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Effect of foliar spray of gibberellic acid and urea on yield and quality of guava (*Psidium guajava* L.) cv.-L-49

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Abstract
An investigation was conducted on uniform, healthy, eight year old trees of guava (*Psidium guajava* L.) cv.-L-49 at Fruit Research Farm, Department of Fruit Science at College of Horticulture and Forestry Jhalawar, during 2017- 2018. Spray of various doses of GA_3 (0 ppm, 50 ppm and 100 ppm), urea (0 %, 1.0 % and 2.0 %) and number of spray (one spray and two spray) compared with control. Maximum number of fruits per plant, fruit weight, fruit yield per plant, estimated yield per hectare and ascorbic acid were recorded with T_{18} treatment (Two spray of GA_3 100 ppm + urea @ 2 %). Further significantly increased quality characteristics like maximum TSS, total sugar, reducing sugar of fruits were recorded with T_{17} treatment (Two spray of GA_3 100 ppm + urea @ 1 %).

Keywords: foliar spray, GA_3, urea, number of spray, yield, quality

Introduction
Guava (*Psidium guajava* L.) which belongs to family Myrtaceae is a native of tropical America though widely grown in the regions of tropical and sub-tropical. The fruit is rich in Vitamin-C and pectin besides being a good source of thiamine and riboflavin. It is known as 'apple of tropics' and can be grown in wide range of soil and climatic conditions. It occupied an area of 2.60 lakh ha. with a total production of 38.26 lakh tonnes **(**Annon, 2016-17). At present in Rajasthan it is occupies an area of 7.7 thousand ha. with a production of 113.5 thousand tonnes annually (Annon, 2016-17). The major guava growing districts in Rajasthan are Udaipur, Bundi, Kota, Baran, Ajmer, Chittorgarh, Swaimadhopur. It was observed that urea had significantly improved the yield and quality characteristics as compared to the control. Total carbohydrates and C: N ratio of leaves were decreased by the application of urea showed good results for most of the fruit characters of guava. Gibberellins control of fruit development in various ways and at different developmental stages. Fruit development is a complex and tightly regulated process. Growing fruits are very active metabolically and act as strong sinks for nutrients with hormones possibly modulating the process (Brenner and Cheikh, 1995). The successful fertilization of the ovule is followed by cell division and cell expansion resulting in the growth of the fruit. Gibberellins are known to influence both cell division and cell enlargement (Adams *et al*., 1975, Kamijima, 1981) The present study will contribute in understanding the physical and biochemical status of guava fruits as influenced by foliar spray of GA_3 and urea which may help in increasing the yield and quality of the fruit.

Materials and Methods
The present investigation was carried out on eight years old of guava (*Psidium guajava* L.*)* cv. L-49 uniform size and growth at the Fruit research farm, Department of Fruit Science, College of Horticulture and Forestry Jhalawar, during the year 2017-18. This experiment was laid out in Factorial Randomized Block Design (RBD) with three replications. The experiment was consisted of 18 treatment combinations with GA_3 (0 ppm, 50 ppm and 100 ppm), urea (0 %, 1 % and 2 %) and number of spray (One spray and Two spray). The treatments were applied after selection of good uniform size and bearer plant. The observations were recorded on different aspects to yield characteristics like number of fruits, fruit weight, fruit yield per plant and estimated fruit yield per hectare and quality characteristics like TSS, total sugar, reducing sugar and ascorbic acid contents were determined by (AOAC 1980) by taking the samples from extracted juice of guava fruits.

Result and Discussion

The maximum number of fruits per plant (122.00) was recorded with T_{18} (Two spray GA_3 100 ppm + Urea @ 2 %) treatment. However, the minimum number of fruits per plant (79.66) was recorded under control treatment. The higher number of fruits per plant might be due to fact that nitrogen is component of chlorophyll and gibberellic acid help in chlorophyll formation that regulate the buildup of proper C: N ratio, which controls the flowering and fruiting of plants. It is also assumed that gibberellin play role in photosynthetic activity and better translocation of metabolites for developing fruit lets. These results are in close conformed to finding of Kumar *et al*., (2014) in Phalsa.

The maximum weight of fruit (186.94 g) was recorded with T_{18} (Two spray GA_3 100 ppm + Urea @ 2 %) and closely followed T_{17} (Two spray GA_3 100 ppm + Urea @ 1 %). However, the minimum weight of fruit (146.44 g) was recorded under control. Increase in fruit weight may be attributed to the strengthening of middle lamella and consequently cell wall, which later may have increase solutes in free passage of the fruits. By the application of GA_3 with urea certain changes of fruit are improved which reflected in more accumulation of water and enhanced deposition of soluble solids. The higher fruit weight due to combined application of higher concentration of urea and GA_3 may be attributed to their stimulatory effect on plant metabolism These findings are in conformity with the results reported by Kumar *et al.* (2010) [7] and Katiyar *et al*. (2009).

The maximum yield in (21.77 kg / plant), was recorded with T_{18} (Two spray GA_3 100 ppm + Urea @ 2 %) treatment and closely followed T_{17} (Two spray GA_3 100 ppm + Urea @ 1 %). However, the minimum yield (11.20 kg / plant) was recorded under control. This may be due to the better physiology of developing fruits in terms of better supply of water, and other compounds vital for their proper growth and development which resulted in improved size and yield. These results are in close conformed with finding of Anawal *et al*., (2015) in pomegranate cv. Bhagwa and Rajput *et al.*, (2015) in guava cv. L-49

The maximum estimated fruit yield (6.22 tonnes / ha.) was recorded with T_{18} (Two spray of GA_3 100 ppm + Urea @ 2 %) treatment. However, the minimum estimated fruit yield (3.26 tonnes / ha.) was recorded under control. The increased yield attributes particularly increased number of fruit per plant and yield (kg per plant) which contributed towards such an increase in average yield tonnes per hectare in guava.

Table 1: Effect of foliar spray of GA_3, urea and number of spray on number of fruits per plant, weight of fruit, yield and estimated yield of guava *(Psidium guajava* L.) cv. L-49

Treatments		Number of fruits per plant	Fruit weight (g)	Yield (Kg / plant)	Estimated yield (tonnes / ha.)
T_1	(U_0 G_0 S_1) control	79.66	146.44	11.20	3.26
T_2	(U_1 G_0 S_1)	84.33	158.10	13.53	3.78
T_3	(U_2 G_0 S_1)	87.00	159.64	14.60	4.12
T_4	(U_0 G_1 S_1)	94.00	161.62	15.65	4.37
T_5	(U_1 G_1 S_1)	97.00	163.44	16.83	4.65
T_6	(U_2 G_1 S_1)	97.66	173.53	17.55	4.88
T_7	(U_0 G_2 S_1)	103.00	177.65	18.58	5.18
T_8	(U_1 G_2 S_1)	104.66	179.92	19.52	5.44
T_9	(U_2 G_2 S_1)	108.33	185.53	20.44	5.62
T_{10}	(U_0 G_0 S_2)	90.00	151.40	13.20	3.32
T_{11}	(U_1 G_0 S_2)	93.00	152.12	14.43	4.08
T_{12}	(U_2 G_0 S_2)	97.00	154.64	15.70	4.30
T_{13}	(U_0 G_1 S_2)	101.00	165.31	16.72	4.66
T_{14}	(U_1 G_1 S_2)	103.33	167.13	17.89	4.83
T_{15}	(U_2 G_1 S_2)	107.66	178.54	18.88	5.30
T_{16}	(U_0 G_2 S_2)	111.33	183.97	19.72	5.54
T_{17}	(U_1 G_2 S_2)	118.00	185.32	20.72	5.70
T_{18}	(U_2 G_2 S_2)	122.00	186.94	21.77	6.22
SEm ±		0.846	1.341	0.073	0.057
CD at 5%		2.432	3.855	0.209	0.164

The significantly increase ascorbic acid (212.25 mg) per 100 g of pulp was recorded maximum with treatment T_{18} (Two spray of GA_3 100 ppm + urea @ 2 %) which was closely followed by, T_{17}, treatments, having values of ascorbic acid (209.98 mg) per 100 g of pulp and minimum ascorbic acid content under control. The increase in ascorbic acid content might have resulted owing to biosynthesis of ascorbic acid from sugar or inhibition of oxidative enzymes or both due to favourable metabolic activity involving certain enzymes and metabolic ions under the influence of plant growth regulators and micro-nutrients (Rajput *et al.* 2016). The possible reason for increase in ascorbic acid of fruit by GA_3 treatment might be due to perpetual synthesis of glucose-6phosphate throughout the growth and development of fruit which is thought to be the precursor of vitamin-C as reported by Kumar and Singh, 1993 in mango.

The highest TSS (12.48 ^{0}B) were recorded with T_{17} (Two spray of GA_3 100 ppm + Urea @ 1 %). However, the minimum TSS was recorded under control. This significant response in improving TSS content of fruit might be explained that interaction of GA_3 and urea stimulated the functioning of number of enzyme in the physiological process which probably increased in TSS content of fruit as reported by Singh *et al*., 1986 in mango. Biswas *et al*. (1988) [3] also reported that the TSS increased due to GA_3 action on converting complex substances into simple ones, which enhances the metabolic activity in fruits.

The maximum total sugar content (9.13 %) was recorded with T_{17} (Two spray of GA_3 100 ppm + Urea @ 1 %) treatment and, minimum total sugar content (6.10 %) was recorded under control. The possible reason for increased total sugar content in GA_3 treatment might be due the increased the activity of the hydrolytic enzyme which converted the complex polysaccharides into simple sugar. Growth regulators also increase translocation of photosynthetic metabolites from other parts of the plant towards to

developing fruits. This finding is in conformity with the result of Kumar *et al*., 1998 in guava.

The maximum reducing sugar content (5.77 %) was recorded with T_{17} (Two spray of GA_3 100 ppm + Urea @ 1 %) treatment and closely followed T_{18} (Two spray GA_3 100 ppm + Urea @ 2 %). However, the minimum reducing sugar content (3.25 %) was recorded under control. reducing sugar might be due to delayed the ripening of fruit and provided a long period of fruits to be remained on tree during which they accumulated more carbohydrates within them as reported by Singh *et al*., (1986) in mango. This might be due to the quick metabolic transformation of accumulated carbohydrates (starch) into soluble sugars. These results are in collaboration with the findings of Agnihotri *et al*. (2013).

Table 2: Effect of foliar spray of GA_3, urea and number of spray on ascorbic acid, TSS,

Treatments		Ascorbic acid (mg/100 g pulp)	TSS (ºBrix)	Total Sugar (%)	Reducing Sugar (%)
T_1	(U_0 G_0 S_1) control	152.38	8.20	6.10	3.25
T_2	(U_1 G_0 S_1)	167.84	9.22	7.08	4.36
T_3	(U_2 G_0 S_1)	176.49	9.64	7.20	4.31
T_4	(U_0 G_1 S_1)	183.21	9.71	7.45	4.53
T_5	(U_1 G_1 S_1)	183.53	10.26	7.66	4.71
T_6	(U_2 G_1 S_1)	187.50	10.58	8.03	4.99
T_7	(U_0 G_2 S_1)	185.80	10.84	8.22	5.16
T_8	(U_1 G_2 S_1)	194.88	11.75	8.74	5.49
T_9	(U_2 G_2 S_1)	208.15	11.48	8.66	5.19
T_{10}	(U_0 G_0 S_2)	162.35	8.26	6.22	3.69
T_{11}	(U_1 G_0 S_2)	171.68	9.59	7.31	4.40
T_{12}	(U_2 G_0 S_2)	185.72	10.10	7.44	4.58
T_{13}	(U_0 G_1 S_2)	188.88	10.28	7.70	4.56
T_{14}	(U_1 G_1 S_2)	194.64	10.63	7.94	4.81
T_{15}	(U_2 G_1 S_2)	198.33	11.01	8.72	4.99
T_{16}	(U_0 G_2 S_2)	201.48	11.40	8.71	5.23
T_{17}	(U_1 G_2 S_2)	209.98	12.48	9.13	5.77
T_{18}	(U_2 G_2 S_2)	212.25	11.62	8.69	5.50
SEm ±		2.190	0.064	0.068	0.057
CD at 5%		6.297	0.183	0.195	0.164

Total sugar and reducing sugar of guava (*Psidium guajava* L.) cv. L-49

Conclusion

On the basis of results obtained from the field experiment, it may be concluded that the foliar spray of GA_3, urea and number of spray was found beneficial for yield and quality of guava cv. L-49 especially under Agro-climatic zone-V of Rajasthan i.e. in Jhalawar condition. However, among different interaction treatments, T_{18} treatment (Two spray of GA_3 100 + Urea 2 %) has given significantly maximum number of fruits per plant, fruit weight, fruit yield per plant, estimated yield per hectare and ascorbic acid. Further, T_{17} treatment (Two spray of GA_3 100 + Urea 2 %) has also significantly maximum TSS, total sugar, reducing sugar content of fruit.

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