Research Article

Effect of GA_3 on Leaf Nutrients and Chemical Composition of Mango

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Abstract

The experiment was carried out in Horticulture Garden of Bihar Agricultural College, Sabour during Rabi season with the objectives focused in this direction on the effect of GA_3 application on physiological regulation of flowering and maturity in mango [*Mangifera indica* L.] cv. Langra. The wide range of Leaf nutrient was observed with different dose of gibberellic acid. The parameters such as nitrogen content (1.31 %) and phosphorus content (0.109 %) were recorded with gibberellic acid @ 0 ppm. Other traits like potassium content (0.91 %) and iron content (79.52 ppm) and manganese content (58.86 ppm) and copper content of leaf (32.90 ppm) were recorded with gibberellic acid @ 200 ppm respectively. The traits like leaf calcium content (1.87 %) and magnesium content (0.188 %) were recorded with gibberellic acid @ 100 ppm while as leaf zinc content (19.97 ppm) was recorded with gibberellic acid @ 0 ppm. A wide range of Chemical parameter was observed with application of different dose of gibberellic acid. The parameters such as total soluble solids (20.53 ^{0}Brix), acidity percentage (0.364 %), total sugar content (16.24 %) and ascorbic acid content (57.65 mg/ 100 g fruit weight) was recorded with gibberellic acid @ 100 ppm, respectively.

Keywords: Mango tree, Variety Langra, GA_3, Leaf nutrient, Sugar and Acidity

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Introduction

Mango (*Mangifera indica* Linn) is the most important fruit of India and is known as "King of fruits".Mango is popular and favorite in our country and is relished by people of all the ages because of its attractive appearance, enticing fragrance, rich aromatic flavour and attractive colour. It is found in North-East India, North-Burma and foot hills of the Himalayas and is said to have originated in the Indo-Burma region. India has vast germplasm and varietal diversity with about 1100 named varieties and no other country surpass but in India only few are grown on a commercial scale. Especially in Bihar, there is immense scope of mango crop because the agro-climatic conditions of Bihar are very congenial for mango production and the state has enormous wealth of mango genotypes.

Mango cv. Langra is predominant variety of Bihar which constitutes about 60 percent area under mango. The availability period of cv. Langra is very short hence it makes glut in the market. The farmers growing cv. Langra are not able to get good remuneration due to short availability. Moreover, the post-harvest life of cv. Langra is very poor that make further problem in market.

The use of plant growth regulators such as GA_3 by many researchers have shown reduced flower drop, high flower retention, increased yield and fruit quality in mango and other fruit species such as citrus, apple and guava [1,4,6]. [2,8] observed that foliar applications of GA significantly increased fruit length, diameter and fruit weight. Recent investigation has been conducted to increase the retention of flowers and fruits using plant growth regulators like GA_3. The present study was conducted to investigate the effect of GA_3 sprays at the flowering stage to improve mango fruit retention, yield and fruit quality in Keitt cultivar [5].

Materials and Methods

The field experiment was conducted in AICRP (Fruits) Sabour, in the permanent experimental site under the Department of Horticulture (Fruit & Fruit Tech.), Bihar Agricultural College, Sabour, Bhagalpur, Bihar. The experimental plot had well drained sandy loam soil of good fertility with leveled surface. The experiment was carried out on plants those were planted in 1980 (33 year) at AICRP-fruit trial area of Bihar Agriculture College, Sabour. All the trees were maintained under uniform cultural practices during the course of investigation. Trees of mango cv. Langra were sprayed with 50, 100 and 200 ppm Gibberellic acid (GA_3) at Pea stage, Marble stage, Stone formation stage, 20 and 10 days before harvest. Control trees were spray with water.

Results and Discussion

Primary nutrient content in leaves

Mango requires sufficient supplies of macronutrients for healthy growth, and nitrogen (N) is a nutrient that is commonly in limited supply. In these parameters **Table 1** indicated that the maximum leaf nitrogen content (1.31%) was recorded with gibberellic acid @ 0 ppm while lowest leaf nitrogen content (1.24%) was recorded in gibberellic acid @ 200 ppm.

The other character, maximum phosphorus content in leaf (0.109%) was recorded with gibberellic acid @ 0 ppm while lowest phosphorus content in leaf (0.92%) was recorded in gibberellic acid @ 200 ppm. In these parameters, the amount of nitrogen was decreasing with increasing amount of GA_3 (Table 1).

The other parameters, potassium content in leaf (0.91%) was recorded with gibberellic acid @ 200 ppm while as lowest leaf potassium content (0.87%) was recorded in gibberellic acid @ 0 ppm. [7] reported that nitrogen (1.09 %) @ 20 ppm and (1.04 %) @ 40 ppm of GA_3 at one month after full bloom in "SuccaryAbiad cv. of mango respectively (Table 1).

Table 1 Effect of GA_3on percentage of nitrogen, phosphorus and potash in mango leaf cv. Langra at different stages

Treatments	Nitrogen (%)			Phosphorus (%)			Potash (%)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
GA_3 application									
Control	1.36	1.26	1.31	0.106	0.112	0.109	0.92	0.82	0.87
50 ppm	1.32	1.24	1.28	0.100	0.104	0.102	0.93	0.85	0.89
100 ppm	1.30	1.23	1.26	0.100	0.099	0.100	0.94	0.87	0.91
200 ppm	1.29	1.20	1.24	0.094	0.090	0.092	0.96	0.86	0.91
SE ± mean	0.004	0.006	0.004	0.001	0.001	0.0004	0.005	0.011	0.006
CD (P=0.05)	0.013	0.018	0.011	0.002	0.002	0.001	0.015	0.032	0.017
Time of application									
Pea stage	1.36	1.25	1.31	0.111	0.108	0.109	0.94	0.83	0.89
Marble stage	1.30	1.23	1.26	0.101	0.103	0.102	0.93	0.81	0.87
Stone formation stage	1.32	1.20	1.26	0.092	0.102	0.097	0.92	0.90	0.91
20 days before expected harvest	1.29	1.22	1.26	0.103	0.086	0.095	0.94	0.86	0.90
10 days before expected harvest	1.32	1.26	1.29	0.093	0.107	0.100	0.94	0.86	0.90
SE ± mean	0.005	0.007	0.004	0.001	0.001	0.0005	0.006	0.012	0.007
CD (P=0.05)	0.014	0.020	0.012	0.002	0.002	0.001	0.017	0.035	0.019

Secondary nutrient content in leaves

Table 2 showed that the maximum leaf calcium content (1.87%) was recorded with gibberellic acid @ 100 ppm while as lowest leaf calcium content (1.81%) was recorded in gibberellic acid @ 0 ppm.

The maximum leaf magnesium content (0.188%) was recorded with gibberellic acid @ 100 ppm and lowest leaf magnesium content (0.180%) was recorded in gibberellic acid @ 0 ppm (Table 2) [7].

Micro nutrient content in leaves

The effect of gibberellic acid was significantly increasing in leaf iron content. Maximum leaf iron content (79.52ppm) was recorded with gibberellic acid @ 200 ppm (Table 2).

The effect of higher concentration of gibberellic acid has been significantly diereses in leaf zinc content. Maximum leaf zinc content (19.97 ppm) was recorded with gibberellic acid @ 0 ppm while as lowest zinc content of leaf (18.43ppm) was recorded in gibberellic acid @ 200 ppm. [9] was also reported the negative effect on zinc (Zn) Afterwards, general high levels of nutrient concentration were observed again mainly in those elements that were strongly affected at the beginning of this study (**Table 3**).

Table 2 Effect of GA_3 on different stages of calcium percent, magnesium percent and iron (ppm) in mango leaf cv. Langra

Treatments	Calcium (%)			Magnesium (%)			Iron (ppm)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
GA_3 application									
Control	1.77	1.86	1.81	0.178	0.181	0.180	84.01	66.41	75.21
50 ppm	1.79	1.88	1.84	0.192	0.179	0.185	86.07	68.45	77.26
100 ppm	1.80	1.94	1.87	0.192	0.183	0.188	88.67	68.57	78.62
200 ppm	1.86	1.85	1.86	0.179	0.189	0.184	89.36	69.68	79.52
SE ± mean	0.012	0.009	0.008	0.001	0.001	0.001	0.48	0.39	0.31
CD (P=0.05)	0.035	0.027	0.022	0.003	0.003	0.002	1.41	1.15	0.88
Time of application									
Pea stage	1.79	1.89	1.84	0.190	0.181	0.186	86.54	67.67	77.10
Marble stage	1.87	1.90	1.89	0.178	0.184	0.181	85.79	68.56	77.18
Stone formation stage	1.84	1.90	1.87	0.184	0.178	0.181	86.78	69.10	77.94
20 days before expected harvest	1.78	1.86	1.82	0.184	0.184	0.184	87.39	68.11	77.75
10 days before expected harvest	1.75	1.87	1.81	0.190	0.186	0.188	88.65	67.94	78.29
SE ± mean	0.013	-	0.008	0.001	0.001	0.001	0.53	-	-
CD (P=0.05)	0.039	NS	0.024	0.003	0.003	0.002	1.57	NS	NS

Table 3 Effect of GA_3 on different stages of zinc (ppm), manganese (ppm) and copper (ppm) in mango leaf cv. Langra

Treatments	Zinc (ppm)			Manganese (ppm)			Copper (ppm)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
GA_3 application									
Control	20.02	19.92	19.97	56.53	56.10	56.32	33.04	28.60	30.82
50 ppm	19.08	19.49	19.29	57.72	57.32	57.52	33.89	28.70	31.30
100 ppm	18.94	18.97	18.96	58.60	57.91	58.26	35.42	29.29	32.35
200 ppm	18.33	18.54	18.43	59.75	57.98	58.86	35.82	29.98	32.90
SE ± mean	0.159	0.176	0.119	0.35	0.25	0.21	0.21	0.16	0.13
CD (P=0.05)	0.472	0.521	0.340	1.03	0.74	0.61	0.63	0.49	0.38
Time of application									
Pea stage	18.74	19.32	19.03	57.76	56.89	57.32	34.00	28.72	31.36
Marble stage	19.44	18.87	19.16	57.20	57.64	57.42	34.43	30.60	32.51
Stone formation stage	18.73	19.99	19.36	58.89	56.38	57.63	34.88	28.80	31.84
20 days before expected harvest	19.45	18.93	19.19	58.28	57.81	58.05	34.59	28.74	31.67
10 days before expected harvest	19.10	19.05	19.08	58.65	57.90	58.27	34.80	28.87	31.83
SE ± mean	0.178	0.197	-	0.39	0.28	0.24	-	0.18	0.15
CD (P=0.05)	0.527	0.582	NS	1.15	0.82	0.69	NS	0.54	0.43

The other characters, maximum manganese content of leaf (58.86 ppm) was recorded with gibberellic acid @ 200 ppm and lowest leaf manganese content (56.32 ppm) was recorded in gibberellic acid @ 0 ppm.

The other parameters, maximum copper content of leaf (32.90ppm) was recorded with gibberellic acid @ 200 ppm and lowest copper content of leaf (30.82ppm) was recorded in gibberellic acid @ 0 ppm. A similar result was also reported by [9] that the both positive and negative effects in mango for Micro nutrient content in leaves with the application of GA_3 (Table 3).

Chemical composition of Fruit

Table 4 showed that the maximum total soluble solids (20.53 ^{0}Brix) were recorded with gibberellic acid @ 100 ppm and lowest total soluble solid (19.43^{0}Brix) was recorded in gibberellic acid @ 50 ppm.

The maximum total sugar content (16.24%) was recorded with gibberellic acid @ 200 ppm followed by gibberellic acid @ 100 ppm (16.14%) and lowest total sugar content (14.92%) was recorded in gibberellic acid @ 0 ppm.

Table 4 Effect of GA_3 on different stages on total soluble solid, total sugar and reducing sugar in mango fruit cv. Langra

Treatments	TSS^{0}B			Total sugar (%)			Reducing sugar (%)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
GA_3 application									
Control	18.65	19.41	19.03	14.71	15.14	14.92	4.59	4.50	4.55
50 ppm	19.69	20.23	19.96	15.73	15.94	15.84	4.70	4.64	4.67
100 ppm	21.31	21.37	21.34	15.94	16.34	16.14	4.94	4.99	4.96
200 ppm	20.19	20.28	20.23	15.96	16.52	16.24	5.08	5.22	5.15
SE ± mean	0.160	0.143	0.107	0.150	0.078	0.085	0.072	0.080	0.054
CD (P=0.05)	0.474	0.423	0.307	0.445	0.231	0.243	0.214	0.238	0.155
Time of application									
Pea stage	19.86	20.01	19.93	15.40	15.45	15.42	4.50	4.71	4.60
Marble stage	19.70	20.17	19.94	15.44	15.83	15.63	4.65	4.70	4.68
Stone formation stage	19.73	19.95	19.84	15.35	15.98	15.67	4.82	4.87	4.85
20 days before expected harvest	19.60	20.28	19.94	15.94	16.34	16.14	4.91	4.85	4.88
10 days before expected harvest	20.91	21.21	21.06	15.80	16.32	16.06	5.26	5.05	5.15
SE ± mean	0.179	0.160	0.120	NS	0.087	0.095	0.081	NS	0.060
CD (P=0.05)	0.530	0.473	0.344	NS	0.258	0.271	0.239	NS	0.173

Table 5 Effect of GA_3 on different stages on non-reducing sugar, acidity percent and ascorbic acid in mango fruit cv. Langra

Treatments	Non reducing sugar (%)			Acidity (%)			Ascorbic acid (mg/100g fruit weight)		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
GA_3 application									
Control	10.12	10.64	10.38	0.239	0.276	0.258	47.45	57.99	52.72
50 ppm	11.04	11.30	11.17	0.241	0.266	0.254	52.37	55.67	54.02
100 ppm	11.00	11.36	11.18	0.233	0.297	0.265	53.60	56.49	55.05
200 ppm	10.88	11.30	11.09	0.243	0.280	0.262	59.22	55.64	57.43
SE ± mean	0.190	0.128	0.115	0.002	0.002	0.002	0.80	0.44	0.46
CD (P=0.05)	0.564	0.378	0.328	0.006	0.007	0.004	2.35	1.31	1.30
Time of application									
Pea stage	10.91	10.74	10.82	0.229	0.264	0.246	48.35	50.05	49.20
Marble stage	10.79	11.13	10.96	0.238	0.281	0.259	60.24	55.87	58.05
Stone formation stage	10.53	11.11	10.82	0.240	0.273	0.256	48.49	57.65	53.07
20 days before expected harvest	11.03	11.50	11.26	0.231	0.281	0.256	54.03	58.66	56.35
10 days before expected harvest	10.54	11.27	10.91	0.258	0.300	0.279	54.69	60.02	57.35
SE ± mean	NS	0.143	NS	0.002	0.003	0.002	0.89	0.50	0.51
CD (P=0.05)	NS	0.423	NS	0.007	0.008	0.005	2.63	1.47	1.46

The maximum reducing sugar content (5.15%) was recorded with gibberellic acid @ 200 ppm while as lowest reducing sugar content (4.55%) was recorded gibberellic acid @ 0 ppm.

Table 5 indicated that the maximum non-reducing sugar content (11.18%) was recorded with gibberellic acid @ 100 ppm while as lowest non-reducing sugar content (10.38 %) was recorded in gibberellic acid @ 0ppm. The amount of non-reducing sugar was also increasing with increasing amount of GA_3. While [3] reported that the amount of TSS, total sugar content was decline with increasing amount of Gibberellic acid.

The maximum acidity percentage (0.367%) was recorded with gibberellic acid (GA3) @ 100 ppm while as lowest acidity percentage (0.354%) was recorded in gibberellic acid @ 50 ppm. [10] reported that the GA_3 spray considerably decreased the acidity content of the fruits. After that [3] also reported that the acidity percentage was decreasing with decreasing amount of GA_3. They found that acidity percentage (0.255 %) @ 0 ppm of GA_3 and highest acidity (0.289 %) @ 100 ppm of GA3 was found.

The maximum ascorbic acid content (97.43mg/100g fruit weight) was recorded with gibberellic acid @ 200 ppm while as lowest ascorbic acid content (92.72 mg/100g fruit weight) was recorded in gibberellic acid @ 0 ppm. [10] reported that the chemical composition of mango fruits in terms of TSS, sugar (reducing and non-reducing) and ascorbic acid was significantly improved and decreased the acidity content by the application of 150 ppm GA_3.

Conclusion

Maximum leaf nitrogen, phosphorus content was recorded with gibberellic acid @ 0 ppm while lowest leaf nitrogen, phosphorus content was recorded in gibberellic acid @ 200 ppm while maximum leaf calcium and magnesium content was recorded with gibberellic acid @ 100 ppm while as lowest leaf calcium and magnesium content was recorded in gibberellic acid @ 0 ppm. The maximum iron, manganese and copper content in leaf were recorded with gibberellic acid @ 200 ppm while lowest iron, manganese and copper content in leaf were recorded in gibberellic acid @ 0 ppm. However, the effect of higher concentration of gibberellic acid was significantly decreases the leaf zinc content. Maximum leaf zinc content was recorded with gibberellic acid @ 0 ppm while as lowest zinc content of leaf was recorded in gibberellic acid @ 200 ppm.

With regard to chemical composition of fruits the maximum total soluble solids, non-reducing sugar content and acidity percentage were recorded with gibberellic acid @ 100 ppm while the maximum total sugar content, reducing sugar and ascorbic acid content was recorded with gibberellic acid @ 200 ppm.

References

[1] A. A. El-Shaikh, B. M. Khalil, A. Y. Hamza. The effect of girdling and some growth regulators on fruit drop of persimmon. *Egypt. J. Agric. Res*., 1999, 77:1707-1724.

[2] A. N. Muarya, J. N. Singh. Effect of three growth regulators on fruit retention and quality of mango (*Mangifera indica*) L. cv. Langra. *J. Agric. India*, 1981, 16:53-56.

[3] D. K. Shrivastava D. K. Jain. Effect of GA3 on physiochemical properties of Mango cv. Langra during on year. *Karnataka J. Agric. Sci*., 2006, 19 (3):754-756.

[4] G. A. Hairdry, B. Jalal-ud-Din, A. Ghaffoor, M. Munir. Effect of NAA on fruit drop, yield and quality of mango, *Mangifera indica* cultivars Langra. *Scientif. Khyber*, 1997, 10:13-20.

[5] G. O. Nkansah, J. Ofosu-Anim, A. Mawuli. Gibberellic Acid and Naphthalene Acetic Acid Affect Fruit Retention, Yield and Quality of Keitt Mangoes in the Coastal Savanna Ecological Zone of Ghana. *American J. of Plant Physiology*, 2012, 7:243-251.

[6] M. Iqbal, M. Q. Khan, Jalal-ud-Din, K. Rehman, M. Munir. Effect of foliar application of NAA on fruit drop, yield and physicochemical characteristic of guava (*Psidium guajava* L.) Red flesh cultivar. *J. Agric. Res*., 2009, 47:259-269.

[7] M. T. Wahdan, S. E. Habib, M. A. Bassal, E. M. Qaoud. Effect of some chemicals on growth, fruiting, yield and fruit quality of "SuccaryAbiad" mango cv. *J. of American Sci*., 2011, 7(2):651-658.

[8] P. Dutta, A. K. Banik. Effect of foliar feeding of nutrients and plant growth regulators on physic-chemical quality of Sardar guava grown in West Bengal. *Acta Horti*., 2007, 335:407-411.

[9] U. R. Singh, A. P. Singh. Control of fruit drop in mango. Annual Report of Horticultural Research Institution, Sharanpur (UP), 1986, pp.213-16.

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