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Growth, yield and quality of rejuvenated guava as influenced by thinning-bending and micronutrients

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ABSTRACT

A study was conducted during 2008-09 to understand the effect of thinning, bending and spray of micronutrients on rejuvenated guava (*Psidium guajava*) cv. Sardar. 50% thinning of the shoots (C_3) was superior to the rest of cultural practices and control in respect to growth, *i.e.*, diameter of the shoot (11.40 mm), canopy volume (370.39 m^3), relative growth of shoot at 75th, 105th and 135th days (41.90, 34.23 and 14.25% respectively), fruit yield (13.28 kg/plant), lowest number of the seeds (163.22), TSS (14%), total sugars (7.46%) and vitamin C content (238.33 mg/100 g pulp). Similarly, double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (S_2) also significantly increased diameter of one-year-old shoot (9.13 mm), canopy volume (321.15 m^3), relative growth of the shoot at 105th and 135th days (28.00% and 10.78%, respectively), fruit yield (12.63 kg/plant) and quality (TSS 13.20%, total sugars 6.98% and vitamin C content 239 mg/100 g pulp) over single spray and control. The interaction of cultural practices and spray of micronutrients were found to be superior over individual effect in rejuvenated guava. However, among all the interaction treatments maximum relative growth rate of the shoot at 135th days (13.98%), fruit retention (71.50%), fruit length (5.13 cm), fruit width (5.09 cm), fruit yield (14.02 kg/plant), size of seed cavity (2.53 cm) and minimum fruit drop (28.51%) and acidity (0.45%) were recorded in 50% thinning + double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (C_3S_2).

Key words: Bending, guava rejuvenation, thinning, yield.

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the most exquisite and valuable fruits of the tropics. Over the year, productivity of guava continues to be low. There are various limiting factors related to production and productivity of the guava and one of them is poorly managed declining old and senile orchards. Thickly shaded, wilt affected and stem borer infested guava orchards are commonly seen in different parts of country. Due attention is required for developing and deploying appropriate technology to manage such senile orchards in order to attain the competitive edge in commercial production and to meet the quality standards of the conscious consumers. Pruning of branches at different intensity is recommended for the rejuvenation of the old and senile orchards. Pruning also helps in maintaining tree height with open architecture and canopy of healthy shoots with outwardly growth facilitating penetration and utilization of light (Singh *et al.*, 14). After heading back of the main stem of the old plants there would be emergence of more number of new shoots that causes competition among shoots for space, light, nutrition and growth. If all the shoots are allowed to grow, the basic purpose of rejuvenation would get defeated. This would lead to dense and bushy canopy of unhealthy shoots with poor bearing potential therefore, selective and regular thinning of shoots is essential for facilitating development of spreading canopy of healthy shoots. Further, bending of some erect growing shoots results increased flower bud formation beyond the bend as restricts the movement of carbohydrates. It increases fruit yield and encouraging fruit set on lower part of tree and control vegetative shoot growth and also increase physico-chemical characteristics of guava fruits (Sarkar *et al*., 9; Shukla *et al*., 12). Further, application of micronutrient also influences the growth, yield and quality of fruit plants. Keeping above in view the present investigation growth, yield and quality of rejuvenated guava as influenced by thinning-bending and micronutrients was conducted.

MATERIALS AND METHODS

The experiment was conducted during 2008-09, on uniform 40-year-old plants of cv. Sardar guava planted at the spacing of 6 m × 6 m and head back at the height of 1.2 m above the ground level at Horticulture Farm of the Maharana Pratap University of Agriculture & Technology, Udaipur, which is situated at 24°34' N latitude and 73°42' E longitude at an

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elevation of 582.17 m above mean sea level. The region falls under agro-climatic Zone IV A (Sub-humid southern plains and Aravali hills) of Rajasthan. There were four cultural practices namely without bending of the shoots (C_0), bending of the shoots (C_1), 25% thinning of the shoots (C_2) and 50% thinning of the shoots (C_3) and three schedules for spray of micronutrients (Zn 0.5%, B 0.2% and Mn 0.1%), *i.e.*, without spray control (S_0), single spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August (S_1) and double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (S_2) were applied alone and in combination. The experiment was laid out in factorial randomized block design with three replications and two plants in each treatment. Standard uniform cultural practices were adopted, *i.e.*, ploughing of orchard with the help of Mitsubishi power tiller in the month of June and application of recommended dose of nutrients at the rate of 50 kg FYM, 460 g N, 440 g P_2O_5 and 720 g K_2O / plant through DAP (34.78 kg), urea (23.71 kg) and MOP (43.2 kg) respectively. After application of organic and inorganic fertilizers a light irrigation was given. Canopy volume (m^3) was calculated as the method described by the Samaddar and Chakrabarti (8). Light interception and LAI were measured between 10 to 12 AM by canopy analyzer (LP80) under natural radiation. Total number of flowers which set into fruits was counted and per cent fruit set was calculated. The per cent fruit retention was calculated on the basis of initial fruit set and fruit reaches to maturity. Diameter of the one-year-old branch, fruit diameter, polar and equatorial was taken with the help of Vernier callipers. Average fruit weight was recorded with the help of electronic balance and fruit quality (TSS, sugars, acidity and vitamin C) attributes were analyzed as per prescribed standard methods (AOAC, 1).

RESULTS AND DISCUSSION

Among various cultural practices 50% thinning of the shoots (C_3) significantly increased relative growth rate of shoot (41.90, 34.23, and 14.25% at 75th, 105th and 135th days respectively), diameter of one-year-old branch (11.40 mm), canopy volume (370.39 m^3), light interception (229.67 Lux) and LAI (2.80) as compared to other cultural practices (Table 1). However, spray of micronutrients Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (S_2) effectively increased diameter of shoot (9.13 mm), canopy volume (321.15 m^3), relative growth of the shoot, light interception and LAI as compared to control. Further, interaction of cultural practices and spray of micronutrients were found to be quite superior to their individual effect particularly with regard to relative growth at 135th days, light interception and LAI (Table 1). Maximum relative growth of shoot at 135th days (13.98%) was recorded in 50% thinning + Double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (C_3S_2). Treatment combination of C_3 S_1, C_3 S_2, C_3 S_0 were found statistically non significant with each other, further, maximum LAI (2.81) was noticed in C_3 S_0. However, treatment combination C_3 S_0, C_3 S_1, C_3 S_2 were found statistically non significant with each other. Better response of thinning of shoots may be due to reduced undesirable competition among shoots for space, light, nutrition and growth. This is in accordance with findings of Bal *et al.* (3) in *ber*, and Pilania *et al.* (7) in guava. The favourable influence of applied micronutrients on relative growth rate of shoots (105 and 135th days after thinning), tree spread, diameter of one-year-old branch, canopy volume and light interception may be due to its catalytic or stimulatory effect on most of the physiological and metabolic processes of plants. Zn + B + Mn are also essential component of enzymes responsible for carbohydrates and nitrogen metabolism, thereby resulting in to increased uptake of nitrogen by the plant. Results are in the conformity with the findings of the Shukla *et al.* (13).

Fifty per cent thinning of the shoots (C_3) gave good response in respect of flowering and yield attributes (Table 2). This treatment resulted early flowering (32.33 days taken to 50% flowering), increased fruit set (55.95%), fruit retention (70.90%), maximum fruit size (4.89 × 4.84 cm), fruit weight (107.40 g), fruit yield/plant (13.28 kg) and estimated yield/ha (34.70 q), while fruit drop decreased significantly. Double sprays of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (S_2) significantly improved yield attributes and reduced fruit drop over control (Table 2). However, combined application of cultural practices and spray of micronutrients significantly influence fruit drop, fruit retention, fruit size, yield/plant, estimated yield/ha. Fifty per cent thinning of the shoots + double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (C_3S_2) significantly increase fruit retention (71.50%), fruit length (5.13 cm), fruit width (5.09 cm), fruit yield/ plant (14.02 kg) and estimated yield/ha (38.98 q) and reduced fruit drop. Opening of the plant canopy created favourable condition for growth of plant which has directly correlated with flowering and yield attributes of the plant and simultaneously reduced undesirable competition of shoots for light, space and nutrition. More healthy vegetative growth might have augmented high photosynthesis, respiration. Synthesis of more carbohydrate required for fruit growth, increase in vegetative growth resulted in production of more

Table 1. Effect of cultural practices and micronutrients sprays and their interaction on growth, light interception and leaf area index.

Treatment	Diameter of one year old shoot (mm)	Canopy volume (m^3)	Light interception (Lux)	LAI	Relative growth of the shoot (%)		
					75th Day	105th Day	135th Day
Cultural practice							
C_0	7.47	200.43	127.67	1.91	33.75 (35.52)	23.60 (29.07)	8.50 (16.94)
C_1	7.70	202.34	145.50	2.15	32.20 (34.57)	21.70 (27.77)	7.08 (15.43)
C_2	8.83	354.77	210.33	2.69	38.76 (38.51)	33.51 (30.51)	11.15 (19.50)
C_3	11.40	370.39	229.67	2.80	41.90 (40.35)	34.23 (35.81)	14.25 (21.17)
CD (p = 0.05)	0.386	45.132	3.587	0.032	0.266	0.144	0.057
Micronutrient spray							
S_0	8.38	248.12	173.25	2.37	36.87 (37.39)	26.10 (30.73)	8.90 (17.36)
S_1	9.03	276.68	179.88	2.38	36.40 (37.11)	27.96 (31.93)	9.82 (18.26)
S_2	9.13	321.15	181.75	2.40	36.60 (37.22)	28.00 (31.96)	10.78 (19.17)
CD (p = 0.05)	0.335	39.086	3.106	NS	NS	0.125	0.049
C_0S_0	7.26	191.78	125.00	1.82	34.41(35.89)	22.66(28.40)	7.15(15.51)
C_0S_1	7.53	182.98	128.00	1.95	33.36 (35.28)	24.10 (29.40)	8.72(17.12)
C_0S_2	7.62	226.54	130.00	1.96	33.52 (35.38)	24.10 (29.40)	9.75 (18.20)
C_1S_0	7.43	185.56	134.00	2.13	32.07 (34.49)	20.50 (26.92)	6.84 (15.16)
C_1S_1	7.79	187.89	147.50	2.20	32.40 (34.70)	22.27 (28.16)	7.11 (15.35)
C_1S_2	7.87	233.57	155.00	2.11	32.10 (34.51)	22.37 (28.22)	7.40 (15.79)
C_2S_0	8.52	297.71	206.00	2.74	39.26 (38.78)	29.09 (32.60)	9.98 (18.42)
C_2S_1	8.97	353.44	213.00	2.60	38.08 (38.11)	31.20 (33.96)	11.00 (19.37)
C_2S_2	9.00	413.16	212.00	2.73	39.00 (38.65)	31.20 (33.96)	12.52 (20.72)
C_3S_0	10.31	317.43	228.00	2.81	42.05 (40.39)	32.89 (35.00)	12.08 (20.34)
C_3S_1	11.85	382.40	231.00	2.78	41.90 (40.33)	34.89 (36.19)	13.09 (21.21)
C_3S_2	12.04	411.33	230.00	2.80	41.90 (40.33)	34.97 (36.25)	13.98 (21.95)
CD (p = 0.05)	NS	NS	6.213	0.056	NS	NS	0.099

C_0 Without bending of shoots, C_1 bending of shoots, C_2 25% thinning of shoots, C_3 50% thinning of shoots, S_0 control (no spraying), S_1 single spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August, S_2 double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October.

food material, which in turn may have been utilized for better development of fruits. Results are in the accordance with Shinde *et al.* (11) in mango cv. Alphonso, Bal *et al.* (3) in *ber*, and Pilania *et al.*(7) in guava. Further, spray of micronutrients reduced fruit drop and increased fruit retention this might be because zinc play an important role in biosynthesis of IAA. Findings are in conformity with El-Sherif *et al.* (4). A direct relationship between vegetative growth and size, weight and yield of fruits is well established fact and conformed by Lal *et al*. (6).

Physico-chemical characteristics of guava fruit significantly influences by cultural practices and spray of the micronutrients. Among the cultural practices 50% thinning of the shoots resulted maximum pulp thickness (1.2 cm), size of seed cavity (2.44 cm), TSS (14.00), total sugars (7.46%), and vitamin C (238 mg/100 g), low seed index (1.99 g), lower number of seed/fruit (163.22) and low acidity (0.46%). Spray of micronutrients had also significant effect on physio-chemical characteristics of guava fruit. Double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October (S_2) improved the quality of the fruit. However, S_2 and S_1 were found to be at par with each other in respect to seed index, size of seed cavity, number of seed per fruit

Table 2. Effect of cultural practices and micronutrients sprays and their interaction on days taken to flowering, fruit set, fruit retention, fruit drop, fruit size and fruit yield.

Treatment	Day taken to 50% flowering	Fruit set (%)	Fruit drop (%)	Fruit retention (%)	Fruit size (length × width) cm	Fruit weight (g)	Yield/ plant (kg)	Yield/ ha. (q)
Cultural practice								
C_0	38.89	43.73 (41.40)	42.60 (40.75)	57.40 (49.25)	3.97 × 3.92	90.82	9.88	27.47
C_1	37.33	53.10 (46.78)	34.95 (36.24)	65.05 (53.76)	4.31 × 4.27	100.94	12.32	34.26
C_2	34.22	55.15 (47.96)	33.87 (35.59)	66.10 (54.40)	4.40 × 4.34	101.50	12.48	34.70
C_3	32.33	55.95 (48.42)	29.10 (32.64)	70.90 (57.36)	4.89 × 4.84	107.40	13.28	36.92
CD (p = 0.05)	0.797	0.343	0.173	0.175	0.037 × 0.025	1.318	0.148	0.410
Micronutrients spray								
S_0	36.17	51.62 (45.94)	37.16 (37.56)	62.85 (52.45)	4.15 × 4.09	96.58	11.13	30.95
S_1	35.42	52.04 (46.17)	35.38 (36.49)	64.63 (53.51)	4.48 × 4.44	101.46	12.21	33.95
S_2	35.50	53.30 (46.31)	32.70 (34.87)	67.30 (55.13)	4.55 × 4.51	102.46	12.63	35.12
CD (p = 0.05)	NS	NS	0.150	0.152	0.032 × 0.021	1.141	0.128	0.355
C_0S_0	38.67	41.28	45.00 (42.13)	55.00 (47.87)	3.92 × 3.84	87.33	8.89	24.71
C_0S_1	39.00	41.56	42.94 (40.94)	57.06 (49.06)	3.98 × 3.93	92.00	10.05	27.94
C_0S_2	39.00	41.37	39.91 (39.18)	60.09 (50.82)	4.02 × 3.99	93.13	10.70	29.75
C_1S_0	38.00	46.37	37.71 (37.89)	62.29 (52.11)	4.06 × 4.00	97.00	11.67	32.43
C_1S_1	37.00	46.72	35.29 (36.44)	64.71 (53.56)	4.41 × 4.39	102.83	12.47	34.66
C_1S_2	37.00	47.23	31.90 (34.39)	68.10 (55.61)	4.47 × 4.43	102.98	12.84	35.70
C_2S_0	35.00	47.77	36.20 (36.99)	63.80 (53.01)	4.10 × 4.05	98.33	11.72	32.58
C_2S_1	33.67	47.94	34.78 (36.14)	65.22 (53.86)	4.51 × 4.45	103.00	12.76	35.47
C_2S_2	34.00	48.17	30.70 (33.65)	69.30 (56.33)	4.59 × 4.51	103.17	12.97	36.05
C_3S_0	33.00	48.33	30.00 (33.21)	70.00 (56.79)	4.53 × 4.45	103.63	12.25	34.06
C_3S_1	32.00	48.44	28.77 (32.44)	71.23 (57.56)	5.01 × 4.97	108.00	13.57	37.72
C_3S_2	32.00	48.47	28.50 (32.27)	71.50 (57.74)	5.13 × 5.09	110.57	14.02	38.98
CD (p = 0.05)	NS	NS	0.300	0.303	0.064 × 0.043	NS	0.256	0.710

C_0 Without bending of shoots, C_1 bending of shoots, C_2 25% thinning of shoots, C_3 50% thinning of shoots, S_0 control (no spraying), S_1 single spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August, S_2 double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October.

and total sugar content of guava (Table 3). Among the treatment combinations 50% thinning + double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) ($C_3S_{2)}$, was superior with regard to size of seed cavity (Table 3). However, C_3S_2 and C_3S_1 were at par with each other. The possible explanation for the increased pulp thickness and seed cavity with 50% thinning of the shoots (C_3) might be due to higher fruit weight and size. Similarly, chemical characters (TSS, vitamin C and total sugars) were also significantly increased by thinning treatment. Thinning treatment resulted in to better exposure of shoots to light and presumably accumulates more carbohydrate. The findings of present study are in accordance with Sharma *et al*. (10), and Babu and Yadav (2). Kavitha *et al*. (5) also supported the present study for the increased pulp thickness and cavity index in papaya fruit with combined application of Zn + B.

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Table 3. Effect of cultural practices and micronutrients sprays and their interaction on physico-chemical characteristics of fruits.

Treatment	Pulp thickness (cm)	Seed index (g)	Size of seed cavity (cm)	No. of seeds/fruit	TSS (%)	Total sugars (%)	Acidity (%)	Vitamin C (mg/100 g)
Cultural practice								
C_0	0.85	2.24	2.32	184.11	12.09	6.23	0.47	212.33
C_1	1.03	2.10	2.23	212.56	13.20	7.05	0.50	233.00
C_2	1.08	2.04	2.21	208.78	12.40	6.85	0.51	227.33
C_3	1.20	1.99	2.44	163.22	14.00	7.46	0.46	238.33
CD (p = 0.05)	0.035	0.037	0.047	10.302	0.163	0.161	0.004	3.026
Micronutrients spray								
S_0	0.98	2.15	2.22	182.92	12.65	6.79	0.52	215.50
S_1	1.05	2.07	2.35	195.75	12.92	6.92	0.48	228.75
S_2	1.09	2.06	2.33	197.83	13.20	6.98	0.45	239.00
CD (p = 0.05)	0.030	0.032	0.041	8.921	0.141	0.139	0.003	2.621
C_0S_0	0.80	8.22	2.48	159.00	12.00	6.11	0.51	202.00
C_0S_1	0.85	7.91	2.27	195.33	12.07	6.21	0.45	210.00
C_0S_2	0.90	7.85	2.21	198.00	12.20	6.37	0.45	225.00
C_1S_0	1.00	7.74	2.03	208.33	12.80	6.98	0.51	218.00
C_1S_1	1.02	7.42	2.36	211.67	13.20	7.02	0.51	235.00
C_1S_2	1.07	7.37	2.31	217.67	13.60	7.14	0.47	246.00
C_2S_0	1.00	7.51	2.08	203.33	12.00	6.79	0.58	216.00
C_2S_1	1.10	7.21	2.28	212.33	12.40	7.05	0.51	228.00
C_2S_2	1.14	7.19	2.27	210.67	12.80	6.72	0.45	238.00
C_3S_0	1.10	7.26	2.29	161.00	13.80	7.29	0.48	226.00
C_3S_1	1.24	7.06	2.51	163.67	14.00	7.39	0.45	242.00
C_3S_2	1.26	7.02	2.53	165.00	14.20	7.71	0.45	247.00
CD (p = 0.05)	NS	NS	0.082	NS	NS	NS	0.007	NS

C_0 Without bending of shoots, C_1 bending of shoots, C_2 25% thinning of shoots, C_3 50% thinning of shoots, S_0 control (no spraying), S_1 single spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August, S_2 double spray of Zn (0.5%) + B (0.2%) + Mn (0.1%) in the month of August and October.

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