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Effect of post harvest treatments on storage life of banana (*Musa paradisiaca* L.) cv. GRAND NAINA

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ABSTRACT

Banana is one of the major fruit crops grown in Gujarat with high productivity. "GRAND NAINE' variety of banana has been popularized because of high yield potential with quality fruits against so popular "BASRAI" bananas. Post Harvest life of banana fruit is short for its perishable and climacteric nature. Physiological *vis-á-vis* biochemical changes occur during ripening. The research was carried out at the Department of Pomology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari to study the effect of some chemicals and growth regulators on post harvest life of banana cv. GRAND NAINE. Results revealed that GA_3 150 ppm and Waxol 8% significantly reduced physiological weight loss, delayed ripening, reduced percentage of ripe fruits, increased marketable fruits (%) with firm flesh for longer time, extended shelf life.

Key words : Post harvest, Banana, Storage life, GA_3, Waxol, $AgNO_3$, $CaCl_{2.}$

Banana (*Musa paradisiaca* L.)is one of the most important fruit crops of the world, In India, banana is predominant and popular among the people as they are relished and consumed by all kind of people. In Gujarat, banana cultivation increases day by day and it is believed that Basrai banana is being replaced by new banana variety Grand naine which is becoming popular among Gujarat banana growers due to its high yield potential with quality fruits.

Since banana is a perishable climacteric fruit and ripens after harvest, post harvest biochemical changes occur and continue up to senescence. Attempts were made to delay ripening using different chemicals and growth regulators. Biochemical changes in banana cv. Lacatan through post harvest treatment were studied by Rao and Chundawat (1986). Since then the information on commercially grown variety GRAND NAINE with post harvest treatment is not available from South Gujarat region. With a view to find out the suitable chemical on storage life of banana, the study was carried out at Department of Pomology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during 2002-03.

MATERIALS AND METHODS

The experiment was conducted in Completely Randomized Design with three repetitions. There were five chemicals with different concentrations *viz*., GA_3 (50,100,150 ppm), Kinetin (10, 15 and 20 ppm), $CaCl_2$ (0.5, 1.0 and 1.5 %), $AgNO_3$ (0.2, 0.4 and 0.6 µ m) and Waxol (4, 6 and 8 %) with water dip as control. The uniform sized banana hands were dipped in each solution for 30 minutes and then air dried for 30 minutes. Distilled water was used for water dip treatment. The fruits were kept at an ambient temperature for recording the observations.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been presented under following heads:

Physiological wt. loss (%):

Data pertaining to weight loss percentage as shown in Table 1 revealed that on 3rd day of storage, GA_3 150 ppm reduced the physiological loss of weight (3.53 %) which was at par with GA 100 ppm (3.80 %), GA_3 50 ppm (4.05 %), Waxol 8% (4.01) and Waxol 6% (4.25%) over control. Similar results were obtained on 6th and 9th day of storage. While, GA_3 150 ppm was effective to minimize the weight loss at 14.72 % and 18.43% on 12th and 15th day of storage, respectively compared to control. In general, GA_3 at all concentrations and Waxol at 8 and 6% reduced the physiological weight loss. Reduction of weight loss might be due to the reduction in respiratory activities through GA_3 as well as Waxol. Rao and Chundawat (1986) and Patil and Hulamani (1988 b) found the similar results which are in conformity with the present findings.

All the concentrations $CaCl_2$ and $AgNO_3$ did not

Table 1 : Effect of post harvest treatments on physiological loss in weight (%) of banana var. GRAND NAINE

Treatments	No. of days (storage period)				
	3rd	6th	9th	12th	15th
GA_3 50 ppm	0.5 (4.05)	1.88 (7.88)	3.53 (10.82)	7.28 (15.65)	10.42 (18.83)
GA_3 100 ppm	0.48 (3.80)	1.75 (7.66)	3.42 (10.65)	7.15 (15.50)	10.33 (18.74)
GA_3 150 ppm	0.38 (3.53)	1.60 (7.20)	3.30 (10.46)	6.49 (14.72)	10.00 (18.43)
Kinetin 10 ppm	1.40 (6.79)	2.75 (9.54)	5.87 (14.02)	7.49 (15.88)	12.01 (20.27)
Kinetin 15 ppm	1.20 (6.28)	2.42 (8.94)	5.70 (13.81)	7.35 15.73)	12.92 (20.19)
Kinetin 20 ppm	1.15 (6.15)	2.30 (8.70)	5.60 (13.68)	7.26 (15.63)	11.81 (20.09)
$CaCl_2$ 0.5 %	0.85 (8.13)	3.01 (9.90)	5.70 (13.81)	9.72 (18.16)	15.81 (23.42)
$CaCl_2$ 1.0 %	0.80 (5.13)	2.90 (9.80)	5.51 (13.57)	9.60 (18.04)	15.69 (23.34)
$CaCl_2$ 1.5 %	0.75 (4.96)	2.80 (9.63)	5.40 (13.43)	9.49 (17.94)	15.70 (23.34)
$AgNO_3$ 0.2 mm	0.74 (4.96)	2.30 (8.70)	4.73 (12.56)	8.51 (16.96)	12.43 (20.64)
$AgNO_3$ 0.4 mm	0.70 (5.70)	2.21 (8.54)	4.60 (12.38)	8.40 (16.84)	12.29 (20.52)
$AgNO_3$ 0.6 mm	0.65 (4.62)	2.04 (9.38)	4.49 (12.23)	8.29 (16.73)	12.08 (20.33)
Waxol 4 %	0.60 (4.44)	2.01 (8.15)	3.95 (11.46)	7.23 (15.59)	10.70 (19.09)
Waxol 6 %	0.55 (4.25)	1.90 (7.92)	3.72 (12.12)	7.17 (15.53)	10.55 (18.95)
Waxol 8 %	0.49 (4.01)	1.83 (7.77)	3.61 (10.95)	7.13 (15.48)	10.30 (18.71)
Control	2.05 (9.54)	5.53 (13.37)	8.70 (17.15)	13.56 (21.60)	16.97 (24.32)
S. E. ±	0.3056	0.3113	0.3440	0.301	0.07
C.D. (P=0.05)	0.8812	0.890	0.9931	0.8843	0.2015
C.V. %	6.931	4.181	3.3313	2.251	0.4013

Figures in parenthesis indicate angular transformed values.

influence on reduction of banana ripening from 6th day to the end of storage. Ripening process was rapid in the fruits treated with both the chemicals.

Days taken to ripen (shelf life) :

The maximum days were significantly recorded for total ripening of bananas by GA_3 150 ppm (23 days). The next best treatments were Waxol 8% and GA_3 100 ppm which recorded 20.67 days equally for both the treatments. Untreated fruits (control) ripened at 9th days of storage. Overall, GA_3 150 ppm was found to be very effective to extend the shelf life by 14 days over control (Table 2).

Days to colour break:

All the treatments under investigation showed significant effect on days taken to break the skin colour over control. The maximum days (11) were recorded in Waxol 8% which was at par with GA_3 150 ppm having 10.33 days. On the other hand, two days were taken to break colour by untreated fruits (control) (Table 2). The possible reason is that Waxol controls the transpiration and respiration through sealing the stomata and thereby reduce the development of yellow pigments during ripening of bananas. This resulted in to attaining the green colour for longer period. Likewise, GA_3 might have promoted the synthesis of chlorophyll and retention of green colour. Thus, the present findings are in line up with Madhav Rao and Rama Rao (1979), Rao and Chundawat (1986) and Patil and Hulmani (1998 b) in banana.

Colour development of fruit :

Initially, the harvested banana fruits were green which gradually turned to yellow passing through the stages *viz.,* green, greenish yellow with green tip, uniform yellow and yellow with brown spots during ripening process. Development in colour was rapid in untreated control compared to treated fruits with different substances. Fruits treated with GA_3 and Waxol exhibited less brownish spots on 12th day of storage. It is obvious from the Table 2 that fruits remained green even up to 6th day in GA_3 150 ppm and Waxol 8% treatments. This might be due to control in ethylene level and respiratory activity. Madhav Rao and Rama Rao (1979) and Patil and Hulmani (1998 b) found the similar results which supported the present findings.

Fruit texture (kg/cm²):

On 13th day of observation, banana fruits treated with GA_3 150 ppm showed significant higher pressure value (5.90 kg / cm^2) which was at par with Waxol 8% (5.33 kg/cm^2). On 16th days of observation, GA_3 150 ppm exhibited promising results recording 2.24 kg/cm^2 followed by Waxol 8% and GA_3 100 ppm with 2.19 and 2.12 kg/ cm^2, respectively, indicating the firmness of treated fruits.

Table 2 : Effect of post-harvests treatments on average number of days taken to ripen (shelf life) and colour break and colour development and fruit texture (kg/cm^2) in banana cv. GRAND NAINE

Treatments	Av. No. of days taken to ripen (shelf life)	Days taken to colour break	No. of days. (Storage period)				Fruit Texture (kg/cm^2) on number of days		
			3rd	6th	9th	12th	13th	15th	19th
GA_3 50 ppm	20.00	9.00	Green	Greenish Yellow	Uniform Yellow	Yellow with small spots	5.12	1.78	1.13
GA_3 100 ppm	20.67	9.33	Green	Greenish Yellow	Uniform Yellow	Yellow with small spots	5.18	2.12	1.36
GA_3 150 ppm	23.00	10.33	Green	Green	Greenish Yellow	Yellowish Green	5.90	2.24	1.82
Kinetin 10 ppm	13.67	6.00	Greenish yellow	Uniform Yellow	Yellow with brown spots	Yellow with big brown spots	4.00	1.16	0.64
Kinetin 15 ppm	14.33	7.00	Greenish Yellow	Uniform Yellow	Yellow with brown spots	Yellow with big brown spots	4.20	1.41	0.74
Kinetin 20 ppm	15.00	8.00	Green	Yellow with Green tip	Yellow with brown spots	Yellow with big brown spots	4.34	1.67	0.81
$CaCl_2$ 0.5 %	13.00	5.00	Greenish Yellow	Uniform Yellow	Yellow with brown spots	Yellow with big brown spots	3.05	1.07	0.68
$CaCl_2$ 1.0 %	13.33	6.00	Greenish Yellow	Uniform Yellow	Yellow with brown spots	Yellow with big brown spots	3.35	1.33	0.67
$CaCl_2$ 1.5 %	13.67	7.33	Green	Yellow with Green tip	Yellow with brown spots	Yellow with big brown spots	3.64	1.52	0.75
$AgNO_3$ 0.2 mm	14.00	4.33	Greenish Yellow	Uniform Yellow	Yellow with brown spots	Yellow with big brown spots	3.10	1.46	0.78
$AgNO_3$ 0.4 mm	14.33	4.67	Greenish Yellow	Uniform Yellow	Yellow with brown spots	Yellow with big brown spots	3.31	1.60	0.80
$AgNO_3$ 0.6 mm	15.33	5.00	Green	Yellow with Green tip	Uniform Yellow	Yellow with brown spots	3.51	1.70	0.81
Waxol 4 %	18.00	8.00	Green	Greenish Yellow	Uniform Yellow	Yellow with brown spots	4.76	1.52	0.71
Waxol 6 %	19.33	9.00	Green	Greenish Yellow	Uniform Yellow	Yellow with brown spots	4.97	1.77	1.03
Waxol 8 %	20.67	11.00	Green	Green	Greenish Yellow	Yellowish Green	5.33	2.19	1.86
Control	9.00	2.00	Greenish Yellow	Yellow with Green tip	Yellow with brown spots	Yellow with big black spots	3.50	0.81	0.51
S. E. ±	0.61	0.261	-	-	-	-	0.24	0.07	0.03
C.D (P=0.05)	1.76	0.759	-	-	-	-	0.70	0.21	0.09
C.V. %	4.66	4.6123	-	-	-	-	7.16	5.68	3.90

Whereas, on 19th days, Waxol 8% significantly found the best treatment with 1.86 kg/cm^2 fruit pressure followed by GA_3 150 ppm (1.82 kg/cm^2) (Table 2).

Decrease in fruit texture is because of ripening of banana fruits during storage. An exogenous application of gibberellin like substances reduces the ethylene level and there by reduction in the softening of cell wall and gives the firmness to fruits. GA_3 also retarded degradation of polysaccharides and maintained the firmness of fruit. These results are in agreement with Madhav Rao and Rama Rao (1979) and Patil and Hulmani (1998b) in banana.

Percentage of ripe fruit:

There was gradual increase in percentage of ripe fruits with the increase in concentration of all the

Table 3 : Effect of post harvest treatments on ripe and marketable banana fruit cv. GRAND NAINE during storage

Treatments	Storage period (in days)							
	Ripe fruit (%)				Marketable fruit (%)			
	6th	9th	12th	15th	3rd	6th	9th	12th
GA_3 50 ppm	1.93	13.47	23.72	41.80	96.07	89.03	78.10	72.35
	(7.98)	(21.53)	(29.14)	(40.28)	(78.56)	(70.65)	(62.09)	(58.27)
GA_3 100 ppm	1.61	13.21	23.51	41.00	98.00	90.52	80.15	74.50
	(7.28)	(21.31)	(29.00)	(39.81)	(81.86)	(72.06)	(63.54)	(59.67)
GA_3 150 ppm	1.40	11.15	21.91	39.04	99.97	93.05	82.30	76.33
	(6.79)	(19.50)	(27.90)	(38.66)	(89.00)	(74.01)	(65.12)	(60.88)
Kinetin 10 ppm	5.81	23.91	50.63	78.00	92.09	78.48	62.28	37.28
	(13.94)	(29.27)	(45.36)	(62.03)	(73.66)	(62.36)	(52.10)	(37.63)
Kinetin 15 ppm	5.69	23.78	50.30	77.40	94.00	80.45	64.06	38.81
	(13.67)	(29.18)	(45.17)	(61.61)	(75.82)	(63.75)	(53.16)	(38.52)
Kinetin 20 ppm	5.55	23.60	50.00	76.43	95.00	82.09	66.10	42.52
	(13.62)	(29.06)	(45.00)	(60.95)	(77.05)	(64.95)	(54.39)	(40.69)
$CaCl_2$ 0.5 %	15.43	36.30	64.20	97.00	86.39	76.45	56.18	36.00
	(23.12)	(37.04)	(53.24)	(80.02)	(68.35)	(60.96)	(48.54)	(36.86)
$CaCl_2$ 1.0 %	15.30	36.11	64.00	95.80	88.55	78.98	58.22	38.59
	(23.02)	(36.93)	(53.13)	(78.17)	(70.22)	(62.71)	(49.73)	(38.40)
$CaCl_2$ 1.5 %	16.12	36.00	63.60	93.04	89.63	77.98	60.41	40.00
	(22.88)	(36.86)	(52.89)	(74.10)	(71.21)	(62.01)	(51.00)	(39.23)
$AgNO_3$ 0.2 mm	12.50	30.55	63.50	88.30	92.82	81.50	62.39	38.63
	(20.70)	(33.53)	(52.23)	(69.99)	(74.45)	(64.52)	(52.13)	(38.42)
$AgNO_3$ 0.4 mm	12.39	30.40	61.10	87.00	93.99	82.47	63.08	38.24
	(20.62)	(33.46)	(51.41)	(68.86)	(75.20)	(62.24)	(52.58)	(38.19)
$AgNO_3$ 0.6 mm	12.21	30.07	60.70	86.05	94.66	83.39	64.11	40.10
	(20.41)	(33.25)	(51.17)	(68.02)	(76.83)	(65.94)	(53.19)	(39.28)
Waxol 4 %	3.21	15.62	25.05	41.80	98.07	91.71	76.00	67.16
	(10.36)	(23.27)	(30.03)	(40.28)	(82.01)	(73.24)	(60.66)	(55.03)
Waxol 6 %	2.86	14.40	24.12	42.43	98.61	92.09	77.62	68.98
	(9.73)	(22.30)	(29.41)	(40.64)	(83.22)	(73.66)	(61.76)	(56.15)
Waxol 8 %	2.10	13.00	23.30	41.73	99.70	92.15	81.09	70.29
	(8.33)	(21.13)	(28.86)	(40.23)	(86.86)	(73.72)	(64.22)	(56.97)
Control	19.44	65.29	83.33	97.67	82.90	63.35	41.71	12.17
	(26.17)	(53.90)	(65.90)	(81.21)	(65.57)	(52.74)	(40.22)	(20.41)
S. E. ±	0.21	0.41	0.45	0.48	0.89	0.80	0.67	0.89
C.D. (P=0.05)	0.63	1.19	1.30	1.42	2.59	0.98	1.93	2.59
C.V. %	1.70	1.68	1.29	1.01	1.43	0.63	1.48	2.46

chemicals and growth regulators with significant difference, however, GA_3 150 ppm and Waxol 8% reduced the percentage of ripe fruits compared to all other treatments (Table 3). Thus, GA_3 (150 ppm) and Waxol (8%) delayed the ripening process and there by increase the shelf life of banana fruits cv. GRAND NAINE. Ripening was delayed due to the reduction in respiratory activities. This might have resulted in to reduction in the ripening events like hydrolysis of starch and enzymes like peroxidase.

Waxol 8% might have reduced the respiration process through sealing the stomatal activity resulting in to reduction in ripening process. The results of present investigation are in accordance with Rao and Chundawat (1986) and Patil and Hulmani (1998 b).

On the other hand, Kinetin reduced the percentage of ripening in banana at 6th day of storage, but later on, ripening was rapid after 9th day of storage. Gibberellins like substances might have controlled the ethylene production and enzymatic activities. Reduction in respiration and transpiration activities might have reduced the ripening process. Corroborative results were obtained by Madhav Rao and Rama Rao (1979), Rao and Chundawat (1991) and Patil and Hulmani (1998 b) in

banana.

Percentage of marketable fruit:

A perusal of data revealed that the percentage of marketable fruits were significantly exhibited variation among treatments from 3rd day to 12th day of storage at an ambient temperature. GA_3 150 ppm treatment found superior over all the treatments including control. However, GA_3 100 ppm and Waxol 8% were equally effective to control the ripening process and thereby increased the percentage of marketable fruits during storage period (Table 3). On 12th day of storage, GA_3 150 ppm recorded the highest value of marketable fruits (60.88%) which was at par with GA_3 100 ppm (59.67%). Waxol 8% also produced the similar effect.

Dipping in gibberellic acid might have controlled the ethylene production and enzymatic activity too. Reduction in respiration (through wax coating) and transpiration activities might have reduced the ripening process. Thus, these treated fruits retained at better marketable quality. This was in line with the findings of Rao and Chundawat (1986) and Das *et al.* (1996) in banana.

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