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Pre harvest application of GA_3 and $CaCl_2$ on physiological loss in weight (PLW) % and storage life of banana cv. Grand Naine

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Abstract
The present study was undertaken at Horticulture Research Station, Department of Fruit Science and Horticulture Technology, College of Agriculture, OUAT, BBSR during 2015-16 and 2016-17 to envisage "Pre harvest application of GA_3 and $CaCl_2$ on physiological loss in weight (PLW) % and storage life of banana cv. Grand Naine". In this experiment fruits were subjected to ten treatments with different concentration of GA_3, $CaCl_2$, their combination, control (with water) and replicated thrice, after male bud removal chemicals were applied to the bunch by spraying. In this experiment maximum physiological loss in weight 13.73% (2015-16), 14.16% (2016-17) was recorded in control on 12th day of storage, where as on 12th day in GA_3 @150 ppm it was 7.25% (2015-16), 6.19% (2016-17) and attains its maximum value on 18th day. Fruits treated with GA_3 @150 ppm had dramatically more delayed physiological weight loss, pulp peel ratio followed by $CaCl_2$@4% compare to control. Maximum shelf life up to 20 days (2015-16), 19 days (2016-17) was recorded in fruits under GA_3 @150 ppm treatment followed by $CaCl_2$@4%, 18 days (2015-16), 19 days (2016-17) compare to minimum 13 days (2015-16), 12 days (2016-17) in control. Thus pre harvest application of GA_3@ 150 ppm was an efficient method of delaying banana fruit ripening with better quality and it allows growers to schedule banana fruit ripening.

Keywords: Banana, fruit weight, PLW, shelf life

Introduction
Banana is a monocarpic, monocotyledon, herbaceous plant and easily available with low cost having multipurpose use accompanied with essential vitamins and minerals. The earliest reference of banana (*Musa* spp.) was found in the Hindu classic-Ramayana. Banana (*Musa paradisiacal* L.) belongs to the family Musaceae in the order Zingiberales is one of the most important fruit crops in the world as it is available throughout the year, relatively inexpensive and is within the reach of all classes of buyers (Saravanan *et al*., 2012) [12]. Banana has assumed more significance now-a-days, as it is the source of regular income for small and marginal farmers and responds very well to crop management system. Banana is considered as the Apple of paradise and the fruits are used for offering to Hindu Deities. Besides the increasing production of Banana, few main challenges faced by fruit industry are the enormous post-harvest losses, lack of scientific information on handling, packaging system, post harvest treatments, short shelf-life and lack of appropriate post harvest technologies for storage (Kudachikar *et al.*, 2007) [4]. Consequently, a new thrust is emerging for higher yield, better fruit quality and longer shelf life with lesser susceptibility to pests and diseases. Therefore to improve the productivity, extending the area of high yielding banana varieties like Grand Naine, Robusta and Dwarf Cavendish are important. Grand Naine is the most accepted international variety (Mustaffa, 2011) [9] and is gaining popularity in the state including its northern part also. Consumers generally attracted by the visual appearance to purchase freshly produce fruits usually that is blemish-free. In Indian fruit processing industry about 30-40% of fruits and vegetables are lost due to improper post-harvest handling (estimated to 40,000 crores/year) and able to utilize only less than 2% of the produce annually (Uma, 2008) [14]. Banana is a climacteric fruit and fully ethylene dependent for ripening. It is highly perishable with 30-40% of post-harvest losses warranting storage between harvesting and consumption (Salunkhe and Desai, 1984) [11]. Since banana is a climacteric and perishable fruit, application of different treatments become necessary to extend shelf-life, maintain the fruit quality for long distance transportation for domestic and export markets and reduce losses hand in hand. With this background, the present investigation was carried out on "Pre harvest application of

GA_3 and $CaCl_2$ on physiological loss in weight (PLW)% and storage life of banana cv. Grand Naine".

Materials and Methods

The research was carried out during 2015-16 and 2016-17 i.e. the plant crop followed by its ratoon crop in the Horticulture Research Station, Department of Fruit Science and Horticulture Technology, College of Agriculture, OUAT, Bhubaneswar. The experiment was conducted in RBD design with 10 different treatments each replicated thrice. Tissue culture plantlets of Grand Naine banana of 1 to 2 month age were collected for the experiment and were planted in pits. Plantlets of Banana (*Musa spp*., AAA group) cv. Grand Naine planted on December 2, 2015. Planting was done in the early morning to limit stress and allowed sufficient time for adaptation. During initial days of establishment, crop was daily irrigated. All cultural practices like manuring, irrigation, management of side suckers, removal of dried and diseased leaves, denavelling, propping of plants were done. After male bud removal, on selected plants spraying was done to the bunches. The treatment details are T1: 2% CaCl2, T2: 3% CaCl2, T3: 4% CaCl2, T4: 50 ppm GA3, T5; 100 ppm GA3, T6: 150 ppm GA3, T7: 50 ppm GA3 + 2% CaCl2, T8: 100 ppm GA3 + 3% CaCl2, T9: 150 ppm GA3 + 4% CaCl2, T10: Control (with water application only). After attainment of maturity, bunches were harvested and sent to post harvest laboratory for further analysis. Hands were washed in normal water to remove latex, latex stains, soil particles and floral remnants. After washing, the hands were dried under shade and kept at room temperature. The physical analysis of fruits were conducted in the Post Harvest Laboratory, Department of Fruit Science and Horticulture Technology, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar. The second, third and fourth hands were used for physical analysis (Mary and Sathiamoorthy, 2003) [6]. Analysis of these stored fruits was done after every two days starting from the day of harvest till the spoilage of fruits. Finger weight, weight of pulp, Weight of fruit peel were recorded with a digital weighing machine and expressed in gram, Pulp to peel ratio was expressed as proportion of pulp weight over peel weight of individual fruits. The physiological loss in weight was calculated by using below given formula: PLW (%) = [Initial weight of the fruit – Final weight of the fruit/Initial weight of the fruit]×100. Shelf life in days was considered generally as green plus yellow life. The shelf life of fruits was recorded based on the development of discolouration i.e. blackened skin, off flavor, fungal attack, skin shriveling and softness. The stage at which more than 10% of the stored fruits become unsuitable for consumption was considered as the end of shelf life and expressed in number of days.

Result and Discussions

Gradual physiological loss in weight and fruit weight of plant and ratoon crop of banana var. Grand Naine fruits after subjecting to different pre-harvest treatments during its storage period was given in Table No: 1.

Fruit weight and physiological loss in weight

The fruit weight gradually decreased with the increase in storage period. It is observed that storage period extended to 18th day and with increasing storage period physiological loss in weight increased (though all treatments did not continue up to 18th days from the day of storing as their fruits ripened well ahead). However, the increase had been at a reduced rate in the GA_3 and $CaCl_2$ treated fruits as compared to others.

Spraying of fruits with GA_3 @150 ppm was found significantly superior, as that has significantly lesser weight reduction throughout the storage period as compared to all other treatments. Among all the treatments the lowest physiological loss in weight of 2.07%, 3.42%, 4.81%, 7.25%, 9.53%, 12.66% in plant crop, 2.18%, 4.48%, 5.13%, 6.19%, 8.62%, 13.70% in ratoon crop were observed on 3rd, 6th, 9th, 12th, 15th and 18th day of storage respectively in GA_3 @ 150 ppm followed by $CaCl_2$ @ 4%.

The highest physiological loss in weight percentage of 5.35, 10.32, 12.22, 13.73 on plant crop and 5.63, 9.87, 13.07, 14.16 on ratoon crop were recorded on 3rd, 6th, 9th and 12th day of storage respectively in control. On T_{10}, T_7 and T_8 no fruits were left during 15th day. After GA_3 @ 150 ppm significantly lesser reduction in fruit weight was observed in $CaCl_2$ @ 4% followed by GA_3 @ 100 ppm and $CaCl_2$ @ 2% in both plant crop and ratoon crop of banana cv. Grand Naine but when we combine GA_3 and $CaCl_2$ in T_7, T_8 and T_9 there was no statistical superiority recorded.

GA_3 accelerate cell division and cell expansion hence fruit weight increased due to pre harvest application. Excess energy produced from the respiration process in the form of heat is released from the fruit by evaporation of water causing a weight loss. Similarly increase in the membrane permeability following respiratory climacteric could result in loss of moisture through the peel. Hence fruit weight gradually decreased and physiological loss in weight increased.

Due to reduction in moisture content, fruit weight gradually decreased. It may eventually makes the material becomes unusable as a result of wilting and shrinking (Salunke and Desai, 1984) [11]. In the present study, fruits treated with GA_3 @ 150 ppm recorded the least PLW followed by $CaCl_2$ @ 4% and found statistically superior. Reduction in weight loss might be due to decreased rate of respiration and transpiration, restricting ethylene accumulation and production in fruits during ripening. Reduction in PLW by GA_3 treatment was also observed in several of banana cultivars earlier by Mulagund *et al*., (2015) [8], Patel *et al*., (2010) [10] in cv. Grand Naine, Gangwar *et al*., (2008) [2] in cv. Harichal, Macwan (2012) [5] in cv. Robusta and Hakim *et al*., (2013) [3] in cv. Sabri and Amritsagar.

Calcium plays an important role on limiting respiration which was attributed to altered membrane permeability, as calcium could have reduced the endogenous substrate catabolism during respiration by limiting the diffusion of substrate from the vacuole to the cytoplasm and favored the uptake of sorbitol thus disallowing its involvement in reactions related to internal breakdown (Mignani, 1995) [7]. The reduction in loss of physiological weight may be also due to thickened cell wall consequent to calcium addition and checking of ethylene biosynthesis in addition to restricting gas exchange. Similar reasons were attributed by Mulagund *et al*., (2015) [8] in banana. In present study calcium unable to show its superiority over GA_3 but after GA_3 it shows superiority over control. The combination of GA_3 and $CaCl_2$ also did not show any significant result whereas GA_3 and $CaCl_2$ alone give better result. It might be due to antagonistic impact of Ca on GA_3.

Table 1: Effect of pre harvest treatment of GA_3 and $CaCl_2$ on physiological loss in weight (%) of banana cv. Grand Naine

Treatment	Fruit Weight		Storage days											
	0		3		6		9		12		15		18	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	154.9	148.7	4.12 (11.68)	4.20 (11.83)	6.47 (14.77)	7.55 (16.00)	8.42 (16.85)	9.06 (13.56)	11.02 (19.37)	10.06 (18.53)	14.63 (22.46)	13.71 (21.72)	-	-
T_2	155.2	148.9	3.19 (10.14)	3.31 (10.47)	4.93 (12.79)	5.63 (13/69)	7.51 (15.89)	6.42 (14.65)	9.60 (18.05)	9.73 (18.15)	13.34 (21.39)	12.38 (20.62)	-	-
T_3	155.9	150.2	2.17 (8.33)	2.32 (8.72)	3.92 (11.54)	3.81 (11.24)	4.79 (12.66)	5.23 (13.11)	7.23 (15.56)	7.31 (15.68)	9.97 (18.34)	10.22 (18.63)	13.16 (21.30)	14.23 (22.14)
T_4	172.7	164.3	3.31 (10.47)	3.16 (10.31)	5.52 (13.56)	6.19 (14.42)	8.15 (16.64)	7.12 (15.45)	10.48 (18.91)	11.21 (19.55)	14.33 (22.22)	14.17 (22.14)	-	-
T_5	173.3	166.3	2.75 (9.63)	3.02 (9.98)	4.21 (11.83)	4.67 (12.39)	5.27 (13.31)	5.42 (13.44)	8.24 (16.64)	7.98 (16.32)	10.97 (19.28)	11.91 (20.18)	13.93 (21.89)	14.05 (21.97)
T_6	179.3	172.4	2.07 (8.13)	2.18 (8.53)	3.42 (10.63)	4.48 (12.11)	4.81 (12.66)	5.13 (13.05)	7.25 (15.68)	6.19 (14.42)	9.53 (17.95)	8.62 (17.05)	12.66 (20.79)	13.70 (21.72)
T_7	158.8	151.3	5.34 (13.31)	4.78 (12.66)	9.52 (18.44)	9.17 (17.66)	12.03 (20.27)	11.51 (19.82)	13.63 (21.54)	14.29 (22.22)	-	-	-	-
T_8	161.6	154.2	5.10 (13.05)	5.21 (13.18)	8.96 (17.36)	9.73 (18.15)	11.29 (19.55)	12.41 (20.62)	12.32 (20.53)	13.03 (21.13)	-	-	-	-
T_9	162.1	155.7	4.18 (11.83)	4.37 (12.11)	7.92 (16.32)	8.11 (16.54)	11.15 (19.55)	10.82 (19.19)	12.44 (20.62)	11.52 (19.82)	14.82 (22.63)	13.41 (21.47	-	-
T_{10}	154.9	147.6	5.35 (13.44)	5.63 (13.69)	10.32 (18.72)	9.87 (18.34)	12.22 (20.44)	13.07 (21.22)	13.73 (21.72)	14.16 (22.14)	-	-	-	-
SE(m)+	5.61	5.80	0.245	0.268	0.230	0.241	0.268	0.277	0.327	0.369	0.234	0.227	0.154	0.627
CD(0.05)	16.67	17.23	0.72	0.79	0.67	0.71	0.79	0.82	0.96	1.09	0.69	0.67	0.45	0.38

Values in parenthesis are angular transformed value

Pulp weight, peel weight and pulp/peel

In this experiment, from table 2, 3 and 4, it is revealed that with the increasing storage period pulp weight increased, whereas peel weight decreased. In control and combination of GA_3 and $CaCl_2$, in T_7 and T_8 no fruits were left in 15th day of storage and on 18th day complete loss of fruits observed in all the treatments, except T_6, T_3 and T_5. Among all the treatments GA_3 @ 150 ppm was found statistically superior, followed by $CaCl_2$ @ 4% as the rate of increase in pulp weight and rate of decrease in peel weight was slower followed by GA_3 @ 100 ppm in both plant crop and ratoon crop.

Fruits under control had a steady uplift of pulp to peel ratio from 1.54 to 3.11 in plant crop and 1.56 to 3.23 in ratoon crop recorded during 0th to 12th day of storage and after that all fruits were discarded from control, GA_3 @ 50 ppm + $CaCl_2$ @ 2% and GA_3 @ 100 ppm + $CaCl_2$ @ 3%. During same period of storage lowest increment in pulp peel ratio of 1.30, 1.37, 1.43, 2.10, 2.32, 2.58, 2.97 in plant crop and 1.28, 1.33, 1.42, 2.08, 2.34, 2.63, 3.34 in ratoon crop recorded in GA_3 @ 150 ppm during 0th, 3rd, 6th, 9th, 12th, 15th and 18th days of storage, respectively. In GA_3 @ 150 ppm, $CaCl_2$ @ 4% and GA_3 @ 100 ppm only fruits left up to 18th day of storage, whereas from all other treatments fruits were discarded.

Pulp peel ratios found to increase with increase in storage period but pulp to peel ratio suggested a delay in ripening of banana fruit in the presence of GA_3 and $CaCl_2$ treatment in concentration dependent manner.

Due to osmotic pressure gradient the higher sugar concentration of the pulp relative to the peel, displacement of water occurs from the peel towards the fruit pulp during the ripening process for which pulp peel ratio increased with increase in storage period.

However present findings corroborate with the findings of Tapas *et al*., 2016 [13], Duguma *et al.*, (2014) [14] but in their experiment after harvesting they dip their fruits in solutions whereas, in one of this experiment pre harvest spraying was also done to the bunches in the field.

Table 2: Effect of pre harvest treatment of GA_3 and $CaCl_2$ on pulp: peel of banana cv. Grand Naine

Treatment	Storage days													
	0		3		6		9		12		15		18	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	1.37	1.36	1.54	1.52	1.66	1.67	2.29	2.33	2.69	2.77	3.26	3.45	-	-
T_2	1.35	1.36	1.48	1.51	1.60	1.69	2.16	2.19	2.51	2.49	3.02	2.89	-	-
T_3	1.28	1.31	1.36	1.39	1.42	1.46	2.09	2.10	2.36	2.37	2.62	2.66	3.07	3.32
T_4	1.37	1.35	1.50	1.49	1.64	1.61	2.19	2.26	2.42	2.65	2.91	3.05	-	-
T_5	1.35	1.35	1.45	1.47	1.59	1.60	2.07	2.14	2.39	2.43	2.67	2.87	3.12	3.25
T_6	1.30	1.28	1.37	1.33	1.43	1.42	2.10	2.08	2.32	2.34	2.58	2.63	2.97	3.34
T_7	1.52	1.58	1.77	1.83	2.04	2.15	2.95	2.83	3.21	3.09	-	-	-	-
T_8	1.48	1.51	1.73	1.76	1.97	2.08	2.75	2.63	3.04	2.96	-	-	-	-
T_9	1.42	1.38	1.61	1.59	1.83	1.78	2.33	2.43	2.67	2.71	3.24	3.17	-	-
T_{10}	1.54	1.56	1.81	1.84	2.23	2.11	2.71	2.93	3.11	3.23	-	-	-	-
SE(m)+	0.153	0.132	0.032	0.041	0.061	0.078	0.093	0.087	0.125	0.101	0.113	0.104	0.043	0.032
CD(0.05)	-	-	0.09	0.12	0.18	0.23	0.27	0.25	0.37	0.30	0.33	0.31	0.12	0.09

Table 3: Effect of pre harvest treatment of GA_3 and $CaCl_2$ on pulp weight (g) of banana cv. Grand Naine

Treatment	Storage days													
	0		3		6		9		12		15		18	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	89.5	85.8	90.0	85.9	90.4	86.1	98.7	94.6	100.5	98.2	101.2	99.5	-	-
T_2	89.2	85.8	89.7	86.6	90.8	88.3	98.1	95.6	100.3	95.9	101.0	96.9	-	-
T_3	87.5	85.2	87.9	85.3	88.1	86.0	100.4	96.5	101.5	97.9	101.6	98.0	102.1	98.9
T_4	99.8	94.3	100.2	95.2	101.4	96.1	108.9	105.8	109.4	105.9	110.1	106.2	-	-
T_5	99.5	95.5	99.9	95.9	101.9	97.5	110.7	107.2	112.1	108.4	112.3	108.6	113.1	109.3
T_6	101.3	96.1	101.5	96.3	101.9	96.6	115.6	110.3	116.2	113.3	116.9	114.1	117.2	114.4
T_7	95.8	92.7	96.0	93.2	96.4	93.8	104.3	97.9	104.6	98.9	-	-	-	-
T_8	96.4	92.8	97.2	93.2	97.6	94.0	105.2	97.8	106.6	100.3	-	-	-	-
T_9	95.1	90.3	95.8	91.4	96.6	92.30	100.8	98.40	103.2	100.7	105.5	102.5	-	-
T_{10}	93.9	89.9	94.4	90.1	96.9	90.2	99.3	95.7	101.1	96.8	-	-	-	-
SE(m)+	2.79	2.82	2.38	2.65	2.11	2.13	3.50	3.35	2.66	2.63	3.34	3.10	2.08	2.26
CD(0.05)	8.2	8.3	7.0	7.3	6.2	6.3	10.3	9.9	7.9	7.8	9.9	3.2	6.2	6.7

Table 4: Effect of pre harvest treatment of GA_3 and $CaCl_2$ on peel weight (g) of banana cv. Grand Naine

Treatment	Storage days													
	0		3		6		9		12		15		18	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	65.4	62.9	58.5	56.5	54.5	51.5	43.1	40.6	37.3	35.5	31.0	28.8	-	-
T_2	66.0	63.1	60.6	57.4	56.7	52.2	45.4	43.7	39.9	38.5	33.5	33.5	-	-
T_3	68.4	65.0	64.6	61.4	61.7	58.9	48.0	45.9	43.0	41.3	38.8	36.9	33.3	29.8
T_4	72.8	70.0	66.8	63.9	61.8	59.0	49.7	46.8	45.2	39.9	37.8	34.8	-	-
T_5	73.7	70.8	68.7	65.4	64.1	60.9	53.5	50.1	46.9	44.6	42.1	37.9	36.2	33.6
T_6	77.9	76.3	74.1	71.7	71.3	68.0	55.1	53.0	50.1	48.4	45.3	43.4	39.5	34.3
T_7	63.0	58.6	54.3	50.9	47.3	43.6	35.4	34.9	32.6	31.7	-	-	-	-
T_8	65.2	61.4	56.2	53.0	49.5	45.2	38.2	37.2	35.1	33.9	-	-	-	-
T_9	66.9	65.4	59.5	57.5	52.7	51.4	43.2	40.5	38.7	37.1	32.6	32.3	-	-
T_{10}	60.9	57.7	52.2	49.0	42.9	42.8	36.7	32.7	32.5	29.9	-	-	-	-
SE(m)+	0.98	2.82	2.38	2.61	2.33	1.94	2.09	1.69	1.48	1.37	1.71	1.62	0.80	0.87
CD(0.05)	2.9	8.3	7.1	7.8	6.9	5.8	6.2	5.0	4.4	4.1	5.09	4.8	2.38	2.58

Shelf life

Highly significant variations were obtained for the shelf life of both plant crop and ratoon crop of banana for this experiment. Maximum shelf life in GA_3 @ 150 ppm of 20days in plant crop and 19 days in ratoon crop was higher than that all other treatments (Table 5). After GA_3 @ 150 ppm treatment fruits under treatment of $CaCl_2$ @ 4% showed superiority with maximum shelf life of 18 and 19 days in plant crop and ratoon crop respectively. The maximum shelf life was observed in GA_3 @ 150 ppm whereas the minimum (13 days in plant crop and 12 days in ratoon crop) was in control.

The treatment GA_3 causes the decrease in the tissue permeability and thereby reduced the rate of water loss leading to delayed fruit ripening leading to enhanced self life (Nirupama *et al*., 2010). Zomo *et al*., (2014), Mulagund *et al*., (2015) [8], were also found similar result.

The rate of decay increased with the increase in ripening and days to storage. Decay of fruits is directly related to rate of respiration of fruits, which leads to deterioration of fruits and reduced shelf life (Tapas *et al*., 2016) [13]. Exogenous application of GA_3 generally reduces the ethylene level in fruits. Higher level of ethylene might cause softening of cell wall and decrease the firmness of fruit and decay % increases. GA_3 retarded degradation of polymers like starch, cellulose and hemicelluloses, thus maintaining the firmness of fruit for which fruit decay% reduceses (Mulagund *et al*., 2015) [8].

Apart from GA_3, the treatment with calcium chloride also showed promising result in extending shelf life. As Calcium was reported to be essential for structural integrity of both the cell wall and plasma membrane. Calcium treatments delayed softening and improve the fruit quality. Calcium chloride ($CaCl_2$) treatment has been shown to increase the shelf-life of fruits, mainly through making cell walls less accessible to pathogens and softening enzymes. Ca2+ does not appear to influence cell wall structure of bananas but appears to influence ripening physiology (Perera and Karunaratne, 2002).

Table 5: Effect of pre harvest treatment of GA_3 and $CaCl_2$ on shelf life of banana cv. Grand Naine

Treatment	Shelf life (Days)	
	2015-16	2016-17
T_1	16	15
T_2	17	17
T_3	18	19
T_4	16	17
T_5	18	18
T_6	20	19
T_7	13	13
T_8	14	13
T_9	15	15
T_{10}	13	12
SE(m)+	0.413	0.378
CD(0.05)	1.21	1.10

Conclusion

The present experiment entitled "Pre harvest application of GA_3 and $CaCl_2$ on physiological loss in weight (PLW)% and

storage life of banana cv. Grand Naine" conducted during 2015-16 and 2016-17 revealed that Pre harvest spray of GA_3 @ 150 ppm followed by $CaCl_2$ @ 4% delayed physiological weight loss, pulp peel ratio. The shelf life of fruits due to pre harvest treatment of GA_3 @ 150 ppm extended up to 20 days followed by 19 days in $CaCl_2$ @ 4%. Thus pre harvest application of GA_3@ 150 ppm was an efficient method of delaying banana fruit ripening with better quality and it allows growers to schedule banana fruit ripening.

References

1. Duguma T, Meseret C, Egigu, Muthuswamy. The effects of gibberellic acid on quality and shelf life of banana (*Musa* spp.), International Journal of Current Reearchs and Review, 2014;6(23):63-69.
2. Gangwar D, Katiyar PN, Singh JP, Singh PC. Effect of post harvest chemical treatments on shelf life and physico chemical quality of banana cv. Harichhal, The Asian Journal of Horticulture. 2008;3(2):386-388.
3. Hakim KA, Sarkar MA, Islam MK. Effect of post harvest treatments on physio chemical characters during storage of two banana (*Musa* spp) cv. Sabri and Amritasagar. International Journal of Biological Scienceses. 2013;3:168-179.
4. Kudachikar VB, Kulkarni SG, Vasantha MS, Aravinda Prasad B, Aradhya SM. Effect of modified atmosphere package on quality and shelf life of 'Robusta' banana (*Musa sp*.) stored at low temperature, Journal of Food Science Technology. 2007;48(3):319-324.
5. Macwan RM, Vihol NH. Effect of post harvest application of growth regulators, wax emulsion and packaging on physical characters and shelf life of banana cv. Robusta, The Asian Journal of Horticulture. 2012;7:541-545.
6. Mary AE, Sathiamoorthy S. Studied on Effect of packing treatments on green life and peel-split of banana cv. rasthali (AAB), Indian Journal of Agricultural Research. 2003;37(1):72-75.
7. Mignani. Calcium physiology and metabolism in fruit trees, Acta Horticulture. 1995;383:15-23.
8. Mulagund J, Porika H, Soorianathasundaram K, Deepika C. Influence of Growth Regulators Combined with Chemicals to Improve Post harvest Fruit Quality in Banana cv. Nendran (*Musa* AAB), Journal of Food Process. 2015;6:3.
9. Mustaffa MM. Vision 2030. National research Centre for Banana, Tiruchirapalli, India. 2011.
10. Patel NI, Padhiar BV, Patel NB. Effect of post harvest treatments on storage life of banana (*Musa paradisiacal* L.) cv. Grand Naine, The Asian Journal of Horticulture. 2010;5(1):80-84.
11. Salunkhe DK, Desai B. Post harvest biotechnology of fruits. Boca Raton. CRC press florida, U.S.A: 1984;1:168.
12. Saravanan S, Suchitra V, Rakesh K, Bandral J. Influence of wax coating and indigenous potassium permanganate based ethylene absorbents on shelf life of banana cv. Dwarf Cavendish, International Journal of Processing and Post-Harvest Technology. 2012;3:129-133.
13. Tapas S, Veena J, Tanmoy S, Sayan S. Effect of post harvest treatments on shelf life and quality of banana cv. Grand Naine, International Journal of Agriculture Sciences, 2016;8(61):3505-3509.
14. Uma S. Indigenous Varieties for Export market. International Conference on Banana, October 24-26, NRCB, Tamil Nadu. India. 2008.