The Pharma Innovation Journal 2022; 11(7): 3411-3413

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 3411-3413

www.thepharmajournal.com
Received: 11-04-2022
Accepted: 29-06-2022

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Effect of plant growth regulators on plant growth and establishment of Guava (*Psidium guajava* L.) cv. Chittidar

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Abstract
An experiment was conducted at Horticulture Research Farm, Department of Horticulture, Sam Higgibottom University of Agriculture Technology and Science, Prayagraj, to observe the effect of plant growth regulators (PGRs) on growth and establishment of guava var. 'Chittidiar'. The experiment was laid out in Randomized Block Design (RBD) with three replications. Results revealed that among the attempted treatments, the application T_7 GA3 @ 150 ppm significantly influenced the vegetative growth attributes such as plant height (96.75cm), number of leaves per plant (122.64), number of branches per plant (12.70), stem girth (cm) (4.60), plant spread (cm) (E-W), plant spread (cm) (N-S) (40.21), leaf area (cm^2) (36.80) and chlorophyll content (SPAD) (73.10). This treatment also positively influenced the survival percentage (73.10) of guava plants.

Keywords: PGRs, vegetative growth, survival percent, Guava, *Psidium guajava* L.

Introduction
Guava (*Psidium guajava* L.) is one of most important fruit crops of the tropics and sub-tropics parts of the world (NHB Database 2021) [4]. It belongs to the family 'Myrtaceae'. Guava is often referred as the 'Apple of tropics' for its nutritive value (Singh 2001; APEDA Database 2021) [10, 1]. Guava (*Psidium guajava* L.), a "poor man's fruit" belongs to tropical and subtropical climate. The genus, Psidium contains 150 species, most of which are fruit bearing trees. The basic chromosomal number of guava is 2n=11. Most of the cultivars are diploid (2n=22), but some are natural and artificial triploids (2n=33), these generally produce seedless fruits (Jaiswal and Nasim, 1992) [5]. Guava is classified under genus Psidium, which encompasses 150 species but only *Psidium guajava* has been exploited commercially in terms of commercial success. India is the leading producer of guava in the world and it shares about 45% of total production of guava in the world.

The leading guava producing states in India are Madhya Pradesh, Uttar Pradesh, Maharashtra, Bihar, West Bengal, Gujarat and Karnataka (NHB Database 2021) [4]. Guava has earned the popularity as "Poor man's apple" available in plenty to every person at very low price during the season. It is no inferior to apple for its nutritive values. Besides, all available high production technologies such as use high yielding varieties, high density orcharding, the use of PGR's has been proved as a powerful tool to meet this demand by influencing fruit production directly or indirectly (Bhardwaj *et al*., 2005) [3]. Guava juice wine and guava pulp wine are also prepared from guava fruits (Bardiya *et al.*, 1874) [2]. The seeds yield 3 to 13% oil, which is rich in essential fatty acid and can be used as salad dressing (Adsule and Kalam, 1995). Fruit yield in terms of production and its postharvest quality are important attributes for marketability (Prasad *et al*. 2020) [8]. Various factors such as plant growth and harvesting method decides the yield of fruit crops (Prasad *et al*. 2019) [7].

The plant growth regulators like auxins, Gibberellins and Cycocel have been extensively used for improving the quality of various fruits. Auxins as well as GA3 have been found to accelerate the translocation of metabolites from other parts of the plant towards developing fruits. Ethrel was found to be accelerated the ripening process while, GA3 and NAA were found to be accelerated cell elongation and increase fruit size. Auxin was to be used for controlling factor in the abscission of plant organ and it possibly acts through Ethylene production (Raghvendra *et al*. 2015) [9].

Keeping this in mind, an experiment was conducted at Horticulture Research Farm, Department of Horticulture, Sam Higgibottom University of Agriculture Technology and Science, Prayagraj, to observe the effect of plant growth regulators (PGRs) such as CCC, NAA and GA_3 on growth and establishment of guava var. 'Chittidiar'.

Materials and Methods

The present investigation was carried out to study the effect of plant growth regulators on plant growth and establishment of Guava (*Psidium guajava* L.) cv. Chittidar under humid subtropical conditions of Uttar Pradesh, District Prayagraj during 2020-2021 at Horticulture Research Farm, Department of Horticulture, Sam Higgibottom University of Agriculture Technology and Science, Prayagraj (U.P.). The research farm is situated at an elevation of 78m from sea level at 25.87^0C north latitude and 81.5^0C east longitude. Region has tropical and sub – tropical climate with extremes of summer and winter. In winter during December to January the temperature goes down as low as 1^0C, during winter frost occurs sometimes, where as in summer specially in May – June temperature goes to 47^0C and hot scorching winds are regular feature, the average rainfall is about 102cm concentrated mostly during the monsoon (i.e., July to September with occasional showers in winters). The soil of the experimental site is Sand (60.60), Silt (19.20), Clay (20.20), Soil pH (7.3), EC (dsm^{-1} at 25^0 C) (0.26), Organic carbon (%) (0.46), Available nitrogen (kg $ha^{-1)}$ (45), Available phosphorus (kg ha^{-1}) (18) and Available potash (kg ha^{-1}) (112.50). Guava plants were spaced at 3m x 3m accommodating 1111 plants per ha.

The experiment was laid out in Randomized Block Design (RBD) with three replications. The experiment of twelve treatment combination *viz*., T_1Control, T_2CCC@ 50 ppm, T_3CCC@ 100 ppm, T_4CCC@ 125 ppm, T_5GA3 @ 100 ppm, T_6GA3 @ 125ppm, T_7GA3 @ 150 ppm, T_8NAA @ 175 ppm, T_9NAA @ 200 ppm, T_{10} NAA @300 ppm, T_{11} NAA @400 ppm and T_{12} NAA @ 500 ppm. The observations on plant height (cm), number of leaves $plant^{-1}$, number of branches $plant^{-1}$, stem girth (cm), plant spread (e-w) and (n-s), leaf area (cm^2), chlorophyll (SPAD) and survival (%) of Guava (*Psidium guajava* L.). Experimental data were statistically analyzed following the analysis of variance method (Panse and Sukhatme, 1984) [6].

Results and Discussion

During the experimental investigation, observations on various vegetative growth parameters, chlorophyll (SPAD), survival of guava plants were recorded. The results of the investigation, regarding the effect of plant growth regulators *viz*., (CCC, NAA, GA_3) on vegetative growth guava and physio-chemical analysis of soil cultivars have been presented in tables, wherever required.

A cursory glance over the data depicted in Table 1 and graphically shows that the treatments showed significant effect of plant growth regulators *viz*., (CCC, NAA, GA_3) on vegetative growth parameters at 180 DAT. progressive increase in plant height (96.75cm) was recorded in T_7GA_3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm, T_{11}NAA @400 ppm, T_{10}NAA @300 ppm, T_9NAA @ 200 ppm and T_8NAA @ 175 ppm whereas the minimum plant height (77.22) was recorded in T_0 Control.

The progressive increase in number of leaves per plant (122.64) was recorded in T_7GA_3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm, T_{11}NAA @400 ppm, T_{10}NAA @300 ppm, T_9NAA @ 200 ppm and T_8NAA @ 175 ppm whereas the minimum number of leaves per plant (71.54) was recorded in T_0 Control. The progressive increase in number of branches per plant (12.70) was recorded in T_7GA_3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm, T_{11}NAA @400 ppm, T_{10}NAA @300 ppm, T_9NAA @ 200 ppm and T_8NAA @ 175 ppm whereas the minimum number of branches per plant (8.43) was recorded in T_0 Control.

The progressive increase in stem girth (cm) (4.60) was recorded in T_7GA_3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm, T_{11}NAA @400 ppm, T_{10}NAA @300 ppm, T_9NAA @ 200 ppm and T_8NAA @ 175 ppm whereas the minimum stem girth (cm) (2.85) was recorded in T_0 Control. The progressive increase in plant spread (cm) (E-W) and (N-S) (40.21) was recorded in T_7GA_3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm, T_{11}NAA @400 ppm, T_{10}NAA @300 ppm, T_9NAA @ 200 ppm and T_8NAA @ 175 ppm whereas the minimum plant spread (cm) (E-W) and (N-S) (24.48) was recorded in T_0 Control.

The leaf area (cm^2), chlorophyll (SPAD) and Survival (%) of Guava (*Psidium guajava* L.) cv. Chittidar as influenced by different levels plant growth regulators of foliar spray of CCC, GA_3 and NAA and their interaction presented in table 1. The data shown that foliar application of different levels of plant growth regulators CCC, GA_3 and NAA have significant effect on leaf area (cm^2), chlorophyll (SPAD) and Survival (%). The maximum leaf area (cm^2) (36.80) was found in T_7 GA3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm, T_{11}NAA @400 ppm, T_{10}NAA @300 ppm, T_9NAA @ 200 ppm and T_8NAA @ 175 ppm. However minimum leaf area (cm^2) (18.61) was recorded T_0Control.

The maximum chlorophyll (SPAD)(73.10) was found in T_7 GA3 @ 150 ppm followed by T_6GA3 @ 125ppm, T_5GA3 @ 100 ppm, T_{12}NAA @ 500 ppm,T_{11}NAA @400 ppm,T_{10}NAA @300 ppm,T_9NAA @ 200 ppm and T_8NAA @ 175 ppm. However minimum chlorophyll (SPAD) (38.84) was recorded T_0 Control. The maximum Survival (%) (73.10) was found in T_7 GA3 @ 150 ppm, T_6 GA3 @ 125ppm, T_5 GA3 @ 100 ppm, T_{12} NAA @ 500 ppm, T_{11} NAA @400 ppm, T_{10} NAA @300 ppm, T_9 NAA @ 200 ppm, T_8 NAA @ 175 ppm, T_4 CCC@ 125 ppm, T_3 CCC@ 100 ppm and T_2 CCC@ 50 ppm. However minimum survival (%) (66.67) was recorded T_0 Control.

Table 1: Effect of plant growth regulators on plant growth and survival of Guava (*Psidium guajava* L.) cv. Chittidar

Treatment notation	Treatment combinations	Vegetative growth parameters						Chlorophyll (SPAD)	Survival (%)
		Plant height (cm)	Number of leaves plant^{-1}	Number of branches plant^{-1}	Stem girth (cm)	Plant spread (E-W) and (N-S)	Leaf area (cm^2)		
T_1	Control	77.22	71.54	8.43	2.85	24.48	18.61	38.84	66.66
T_2	CCC@ 50 ppm	84.47	90.42	9.43	3.29	28.85	25.07	48.58	100.00
T_3	CCC@ 100 ppm	85.33	92.51	9.57	3.43	31.33	27.86	49.97	100.00
T_4	CCC@ 125 ppm	86.82	94.61	9.63	3.49	31.74	28.40	51.81	100.00
T_5	GA3 @ 100 ppm	95.29	114.55	12.44	4.41	37.32	33.80	65.99	100.00
T_6	GA3 @ 125ppm	95.50	117.32	12.44	4.45	38.47	35.21	69.05	100.00
T_7	GA_3 @ 150 ppm	96.75	122.64	12.70	4.60	40.21	36.80	73.10	100.00
T_8	NAA @ 175 ppm	83.44	95.71	9.63	3.55	33.62	29.03	54.54	100.00
T_9	NAA @ 200 ppm	85.54	99.00	10.09	3.76	34.01	24.75	56.51	100.00
T_{10}	NAA @300 ppm	91.75	101.01	10.90	3.86	34.28	29.61	60.44	100.00
T_{11}	NAA @400 ppm	92.75	105.04	12.33	4.24	36.33	31.51	63.63	100.00
T_{12}	NAA @ 500 ppm	94.63	109.86	12.26	4.22	36.97	31.73	65.33	100.00
	F-Test	S	S	S	S	S	S	S	S
	C.D. at 0.5%	3.048	5.287	0.470	0.180	1.623	5.806	6.010	0.722
	S.Ed (+)	1.081	2.549	0.227	0.087	0.782	2.800	2.898	0.348

Conclusion

On the basis of the investigation, it can be concluded that T_7 GA3 @ 150 ppm results as the best treatment combination in terms of vegetative growth parameters, leaf area (cm^2), chlorophyll (SPAD), survival and mortality (%) showed better results in Prayagraj agro climatic condition However, since this is based on one-year experiment, further trials may be needed to substantiate the results.

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