Madras Agric. J., **2018**, *105 (7-9)(2)*: 430-433; doi: 10.29321/MAJ.2018.000177

Temperature Modifications during Storage to Overcome Weak Neck Disorder in Banana (cv. Rasthali) using α- Amino Isobutyric Acid

V. Rajeswari[1]*, P. Jeyakumar[1], M.K. Kalarani[2], K.S. Subramanian[3] and M. Kavino[4]

[1]Department of Crop Physiology, TNAU, Coimbatore.
[2]Tapioca and Castor Research Station, Yethapur.
[3]Department of Nano Science and Technology, TNAU, Coimbatore.
[4]Department of Fruit Crops, HC&RI, TNAU, Coimbatore.

Climacteric fruits respond well to the environmental temperature, because the respiration rate and ethylene production would vary according to the temperature. Banana fruit possess very short postharvest life, prone to injuries and postharvest disorders like weak neck because of the climacteric and perishable nature of the fruit. Hence an attempt was made with α- Amino isobutyric acid (AIB) to study the weak neck disorder of the banana under cold storage condition to increase the postharvest life. AIB is an ethylene biosynthesis inhibitor which inhibits the ethylene synthesis by inhibiting ACC oxidase enzyme. Banana fruits were treated with different AIB concentrations (50, 100, 150, 200 ppm along with control) and spraying methods (Dipping and Spraying). AIB @ 150 ppm dipped for 5 minutes showed decreased finger dislodge from the hands (50-70 per cent at 11th day after treatment) compared to control fruits (100 per cent at 9th day after treatment). On comparing AIB with ethylene inhibitor (1-MCP) and chemicals (Hexanal and calcium chloride) under cold and ambient storage condition, AIB showed better result with reduced finger drop. At 11th day of cold storage AIB treated fruits exhibited minimum finger drop of 50 per cent followed by 1-MCP vaporization with finger drop percentage of 60 and control fruits reported the maximum number of finger drop (90 per cent). Under ambient condition at 7th day itself the AIB treated fruits showed 60 per cent finger drop. Hence from the present study, the external temperature would alter the storage life of the fruits which may be an important factor and noted for further improvement of postharvest life of fruits by storing under required temperatures and minimizing the postharvest losses.

Key words: Weak neck, α- Amino isobutyric acid, Storage condition

Banana is a foremost food crop cultivated in all over the world and it occupied fourth most important crop after rice, wheat and maize and in India it is second most important fruit crop next to mango. Banana is a non-seasonal fruit that is grown and consumed in more than 135 countries throughout the tropics and subtropics. India shares about 31.6 per cent of total global production and ranks first in area (0.88 M ha) and production (30 mT). In India, Tamil Nadu ranks first in area (0.11 M ha), production (5.65 mT) and productivity (48 MT ha^{-1}) (www.indiastat.com 2016). *Rasthali* is a medium tall variety commercially grown in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Bihar. Its unique fruit quality has made *Rasthali* popular and a highly prized cultivar for table purpose. Banana contains high nutritive and medicinal value, is an important component in human diet, but possesses very short postharvest shelf life. As they ripen, they become very soft and more prone to injuries, which make them highly perishable.There are many obstacles faced by the farmers that are interrelated with the development of *Rasthali* as a superior commodity, particularly on productivity and postharvest handling. Two of the main obstacles faced by farmers are packing and dispatching the fruit to the market. Long distance transportation causes fruit to be detached from its hand. This is called weak neck or finger drop.Weak neck is the physiological weakening at the pedicel of the fruit that causes individual fruit to be released prematurely from its hand (Saengpook *et al.,* 2007). Three possible causes for weak neck are genetics (Semagen *et al.,* 2006), nutrition (Williams, 2002) and postharvest handling (Sairam *et al.,* 2008). Postharvest handling can be altered for delaying finger drop and increasing the shelf life of the fruit. Ethylene plays major role where weak neck increases if the concentration of ethylene in the storage and ripening process increases. To overcome this issue ethylene biosynthesis and action inhibitors are used to block the ethylene synthesis and actions respectively to reduce the finger drop and increase the shelf life and quality of *Rasthali*. The two rate limiting enzymes regulating ethylene biosynthesis are ACC Synthase (ACS) and ACC Oxidase (ACO) where it also down regulated with many ethylene inhibitors. There are several ethylene inhibitors such as α -Aminoisobutyric acid (AIB)

*Corresponding author's email:vrajeswari126@gmail.com

(ethylene biosynthesis inhibitor), 1-Methylcyclopropene (1-MCP) (ethylene receptor inhibitor) available in the market and chemicals like hexanal in the form of enhanced freshness formulation (Phospholipase D (PLD) enzyme inhibitor) and $CaCl_2$ (structural and membrane integrity and strengthener) were used in the study to assess the influence on postharvest shelf life of *Rasthali* banana fruit. With this background, the present work has been conducted to assess the optimum concentration of AIB to reduce the weak neck disorder and comparing of ethylene inhibitors and chemicals to improve shelf life of banana fruits.

Material and Methods

The study was carried out at the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore to modify the ripening behavior and to study the weak neck physiological disorder of banana *cv. Rasthali* using ethylene inhibitor α-amino isobutyric acid (AIB). Initially, standardization of AIB concentration for improving shelf life was carried out. Later, the best concentration of AIB was compared with other ethylene inhibitors for delaying the ripening. This experiment was carried out at the ripening chamber facility available at Post Harvest Technology Centre, Tamil Nadu Agricultural University, Coimbatore and Vilvaa Agro Foods Farm, Coimbatore. The *Rasthali* banana fruits of uniform maturity pre-treated with 100 ppm of ethylene were used for the study. The banana fruits were selected at 75 per cent ripening stage.

α- Amino isobutyric acid (AIB), a new emerging ethylene inhibitor was used for the first time in the area of postharvest study of banana. The research with AIB on postharvest shelf life improvement is very limited especially in banana and has also been reported only in preservation of cut fruit and vegetables. With this background an attempt was carried out to standardize the AIB dosage for the postharvest application on fruit with five different concentrations AIB @ 50, 100, 150, 200 ppm along with control. For standardization experiment, dipping and spraying method of application was employed for all four different concentrations along with control. The fruits were dipped for 5 minutes in AIB solution and air dried and arranged in crates and kept in cold chamber for further observation. The fruits were sprayed with different concentrations of AIB in hand sprayer over the fruit till the whole hand of the fruits gets completely wet, further the air dried fruits were kept for observation under cold storage (CS) condition (17°C). The best dosage of AIB with improved quality and shelf life and reduced weak neck were selected and compared with different other ethylene inhibitors and chemicals. After the ethylene treatments the fruits were dipped with AIB @ 150 ppm (T_2), EFF (0.2 % hexanal) @ 2% (T_4), $CaCl_2$ @ 0.5% (T_4) solution and control fruits (T_1) in normal water for five minutes. For 1-MCP application is by vaporization, were fruits are loaded into the containers (150 L capacity). After loading the fruit, 1-MCP generator attached with the release vial was placed inside the container. 18±5 mL of the activator solution was added the release vial. Then the appropriate concentration tablets + 1 activator tablet was added to the vial for the release of 1-MCP gas. The treatment container was tightly sealed within 30 seconds. 1-MCP was thus applied to banana fruit for duration of 16 hours @ 17°C, RH 90-95 per cent. After treatment the fruits are arranged in crates and stored at ambient @ 27±2°C and cold storage @ 17° C condition for observations at periodic intervals until consumer acceptance (T_3). The observations on physical, physiological and biochemical changes were recorded on alternate days.

Scoring for weak neck

The finger drop or weak neck is calculated by raising banana 15 cm above the table for thirty seconds and subjecting to gentle manual shaking (Imsabai *et al.,* 2006). Per cent finger drops is calculated using the following formula.

$$\text{Finger drop \%} = \frac{\text{Number of fruits dislodge}}{\text{Number of fruits per hand}} \times 100$$

Shelf life

Shelf life of the fruit were taken based on the keeping quality and expressed in days.

Results and Discussion

Finger drop is a major problem in *Rasthali* banana where individual fingers are dislodged from the hand which reduces the market value of the hands (Imsabai *et al.,* 2006). The result showed a significant variation among weak neck character of banana fruits between different concentrations of the AIB treatments (Table 1). AIB application resulted in reduced finger drop than that of the control. Control fruit reported 100 per cent of fruit drop during the 9th day of observation, while there was minimum finger drop of 50-70 per cent on the 11th day of observation when the fruits are treated with AIB at 150 ppm dipping treatment.The study of different concentrations of AIB on banana fruits showed significant result among application methods and treatments in cold storage condition.

The 150 ppm dipping treatment preforms better result by minimizing the rate of finger drop. According

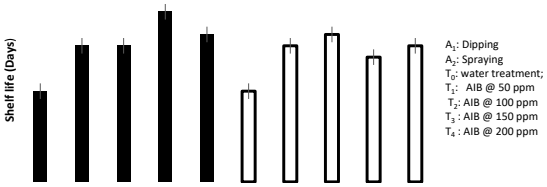

Fig. 1. Effect of ethylene inhibitors and chemicals on shelf life of *Rasthali* banana fruit under cold and ambient storage

to Paull, (1996) ethylene is an important factor responsible for weak neck.Thus use of AIB, ethylene biosynthesis inhibitor decreases the rate of finger drop by inhibiting ACC oxidase enzyme which converts the 1-Aminocyclopropane-1-carboxylic acid (ACC) to ethylene (Onozaki *et al.,* 1998).

Shelf life of the banana was increased by the application of AIB to about 15 days under cold

storage. Shelf life of the fruits can be enhanced by reducing the ethylene evolution and respiration rate of the fruits and storing the fruit below 20° C. This was supported by the results given by Wang *et al.* (2015) that storage life of longan fruit was extended effectively by AIB treatments (Fig. 1). After the analysis of AIB concentration and spraying method the most effective dosage of 150 ppm were selected and taken to further experiment and evaluated the effect of ethylene inhibitors (AIB, 1- MCP) and chemicals (Hexanal and $CaCl_2$) on improving the quality and shelf life of banana fruit

Table 1. Effect of AIB on finger drop (%) or weak neck of Rasthali banana fruit

Treatments	3rd day	5th day	7th day	9th day	11th day	Mean
A_1T_0	10	20	40	100	-	28.33
A_1T_1	-	10	20	30	70	21.67
A_1T_2	-	-	10	40	60	18.33
A_1T_3	-	-	10	20	40	11.67
A_1T_4	-	-	10	20	50	13.33
A_2T_0	10	30	50	100	-	31.67
A_2T_1	-	-	10	20	60	15.00
A_2T_2	-	10	10	10	50	13.33
A_2T_3	-	-	10	20	60	15.00
A_2T_4	-	10	20	10	70	18.33
Mean	2.00	8.00	19.00	37.00	46.00	
SEd	0.04	0.12	0.23	0.49	0.48	
CD (P=0.05)	NS	0.26	0.47	1.00	0.99	

(A_1: Dipping; A_2: Spraying; T_0: water treatment; T_1: AIB @ 50 ppm; T_2: AIB @ 100 ppm; T_3 : AIB @ 150 ppm; T_4 : AIB @ 200 ppm)

Weak neck or finger drop is a typical character of *Rasthali* banana where the individual fruit get dislodge from the hand which makes hands unsuitable for long distance transport and consumer preference. The breakage might be due to a number of factors such as low fiber content, modification of cell wall structure, and degradation of cell wall macromolecules. The cell wall connection between the cells might be weakened

Table 2. Effect of ethylene inhibitors and chemicals on finger drop (%) or weak neck

Treatments	Cold storage (17°C)						Ambient storage (27±2°C)			
	3rd day	5th day	7th day	9th day	11th day	Mean	3rd day	5th day	7th day	Mean
T1	10	30	50	60	90	40.00	20	80	100	50.00
T2	0	10	20	40	50	20.00	10	30	60	25.00
T3	0	10	30	40	60	23.33	10	40	70	30.00
T4	0	10	20	50	70	25.00	10	50	80	35.00
T5	0	20	30	50	80	30.00	10	60	90	40.00
Mean	2.00	16.00	30.00	48.00	70.00		12.00	52.00	80.00	
SEd	0.02	0.14	0.27	0.40	0.60		0.10	0.44	0.69	
CD(P=0.05)	0.06	0.30	0.59	0.87	1.29		0.21	0.95	1.48	

by degradation of pectic components in the primary cell walls and the middle lamella. In the pedicle region formation of abscission layer is due to the weakening of the peel cells, because of the lower water content of the peel by osmotic exchange resulting in finger drop (Imsabai *et al.,* 2006).In present study among the chemicals and ethylene inhibitors, AIB recorded the lowest percentage of fruits drop compared with other treatments (Table 2.). In cold storage 20 per cent finger drop in bana cv. *Rasthali* is minimized compared to that of ambient storage. And it was also added that weakening might be by water soluble pectin degradation in the rupture area where bananas held under high significantly shows higher fruit drop than in fruits held at low relative humidity (Saengpook *et al.,* 2007).

The shelf life of *Rasthali* fruits was extended up to 15 days under CS and 8 days under AS condition by the use of ethylene inhibitors, while the weak neck per cent of *Rasthali* fruits was significantly minimized with the application of AIB. The ethylene inhibitors and chemicals have different role of action in delaying the ripening process and quality improvement. Further research can employ with the use of ethylene inhibitors and chemicals, separately or in combinations, for the enhancement of postharvest life, quality maintenance, reduction in physiological diseases and disorders of banana fruit.

References

Imsabai, W., Ketsa, S. and Wouter, G. 2006. Physiological and biochemical changes during banana ripening and finger drop. *Postharvest Biol. Technol.*, **39**: 211-216.

Onozaki, T., Ikeda, H. and Yamaguchi, T. 1998. Effect of calcium nitrate addition to (alpha)-aminoisobutyric acid (AIB) on the prolongation of the vase life of cut carnation flowers. *J. Jpn. Soc. Hortic. Sci.,* **67(2)**: 198-203.

Paull, R.E. 1996. Ethylene, storage and ripening temperatures affect Dwarf Brazilian banana finger drop. *Postharvest Biol. Technol.,* **8:** 65-74.

Saengpook, C., Kesta, S. and Van Doorn, W.G. 2007. Effects of relative humidity on banana fruit drop. *Postharvest Biol. Technol.,* **45:** 151-154.

Sairam, R.K., Kumuthaa, D., Ezhilmathi, K., Deshmukh, P.S. and Srivastava, G.C. 2008. Physiology and biochemistry of water logging tolerance in plants. *Biol. Plant.,* **52**: 401-412.

Semagen, K., Bjornstad, A. and Ndjiondjop, M.N. 2006. Principles, requirements and prospects of genetic mapping in plants. *Afr. J. Biotechnol.,* **5:** 2569-2587.

Wang, H., Zhi, W., Qu, H., Lin, H. and Jiang, Y. 2015. Application of α-aminoisobutyric acid and β-aminoisobutyric acid inhibits pericarp browning of harvested longan fruit. *Chem. Cent. Journ.,* **9**: 54.

Williams, R. 2002. Banana industry and R and D in Malaysia. In: Advancing Banana and Plantain R and D in Asia and the Pacific-Volume II. INIBAB-AP, Los Banos, Laguna, Philippines, pp: 99-106