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Standardization of Packing Material Gauge and Ventilation Levels to Minimize the Post-Harvest Losses in Banana cv. Grand Naine at Ambient Storage Conditions

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A B S T R A C T

In order to identify and compare the effects of different gauges of polythene packing and ventilation levels on improving the keeping quality of banana fruits cv. Grand Naine, a study was conducted using polyethylene bags of 150, 200, 250 and 300 gauges with ventilations of 0.5 and 1% under ambient conditions. Fruits packed in polythene covers of 300 gauge with 1% vents recorded significantly lower PLW (%); pulp to peel ratio, spoilage (%), TSS (^{o}B) and total sugars (%). Significantly higher firmness (kg/cm^{2}), good colour development, acidity (%), ascorbic acid content (mg/100 g) and correspondingly increased the shelf life up to 18.19 days with 300 gauge polyethylene packing with 1% ventilation.

Introduction

Banana sometimes called "apple of paradise" is one of the oldest fruits known to humankind. It is one of the widely grown and consumed fruits due to their distinct aroma and taste, in all parts of the world. It is the staple food and economic life line for many countries. It is cheap source of carbohydrate and rich source of potassium, calcium, antioxidants and other micronutrients. India is one of the major producers of bananas cultivating in an area of 83 lakh hectare with a production over 2.9 million tonnes worth of $83,55 crores as reported for the year 2011 (FAO, 2011). Indian bananas though equally tasty have skins which are either spotted or with black strips owing to improper post-harvest handling and storage which has made Indian bananas unsuitable for export.

Banana is highly perishable fruit with post-harvest losses as high as 30-40 % (Salunkhe and Desai, 1984). Post-harvest losses can be minimized by adopting proper post-harvest handling practices and better understanding of the biochemical control of fruit ripening and senescence.

Banana is a climacteric fruit with typical ethylene dependent ripening. The shelf life of the banana fruit deteriorates as soon as the climacteric peak is reached. Therefore, there is a need to regulate its ripening so as to improve its shelf life. Dipping of the fruits in different chemicals retains the residue of the in the fruits leads to unacceptability of the fruits due to quarantine problems. In such scenario bananas wrapped in polythene bags, prolonged the storage life, reduce the weight loss and occurrence of storage rots. Many reports are indicating that the shelf life of banana will be increased by packing in polyethylene bags (Narayana *et al.,* 2002). But, there are no consolidated studies on the effect of gauge of polythene and ventilation levels on minimizing the post-harvest losses in banana specially the cv. Grand Naine. Hence, the present study was undertaken with an objective to study the effect of polythene packing at different gauges and at different ventilation levels on physico-chemcial changes in banana fruits with the progression of ripening under ambient storage conditions.

Materials and Methods

Banana cv. Grand Naine was selected for carrying out the present investigation. The fruits were obtained from the banana orchard located at Sangareddy, Medak district, Telangana at three-quarters (70-75%) ripe stage. Bunches of uniform size having cylindrical or nearly cylindrical shape were selected. In the bunches green, unripe, whole and clean fruits free from scratches, bruises, sun burns and fungal/insect attack were selected and brought to the laboratory. The fruits were cleaned with tap water and then allowed to dry in shade prior to imposition of the treatments. Polyethylene bags of 150, 200, 250 and 300 gauges of size 30 x 25 cm with ventilations of 0.5 and 1% were used for packing of banana fruits. Circular holes with 0.5 mm diameter were made to cover the percent of the surface area of the bags. Experiment was conducted in a completely randomized division with nine different treatments in three replications. The treatments are as follows.

T_1 – Hands packed in polythene covers of150 gauge +0.5%vent

T_2 – Hands packed in polythene covers of 150 gauge +1% vent

T_3 – Hands packed in polythene covers of 200 gauge +0.5%vent

T_4 – Hands packed in polythene covers of 200 gauge +1% vent

T_5 – Hands packed in polythene covers of 250 gauge +0.5%vent

T_6 – Hands packed in polythene covers of 250 gauge +1% vent

T_7 – Hands packed in polythene covers of 300 gauge +0.5% vent

T_8 – Hands packed in polythene covers of 300 gauge +1% vent

T_9 – Control

The changes in physical attributes such as physiological loss of weight, pulp to peel ratio, firmness, spoilage of fruit were recorded at every three days interval in each treatment (Fig. 1).

Similarly, biochemical parameters such as TSS, titrable acidity, total sugars and ascorbic acid content were recorded at every three days interval with the progression of ripening at ambient storage conditions.

Physiological loss in weight (%)

The weight of the fruits was recorded on every third day and subtracted from the initial weight. The loss of weight in grams in relation to initial weight was calculated and expressed as percentage.

$$PLW (\%) = \frac{\text{(Initial weight- weight after storage)}}{\text{Initial weight}} \times 100$$

Pulp to peel ratio

The pulp and peel weights at regular intervals of time were recorded till the end of storage period and their ratio was calculated.

Firmness (kg/cm^2)

A table top penetrometer was used to record the firmness of the fruits and obtained direct readings in kg/cm^2.

Spoilage (%)

The number of fruits spoiled in a replication was counted and expressed in percentage. The spoilage was determined based on the following visual observations.

Shrivelling of the fruit and hardening of the rind.

Fungal infection and subsequent rotting.

$$\text{Spoilage} (\%) = \frac{\text{Number of spoiled fruits}}{\text{Total number of fruits}} \times 100$$

Physico chemical parameters such as total soluble solids (˚B), Titrable acidity (%), total sugars (%) and ascorbic acid content (mg/100g) were measured as per the standard protocols given by Ranganna, 1986. The shelf life of fruits was determined by recording the number of days the fruits remained in good condition in storage. The stage where in more than 50 percent of the stored fruits became unfit for consumption was considered as end of shelf life in that particular treatment and expressed as mean number of days (Padmalatha,1995).

Results and Discussion

The experimental results obtained on effect of packaging material on shelf life of banana cv. Grand Naine are presented below

Physiological loss in weight (%)

The physiological loss in weight indicates the progress of ripening in climacteric fruit. In the present investigation, the PLW of banana fruit was found to be increased with increase in storage period irrespective of treatments. However, the increase has been at a reduced rate in all the treated fruits as compared to control.

The decrease in weight loss could be due to moisture loss (Sanjay, 1996). The present experimental findings have revealed that there was lower PLW in fruits kept in polythene covers of 300 gauge + 1 % ventilation.

This might be due to lower rate of transpiration, oxygen depletion, CO_2 accumulation in the polythene bags reaching on equilibrium and as a result the respiratory process was slowed down. Similar results were reported by Gautam and Neeraja (2005) and Borkar *et al.,* (2008).

Pulp to peel ratio

There was a progressive increase in pulp to peel ratio as ripening advanced. The pulp to peel ratio was narrow in fruits kept in 300 gauge + 1 % ventilation.

During ripening of banana, pulp increases in weight due to increase in water content, which was obtained from peel. Because of this peel loss weight and cause change in pulp to peel ratio. The narrow ratio of pulp to peel in 300 gauge + 1% ventilation may be due to slow rate of ripening as well as modified atmosphere created by O_2 depletion and CO_2 accumulation. The results are in confirmation with the findings of Borkar *et al.,* 2008.

Fruit firmness (kg/cm^2)

The fruit firmness was gradually decreased from harvest to ripening and further towards the end of shelf life.

Firmness of the fruit in terms of pressure was found to reduce with an increase in storage period. From the results it was observed that higher firmness was with fruits packed in polythene bag of 300 gauge + 1 % vent. The rate of decrease in firmness was slow in fruits might indicate hindrance of ripening process. This higher firmness may be due to low rate of respiration and high moisture in polythene bags.

Spoilage (%)

An increase in the spoilage of fruits with progress of storage period was observed in all the treatments and this increase was found highest in control where no packing material was used.

Spoilage of fruits was directly related to the rate of respiration of fruits which leads to deterioration of the fruits. Fruits packed in 300 gauge + 1 % vent recorded the lowest spoilage per cent during the different days of storage. The decrease in spoilage per cent might be due to less respiration, transpiration and ethylene production. Narayana *et al.*, (2002) observed less spoilage in banana fruits stored in 400 gauge polyethylene bags with 0.5% ventilation. Similar result was reported by Gautam and Neeraja (2005) in mango.

Biochemical changes

Total soluble solids (^{0}Brix)

TSS was significantly influenced by the treatments imposed in the experiment. There was a progressive increase in TSS in all treatments from harvest to ripening and there after followed the declining trend till the end of shelf life. TSS content of the fruits reached maximum at the ripe stage and started declining towards the end of shelf life. The increase in the TSS during ripening was due to break down of starch and polysaccharides in to sugars. Further due to over ripening/senescence the sugar is degraded to CO_2 because of respiration (Wills *et al.*, 1989). The TSS was maximum in control, while it was minimum in 300 gauges + 1 % vents. This may be due to reduced respiration rate causing slower utilization of soluble fraction as respiring substrates. Similar results were observed by Gautam and Neeraja (2005) in mango and Borkar *et al.*, (2008) in banana (Fig. 2).

Titratable acidity (%)

The Titratable acidity showed a constant decrease during the storage period. The decline in acidity may be attributed to utilization of acids in the process of ripening in the presence of reduced supply of sugar as a substrate of respiration which might be due to lower rate of starch degradation during ripening. Fruits stored in 300 gauge + 1 % vent polythene bag maintain higher level of acidity. Fruits packed in 250 gauge non perforated HDPE bags recorded higher acidity in banana reported by Borkar *et al.*, (2008), Gautam and Neeraja (2005) reported that mango fruits stored in polythene bags (150, 250 and 350 gauge) maintained higher acidity in Banganapalli mangoes.

Fig.1 Changes in physical attributes of banana fruits cv. Grand Naine with different gauges of polythene and ventilation levels

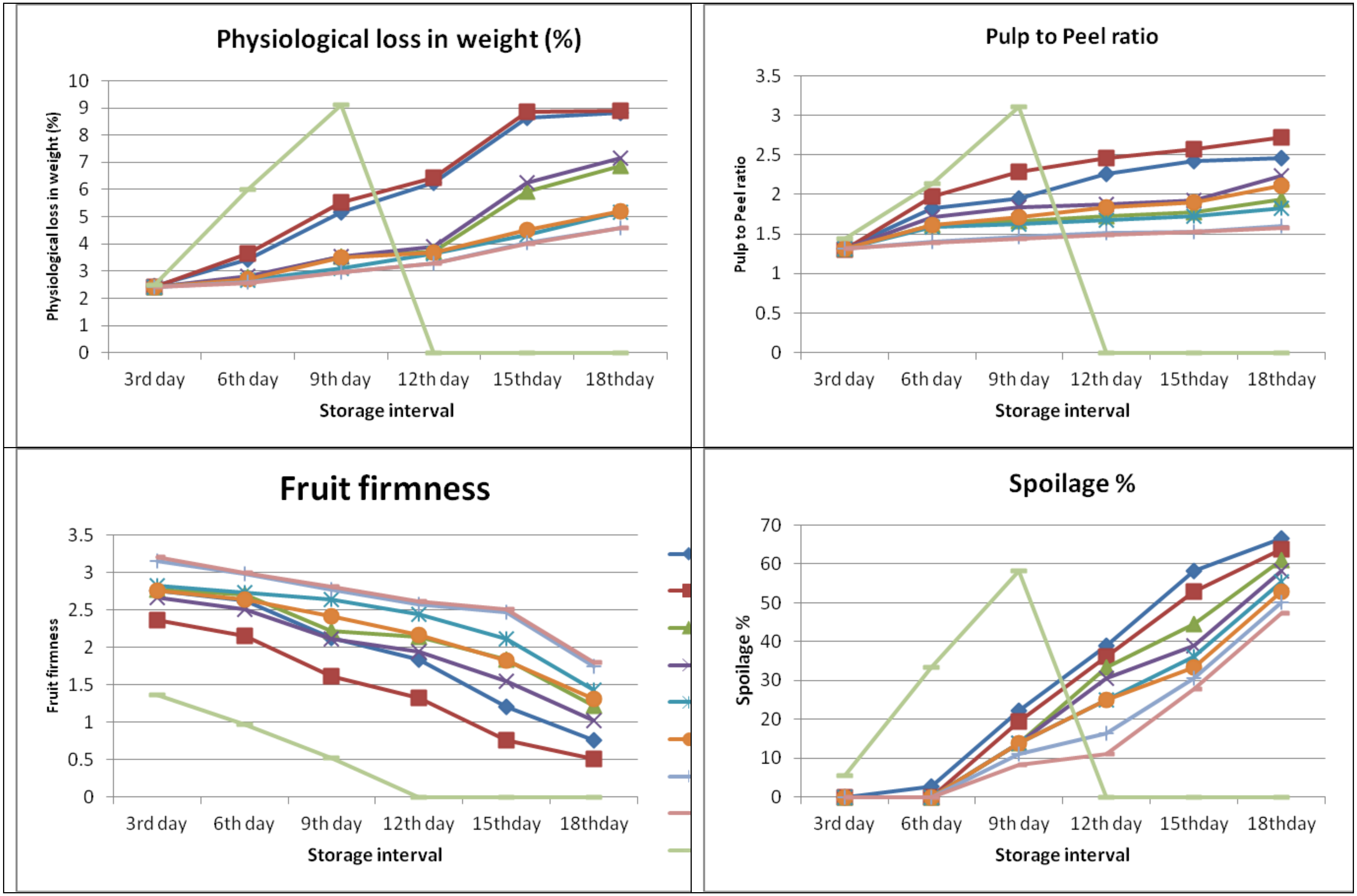
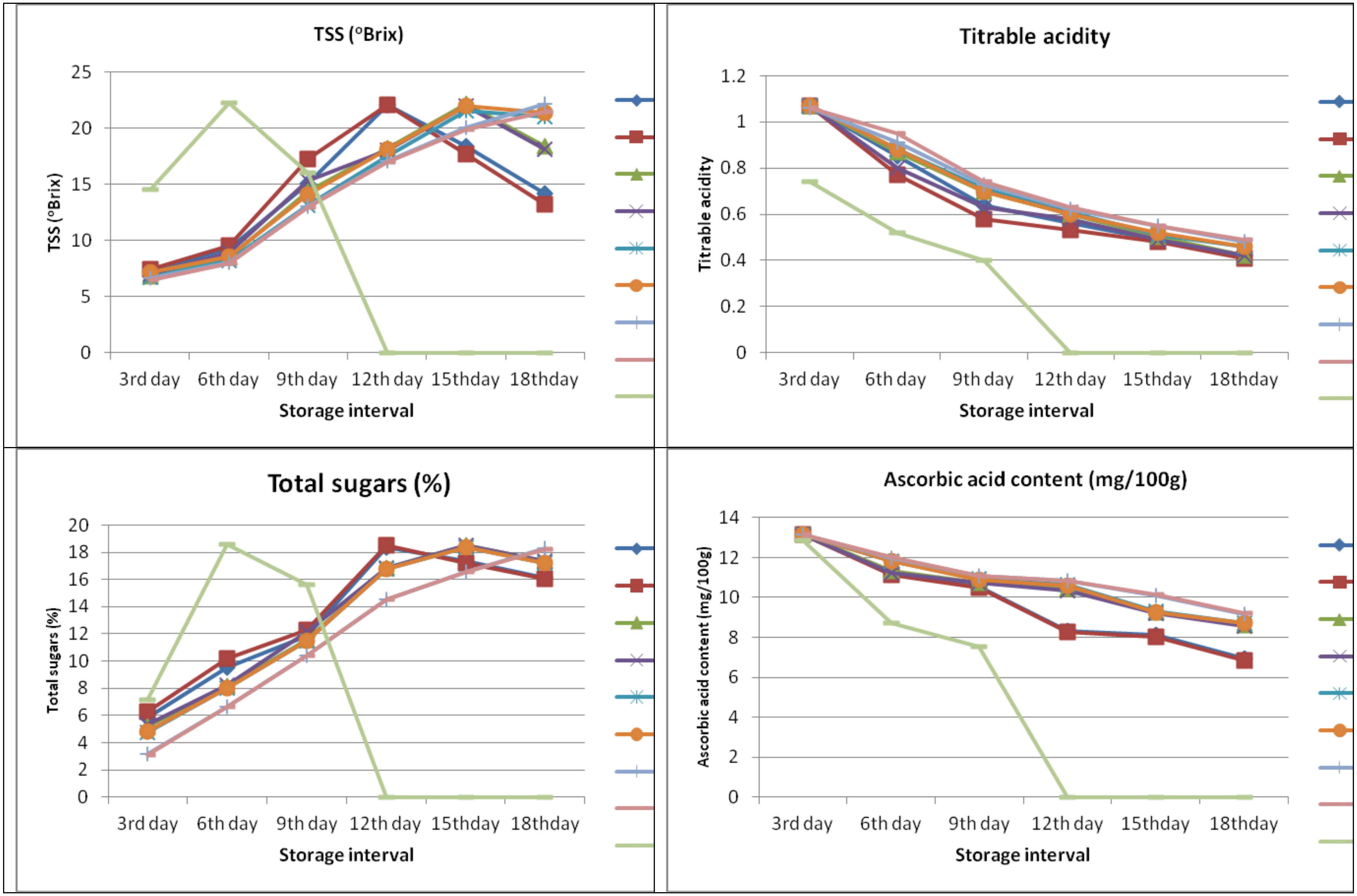


Fig.2 Changes in biochemical attributes of banana fruits cv. Grand Naine with different gauges of polythene and ventilation levels



Total sugars (%)

The total sugars were found to be increased up to ripening thereafter showed a decline at the end of shelf life in all the treatments. Similar trends of total sugars contents were reported by Haribabu and Shantha (1993) in Alphonso mangoes and sapota (Singh *et al.*, 2000). The initial raise in sugars content may be due to conversion of starch into sugars, while later the decrease was due to consumption of sugars for respiration during storage.

The total and reducing sugars were higher in control; while it was minimum in fruits packed in 300 gauge + 1 % vent polythene covers. This may be due to slow hydrolysis of starch to sugars and gradual build-up of sugars in polythene covers may be attributed to retarded ripening. Similar result was observed in banana fruits stored in 400 gauge with 0.5 % vents (Narayana *et al.*, 2002).

Ascorbic acid (mg/100g)

There was a progressive decrease in ascorbic acid content up to the end of shelf life. The loss in ascorbic acid content on prolonged storage might be mainly due to rapid conversion of L-ascorbic acid into dehydro ascorbic acid in the presence of enzyme ascorbinase (Tripathi, 1989). Fruits packed in 300 gauge with 1 % vent exhibited the maximum ascorbic acid content during storage.

This might be due to reduced rate of oxidation of ascorbic acid which in turn lower respiration rate (Gautam and Chundawat, 1988). Further, Khedkar *et al.*, (1982) reported highest content of Vitamin C in guava fruits packed in 300 gauge polythene bags indicating that ascorbic acid content was protected from deterioration during storage by packing in polythene bags.

Shelf life (Days)

In the present investigation, it was observed that, 300 gauge with 1 % and 0.5 % vents recorded the maximum shelf life of 18.19 and 18.08 days respectively. This might be due to accumulation or maintenance of high relative humidity in the polythene bags there by reduced rate of transpiration. Borkar *et al.*, (2008) reported that shelf life of banana was extended to 15 days with non-perforated HDPE (250 gauge) with ethylene absorbent.

Reduction of post-harvest food losses is a critical component of ensuring future global food security. Post production losses of banana can be reduced by adopting various post-harvest management practices that are currently in practice all over the world to prolong its shelf life. Out of the different methods available polyethylene packing with 300 guage material and providing 1% ventilation to the packaging material was found best to minimize the postharvest losses in the banana cv. Grand Naine.

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