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Effect of different crop regulation methods on vegetative attributes of guava (*Psidium guajava* L.) cv. G-27

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Abstract
A crop regulation study was carried out on six- seven year old orchard of guava cv. G-27 during 2020-2021 and 2021-2022 to evaluate the effect of different crop regulation methods on vegetative characteristics. The experiment was laid out in Randomized Block Design comprised of 16 treatments with three replication consisting of foliar spray of KI (0.5%, 0.75% and 1.0%), NAA (400 ppm, 600 ppm and 800 ppm), ethephon (600 ppm, 800 ppm and 1800 ppm), bending of lateral branches with partial removal of old leaves (Mid-April, Mid-May and Mid-June) and pruning of shoot with complete removal of old leaves (up to 15 cm, up to 30 cm and up to 45 cm) and water spray as control. The result indicated that all the treatment were effective in summer deblossoming and improve vegetative characters in rainy season during both the year as well as pooled data as compared to control. Among the treatments, bending in Mid-June was recorded minimum days taken to sprouting of new shoots (13.17 days), minimum days taken to emergence of new leaves (15.17 days) and maximum shoot length (7.24, 18.41 and 35.87 cm) at 30, 60 and 90 DAT followed by bending in Mid-May in pooled data.

Keywords: Guava, crop regulation, KI, NAA, ethephon, bending and pruning

Introduction
Guava (*Psidium guajava* L.) is the fifth most important fruit crop of India after Mango, Banana, Papaya and Citrus as well as a popular fruit crop of tropical and subtropical areas of the world. It is easily available with reasonable price thus, named as "apple of tropics" and due to its rich nutritional values it is also consider as "super fruit" (Nimisha *et al*., 2013) [7].

India rank first in production of guava which comprises about 45.22% of the world production. Area of guava in India is 265,000 ha in which production of 40, 54,000 MT of guava. In India, Madhya Pradesh produce about 6, 86,700 MT of guava from area 35,080 ha with productivity of 19.58 MT/ha which rank 2nd just after Uttar Pradesh which has production of 928440 MT from 49530 ha area with productivity of 18.75 MT/ha (Anonymous, 2018) [2]. The fruits of guava are rich source of vitamin-C, pectin and fibre. It contains water (77.9-86.9%), TSS (9.73^{o} Brix), Ash (0.51-1.02%), vitamin-C (75.2 to 234.3 mg/100g), Acidity (0.22 to 0.39%), thiamin (0.03 to 0.007) and crude protein (0.82 to 1.45 g/100 g pulp).

Guava is an evergreen shallow-rooted shrub and small tree spreading up to 4-10 meter in height having branches close to the trunk with smooth, greenish or reddish brown bark peeling annually in thin flakes. The newly shoots are square in cross section and pubescent. Leaves are opposite, oval almost sessile and light green in colour. Veins of guava are prominent on soft under surface and markedly depressed on upper surface. However, the density and activity of feeder roots decrease with an increase in distance from 120 cm to 360 cm from tree trunk.

In sub-tropical conditions of India there are two major flowering seasons, one during March - April (Ambe bahar), the fruits are harvested in rainy season *i.e.* July - August and second flowering season comes in June – July (mrig bahar) and the fruits are harvested during winter season *i.e*. October to March (Singh, 2007). The fruit of rainy season crop are usually insipid and poor in quality also attacked by many insect pests and diseases and such fruits are not fit for marketing and ultimate consumption. On the other hand, winter season crop fetches higher price because supply is less and demand is more in the market as compared to rainy season crop (Lal *et al*., 2000) [4].

The flowering of guava should be regulated in such a way that only best quality fruits can be harvested during the winter season, as the winter season crop is superior in quality, free from pests and diseases and fetches higher profits and also extends the period of harvesting *i.e.* from October to March. In guava crop regulation has been achieved by various methods *i.e.* use of chemicals, different PGR's, shoot pruning and bending of lateral shoots, manual removal of flower buds, withholding irrigation and exposure of roots.

Bending of lateral branches in guava is one of the most important and economical practices for crop regulation. Bending of lateral branches of guava improves various vegetative parameters during rainy season. The most suitable time of bending for producing better quantity and quality of guava during mrig bahar is reported in May to June month under sub-tropical region. Bending induces profuse flowering and fruiting as well as fetches greater return in guava (Ghosh, 2003) [3].

Methods and material

The experiment was laid out in the field of Horticulture Research Orchard, Department of Horticulture, College of Agriculture, RVSKVV, Gwalior (M.P.) during 2020-2021 and 2021-2022. In this experiment comprised of 16 treatments consisting of foliar spray of KI, NAA, ethephon, different bending months with partial removal of old leaves and different pruning level with complete removal of old leaves of the shoot with one control *viz*. T_0 (without any treatment), T_1 (0.5% KI), T_2 (0.75% KI), T_3 (1% KI), T_4 (400 ppm NAA), T_5 (600 ppm NAA), T_6 (800 ppm NAA), T_7 (600 ppm Ethephon), T_8 (1200 ppm Ethephon), T_9 (1800 ppm Ethephon), T_{10} (Bending of lateral branches with partial removal of old leaves in mid-April), T_{11} (Bending of lateral branches with partial removal of old leaves in mid-May), T_{12} (Bending of lateral branches with partial removal of old leaves in mid-June), T_{13} (15 cm shoot pruning with complete removal of old leaves), T_{14} (30 cm shoot pruning with complete removal of old leaves) and T_{15} (45 cm shoot pruning with complete removal of old leaves). Water soluble chemical and PGR's *viz;* KI, ethephon were sprayed with water and NAA was sprayed after dissolving in alcohol and after making solution of respective concentration. The experiment was laid out in randomized block design with three replications. Observations were recorded using standard procedure and statistically analyzed.

Days taken to sprouting of new shoots

The days taken for sprouting of new shoots were counted from the each treatment.

Day taken to emergence of new leaves

The days taken for emergence of new leaves were counted from the each treatment.

Shoot length (cm) at 30, 60 and 90 DAT

Newly five initiated shoots from current season growth were randomly selected and tagged for measuring the shoot length. The length of these shoots was measured after treatment application and then periodical observation at 30 days interval for a period of 90 days with the help of measuring scale.

Result

Days taken to sprouting of new shoots

By interpretation of data which is presented in table 1 indicates that significantly differ due to treatments as compared to control. It is implicated that among all the treatments, minimum days taken to sprouting of new shoots was recorded under treatment of bending in Mid-June (13.17 days), which was recorded significantly lower followed by bending in Mid-May (14.83 days) as compared to other treatments in pooled data.

Table 1: Effect of different methods of crop regulation on days taken to sprouting of new shoots of guava

Treatments	Days taken to sprouting of new shoots		
	I Year	II Year	Pooled
Control	28.67	27.67	28.17
KI 0.5%	25.33	24.67	25.00
KI 0.75%	23.33	23.00	23.17
KI 1%	20.33	20.00	20.17
NAA 400 ppm	26.33	25.67	26.00
NAA 600 ppm	24.33	24.00	24.17
NAA 800 ppm	22.33	21.67	22.00
Ethephon 600 ppm	25.67	25.00	25.33
Ethephon 1200 ppm	24.33	23.67	24.00
Ethephon 1800 ppm	21.00	20.33	20.67
Bending in mid-April	18.67	18.00	18.33
Bending in mid-May	15.00	14.67	14.83
Bending in mid-June	13.33	13.00	13.17
Pruning up to 15 cm	16.00	15.67	15.83
Pruning up to 30 cm	17.33	17.00	17.17
Pruning up to 45 cm	19.00	18.67	18.83
S.E.(m) d ±	0.814	0.513	0.481
C.D. (at 5%)	1.662	1.048	0.962

Days taken to emergence of new leaves

A perusal of flushing data presented in Table 2 Showed the significant decreasing days taken to emergence of new leaves as compared to control. Among all the treatments, minimum days taken to emergence of new leaves was recorded under bending in Mid-June (15.17 days), which was recorded significantly lower followed by bending in Mid-May (16.83 days) over the other treatments in pooled data.

Table 2: Effect of different methods of crop regulation on days taken to emergence of new leaves of guava

Treatments	Days taken to emergence of new leaves		
	I Year	II Year	Pooled
Control	31.67	30.67	31.17
KI 0.5%	28.33	27.67	28.00
KI 0.75%	26.33	26.00	26.17
KI 1%	22.67	22.00	22.33
NAA 400 ppm	29.33	28.67	29.00
NAA 600 ppm	27.33	27.00	27.17
NAA 800 ppm	24.33	23.67	24.00
Ethephon 600 ppm	28.67	28.00	28.33
Ethephon 1200 ppm	27.33	26.67	27.00
Ethephon 1800 ppm	23.00	22.33	22.67
Bending in mid-April	21.67	21.00	21.33
Bending in mid-May	17.00	16.67	16.83
Bending in mid-June	15.33	15.00	15.17
Pruning up to 15 cm	18.33	17.67	18.00
Pruning up to 30 cm	19.33	19.00	19.17
Pruning up to 45 cm	22.00	21.67	21.83
S.E.(m) d ±	0.596	0.614	0.428
C.D. (at 5%)	1.218	1.254	0.856

Shoot length (cm) at 30, 60 and 90 DAT

A perusal of flushing data presented in Table 3 to 5 showed the significant improvement shoot length as compared to control. Among all the treatments, bending in Mid-June was recorded highest shoot length (7.24, 18.41 and 35.87 cm) at 30, 60 and 90 DAT which was significantly highest, followed by bending in Mid-May (7.15, 18.22 and 34.69 cm) than the recorded as compared to other treatments in pooled analysis, respectively.

Table 3: Effect of different methods of crop regulation on shoot length (cm) at 30 DAT of guava

Treatments	Shoot length (cm) at 30 DAT		
	I Year	II Year	Pooled
Control	4.04	4.38	4.21
KI 0.5%	5.05	5.09	5.07
KI 0.75%	5.51	5.57	5.54
KI 1%	6.08	6.10	6.09
NAA 400 ppm	4.50	4.56	4.53
NAA 600 ppm	5.18	5.23	5.21
NAA 800 ppm	5.70	5.76	5.73
Ethephon 600 ppm	4.88	4.91	4.89
Ethephon 1200 ppm	5.40	5.46	5.43
Ethephon 1800 ppm	5.90	5.98	5.94
Bending in mid-April	6.69	6.77	6.73
Bending in mid-May	7.10	7.20	7.15
Bending in mid-June	7.18	7.30	7.24
Pruning up to 15 cm	6.82	6.96	6.89
Pruning up to 30 cm	6.74	6.77	6.75
Pruning up to 45 cm	6.11	6.15	6.13
S.E.(m) d ±	0.053	0.087	0.051
C.D. (at 5%)	0.108	0.177	0.102

Table 4: Effect of different methods of crop regulation on shoot length (cm) at 60 DAT of guava

Treatments	Shoot length (cm) at 60 DAT		
	I Year	II Year	Pooled
Control	14.83	14.79	14.81
KI 0.5%	16.10	16.13	16.11
KI 0.75%	16.72	16.77	16.74
KI 1%	17.13	17.18	17.16
NAA 400 ppm	15.23	15.27	15.25
NAA 600 ppm	16.22	16.34	16.28
NAA 800 ppm	16.82	16.82	16.82
Ethephon 600 ppm	15.71	15.72	15.72
Ethephon 1200 ppm	16.32	16.37	16.35
Ethephon 1800 ppm	16.98	17.05	17.02
Bending in mid-April	17.82	17.84	17.83
Bending in mid-May	18.22	18.21	18.22
Bending in mid-June	18.42	18.40	18.41
Pruning up to 15 cm	18.12	18.15	18.13
Pruning up to 30 cm	17.89	17.95	17.92
Pruning up to 45 cm	17.57	17.63	17.60
S.E.(m) d ±	0.079	0.058	0.049
C.D. (at 5%)	0.162	0.118	0.098

Table 5: Effect of different methods of crop regulation on shoot length (cm) at 90 DAT of guava

Treatments	Shoot length (cm) at 90 DAT		
	I Year	II Year	Pooled
Control	26.12	25.95	26.03
KI 0.5%	28.65	28.71	28.68
KI 0.75%	31.08	31.13	31.11
KI 1%	32.78	32.68	32.73
NAA 400 ppm	27.42	27.52	27.47
NAA 600 ppm	29.56	29.55	29.56
NAA 800 ppm	31.52	31.61	31.56
Ethephon 600 ppm	28.11	28.14	28.12
Ethephon 1200 ppm	30.19	30.32	30.25
Ethephon 1800 ppm	32.11	32.23	32.17
Bending in mid-April	33.81	33.62	33.71
Bending in mid-May	34.64	34.75	34.69
Bending in mid-June	35.79	35.95	35.87
Pruning up to 15 cm	33.93	34.23	34.08
Pruning up to 30 cm	33.58	33.66	33.62
Pruning up to 45 cm	33.08	33.16	33.12
S.E.(m) d ±	0.106	0.062	0.062
C.D. (at 5%)	0.217	0.127	0.123

Discussion

A perusal of the data reveals that vegetative parameters of the crop as judged by significantly decrease in the days taken to sprouting of new shoots and days taken to emergence of new leaves and significantly increase in the shoot length by KI, NAA, ethephon, bending of lateral branches and pruning over control.

Among all the treatments, bending in mid-June was recorded significantly better all the vegetative parameters *viz.*, days taken to sprouting of new shoot, days taken to emergence of new leaves and shoot length at 30, 60 and 90 DAT as compared to other treatments of KI, NAA, ethephon, bending and pruning. The reason behind this may be that due to bending of lateral branches along with partial removal of old leaves consequence canopy structure changed that resulted in high penetration and interception of sunlight to the different plant parts thus improving photosynthetic activity of plant and also shift in secondary metabolites and photosynthetic compound from the rainy season to the winter season and thus increase in vegetative parameters. Similar result was also observed by Sarkar and Ghosh (2006), Aly *et al.* (2012), Nandi *et al.* (2017), Samant *et al.* (2016) and Mishra (2020) [9, 1, 6, 8, 5].

Conclusion

The investigation revealed that crop regulation by using various methods like application of KI, NAA, ethephon, bending and pruning resulted significant effect in various vegetative parameters. By analyzing all the data it can be concluded that bending of lateral branches in Mid-June with partial removal of old leaves was found to be most effective crop regulation method which decreased the days taken to sprouting of new shoots as well as decrease days taken to emergence of new leaves and increase in shoot length during rainy season.

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