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Effect of different concentration of ethylene and application of lime on ripening pattern and sensory quality of banana (*Musa paradisiaca*) CV Safed velchi

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Abstract
An investigation on the Effect of ethylene on ripening pattern 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.
In case of ripening pattern, faster rate of ripening and lower shelf life are observed in higher concentration of ethylene compared to control and lime application. Higher concentration of ethylene helps to increase the ripening rate but decrease the shelf life and appearance, taste, colour, flavour and texture of fruits after specific days compared to control and lime treatment.

Keywords: banana, ethylene, ripening pattern, sensory, shelf life

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 term "banana" includes all edible varieties eaten as ripe fruits or as cooked food. 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". The generic name of banana –Musa was derived from the Arabic word "Mouxh". Presumably, bananas were known to the Arabs from very early times and it appears in 'Holy Khoran' as the Tree of Paradise – which is equivalent to the "tree of knowledge" of Christian tradition. In India, banana is commonly called as "Kela" in the northern states and 'Arati' in South India. In the Sanskrit literature, it is often referred to as 'Kadali' or 'Rambha'.
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.
In Maharashtra, Basrai, Shreemanti and Grand Naine of the important commercial varieties preferred for cultivation on a commercial scale as sole as well as intercrops. In konkan region of Maharashtra is characterized with undulated hilly terrain with hot and humid climatic conditions. In such a climatic conditions suitable variety of Banana is Safed Velchi.
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.
SafedVelchi is one of the leading commercial cultivars of banana in Thane district. Out of total banana production in Thane district, about 76.27 per cent of production is of variety Safed Velchi followed by 6.71 and 6.54 per cent of Bhurkel and Lalvelchi, respectively. The production of other different local varieties is 10.48 per cent (Kshirsagar, 1998) [3].
Safed Velchi is considered a good quality fruit for table purpose. This variety is medium sized 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 pattern of this variety.
Therefore, its need to study on "Effect of different concentration of ethylene and application of lime on ripening pattern and sensory quality of banana (*Musa paradisiaca*) CV Safed velchi (*Musa paradisiaca* L.) cv. Safed Velchi.

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 ripening pattern, sensory quality and shelf life of banana at two days intervals.

3. Result and Discussion

3.1 Ripening pattern

It is apparent from the data in Table 1 to Table 6 that treatments T_5 (500 ppm ethrel) had faster rate of ripening (41.66 % ripe fruits) at 6th days followed by T_4 (16.66% ripe fruits) whereas treatment T_7 (control) recorded lowest (50 % green, 50 % turning). On 9th day of storage period, 58.33% ripe fruit, 41.66% over ripe fruit of T_5 and followed by T_4 (400ppm ethrel) 41.66% half ripe fruit, 58.33 ripe fruit. Whereas treatment T_7 (control) recorded lowest 41.66 half ripe only. On 12th day T_5 58.33% over ripe, shrivelled 16.67%, followed by $T_4$75% ripe, 25% over ripe. In respect of lime treated and control fruits less number of fruits ripen than ethrel treated fruits on 6th, 9th and 12thday of storage period. On 15th of storage period highest (58.33 % over ripe and 41.66% shrivelled) fruits noticed in T_5 (500 ppm ethrel) followed by T_4 (58.33% ripe, 25 % over ripe, 16.67%% shrivelled) fruits whereas lowest (91.66 % ripe and 8.33 % over ripe) fruits obtained in control.

Results on similar line were observed by Kulkarni *et al*. (2004) [4] in mango cv. Neelum, Godambe (2012) [4] in mango cv. Alphonso. Hai *et al.* (2009) [2] in mango cv. Tron and Hoi.

Table 1: Effect of ethrel and lime application treatments on ripening pattern of banana at ambient storage condition At 0 Days:

Treatment	Green	Turning	Half- ripe	Ripe	Over- ripe	Shrivelled	Diseased	Total
T_1	12 (100)	0 (00)	0 (00)	0 (00)	0(00)	0(00)	0 (00)	12(100)
T_2	12(100)	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_3	12(100)	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_4	12(100)	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_5	12(100)	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_6	12(100)	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_7	12(100)	000)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)

Table 2: Effect of ethrel and lime application treatments on ripening pattern of banana at ambient storage condition at 3days

Treatment	Green	Turning	Half- ripe	Ripe	Over- ripe	Shrivelled	Diseased	Total
T_1	9(75)	3(25)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_2	10(83.33)	2(16.67)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_3	9(75)	3(25)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)
T_4	7(58.33)	3(25)	2(16.67)	0(00)	0(00)	0(00)	0(00)	12(100)
T_5	0(00)	7(58.33)	5(41.67)	0(00)	0(00)	0(00)	0(00)	12(100)
T_6	0(00)	8(66.66)	4(33.34)	0(00)	0(00)	0(00)	0(00)	12(100)
T_7	12(100)	0(00)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)

Table 3: Effect of ethrel and lime application treatments on ripening pattern of banana at ambient storage condition At 6 Days

Treatment	Green	Turning	Half- ripe	Ripe	Over- ripe	Shrivelled	Diseased	Total
T_1	6(50)	3(25)	3(25)	0(00)	0(00)	0(00)	0(00)	12(100)
T_2	5(41.66)	4(33.33)	3(25)	0(00)	0(00)	0(00)	0(00)	12(100)
T_3	5(41.66)	4(33.33)	3(25)	0(00)	0(00)	0(00)	0(00)	12(100)
T_4	0(00)	4(33.33)	6(50)	2(16.66)	0(00)	0(00)	0(00)	12(100)
T_5	0(00)	3(25)	4(33.33)	5(41.66)	0(00)	0(00)	0(00)	12(100)
T_6	0(00)	8(66.66)	4(33.33)	0(00)	0(00)	0(00)	0(00)	12(100)
T_7	6(50)	6(50)	0(00)	0(00)	0(00)	0(00)	0(00)	12(100)

Table 4: Effect of ethrel and lime application treatments on ripening pattern of banana at ambient storage condition At 9 Days

Treatment	Green	Turning	Half- ripe	Ripe	Over ripe	Shrivelled	Diseased	Total
T_1	0(00)	0(00)	3 (25)	9(75)	0(00)	0(00)	0(00)	12 (100)
T_2	0(00)	0(00)	3(25)	9(75)	0(00)	0(00)	0(00)	12(100)
T_3	0(00)	0(00)	6(50)	6(50)	0(00)	0(00)	0(00)	12(100)
T_4	0(00)	0(00)	5(41.66)	7(58.33)	0(00)	0(00)	0(00)	12(100)
T_5	0(00)	0(00)	0(00)	7(58.33)	5(41.66)	0(00)	0(00)	12(100)
T_6	0(00)	3(25)	5(41.66)	4(33.33)	0(00)	0(00)	0(00)	12(100)
T_7	3(25)	4(33.33)	5(41.66)	0(00)	0(00)	0(00)	0(00)	12(100)

Table 5: Effect of ethrel and lime application treatments on ripening pattern of banana at ambient storage conditionAt 12 days

Treatment	Green	Turning	Half- ripe	Ripe	Over- ripe	Shrivelled	Diseased	Total
T_1	0 (00)	0(00)	0(00)	12(100)	0(00)	0(00)	0(00)	12(100)
T_2	0(00)	0(00)	1(8.33)	10(83.33)	1(8.33)	0(00)	0(00)	12(100)
T_3	0(00)	0(00)	0(00)	10(83.33)	2(16.67)	0(00)	0(00)	12(100)
T_4	0(00)	0(00)	0(00)	9(75)	3(25)	0(00)	0(00)	12 (100)
T_5	0(00)	0(00)	0(00)	3(25)	7(58.33)	2(16.67)	0(00)	12(100)
T_6	0(00)	0(00)	8(66.66)	4(33.33)	0(00)	0(00)	0(00)	12(100)
T_7	0(00)	0(00)	6(50)	4(33.33)	0(00)	0(00)	0(00)	12(100)

Table 6: Effect of ethrel and lime application treatments on ripening pattern of banana at ambient storage condition At 15 Days

Treatment	Green	Turning	Half- ripe	Ripe	Over- ipe	Shrivelled	Diseased	Total
T_1	0 (00)	0 (00)	0 (00)	4 (33.33)	6 (50)	2 (16.67)	0 (00)	12 (100)
T_2	0(00)	0 (00)	0 (00)	3 (25)	7 (58.33)	2 (16.67)	0 (00)	12 (100)
T_3	000)	0 (00)	0(00)	2(16.67)	8(66.66)	1(8.33)	1(8.33)	12(100)
T_4	0(00)	0(00)	0(00)	7(58.33)	3(25)	2(16.67)	0(00)	12(100)
T_5	0(00)	0(00)	0(00)	0(00)	7(58.33)	5(41.66)	0(00)	12(100)
T_6	0(00)	0(00)	4(33.33)	7(58.33)	1(8.33)	0(00)	0(00)	12(100)
T_7	0(00)	0(00)	0(00)	11(91.66)	1(8.33)	0(00)	0(00)	12(100)

3.2 Sensory evaluation

Data presented in Table 7, regarding sensory evaluation of safed velchi banana fruits indicated that application of lime treated fruits T_6 (8.00) registered highest average sensory and treatment T_1 recorded lowest sensory score (7.50).

Table 7: Effect of ethrel treatments on sensory qualities of safed velchi banana fruits

Treatments	Sensory Score			
	Colour	Flavour	Texture	Mean
T_1	7.83	7.17	7.67	7.56
T_2	8.00	8.00	7.83	7.83
T_3	7.50	7.67	7.50	7.56
T_4	7.50	7.90	7.50	7.74
T_5	7.00	7.33	7.67	7.33
T_6	7.67	8.00	8.00	7.89
T_7	8.00	7.83	8.00	7.94
GM	7.64	7.70	7.74	
S.Em +	0.24	0.43	0.33	
CD at 1 %	0.71	1.32	0.99	

1. Colour

The average highest (8.00) colour score was recorded in T_7 (Control) and T_2 the lowest (7.00) fruit colour score was recorded in T_5, (500ppm ethrel)

2. Flavour

The sensory score for fruit flavour in banana significantly varied among the treatments. The highest (8.00) sensory score for flavour was reported in $T_2$and T_6 (Lime application). Whereas the lowest (7.17) sensory score of fruit flavour was recorded in T_1 (100ppm).

3. Texture

The data regarding sensory score for texture revealed that T_6 (Lime application) and T_7 (control) Recorded the highest (8.00) sensory texture score. Whereas the lowest (7.50) sensory texture same score was recorded in T_3 (100ppm) and T_4 (400ppm).

4. Overall acceptance

The overall acceptance of ethrel and lime treated banana it should be depend on average sensory score including colour, flavour and texture during sensory evaluation. However, maximum acceptance was found in T_7 (7.94), minimum acceptance was found in T_5 (7.33). However the fruits of all the treatments were acceptable limit i.e. 5.5.

3.3 Shelf life of fruits

The data pertaining to shelf life of safed velchi banana fruits during storage at ambient temperature are presented in table 8.

Table 8: 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

Data regarding shelf life of banana fruits treated various ripening treatment revealed that highest shelf life (12.67 days) was noticed in control followed by T_6 and T_1. However, lowest (6.33 days) was found in treatment T_5 (500ppm ethrel) followed by (6.67days) in T_4 (400ppm ethrel).

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 T_5 as compared to the other treatments. The maximum shelf life of 12 days was recorded in T_7which 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) in mango CV Alphonso.

Ethylene is a hormone to promote respiration rate. External concentrations of ethylene can transiently increase their respiration rate proportionally to ethylene concentrations. This transient increase in respiration rate may be evoked more than once but ethylene exposure hastens their senescence, shortening their storage life and potentially causing a loss of eating quality. Therefore, these experiment also shown that increase the concentration of ethylene leads to ripening of fruit also impact on sensory quality as same.

4. Conclusion

Different concentration of ethrel treatments helped to enhance ripening of banana fruit i.e. advancement of days. However, the shelf life of fruit in T_5 (6.33 days) also less followed by T_4 (6.67days)

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 werefound to be beneficial forripening of Konkan safed velchi banana. Thus, ripening of banana fruits can be hastened by 6 days depending upon requirement by treading the fruits by various concentrations of ethrel.

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6. References

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