.84
P_1T_3	228.75	4.58	96.20	21.18
P_1T_4	253.50	4.67	134.93	28.92
P_1T_5	252.75	3.05	98.35	33.08
P_2T_1	350.50	4.78	82.60	17.72
P_2T_2	180.75	2.91	139.44	48.76
P_2T_3	250.00	4.43	101.39	23.13
P_2T_4	214.25	3.85	131.27	34.69
P_2T_5	225.00	4.28	123.49	29.01
S.Em±	4.61	0.26	4.20	2.00
CD at 5%	13.37	0.74	12.19	5.82
CV (%)	3.66	12.04	7.53	14.30

Pruning followed at 10-20 cm of shoot length

Table 3: Calculation of cost economics of well-established guava orchard

Treatments	Yield / ha (tonnes)	Gross returns	Total cost of cultivation	Net returns	B:C ratio
Pruning					
P_1(No pruning)	1.34	26,800	19,745	7,055	1.35
P_2 (Pruning)	1.52	30,400	20,457	9,943	1.49
Bio regulator treatments					
T_1 (Control)	0.80	16,000	19,745	-3,745	0.81
T_2(NAA 250 ppm)	1.83	36,600	21,655	14,945	1.69
T_3 (Urea 15%)	1.62	32,400	22,082	10,318	1.47
T_4(Ethrel 500 ppm)	1.40	28,000	21,378	6,622	1.31
T_5(Cycocel 50 ppm)	1.47	29,400	20,732	8,668	1.42
Interactions					
P_1T_1	0.74	14,800	19,745	-4,945	0.75
P_1T_2	1.74	34,800	21,655	13,145	1.61
P_1T_3	1.40	28,000	22,082	5,918	1.27

P_1T_4	1.38	27,600	21,378	6,222	1.29
P_1T_5	1.41	28,200	20,735	7,465	1.36
P_2T_1	0.87	17,400	20,457	-3,057	0.85
P_2T_2	1.92	38,400	22,367	16,033	1.71
P_2T_3	1.83	36,600	22,794	13,806	1.61
P_2T_4	1.42	28,400	22,090	6,310	1.29
P_2T_5	1.54	30,800	21,444	9,356	1.44

Fruit selling price - Rs.20

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