International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(1): 1480-1484

Received: 04-10-2020
Accepted: 15-12-2020

Deen Dayal Singh
Ph.D., Scholar, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

RR Singh
Dean, Department of Agriculture, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Pankaj Kumar Ray
Subject Matter Specialist, Department of Horticulture, Krishi Vigyan Kendra, Saharsa, Bihar, India

Corresponding Author:
Pankaj Kumar Ray
Subject Matter Specialist, Department of Horticulture, Krishi Vigyan Kendra, Saharsa, Bihar, India

Effect of pre-harvest treatment of GA_3 on physiological behaviour in Mango

Deen Dayal Singh, RR Singh and Pankaj Kumar Ray

DOI: https://doi.org/10.22271/chemi.2021.v9.i1u.11432

Abstract
Mango (*Mangifera indica* L.) is one of the most important fruit crops of many tropical and sub-tropical countries of world which belongs to the family Anacardiaceae (Nakasone and Paul 1998 and Purseglove 1972). 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. A critical analysis of data revealed that wide range of observation was observed on physiological traits. The traits such as photosynthetic rate (8.71 µmol/m^2/sec) and internal CO_2 concentration (283.80 ppm) was recorded with gibberellic acid @ 200 ppm while Stomatal conductance of leaf (0.163 µmol/m^2/sec) was recorded at the time of stone formation stage. A wide range was observed with application of gibberellic acid on Physiological parameters.

Keywords: Mango tree, variety Langra, GA_3, photosynthesis and application rate

Introduction
Mango (*Mangifera indica* L.) is one of the best fruit crops of many tropical and sub-tropical countries of world which belongs to the family Anacardiaceae (Nakasone and Paul 1998 and Purseglove 1972) [10, 12]. 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 flavor 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 (Hairdry *et al*., 1997; El-Shaikh, 1999; Iqbal *et al*., 2009) [3, 2, 5]. Muarya and Singh (1981) [9] and Dutta and Banik (2007) [1] 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 (Nkansah *et al*., 2012) [11].

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

Photosynthesis rate (µmol/m^2/sec)

The data related to the photosynthetic rate are presented in Table-1 and represented graphically in Fig. - 1(a). The maximum photosynthetic rate (8.71 µmol/m^2/sec) was recorded with gibberellic acid (GA_3) @ 200 ppm which at par with gibberellic acid (GA_3) @ 100 ppm. Minimum photosynthetic rate (7.42 µmol/m^2/sec) was recorded in gibberellic acid (GA_3) @ 0 ppm which at par with gibberellic acid (GA_3) @ 50 ppm.

The maximum photosynthetic rate (8.36 µmol/m^2/sec) was recorded at the time of 10 days before expected harvest stage which at par with the time of stone formation stage. Minimum photosynthetic rate (7.75 µmol/m^2/sec) was recorded at the pea stage which at par with the time of 20 days before expected harvest stage.

The interaction effect was found to be significant effect on the photosynthetic rate shown in Table-2 and represented graphically in Fig.- 1(b). It clearly indicates that the highest photosynthetic rate (9.67 µmol/m^2/sec) was recorded with gibberellic acid (GA_3) @ 200 ppm within stone formation stage fallowed by (9.13 µmol/m^2/sec) with gibberellic acid (GA_3) @ 100 ppm within pea stage whereas, the lowest photosynthetic rate (6.69 µmol/m2/sec) was found gibberellic acid (GA_3) @ 0 ppm within 20 days before expected harvest stage. (Hayashi, 1961; Little and Loach, 1975; Whiley, 1986; Wieland and Wample, 1985; Khandaker *et al*., 2013 and Kasambhai, 2015) [4, 8, 13, 14, 7, 6].

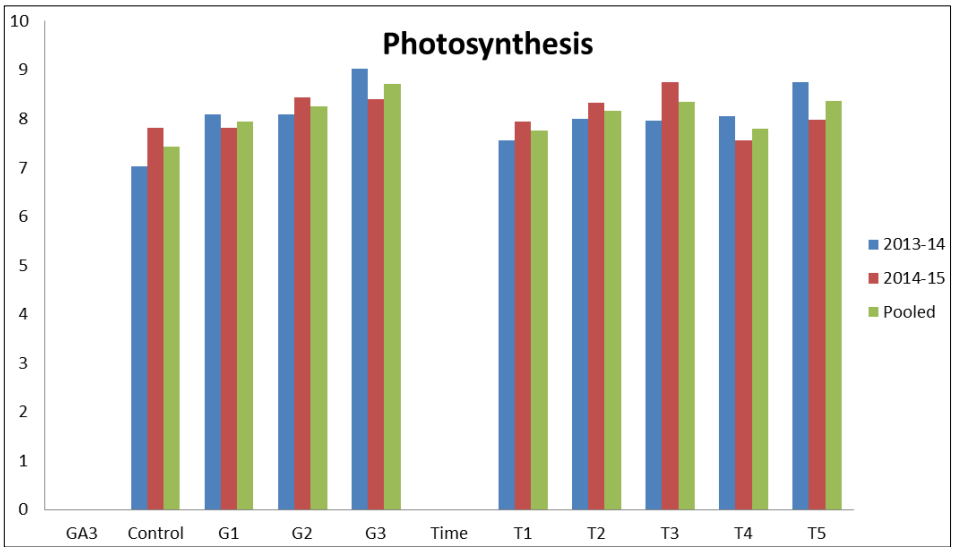

Fig 1(a): Effect of GA_3 application on different stages on photosynthesis (µmol/m^2/sec) in mango cv. Langra

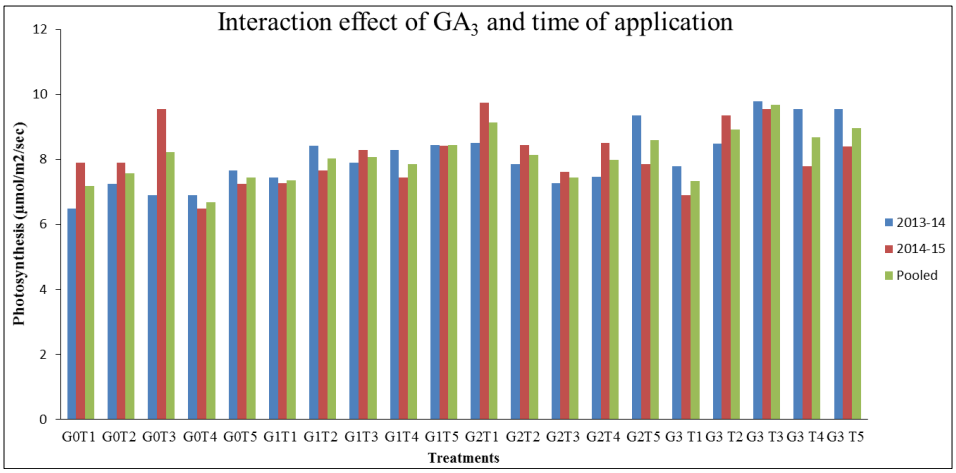

Fig 1(b): Interaction effect of GA_3 and its application time on photosynthesis (µmol/m^2/sec) in mango cv. Langra

Table 1: Effect of GA_3 application on different stages on photosynthesis (µmol/m^2/sec), stomatal conductance (µmol/m^2/sec) and Internal CO_2 concentration of leaf (ppm) in mango cv. Langra

	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
GA_3 application									
Control	7.03	7.81	7.42	0.153	0.161	0.157	275.30	273.90	274.60
50 ppm	8.09	7.81	7.95	0.155	0.159	0.157	282.50	280.30	281.40
100 ppm	8.09	8.43	8.26	0.159	0.157	0.158	283.80	281.60	282.70
200 ppm	9.03	8.39	8.71	0.168	0.158	0.163	283.80	283.80	283.80
SE ± mean	0.039	0.038	0.027	0.003	-	-	1.90	2.22	1.46

CD (P=0.05)	0.116	0.112	0.078	0.008	NS	NS	5.63	6.56	4.18
Time of application									
Pea stage	7.55	7.94	7.75	0.158	0.163	0.160	281.38	275.38	278.38
Marble stage	8.00	8.33	8.16	0.149	0.159	0.154	280.63	282.13	281.38
Stone formation stage	7.96	8.75	8.35	0.155	0.171	0.163	279.88	282.50	281.19
20 days before expected harvest	8.05	7.55	7.80	0.173	0.150	0.161	281.50	280.13	280.81
10 days before expected harvest	8.75	7.98	8.36	0.160	0.151	0.156	283.38	279.38	281.38
SE ± mean	0.044	0.042	0.030	0.003	0.003	0.002	-	-	-
CD (P=0.05)	0.129	0.125	0.087	0.009	0.010	0.007	NS	NS	NS

Table 2: Interaction effect of GA_3 and its application time on photosynthesis (µmol/m2/sec), stomatal conductance (µmol/m^2/sec) and Internal CO_2 concentration of leaf (ppm) in mango cv. Langra

GA_3 application	**Time of application**	**Photosynthesis (µmol/m^2/sec)**			**Stomatal conductance (µmol/m^2/sec)**			**Internal CO_2 concentration of leaf (ppm)**		
		2013-14	**2014-15**	**Pooled**	**2013-14**	**2014-15**	**Pooled**	**2013-14**	**2014-15**	**Pooled**
GA_3 @ 0 ppm	Pea stage	6.48	7.89	7.18	0.16	0.18	0.17	274.00	267.50	270.75
	Marble stage	7.25	7.89	7.57	0.15	0.18	0.16	273.00	282.50	277.75
	Stone formation stage	6.89	9.55	8.22	0.16	0.17	0.16	274.00	282.50	278.25
	20 days before expected harvest	6.89	6.48	6.69	0.16	0.14	0.15	278.50	269.00	273.75
	10 days before expected harvest	7.65	7.25	7.45	0.15	0.15	0.15	277.00	268.00	272.50
GA_3 @ 50 ppm	Pea stage	7.44	7.26	7.35	0.15	0.16	0.15	283.00	277.00	280.00
	Marble stage	8.42	7.65	8.03	0.17	0.14	0.15	281.00	277.00	279.00
	Stone formation stage	7.89	8.28	8.08	0.14	0.19	0.16	282.50	283.50	283.00
	20 days before expected harvest	8.28	7.44	7.86	0.19	0.16	0.17	283.50	283.00	283.25
	10 days before expected harvest	8.44	8.42	8.43	0.15	0.17	0.16	282.50	281.00	281.75
GA_3@ 100ppm	Pea stage	8.51	9.74	9.13	0.16	0.18	0.17	285.00	278.00	281.50
	Marble stage	7.85	8.44	8.14	0.15	0.15	0.15	286.50	282.50	284.50
	Stone formation stage	7.26	7.62	7.44	0.16	0.17	0.16	285.00	276.00	280.50
	20 days before expected harvest	7.47	8.51	7.99	0.17	0.15	0.16	276.00	285.00	280.50
	10 days before expected harvest	9.35	7.85	8.60	0.18	0.16	0.17	286.50	286.50	286.50
GA_3@200 ppm	Pea stage	7.78	6.89	7.33	0.18	0.15	0.16	283.50	279.00	281.25
	Marble stage	8.49	9.35	8.92	0.14	0.18	0.16	282.00	286.50	284.25
	Stone formation stage	9.79	9.55	9.67	0.18	0.17	0.17	278.00	288.00	283.00
	20 days before expected harvest	9.55	7.78	8.67	0.18	0.17	0.17	288.00	283.50	285.75
	10 days before expected harvest	9.55	8.39	8.97	0.18	0.14	0.16	287.50	282.00	284.75
SE ± mean		0.087	0.085	0.061	0.006	0.007	0.005	-	-	-
CD (P=0.05)		0.259	0.250	0.174	0.018	0.021	0.013	NS	NS	NS

Stomatal conductance (µmol/m^2/sec)

The data related to the Stomatal conductance of leaf are presented in Table-1 and represented graphically in Fig. - 2(a). There are no significant effects of Stomatal conductance of leaf with application of gibberellic acid (GA_3) which range from 0.157µmol/m^2/sec to 0.163 µmol/m^2/sec.

The maximum Stomatal conductance of leaf (0.163 µmol/m^2/sec) was recorded at the time of stone formation stage which at par with the time of 20 days before expected harvest stage. Minimum Stomatal conductance of leaf (0.154 µmol/m^2/sec) was recorded at the marble stage which at par with the time of 10days before expected harvest stage.

The interaction effect was found to be significant effect on the Stomatal conductance of leaf shown in Table-2 and represented graphically in Fig.- 2(b). It clearly indicates that the highest Stomatal conductance (0.17 µmol/m^2/sec) and lowest Stomatal conductance (0.15 µmol/m^2/sec) was found. Similar findings were reported by Khandaker *et al.*, 2013) [7].

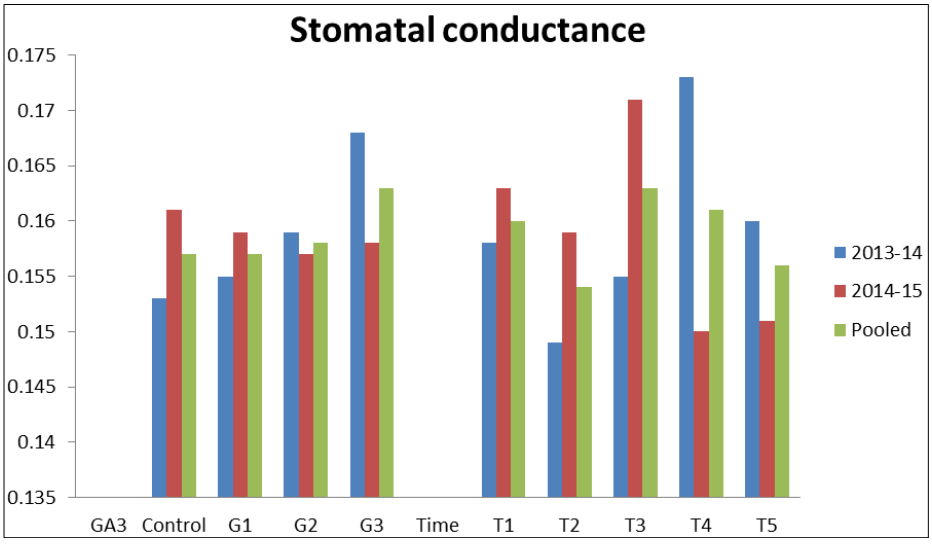

Fig 2(a): Effect of GA_3 application on different stages on stomatal conductance (µmol/m^2/sec) in mango cv. Langra

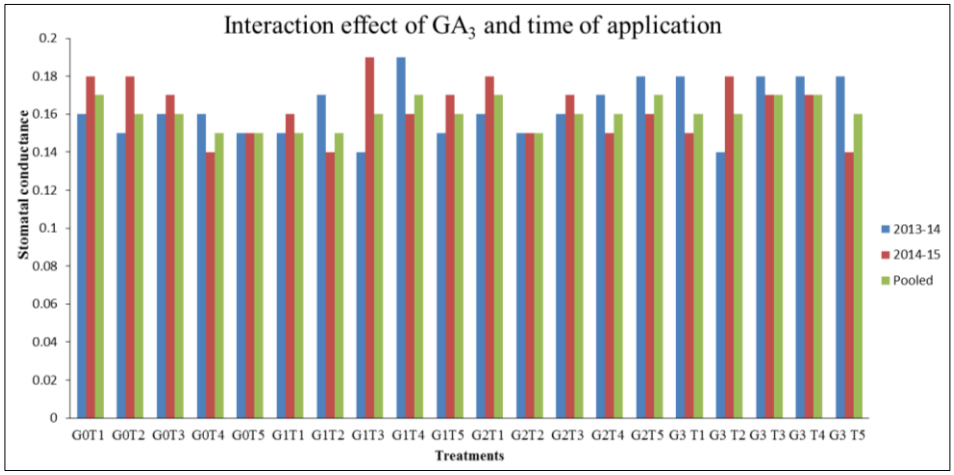

Fig 2(b): Interaction effect of GA_3 and its application time on stomatal conductance (µmol/m^2/sec) in mango cv. Langra

Internal CO_2 concentration of leaf (ppm)

The data related to the internal CO_2 concentration of leaf are presented in Table- 1 and represented graphically in Fig.- 3(a). There is significant effect of internal CO_2 concentration of leaf with application of gibberellic acid (GA_3). The maximum internal CO_2 concentration of leaf (283.80 ppm) was recorded with gibberellic acid (GA_3) @ 200 ppm which at par with gibberellic acid (GA_3) @ 100 ppm. Minimum internal CO_2 concentration of leaf (274.60 ppm) was recorded with gibberellic acid (GA_3) @ 0 ppm which at par with gibberellic acid (GA_3) @ 50 ppm. There was no significant effect of internal CO_2 concentration on leaf and range varies from 278.38 ppm to 281.38 ppm.

The interaction effect did not have any significant effect on the internal CO_2 concentration on leaf shown in Table-2 and represented graphically in Fig.- 3(b). The highest internal CO_2 concentration on leaf (86.50 ppm) was recorded with gibberellic acid (GA_3) @ 100 ppm within 10 days before expected harvest stage. However, the lowest internal CO_2 concentration of leaf was observed (270.75 ppm) with gibberellic acid (GA_3) @ 0 ppm within pea stage. Similar findings were reported by Zaharah *et al.*, 2012 [15].

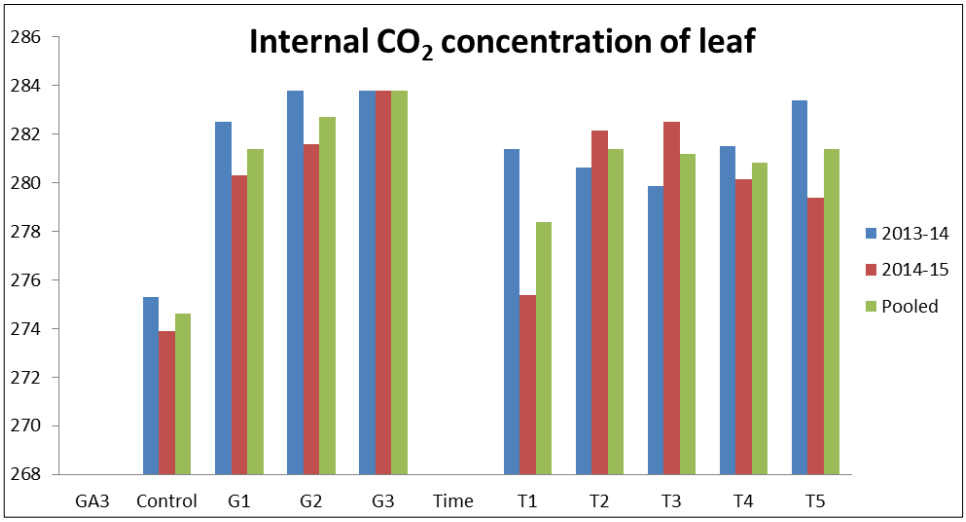

Fig 3(a): Effect of GA_3 on different stages on Internal CO_2 concentration of leaf (ppm) in mango cv. Langra

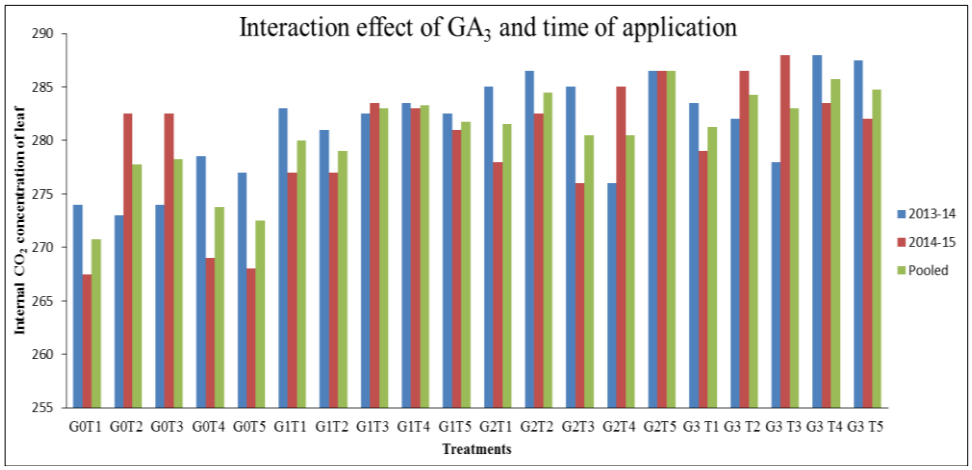

Fig 3(b): Interaction effect of GA_3 and its application time Internal CO_2 concentration of leaf in mango cv. Langra

Conclusion

The maximum photosynthetic rate (8.71 µmol/m^2/sec) was recorded with gibberellic acid (GA_3) @ 200 ppm and at the time of 10 days before expected harvest stage. There are no significant effects of Stomatal conductance of leaf with application of gibberellic acid (GA_3) which ranged from 0.157µmol/m^2/sec to 0.163 µmol/m^2/sec. The maximum Stomatal conductance of leaf (0.163 µmol/m^2/sec) was recorded at the time of stone formation stage. There is significant effect of internal CO_2 concentration of leaf with application of gibberellic acid (GA_3) while the interaction effect was non-significant to the internal CO_2 concentration on leaf. The maximum internal CO_2 concentration of leaf (283.80 ppm) was recorded with gibberellic acid (GA_3) @ 200 ppm.

References

1. Dutta P, Banik AK. 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.
2. El-Shaikh AA, Khalil BM, Hamza AY. The effect of girdling and some growth regulators on fruit drop of persimmon. Egypt. J Agric. Res 1999;77:1707-1724.
3. Hairdry GA, Jalal-ud-Din B, Ghaffoor A, Munir M. Effect of NAA on fruit drop, yield and quality of mango, Mangifera indica cultivars Langra. Scientif. Khyber 1997;10:13-20.
4. Hayashi T. The effect of gibberellin treatment on the photosynthetic activity of plants. IVth Intern Conf Plant Growth Regulation 1961, 579-587. Iowa State Press.
5. Iqbal M, Khan MQ, Jalal-ud-Din Rehman K, Munir M. Effect of foliar application of NAA on fruit drop, yield and physicchemical characteristic of guava (*Psidium guajava* L.) Red flesh cultivar. J Agric. Res 2009;47:259-269.
6. Kasambhai MS. Effect of foliar application of chemicals on fruit retention, yield and quality of mango (*Mangifera indica* L.) cv. Kesar. M.Sc. (Hort) thesis. Navsari Agricultural University, Navsari 2015, 128.
7. Khandaker MM, Boyce AN, Osman N, Golam F, Rahman MM, Sofian Azirun M. Fruit development, pigmentation and biochemical properties of wax apple as affected by localized Application of GA_3 under field conditions. Brazilian Archives of Biology and Technology 2013;56(1):11-20.
8. Little CHA, Loach K. Effect of gibberellic acid on growth and photosynthesis in *Abies balsamea*. Can. J Bot 1975;53:1805-1810.
9. Muarya AN, Singh JN. Effect of three growth regulators on fruit retention and quality of mango (*Mangifera indica*) L. cv. Langra. J Agric. India 1981;16:53-56.
10. Nakasone HY, Paul RE. Tropical Fruits. CAB International, Wallingford, Oxon, UK 1998.
11. Nkansah GO, Ofosu-Anim J, Mawuli A. 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.
12. Purseglove JW. Mangoes west of India. Acta Horti 1972;24:170-174.
13. Whiley AW. Crop management review. Proceeding first Australian mango research workshop. CSIRO, Australia, Melbourne 1986, 186-195.
14. Wieland WF, Wample RL. Effect of paclobutrazol on growth, photosynthesis and carbohydrate content of delicious apple. Scientia Horticulturae 1985;26:139-147.
15. Zaharah SS, Singh Z, Symons GM, Reid JB. Role of brassinosteroids, ethylene, abscisic acid, and indole-3-acetic acid in mango fruit ripening. J of Plant Growth Regulators 2012;31(3):363-372.