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Effect of different concentration of ethylene and application of lime on ripening behaviour of banana (*Musa paradisiaca*) cv. Safed velchi

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Abstract

An investigation on the Effect of ethylene on ripening behaviour of banana. cv. Safed Velchi. was undertaken at the Department of Horticulture, College of Agriculture, Dapoli during May to July, 2012. The experiments were laid out in Completely Randomised Design with seven treatments viz., T₁- 100ppm ethrel; T₂- 200ppm ethrel; T₃- 300ppm ethrel; T₄- 400ppm ethrel; T₅- 500ppm ethrel; T₆- Lime application; T₇- Control and 3 replications. Banana bunches were harvested at 135 days after flowering, i.e. proper stage of maturity and utilized for ripening study at ambient storage condition.

The highest (32.18 °B) total soluble solids was found in T₅ (500ppm ethrel) at 15days. This was at par with T₄ (400ppm ethrel). The maximum acidity (0.67%) was found in T₇ (control). This was at par with T₆ (lime application). The highest (8.81%) reducing sugar was found in T₃(300ppm ethrel). This was at par with the treatment T₄ (400ppm ethrel). The highest (12.44%) total sugar was found in T₅(500ppm ethrel). This was at par with the T₄ (400ppm ethrel).

Different concentration of ethrel treatments helped to enhance ripening of banana fruit i.e. advancement of days. The highest (10.29%) physiological loss in weight was found in treatment T₅ i.e. (500ppm ethrel), which was 18.58%, 24.20%, and 27.46% at 6th, 9th, 12th and was at par with T₄ i.e. (400ppm ethrel). The lowest physiological loss in weight of 6th day (7.52), 9th (9.97), 12th day (11.63) and 15th day (15.37) banana fruit was recorded in T₇ (control). However, the shelf life of fruit in T₅ (6.33 days) also less followed by T₄ (6.67days). However, increases in concentration of ethylene reduce the shelf life of banana.

Keywords: Banana, Ethylene, Ripening, physico-chemical properties

1. Introduction

Banana (*Musa paradisiaca* L.) is a large herbaceous perennial monocot plant which belongs to the family Musaceae. Banana, one of the earliest crops cultivated by man remains to be the most important fruit crop especially of the tropics. The earliest reference to banana is found in the Hindu classics. A picturesque description of the banana plantation around the green bower of "Valmiki Maharshi" is given in the "Ramayana". Banana could be considered as "poor man's apple" and cheapest among all fruits in the country. Banana is a rich source of carbohydrates, vitamins A and fair source of Vitamin C, B₁ and minerals. The nutritive value of banana has been appreciated for a very long time and it provides a more balanced diet than many other fruits. From the nutritional point of view, banana has a calorific value ranging from 116 calories per 100 g and is closely comparable with potatoes but digested more easily (Gopalan *et al.*, 2004) [4].

Safed Velchi is considered a good quality fruit for table purpose and is cultivated in the Thane and Nasik districts of Maharashtra. It is grown under the shade of arecanut gardens in the South Kanara districts of Karnataka. Safed Velchi is considered a good quality fruit for table purpose. This variety is medium size with slender yellowish green pseudo stem and can be recognized by the raddish petiole margins, large fruits, very thin and papery rind and white firm flesh that is very sweet. The average bunch weight is about 12 kg with about 150 fruits/bunch. The variety is gaining popularity among the farmers especially as an intercrop in coconut based cropping system. Due to its excellent quality, fruits gets higher prices in market as compared to Grand Nain a leading commercial variety in Maharashtra. However, no research work has been done on ripening behaviour of this variety. Hence experiment was conducted to Effect of different level of ethylene on ripening behaviour of Banana (*Musa paradisiaca* L.) cv. Safed Velchi was carried out.

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2. Material and Method

The experimental banana orchard is situated in coconut based farming system, nursery no.4, Department of Horticulture, College of Agriculture, Dr. B.S.K.K.V, Dapoli. These trees are planted at 2.5 x 2.5m spacing with uniform vigour and growth. This orchard is located at an elevation of 280 meters above MSL. The climate of Dapoli is warm and humid with the mean annual rainfall 4721.1 mm.

An investigation on the Effect of ethylene on ripening behaviour of banana. cv. Safed Velchi. was undertaken at the Department of Horticulture, College of Agriculture, Dapoli during May to July, 2012. The experiments were laid out in Completely Randomised Design with seven treatments viz., T₁- 100ppm ethrel; T₂- 200ppm ethrel; T₃- 300ppm ethrel; T₄- 400ppm ethrel; T₅- 500ppm ethrel; T₆- Lime application; T₇- Control and 3 replications. Banana bunches were harvested at 135 days after flowering, i.e. proper stage of maturity and utilized for ripening study at ambient storage condition. After giving above treatments fruits were observed for the chemical parameter i.e. sugars, acidity, Physiological loss in weight and shelf life of banana at two days intervals.

3. Result and Discussion

3.1 TSS (⁰Brix)

The changes in the TSS content of banana fruits with ethrel and lime application treatments are presented in Table 1 depicted that the highest (3.65⁰B) TSS was observed in treatment T₇. The lowest (3.60⁰B) TSS of banana fruit was noticed in T₂ (200ppm). Similarly at 3rd day of storage the lowest (4.37⁰B) TSS of banana fruit was found in treatment T₁ (100ppm), whereas the highest (17.02⁰B) TSS was observed in T₅(500 ppm ethrel). Similar trend was observed at 6th day of storage period. The highest (20.99⁰B) TSS was obtained in T₅ (500 ppm ethrel). Whereas the lowest (12.21⁰B) TSS was recorded in treatment T₇ (control). Similarly, at 9th day of storage the TSS of banana fruit was highest (27.84⁰B) in treatment T₅ (500 ppm ethrel) and was significantly superior over rest of the treatments. The lowest (24.16⁰B) TSS of banana fruit was found in T₆ (lime application). However, at 15th day of storage highest (32.18⁰B) TSS of banana fruit was obtained in treatment T₅ (500 ppm ethrel) and it was superior over all the treatments. The lowest (28.20⁰B) TSS of banana fruit was noticed in treatment T₇ (control).

These results corroborate well with the Das *et al.*, (2011) ^[1] Mahajan *et al.*, (2009) ^[6] in banana Cv. Grand Naine.

Table 1: Effect of ethrel treatments on total soluble solids of banana cv. safed velchi

Treatment	TSS ⁰ B						Mean
	At 1st day	At 3rd day	At 6th day	At 9th day	At 12th day	At 15th day	
T ₁	3.64	4.37	12.24	24.21	5.14	28.68	13.05
T ₂	3.60	4.94	13.09	26.38	7.81	28.91	14.12
T ₃	3.62	7.03	13.51	26.67	8.14	29.94	14.82
T ₄	3.62	16.19	17.51	26.96	8.58	30.72	17.26
T ₅	3.64	17.02	20.99	27.84	12.44	32.18	19.02
T ₆	3.63	5.41	12.96	24.16	11.96	28.63	14.46
T ₇	3.65	4.54	12.21	24.19	9.65	28.20	13.74
Mean	3.63	8.50	14.64	25.77	9.10	29.61	
S.E.m ±	0.026	0.085	0.051	0.100	0.560	0.072	
C.D. at 1%	0.080	0.020	0.031	0.018	0.026	0.028	

3.2 Titratable acidity (%)

The analysis of titratable acidity (Table.2) of ethrel and lime treated banana fruit at 3rd day of storage revealed that significantly highest (0.37%) titratable acidity was observed in treatment T₆ (lime application) and the lowest (0.32%) titratable acidity of banana fruit was recorded in T₄ (400ppm). However at 6th day of storage titratable acidity was highest (0.68%) in T₁ (100 ppm ethrel), whereas lowest (0.43%) titratable acidity was recorded in T₅ (500 ppm ethrel). Similarly at 9th day of storage the titratable acidity of banana fruit in treatment T₃ (300 ppm ethrel) was highest (0.14%) which was the lowest (0.06%) titratable acidity of banana fruit was found in T₄i.e. 400 ppm ethrel. Similar trend was observed at 12thday of storage period. Highest (0.67%) titratable acidity of banana fruit was observed in treatment T₇ (control) and the lowest (0.52%) titratable acidity of banana

fruit was noticed in T₂. Similarly, at 15th day of storage the highest (0.55%) titratable acidity of banana fruit was observed in treatment T₁ (100ppm ethrel) superior over rest of the treatments. The fruits of treatment T₂ (200 ppm ethrel) recorded the lowest (0.41%) titratable acidity.

It is apparent from the above results obtained that during ripening of the ethrel treated banana fruits had minimum titratable acidity on different day of storage period according to concentration of ethrel. Due to ethrel there was an increase in the membrane permeability which permits the acid stored in cell vacuole to respire at faster rate and it results in to the reduction of acidity during ripening.

Results on similar line were observed by Kulkarni *et al.*, (2004) ^[5] in mango cv. Neelum, Mahajan *et al.*, (2009) ^[6] in banana cv. Grand nine in banana fruits.

Table 2: Effect of ethrel treatments on acidity (%) of banana cv. safed velchi

Treatments	Acidity (%)						Mean
	at 1st day	at 3rd day	at 6th day	at 9th day	at 12th day	at 15th day	
T ₁	0.17	0.35	0.68	0.13	0.64	0.55	0.42
T ₂	0.17	0.33	0.61	0.12	0.52	0.41	0.36
T ₃	0.15	0.33	0.53	0.14	0.56	0.52	0.37
T ₄	0.15	0.32	0.48	0.06	0.55	0.45	0.33
T ₅	0.15	0.33	0.43	0.09	0.54	0.41	0.32
T ₆	0.16	0.37	0.58	0.12	0.52	0.44	0.36
T ₇	0.17	0.34	0.54	0.08	0.67	0.43	0.37
Mean	0.15	0.34	0.55	0.11	0.57	0.46	
SEm±	0.027	0.007	0.010	0.006	0.009	0.009	
CD at 1%	0.081	0.020	0.031	0.018	0.026	0.028	

3.3 Reducing sugars (%)

The data (Table.3) regarding analysis of banana fruit at initial day of storage indicated that highest (0.08%) reducing sugars were found in treatment T₁. The lowest (0.06%) reducing sugars were recorded in T₆. Similarly at 3rd day of storage the highest (0.37%) reducing sugars was observed in treatment T₆ and the lowest (0.32%) reducing sugars of banana fruit was recorded in T₄. Similarly, at 6th day of storage the highest (5.75%) reducing sugars was found in treatment T₅ and the lowest (3.57%) reducing sugars of banana fruit were observed in T₁. However, at 9th day of storage the lowest (4.38%) reducing sugars was noticed in treatment T₁, whereas the

highest (7.86%) in T₅ (500 ppm). Similarly, at 12th day of storage the highest (7.20%) reducing sugars was found in treatment T₇ and was superior over all the treatments. The lowest (3.14%) reducing sugar of banana fruit was recorded in T₂. Similar trend was observed at 15th day of storage period. The highest (8.81%) reducing sugars were noticed in treatment T₃ but were at par with T₄ (8.52%). The lowest (5.80%) reducing sugars of banana fruit were found in treatment T₆.

Result on similar line were observed by Kulkarni *et al.*, (2004) [5] in mango fruits Cv. Neelum, Godambe (2012) [3] in Alphonso mango.

Table 3: Effect of ethrel treatments on reducing sugar (%) of banana cv. safed velchi

Treatment	Reducing sugar						Mean
	At 1st day	At 3rd day	At 6th day	At 9th day	At 12th day	At 15th day	
T ₁	0.08	0.35	3.57	4.38	3.83	6.63	3.14
T ₂	0.07	0.33	5.74	7.17	3.14	7.44	3.98
T ₃	0.07	0.33	5.60	6.95	5.51	8.81	4.54
T ₄	0.08	0.32	5.70	5.65	5.02	8.52	4.21
T ₅	0.08	0.33	5.75	7.86	5.20	6.74	4.32
T ₆	0.06	0.37	4.69	6.53	4.88	5.80	3.72
T ₇	0.08	0.34	4.24	4.96	7.20	7.36	4.03
Mean	0.08	0.34	5.04	6.21	4.97	7.33	
SEm±	0.009	0.007	0.130	0.181	0.149	0.410	
CD at 1%	0.028	0.020	0.394	0.548	0.451	1.244	

3.4 Total sugars (%)

The data (Table.4) regarding analysis of banana fruit at initial day of storage revealed that the significantly highest (0.62%) total sugars were observed in treatments T₇. The lowest (0.30%) total sugars were noticed in T₄ (400ppm ethrel). Similarly, at 3rd day of storage the lowest (2.34%) total sugars of banana fruit was found in treatment T₆ and was at par with T₇ (2.38%) and T₁ (2.40). The highest (5.05%) total sugars were observed in T₅ (500 ppm ethrel) significantly superior than all other treatment. However, at 6th day of storage the highest (6.78%) total sugars was obtained in T₃ and was at par with the T₄ (6.70%), T₂ (6.62%), T₅ (6.54%). The lowest (4.02%) total sugars were recorded in treatment T₁ (100ppm) and was at par with the T₇ (4.62%). Similarly at 9th day of storage the total sugars of banana fruit was highest (9.46%) in

T₅ (500 ppm ethrel) which was superior over rest of the treatments. The shortest (6.14%) total sugars of banana fruit were found in T₇ (lime application). Similarly at 15th day of storage period. The highest (6.76%) total sugars of banana fruit was obtained in treatment T₅ (500ppm ethrel). The lowest (4.10%) total sugars of banana fruit was noticed in treatment T₁ (control).

It is evident from the above results obtained that under study the ethrel treated banana fruits showed highest total sugars over lime application and control treated fruits. The increase in total sugars content during ripening could be attributed to hydrolysis of starch into sugars.

Result on similar line were observed in Teatota *et al.*, (1972) [7] in banana cv. Basarai,

Table 4: Effect of ethrel treatments on total sugars (%) of banana cv. safed velchi

Treatment	Total sugars						Mean
	At 1st day	At 3rd day	At 6th day	At 9th day	At 12th day	At 15th day	
T ₁	0.40	2.40	4.02	8.52	5.14	4.10	4.10
T ₂	0.43	2.89	6.62	9.07	7.81	5.36	5.36
T ₃	0.49	4.09	6.78	8.02	8.14	5.50	5.50
T ₄	0.49	4.24	6.70	8.21	8.58	5.64	5.64
T ₅	0.30	5.05	6.54	9.46	12.44	6.76	6.76
T ₆	0.38	2.34	5.77	8.13	11.96	5.72	5.72
T ₇	0.62	2.38	4.62	6.14	9.65	4.68	4.68
Mean	0.44	3.34	5.86	8.22	9.10		
SEm±	0.209	0.123	0.196	0.078	0.560		
CD at 1%	0.633	0.374	0.596	0.235	1.698		

3.5 Physiological loss in weight (%)

The data (Table.5) regarding analysis of banana fruit at 3rd day of storage indicated that significantly highest (5.85%) physiological loss in weight was found in treatment T₅ i.e. (500ppm ethrel). The lowest (4.06%) physiological loss in weight was recorded in T₇ (control). However, at 6th day of storage the highest (10.29%) physiological loss in weight was observed in treatment T₅ i.e. (500ppm ethrel) and was

superior over rest of the treatments, which was the lowest (7.52%) physiological loss in weight of banana fruit was recorded in T₇ (control). Similarly, at 9th day of storage the highest (18.58%) physiological loss in weight was found in treatment T₅ and was significantly higher over rest of the treatment. The lowest (9.97%) physiological loss in weight of banana fruit was observed in T₇ (control). However, at 12th day of storage the lowest (11.63%) physiological loss in

weight was noticed in treatment T₇ (control) whereas the highest (24.20%) physiological loss in weight of banana fruit was observed in T₅ (500ppm ethrel). Similarly, at 15th day of storage the highest (27.46%) physiological loss in weight was found in treatment T₅, but was at par with T₄ (25.49%).The

lowest Physiological loss in weight(15.37%) in treatment T₇(control).

Similar finding was observed by Desai (1999) [2] in banana cv. Basrai,

Table 5: Effect of ethrel and lime application on PLW (%) content of safed velchi banana

Treatment	PLW (%)					Mean
	At 3rd day	At 6th day	At 9th day	At 12th day	At 15th day	
T ₁	4.20	8.98	13.91	21.30	22.81	14.24
T ₂	5.24	8.59	13.45	20.49	22.57	14.07
T ₃	5.05	9.83	15.54	22.42	24.14	15.40
T ₄	5.16	9.41	15.49	22.87	25.49	15.68
T ₅	5.85	10.29	18.58	24.20	27.46	17.28
T ₆	4.15	7.99	10.20	14.75	18.73	11.16
T ₇	4.06	7.52	9.97	11.63	15.37	9.71
Mean	4.82	8.94	13.88	19.67	22.37	13.94
SEm±	0.894	0.667	0.893	0.844	0.920	
CD at 1%	2.712	2.023	2.710	2.559	2.789	

3.6 Shelf life of fruits

Data regarding shelf life (Table.6) of banana fruits treated various ripening treatment revealed that highest shelf life (12.67 days) was noticed in control followed by T₆ (Lime) and T₁ (100ppm).However, lowest (6.33 days) was found in treatment T₅ (500ppm ethrel), followed by T₄ (400ppm ethrel),(6.67days).

It was also observed that with the increasing concentration of ethrel from 100 to 500 ppm, there was advancement in ripening. Whereas at the same time shelf life of banana fruit was minimised with increasing concentration. It might be due to faster ripening rate in T₅ as compared to the other treatments. The maximum shelf life of 12 days was recorded in T₇which is control where no treatment was given. In this treatment the slow ripening rate might have increased the shelf life of banana fruits.

These results corroborate well with the Godambe (2012) [3] in mango cv. Alphonso.

Table 6: Effect of ethrel and lime application on Shelf life (days) of safed velchi banana

Treatments	Shelf life (days)
T ₁	7.67
T ₂	7.33
T ₃	7.00
T ₄	6.67
T ₅	6.33
T ₆	10.00
T ₇	12.67
Mean	8.24
S. Em ±	0.418
C. D. at 1%	1.267

4. Conclusion

In commercial point of view if farmer wants to ripe banana as par market demand within 5to7 days after harvesting, then fruit be treated with500ppm ethrel; within 8to10 days then treated with 400ppm ethrel; within 10to11 days then treated with 300ppm ethrel; within 11to12 days then treated with 200ppm ethrel; within 12to13 days then treated with 100ppm ethrel; within 14to15 days, lime application treatments were found to be beneficial for ripening of safed velchi banana.

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