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Influence of pre-harvest bagging on acidity and sugar of *Litchi chinensis* cv. Rose Scented

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Abstract

The present investigation was undertaken at Horticultural Research Centre, Patharchatta of G. B. Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand to see the effects of different bagging materials (brown paper bag, black polythene bag, muslin cloth bag, cellophane bag, single parchment paper bag, double parchment paper bag, triple parchment paper bag, net bag, news paper bag and control) eight bagging dates (48 days before normal harvest, 42 days before normal harvest, 36 days before normal harvest, 30 days before normal harvest, 24 days before normal harvest, 18 days before normal harvest, 12 days before normal harvest and 6 days before normal harvest) during the year 2016 and 2017. Fruits bagged triple parchment shows the significant effect to decrease the acidity by 3.70 % as compare to unbagged fruits 4.27 %. The same bag also helpful increase the TSS (21.03°Brix) as well as total sugar, reducing sugar and non-reducing sugar. Among the different bagging days fruits bagged 48 days prior to harvest shows significant effect for all the parameters.

Keywords: bagging materials, physic-chemical quality, bagging dates

Introduction

Litchi (*Litchi chinensis*) is a delicious, juicy fruit of excellent quality. It is popular member of the family Sapindaceae and sub family Nephelaeae, which has about 150 genera and more than 200 species. The tree is native to Southern China and Southern eastern Asia. It has been cultivated for its delicious nature since 1766 BC and it is most important fruit plant of family Sapindaceae (Menzel, 1984). In India, it was first introduced in Bengal and then spread to Bihar and sub-mountainous district of Uttar Pradesh in 19th century (Pandey and Sharma, 1989). Presently litchi is produced on large scale in the states like Bihar, Uttar Pradesh, Bengal, Jharkhand, Punjab and Uttarakhand. China and India account for 91 per cent of the total world production of litchi (Singh and Babita, 2002). India is the second largest producer of litchi next to china. It is cultivated on 90 thousand hectares area in India and annual production of 559 thousand tons with the productivity of 6.2 metric tons/ha (Anonymous, 2016). Due to its eating quality and flavour, popularly litchi is known as “Queen of fruits” (Pandey and Sharma, 1989). The litchi fruit consists of about 60 per cent juice, 8per cent rag, 19 per cent seed and 13 per cent skin which varies with the variety and climatic condition. During the growth and development, fruit undergoes several physical and chemical changes. At the same time, fruits are susceptible to infestations of various pests, birds attack pathogens and as well as some mechanical damages. Which can reduce the commercial value of fruit and thereby, cause significant economic and yield loss. The physical appearances of the peel are especially important in highly competitive export market and in some local niche up markets like supermarket. Buyers in this prime markets require consistent supplies of uniformed coloured fruits with blemish free peel. Litchi bunch covers with the help of various bagging materials allow for production of high quality litchi fruit. The present experiment is proposed to be conducted on the effect of bagging materials at different dates from harvesting on acidity and sugar content of *Litchi chinensis* cv. ‘Rose Scented’.

Material and Methods

The experiment was conducted at Horticultural Research Centre, Patharchatta of G.B. Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar, Uttarakhand. Litchi cv. ‘Rose Scented’ planted in square system at 10 meter distance. The 30 treatment combinations were comprised of nine bagging materials (brown paper bag, white polythene

bag, black polythene bag, single, double & triple parchment paper bag, cellophane bag, net bag and muslin cloth bag) with one unbagged and eight bagging dates (48 days before normal harvest, 42 days before normal harvest, 36 days before normal harvest, 30 days before normal harvest, 24 days before normal harvest, 18 days before normal harvest, 12 days before normal harvest and 6 days before normal harvest).

The experiment was laid out in Factorial Randomized Block Design with three replications. Bagging materials (M) were considered as a first factor and days before harvest (D) as second factor. The size of each bag was kept 48 cm × 58 cm and the end of each bag was kept open with 2 % area of each bag perforated by making 8 holes per bag each having 3 cm diameter. The observations were recorded by randomly selected fruits from each bag. Data were recorded for the acidity (%), TSS (^oBrix), reducing sugar (%), non reducing sugar (%), total sugar (%). The significance of the treatments was determined by developing analysis of variance (ANOVA) and the means were compared by calculating critical difference (C.D.) at $p < 0.05$.

Acidity

Sample was prepared by taking 10 grams of fruit pulp and extracts the juice with the help of muslin cloth in a volumetric flask (100 ml) and final volume was made up with distilled water. Then, 10 ml of this solution were taken for titration. Acidity of litchi fruits were calculated by titrating the pulp extract with N/10 NaOH as described by Ranganna (1986) using phenolphthalein as an indicator and was expressed in percentage (%):

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of alkali} \times \text{Equivalent weight of acid} \times \text{volume made up}}{\text{weight of sample taken} \times \text{volume of aliquot} \times 1000} \times 100$$

Total soluble solids

Total soluble solids in the fruits were recorded at room temperature using hand refractometer and were expressed in terms of ^oBrix. Ten fruits were taken from each treatment for taking the average value. A small amount of fruit pulp was taken in muslin cloth and crushed to obtain the juice. The refractometer was wiped clear with the help of moist muslin cloth. A drop of juice of crushed pulp was taken on the lens of refractometer and the value was read against light and represent in ^oBrix.

Total sugars

Modified Lane and Eynon method as described by Ranganna (1986) was used to determine total sugar content in the fruits. fifty ml filtered juice were mixed with 100 ml distilled water and neutralized with 0.1 N NaOH solution using phenolphthalein as indicator and the solution was allowed to stand for ten minutes. Then 8 ml of potassium oxalate solution was added and the volume was made upto 250 ml by adding distilled water. Five ml of the extract were taken in burette and titrated against 10 ml mixed Fehling solution (5 ml Fehling solution A + 5 ml Fehling solution B) using methylene blue as indicator. The end point was indicated by decolorization of the solution. The following formula was used for determining the total sugars in fruits.

$$\text{Total sugar (\%)} = \frac{\text{Factor for Fehlings solution} \times \text{Dilution}}{\text{Titre value} \times \text{Weight of sample taken}} \times 100$$

Where, factor for Fehling solution denotes the gram of invert sugar given by, Factor = (Titre × 2.5)/100

Reducing sugars

Reducing sugars were estimated by Lane and Eynon method as described by Ranganna (1986). The extract was taken and titrated against 10 ml of mixed Fehling solution (5 ml fehling solution A + 5 ml fehling solution B) using methylene blue as indicator. It was then boiled for two minutes, 2- 3 drops of methylene blue indicator were added and titration was completed within a minute. The end point was identified when the discolouration of indicator occurred. The results were expressed as percentage of reducing sugar.

$$\text{Reducing sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution}}{\text{Titre value} \times \text{Weight of sample} \times 1000} \times 100$$

Non- reducing sugars

The non- reducing sugars was calculated by the formula given below:

$$\text{Non- reducing sugars (\%)} = \text{Total sugar} - \text{Reducing sugar}$$

Result and discussion

1.1 Acidity

Data related with the effect of bagging dates, materials and their interaction shown in Table 4.1.1 and all the treatments showed significant results with regards to both the factors. Among the different bagging materials fruits bagged with triple parchment paper bag showed significant decrease in acidity with the value of 3.67 % which was closely followed by fruits bagged with double parchment paper (3.75 %) and maximum was found in unbagged fruits (4.28 %) followed by net bag (4.15 %). With respect to bagging days minimum acidity (3.86 %) was observed with the fruits bagged 48 days before harvest followed by 3.89 %, 3.93 %, 03.96 % and 4.00 % in fruits bagged 42, 36, 30 and 24 days before normal harvest, respectively. Interaction effect due to bagging dates and materials was found significant with respect to acidity of fruits. It was found minimum (3.52 %) in fruits bagged 48 days before harvesting with triple parchment paper bag, which was followed by fruits bagged 42 days before harvesting with same bagging material (3.55 %) and the maximum acidity was observed in unbagged fruits tagged 36 days before harvest which was 4.32 % during the first year. Second year data represented in Table 1.1.2 showed that the minimum acidity was found in fruits bagged with triple parchment paper bag (3.72 %) followed by double parchment paper bag (3.79 %) while maximum recorded in unbagged fruits (4.25 %). Among the different bagging days fruits bagged 48 days prior to harvest had minimum value of fruit acidity per cent which was 3.88 which was *at par* with fruits bagged 42 days prior to harvest (3.92 %). Acidity was recorded maximum in fruits bagged 6 days prior to harvest (4.12 %). The data regarding to interaction showed the significant result. The minimum acidity per cent was recorded in fruits bagged 48 days prior to harvest with triple parchment paper (3.57 %) which was followed by fruits bagged 42 days prior to harvest with same bagging materials (3.61 %) and it was recorded maximum (4.30 %) in unbagged fruits tagged 6 days prior to harvest.

Pooled data represented in Table 1.1.3. showed that the minimum acidity was found in fruits bagged with triple parchment paper bag (3.70 %) followed by double parchment paper bag (3.77 %) while maximum recorded in unbagged fruits (4.27 %). Among the different bagging days fruits bagged 48 days prior to harvest had minimum value of fruit

acidity per cent which was 3.87 which was *at par* with fruits bagged 42 days prior to harvest (3.91 %). Acidity was recorded maximum in fruits bagged 6 days prior to harvest (4.10 %). The data regarding to interaction showed the significant result. The minimum acidity per cent was recorded in fruits bagged 48 days prior to harvest with triple parchment paper (3.54 %) which was followed by fruits bagged 42 days prior to harvest with same bagging materials (3.58 %) and it was recorded maximum (4.29 %) in unbagged fruits tagged 6 and 18 days prior to harvest.

In present findings significant increase in acidity was observed in bagged fruit as compared to control. These findings are also in accordance with the findings of XianMing *et al.* (2008) and Huang *et al.* (2009) in pear. This can be explained in light of statement that harvesting of bagged and unbagged fruits was taken at same date and bagging resulted early maturation of fruits. Thus acidity was found lowest in unbagged fruits as compared to bagged fruits.

1.2 Total soluble solids (° Brix)

The analysed data of first year (Table 1.2.1.) revealed that the TSS was significantly varied among different bagging days, material and their interaction. The maximum amount of Total soluble solids recorded in fruits bagged with triple parchment paper bag (21.03° Brix) followed by fruits bagged with double parchment paper bag (20.96° Brix) and black polythene bag (20.91° Brix) while minimum recorded in unbagged fruits (18.75° Brix) followed by fruits bagged with net bag (19.38° Brix). Among different bagging days, fruits bagged 48 days prior to harvest had maximum amount of total soluble solids (20.84° Brix) which was *at par* with fruits bagged 42 (20.67° Brix) and 36 (20.44) days prior to harvest respectively and minimum recorded in fruits bagged 6 days prior to harvest (19.50 ° Brix). The data related to interaction showed that the fruits bagged 48 days prior to harvest with triple parchment paper bag (22.47° Brix) had maximum amount of total soluble solids which was closely followed by fruits bagged 48 days prior to harvest with black polythene bag (22.18° Brix) however minimum recorded in unbagged fruits tagged 12 and 48 days prior to harvest (19.11° Brix).

During the second year (Table 1.2.2.) the maximum amount of total soluble solids recorded in fruits bagged with triple parchment paper (21.00 ° Brix) which was *at par* with fruits bagged with black polythene bag (20.93 ° Brix) and double parchment paper bag (20.81 ° Brix) however recorded minimum in unbagged fruits (18.70 ° Brix). Fruits bagged 48 days prior to harvest had maximum amount of total soluble solids (20.81 ° Brix) followed by fruits bagged 42 days before harvesting (20.64). Whereas it was recorded minimum in fruits bagged 6 days prior to harvest (19.40 ° Brix). Interaction effect due to bagging days and materials on total soluble content was statistically significant. It was found maximum in fruits bagged with triple parchment paper 48 days prior to harvest (22.44 ° Brix) followed by fruits bagged 48 days prior to harvest with black polythene bag (22.15 ° Brix) and minimum observed in unbagged fruits tagged 48 days prior to harvest (19.10° Brix).

However pooled analysis (Table (1.2.3.) showed the maximum amount of Total soluble solids recorded in fruits bagged with triple parchment paper bag (21.02° Brix) followed by fruits bagged with black polythene bag (20.91° Brix) and double parchment paper bag (20.89° Brix) while minimum recorded in unbagged fruits (18.72° Brix) followed by fruits bagged with net bag (19.37° Brix). Among different bagging days, fruits bagged 48 days prior to harvest had

maximum amount of total soluble solids (20.82° Brix) which was *at par* with fruits bagged 42 days prior to harvest (20.65° Brix) and minimum recorded in fruits bagged 6 days prior to harvest (19.45 ° Brix). The data related to interaction showed that the fruits bagged 48 days prior to harvest with triple parchment paper bag (22.46° Brix) had maximum amount of total soluble solids which was closely followed by fruits bagged 48 days prior to harvest with black polythene bag (22.17° Brix) however minimum recorded in unbagged fruits tagged 12 and 48 days prior to harvest (19.10° Brix).

Increase in total soluble solids due bagging has been reported by several workers *viz.* Harhash and Al- Obeed (2010) in date palm fruits bagged with black polythene bag. Debnath and Mitra (2008) in litchi fruit by using brown paper bag. The covered panicles had more total soluble solids than the control one, probably because the higher temperature under the bags favored the conversion of starch into sugars.

1.3 Total sugar (%)

A glance at Table 1.3.1 revealed that the total sugar the significantly varied among different bagging days, materials and interactions effect of both the factors. Maximum (21.99 %) total sugar was recorded in fruits bagged with single parchment paper bag followed by fruits bagged with double parchment paper (21.75 %) and triple parchment paper bag (21.65 %) respectively and recorded minimum (20.99 %) in unbagged fruits. Among different bagging days fruits bagged 48 days prior to harvest showed maximum (21.61 %) total sugar in fruits. This value is closely followed by fruits bagged 42 (21.54 %) and 36 (21.49 %) days prior to harvest. The interaction effect of both the factors showed that the fruits bagged 48 days prior to harvest with single parchment paper bag had maximum amount (22.34 %) of total sugar followed by fruits bagged 42 days prior to harvest with same material (22.25 %) and fruits abgged 48 days prior to harvest with double parchment paper bag (22.20 %). However it was minimum (20.98 %) in unbagged fruits tagged 24 days prior to harvest.

However during the second year (Table 1.3.2) the trend was similar with maximum total sugar per cent (21.96 %) in fruits bagged with single parchment paper which was *at par* with the fruits bagged with double parchment paper (21.72 %) and observed minimum (20.97 %) in unbagged fruits. Among the different bagging days the fruits bagged 48 days before normal harvest had maximum value (21.58 %) of total sugar *at par* with fruits bagged 42 days before normal harvest (21.52 %) while it was minimum in fruits bagged 6 days before normal harvest (21.12 %). interaction effect due to bagging dates and materials on total sugar content was significant. It was observed that fruits bagged 48 days prior to harvest with single parchment paper had highest total sugar content (22.31 %) which was followed by fruits bagged 42 days prior to normal harvest with same material (22.25 %) while it was minimum in unbagged fruits tagged 12 days prior to harvest.

Pooled analysis (Table 1.3.3.) showed the maximum total sugar (21.98 %) in fruits bagged with single parchment paper bag which was found *at par* with fruits bagged with double parchment paper (21.74 %), while minimum in unbagged fruits (20.98 %). Among different bagging days fruits bagged 48 days prior to harvest had showed maximum (21.60 %) amount of total sugar which was closely followed by fruits bagged 42 (21.60 %) and 36 (21.48 %) days prior to harvest and recorded minimum in fruits bagged 6 days prior to harvest (21.12 %). The interaction effect due to bagging days

and materials in total sugar per cent was found significant. It was recorded maximum (22.32 %) in fruits bagged 48 days prior to harvest with single parchment paper bag. This value was at par with the fruits bagged 42 days before harvesting with same material (22.24 %) while, recorded minimum (20.97 %) in unbagged fruits tagged 6 days prior to harvest.

Present study revealed that total sugar was significantly influenced by bagging dates and bagging materials. The increase in level of total sugar inside the bagged fruits may be due to enzymatic activity of sucrose synthase (SS) and sucrose-phosphate synthase (SPS). SS is an enzyme that plays a key role in sucrose decomposition. These results are in conformity with the findings of Harhash and Al-Obeed (2010) in date palm. In the course of sucrose metabolism SPS is a key enzyme that regulates sucrose synthesis in the plant.

The activity of SS in the bagged fruit increased during fruit development and was higher than that in the non-bagged fruit.

1.4 Reducing sugar

The data presented in Table 1.4.1 revealed significant difference in reducing sugar by dates and materials. The highest (20.49 %) reducing sugar was noticed in fruits bagged with single parchment paper which was found *at par* with fruits bagged with double parchment paper (20.27 %) and triple parchment paper (19.96 %) while the minimum sugar (%) was observed in unbagged fruits (18.86 %). among various bagging days the highest (19.80 %) level of reducing sugar recorded in fruits bagged 48 days before normal harvest followed by fruits bagged 42 days before normal harvest (19.75 %). however it was minimum (19.51 %) in fruits bagged 6 days before normal harvest. Interaction effect due to bagging date and bagging materials on reducing sugar content was also significant. It was observed that fruits bagged 48 days before normal harvest with single parchment paper had maximum (20.77 %) content of reducing sugar followed by fruits bagged with same material at 42 days before normal harvest (20.67 %). however it was minimum (18.85 %) in fruits tagged 18 and 30 days before normal harvest during the first year.

However during the second year (Table 1.4.2.) the trend was

similar with maximum sugar per cent (20.46) in fruits bagged with single parchment paper followed by fruits bagged with double parchment paper (20.21 %) while it was minimum (18.90 %) in unbagged fruits. Among the different bagging days the fruits bagged 48 days before normal harvest had maximum value (19.77 %) of reducing sugar *at par* with fruits bagged 42 days before normal harvest (19.73 %) while it was minimum in fruits bagged 6 days before normal harvest (19.49 %). interaction effect due to bagging dates and materials on reducing sugar content was significant. It was observed that fruits bagged 48 days prior to harvest with single parchment paper had highest reducing sugar content (20.74 %) which was followed by fruits bagged 42 days prior to normal harvest with same material (20.63 %) while it was minimum in unbagged fruits tagged 6 and 48 days prior to harvest

Pooled analysis represented in table 1.4.3. Revealed that the maximum reducing sugar (20.47 %) in fruits bagged with single parchment paper bag which was found *at par* with fruits bagged with double parchment paper (20.24 %) and triple parchment paper bag (19.94 %). Among different bagging days, fruits bagged 48 days prior to harvest had maximum 19.79 per cent of total sugar followed by fruits bagged 42 (19.74 %) and 36 (19.72 %) days prior to harvest and found minimum (19.50 %) in fruits bagged 6 days prior to harvest. The interaction of both the factors was found significant on reducing sugar per cent. It was noticed maximum (20.76 %) in fruits bagged 48 days prior to harvest with single parchment paper bag followed by fruits bagged 42 days prior to harvest with same material (20.65 %) while, recorded minimum (18.85 %) in unbagged fruits tagged 6 days prior to harvest.

In the present investigation, it has been noticed that reducing sugar was appreciably influenced by both factors, namely bagging dates and materials. The higher reducing sugar may be due to conversion of sucrose into glucose inside the bag (more sucrose synthase and sucrose-phosphate synthase activity inside the bag). The results obtained in the present investigation also get support from the findings of Harhash and Al-Obeed (2010) in date palm.

Table 1.1.1.: Effect of bagging materials and days on titrable

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	0.46 (3.87)	0.43 (3.77)	0.46 (3.90)	0.49 (4.03)	0.40 (2 3.70)	0.40 (3.64)	0.38 (3.52)	0.45 (3.85)	0.50 (4.04)	0.56 (4.28)	0.46 (3.86)
42	0.47 (3.92)	0.44 (3.82)	0.47 (3.94)	0.50 (4.04)	0.43 (3.75)	0.41 (3.66)	0.38 (3.55)	0.46(3.87)	0.50 (4.07)	0.56 (4.30)	0.46 (3.89)
36	0.48 (3.96)	0.45 (3.85)	0.49 (4.03)	0.50 (4.05)	0.43 (3.77)	0.42 (3.72)	0.40 (3.61)	0.47 (3.92)	0.51 (4.10)	0.57 (4.32)	0.47 (3.93)
30	0.49 (4.00)	0.46 (3.90)	0.50 (4.07)	0.51 (4.10)	0.45 (3.83)	0.43 (3.75)	0.41 (3.67)	0.47 (3.92)	0.52 (4.12)	0.56 (4.28)	0.48 (3.96)
24	0.50 (4.04)	0.46 (3.90)	0.51 (4.11)	0.52 (4.14)	0.45 (3.86)	0.43 (3.76)	0.42 (3.72)	0.48 (3.97)	0.53 (4.16)	0.56 (4.29)	0.49 (4.00)
18	0.50 (4.05)	0.47 (3.94)	0.52 (4.15)	0.53 (4.17)	0.46 (3.90)	0.44 (3.8)	0.43 (3.75)	0.49 (4.00)	0.54 (4.20)	0.56 (4.28)	0.49 (4.03)
12	0.51 (4.10)	0.48 (3.99)	0.54 (4.20)	0.54 (4.23)	0.46 (3.89)	0.44 (3.82)	0.43 (3.77)	0.5 0 (4.04)	0.55 (4.24)	0.55 (4.25)	0.5 (4.05)
6	0.52 (4.12)	0.49 (4.03)	0.54 (4.21)	0.54 (4.21)	0.47 (3.94)	0.45 (3.85)	0.44 (3.79)	0.51 (4.08)	0.55 (4.27)	0.56 (4.28)	0.51 (4.08)
Mean	0.49 (4.01)	0.46 (3.90)	0.5 (4.08)	0.52 (4.12)	0.45 (3.83)	0.43 (3.75)	0.41 (3.67)	0.48 (3.96)	0.53 (4.15)	0.56 (4.28)	
	S.Em±						CD at 5 %				
	Materials (M)						0.173				
	Days (D)						0.155				
	Interaction (MXD)						0.490				

acidity (%) of litchi fruit cv. Rose Scented

Table 1.1.2: Effect of bagging materials and days on titrable acidity (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	0.47 (3.92)	0.44 (3.82)	0.48 (3.96)	0.49 (4.01)	0.43 (3.75)	0.41 (3.69)	0.39 (3.57)	0.46 (3.89)	0.51 (4.08)	0.53 (4.16)	0.46 (3.88)
42	0.48 (3.96)	0.45 (3.86)	0.49 (4.00)	0.50 (4.07)	0.44 (3.79)	0.42 (3.70)	0.4 (3.61)	0.47 (3.92)	0.51 (4.11)	0.54 (4.20)	0.47 (3.92)
36	0.49 (4.00)	0.46 (3.89)	0.5 (4.07)	0.51 (4.11)	0.45 (3.83)	0.43 (3.76)	0.41 (3.66)	0.48 (3.96)	0.52 (4.15)	0.54 (4.23)	0.48 (3.96)
30	0.5 (4.05)	0.47 (3.94)	0.52 (4.12)	0.52 (4.15)	0.46 (3.87)	0.44 (3.79)	0.42 (3.72)	0.48 (3.97)	0.53 (4.17)	0.55 (4.24)	0.49 (4.00)
24	0.51 (4.08)	0.48 (3.97)	0.52 (4.15)	0.53 (4.17)	0.47 (3.92)	0.44 (3.80)	0.43 (3.76)	0.49 (4.01)	0.54 (4.21)	0.55 (4.27)	0.5 (4.04)
18	0.51 (4.11)	0.49 (4.00)	0.54 (4.20)	0.54 (4.21)	0.48 (3.96)	0.45 (3.83)	0.44 (3.79)	0.5 (4.04)	0.55 (4.25)	0.56 (4.29)	0.51 (4.07)
12	0.52 (4.12)	0.50 (4.04)	0.55 (4.24)	0.55 (4.27)	0.48 (3.97)	0.45 (3.86)	0.44 (3.82)	0.51 (4.08)	0.56 (4.28)	0.56 (4.29)	0.51 (4.10)
6	0.53 (4.17)	0.5 (4.07)	0.55 (4.27)	0.56 (4.29)	0.49 (4.00)	0.46 (3.89)	0.45 (3.83)	0.52 (4.12)	0.56 (4.29)	0.56 (4.30)	0.52 (4.12)
Mean	0.5 (4.05)	0.47 (3.95)	0.52 (4.13)	0.53 (4.16)	0.46 (3.89)	0.44 (3.79)	0.42 (3.72)	0.49 (4.00)	0.54 (4.19)	0.55 (4.25)	
					S.Em±			CD at 5 %			
Materials (M)					0.438			0.122			
Days (D)					0.392			0.109			
Interaction (MXD)					0.124			0.346			

Table 1.1.3.: Effect of bagging materials and days on titrable acidity (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	0.46 (3.90)	0.44 (3.80)	0.47 (3.93)	0.49 (4.02)	0.42 (3.72)	0.41 (3.66)	0.38 (3.54)	0.46 (3.87)	0.5 (4.06)	0.54 (4.22)	0.46 (3.87)
42	0.47 (3.94)	0.45 (3.84)	0.48 (3.97)	0.50 (4.05)	0.43 (3.77)	0.41 (3.68)	0.39 (3.58)	0.46 (3.90)	0.51 (4.09)	0.55 (4.25)	0.47 (3.91)
36	0.48 (3.98)	0.46 (3.87)	0.50 (4.05)	0.51 (4.08)	0.44 (3.80)	0.43 (3.74)	0.40 (3.63)	0.47 (3.94)	0.52 (4.12)	0.56 (4.27)	0.48 (3.95)
30	0.49 (4.03)	0.47 (3.92)	0.51 (4.10)	0.52 (4.12)	0.45 (3.85)	0.43 (3.77)	0.42 (3.69)	0.47 (3.94)	0.52 (4.15)	0.55 (4.26)	0.48 (3.98)
24	0.5 (4.06)	0.47 (3.94)	0.52 (4.13)	0.53 (4.16)	0.46 (3.89)	0.44 (3.78)	0.43 (3.74)	0.49 (3.99)	0.53 (4.19)	0.56 (4.28)	0.49 (4.02)
18	0.51 (4.08)	0.48 (3.97)	0.53 (4.17)	0.54 (4.19)	0.47 (3.93)	0.44 (3.82)	0.43 (3.77)	0.49 (4.02)	0.54 (4.23)	0.56 (4.29)	0.50 (4.05)
12	0.51 (4.11)	0.49 (4.01)	0.54 (4.22)	0.55 (4.25)	0.47 (3.93)	0.45 (3.84)	0.44 (3.80)	0.50 (4.06)	0.55 (4.26)	0.56 (4.27)	0.51 (4.07)
6	0.52 (4.15)	0.50 (4.05)	0.55 (4.24)	0.55 (4.25)	0.48 (3.97)	0.46 (3.87)	0.44 (3.81)	0.51 (4.10)	0.56 (4.28)	0.56 (4.29)	0.51 (4.10)
Mean	0.49 (4.03)	0.47 (3.92)	0.51 (4.10)	0.52 (4.14)	0.45 (3.86)	0.43 (3.77)	0.42 (3.70)	0.48 (3.98)	0.53 (4.17)	0.56 (4.27)	
					S.Em±			CD at 5 %			
Materials (M)					0.430			0.119			
Days (D)					0.384			0.107			
Interaction (MXD)					0.122			0.338			

1.5 Non-reducing sugar

A glance at table 1.5.1 reveals that the non-reducing sugar was significantly varied among the litchi fruits bagged with different bagging material and days during both the years. During the first year maximum (7.30%) non reducing sugar observed in unbagged fruits. While the minimum non reducing sugar was observed in fruits bagged with triple parchment paper (6.70 %) followed by fruits bagged with single parchment paper (6.85%) and cellophane bag (6.90%). with regarding to bagging days maximum non reducing sugar was found in fruits bagged 6 days before normal harvest (7.58 %) followed by fruits bagged 12 days prior to harvest (7.30 %) and minimum (7.06 %) recorded in fruits bagged 48 days prior to normal harvest.

The second year data (Table 1.5.2.) showed that maximum non-reducing sugar was found in unbagged fruit (8.75%) followed by fruits bagged with Net bag (8.35%) while minimum recorded in fruits bagged with single parchment paper (7.61%) followed by fruits bagged with single parchment paper (7.63 %). The interaction effect showed that maximum non-reducing sugar (8.86 %) found in fruits tagged 6 and 48 days prior to harvest and minimum in fruits bagged

with single parchment paper (6.98 %) 6 days prior to harvest at par with fruits bagged on same date with double parchment paper (7.08 %).

However the pooled data (1.5.3.) showed that the maximum non-reducing sugar observed in fruits bagged with brown paper bag (8.16 %) followed by unbagged fruits (7.32 %). while minimum recorded in fruits bagged with triple parchment paper (6.75 %) which was at par with fruits bagged with single parchment paper (6.85 %). among the bagging days the fruits bagged 6 days prior to normal harvest had maximum value (7.37 %) followed by fruits bagged 12 days prior to harvest (7.30%) and it was minimum in fruits bagged 48 days prior to harvest (7.11 %). the interaction effect showed that maximum value of non reducing sugar was observed in fruits bagged 48 days prior to harvest with brown paper bag (8.51 %) followed by fruits bagged with same material 42 days prior to harvest and it was recorded minimum in fruits bagged with black polythene bag 6 days prior to harvest (7.73).

Similar beneficial effects of bagging dates on non - reducing sugar have also been reported by Harhash and Al-Obeid (2010) in date palm.

Table 1.2.1: Effect of bagging materials and days on total soluble solids (° Brix) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	20.53	22.18	20.43	20.34	21.01	22.04	22.47	20.69	19.57	19.11	20.84
42	20.42	22.01	20.27	20.16	20.87	21.87	22.03	20.37	19.53	19.14	20.67
36	20.08	21.57	20.04	19.97	20.78	21.49	21.68	20.19	19.46	19.12	20.44
30	19.86	21.01	19.77	19.69	20.57	21.22	21.00	20.02	19.41	19.13	20.17
24	19.70	23.67	19.57	19.51	20.43	20.47	20.76	19.87	19.37	16.12	19.95
18	19.57	20.27	19.50	19.46	20.14	20.21	20.46	19.67	19.32	19.12	19.77
12	19.46	20.04	19.35	19.32	19.95	20.68	20.04	19.51	19.24	19.11	19.67
6	19.30	20.52	19.26	19.24	19.52	19.71	19.78	19.33	19.17	19.12	19.50
Mean	19.87	21.41	19.77	19.71	20.41	20.96	21.03	19.96	19.38	18.75	
S.Em±						CD at 5 %					
Materials (M)						0.170					
Days (D)						0.152					
Interaction (MXD)						0.480					

Table 1.2.2: Effect of bagging materials and days on total soluble solids (° Brix) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	20.49	22.15	20.41	20.30	20.99	22.03	22.44	20.65	19.53	19.10	20.81
42	20.38	21.98	20.25	20.13	20.85	21.85	22.02	20.34	19.50	19.12	20.64
36	20.08	21.55	20.03	19.94	20.74	21.47	21.64	20.16	19.44	19.10	20.42
30	19.83	21.01	19.74	19.65	20.54	20.86	20.97	19.99	19.39	15.78	19.78
24	19.67	20.64	19.51	19.48	20.42	20.44	20.74	19.84	19.36	19.12	19.92
18	19.54	20.25	19.47	19.42	20.12	20.19	20.43	19.63	19.28	19.11	19.74
12	19.43	20.02	19.32	19.28	19.92	19.99	20.03	19.47	19.22	19.12	19.58
6	19.27	19.82	19.24	19.21	19.48	19.68	19.74	19.31	19.17	19.11	19.40
Mean	19.84	20.93	19.75	19.68	20.38	20.81	21.00	19.92	19.36	18.70	
S.Em±						CD at 5 %					
Materials (M)						0.131					
Days (D)						0.117					
Interaction (MXD)						0.371					

Table 1.2.3: Effect of bagging materials and days on total soluble solids (° Brix) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	20.51	22.17	20.42	20.32	21.00	22.03	22.46	20.67	19.55	19.10	20.82
42	20.40	21.99	20.26	20.15	20.86	21.86	22.03	20.35	19.51	19.13	20.65
36	20.08	21.56	20.03	19.96	20.76	21.48	21.66	20.18	19.45	19.11	20.43
30	19.85	21.01	19.75	19.67	20.56	21.04	20.99	20.01	19.40	17.46	19.97
24	19.68	22.15	19.54	19.50	20.42	20.46	20.75	19.86	19.37	17.62	19.94
18	19.56	20.26	19.49	19.44	20.13	20.20	20.45	19.65	19.30	19.11	19.76
12	19.45	20.03	19.34	19.30	19.94	20.34	20.04	19.49	19.23	19.11	19.63
6	19.29	20.17	19.25	19.22	19.50	19.69	19.76	19.32	19.17	19.12	19.45
Mean	19.85	21.17	19.76	19.70	20.40	20.89	21.02	19.94	19.37	18.72	
S.Em±						CD at 5 %					
Materials (M)						0.108					
Days (D)						0.962					
Interaction (MXD)						0.304					

Table 1.3.1: Effect of bagging materials and days on total sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	13.55 (21.60)	13.7 (21.72)	13.25 (21.35)	13.12 (21.24)	14.45 (22.34)	14.28 (22.20)	14.13 (22.08)	13.4 (21.48)	12.98 (21.12)	12.84 (21.00)	13.57 (21.61)
42	13.46 (21.52)	13.6 (21.64)	13.20 (21.30)	13.07 (21.19)	14.33 (22.25)	14.14 (22.09)	14.03 (21.99)	13.29 (21.38)	12.94 (21.08)	12.83 (20.99)	13.49 (21.54)
36	13.39 (21.46)	13.48 (21.54)	13.17 (21.28)	13.03 (21.16)	14.24 (22.17)	14.01 (21.98)	13.91 (21.90)	13.24 (21.34)	12.92 (21.06)	12.84 (21.00)	13.42 (21.49)
30	13.26 (21.35)	13.39 (21.47)	13.1 (21.22)	13.01 (21.14)	14.1 (22.06)	13.83 (21.83)	13.74 (21.75)	13.16 (21.27)	12.9 (21.05)	12.84 (21.00)	13.33 (21.41)
24	13.18 (21.29)	13.3 (21.39)	13.05 (21.18)	12.97 (21.11)	14 (21.97)	13.66 (21.69)	13.54 (21.59)	13.1 (21.22)	12.88 (21.03)	12.82 (20.98)	13.25 (21.34)
18	13.1 (21.22)	13.22 (21.32)	13.01 (21.14)	12.92 (21.06)	13.84 (21.84)	13.47 (21.53)	13.33 (21.42)	13.04 (21.17)	12.87 (21.03)	12.84 (20.99)	13.16 (21.27)

12	13.04 (21.17)	13.13 (21.24)	12.96 (21.10)	12.86 (21.01)	13.71 (21.74)	13.28 (21.37)	13.17 (21.28)	13.01 (21.14)	12.85 (21.01)	12.84 (20.99)	13.09 (21.21)
6	12.99 (21.13)	13.03 (21.16)	12.90 (21.05)	12.82 (20.98)	13.53 (21.58)	13.19 (21.30)	13.08 (21.20)	12.65 (20.83)	12.82 (20.98)	12.83 (20.99)	12.98 (21.12)
Mean	13.25 (21.34)	13.36 (21.44)	13.08 (21.20)	12.98 (21.11)	14.03 (21.99)	13.73 (21.75)	13.62 (21.65)	13.11 (21.23)	12.9 (21.05)	12.84 (20.99)	
	S.Em±						CD at 5 %				
Materials (M)	0.108						0.302				
Days (D)	0.968						0.270				
Interaction (MXD)	0.306						0.855				

Table 1.3.2: Effect of bagging materials and days on total sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	13.5 (21.56)	13.67 (21.70)	13.21 (21.31)	13.09 (21.21)	14.41 (22.31)	14.23 (22.16)	14.09 (22.05)	13.35 (21.43)	12.95 (21.09)	12.81 (20.97)	13.53 (21.58)
42	13.43 (21.50)	13.56 (21.61)	13.16 (21.27)	13.05 (21.17)	14.31 (22.22)	14.12 (22.07)	13.99 (21.96)	13.26 (21.35)	12.92 (21.06)	12.81 (20.97)	13.46 (21.52)
36	13.36 (21.44)	13.46 (21.53)	13.14 (21.25)	13 (21.14)	14.2 (22.14)	13.97 (21.95)	13.86 (21.85)	13.21 (21.31)	12.9 (21.05)	12.81 (20.97)	13.39 (21.46)
30	13.22 (21.32)	13.36 (21.44)	13.08 (21.21)	12.97 (21.11)	14.07 (22.03)	13.82 (21.82)	13.71 (21.73)	13.14 (21.25)	12.89 (21.04)	12.81 (20.97)	13.31 (21.39)
24	13.15 (21.26)	13.27 (21.36)	13.03 (21.16)	12.94 (21.09)	13.98 (21.95)	13.63 (21.67)	13.5 (21.56)	13.08 (21.20)	12.87 (21.03)	12.82 (20.98)	13.23 (21.33)
18	13.08 (21.21)	13.17 (21.28)	12.98 (21.12)	12.89 (21.04)	13.83 (21.83)	13.42 (21.49)	13.3 (21.39)	13.02 (21.15)	12.86 (21.01)	12.81 (20.97)	13.14 (21.25)
12	13.01 (21.15)	13.09 (21.21)	12.93 (21.07)	12.84 (21.00)	13.65 (21.69)	13.25 (21.35)	13.14 (21.26)	12.98 (21.11)	12.84 (20.99)	12.81 (20.97)	13.05 (21.18)
6	12.97 (21.11)	13.01 (21.14)	12.87 (21.03)	12.8 (20.97)	13.45 (21.52)	13.16 (21.27)	13.04 (21.17)	12.92 (21.07)	12.8 (20.97)	12.82 (20.98)	12.98 (21.12)
Mean	13.22 (21.32)	13.32 (21.41)	13.05 (21.18)	12.95 (21.09)	13.99 (21.96)	13.7 (21.72)	13.58 (21.62)	13.12 (21.24)	12.88 (21.03)	12.81 (20.97)	
	S.Em±						CD at 5 %				
Materials (M)	0.206						0.576				
Days (D)	0.185						0.516				
Interaction (MXD)	0.584						0.163				

Table 1.3.3: Effect of bagging materials and days on total sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	13.53 (21.58)	13.68 (21.71)	13.23 (21.33)	13.1 (21.22)	14.43 (22.32)	14.26 (22.18)	14.11 (22.06)	13.38 (21.45)	12.97 (21.11)	12.83 (20.99)	13.55 (21.60)
42	13.44 (21.51)	13.58 (21.62)	13.18 (21.29)	13.06 (21.18)	14.32 (22.24)	14.13 (22.08)	14.01 (21.98)	13.28 (21.37)	12.93 (21.07)	12.82 (20.98)	13.48 (21.53)
36	13.38 (21.45)	13.47 (21.53)	13.15 (21.26)	13.02 (21.15)	14.22 (22.15)	13.99 (21.96)	13.88 (21.88)	13.22 (21.32)	12.91 (21.06)	12.83 (20.98)	13.41 (21.48)
30	13.24 (21.34)	13.38 (21.45)	13.09 (21.21)	12.99 (21.13)	14.09 (22.04)	13.83 (21.83)	13.72 (21.74)	13.15 (21.26)	12.90 (21.05)	12.83 (20.98)	13.32 (21.40)
24	13.17 (21.27)	13.29 (21.38)	13.04 (21.17)	12.96 (21.10)	13.99 (21.96)	13.65 (21.68)	13.52 (21.57)	13.09 (21.21)	12.88 (21.03)	12.82 (20.98)	13.24 (21.34)
18	13.09 (21.21)	13.20 (21.30)	13.00 (21.13)	12.90 (21.05)	13.84 (21.84)	13.44 (21.51)	13.32 (21.40)	13.03 (21.16)	12.87 (21.02)	12.82 (20.98)	13.15 (21.26)
12	13.03 (21.16)	13.11 (21.23)	12.94 (21.09)	12.85 (21.01)	13.68 (21.71)	13.27 (21.36)	13.16 (21.27)	12.99 (21.13)	12.85 (21.00)	12.82 (20.98)	13.07 (21.19)
6	12.98 (21.12)	13.02 (21.15)	12.89 (21.04)	12.81 (20.97)	13.49 (21.55)	13.18 (21.28)	13.06 (21.19)	12.79 (20.95)	12.81 (20.97)	12.82 (20.98)	12.99 (21.12)
Mean	13.23 (21.33)	13.34 (21.42)	13.07 (21.19)	12.96 (21.10)	14.01 (21.98)	13.72 (21.74)	13.60 (21.64)	13.12 (21.23)	12.89 (21.04)	12.82 (20.98)	
	S.Em±						CD at 5 %				
Materials (M)	0.703						0.195				
Days (D)	0.629						0.175				
Interaction (MXD)	0.199						0.553				

Table 1.4.1: Effect of bagging materials and days on reducing sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	11.35 (19.69)	11.59 (19.90)	11.23 (19.58)	11.18 (19.54)	12.58 (20.77)	12.18 (20.43)	11.9 (20.18)	11.33 (19.67)	11.04 (19.41)	10.46 (18.87)	11.48 (19.80)
42	11.32 (19.66)	11.55 (19.87)	11.18 (19.53)	11.14 (19.49)	12.46 (20.67)	12.15 (20.4)	11.8 (20.09)	11.28 (19.62)	10.97 (19.34)	10.46 (18.87)	11.43 (19.75)
36	11.27 (19.62)	11.52 (19.84)	11.15 (19.51)	11.12 (19.48)	12.36 (20.59)	12.08 (20.34)	11.74 (20.04)	11.24 (19.59)	10.88 (19.26)	10.45 (18.86)	11.38 (19.71)
30	11.24 (19.59)	11.46 (19.79)	11.12 (19.48)	11.1 (19.46)	12.26 (20.5)	12.02 (20.29)	11.7 (20.00)	11.22 (19.57)	10.84 (19.22)	10.44 (18.85)	11.34 (19.67)
24	11.21 (19.56)	11.42 (19.75)	11.1 (19.46)	11.08 (19.44)	12.21 (20.45)	12.29 (20.52)	11.56 (19.88)	11.18 (19.53)	10.79 (19.18)	10.46 (18.87)	11.33 (19.66)
18	11.17 (19.53)	11.37 (19.71)	11.07 (19.43)	11.06 (19.42)	12.11 (20.36)	11.9 (20.18)	11.55 (19.86)	11.11 (19.47)	10.73 (19.12)	10.44 (18.85)	10.92 (19.14)
12	11.14 (19.50)	11.31 (19.65)	11.05 (19.42)	11.03 (19.4)	12.04 (20.3)	11.77 (20.06)	11.5 (19.82)	11.08 (19.44)	10.66 (19.06)	10.45 (18.86)	11.2 (19.55)
6	11.12 (19.48)	11.26 (19.61)	11.02 (19.38)	10.99 (19.36)	12 (20.27)	11.68 (19.98)	11.45 (19.78)	11.05 (19.42)	10.59 (18.99)	10.45 (18.86)	11.16 (19.51)
Mean	11.23 (19.58)	11.44 (19.76)	10.7 (18.91)	11.09 (19.45)	12.25 (20.49)	12.01 (20.27)	11.65 (19.96)	11.19 (19.54)	10.81 (19.20)	10.45 (18.86)	
	S.Em±						CD at 5 %				
Materials (M)	0.179						0.499				
Days (D)	0.160						0.423				
Interaction (MXD)	0.505						0.612				

Table 1.4.2: Effect of bagging materials and days on reducing sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)											
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean	
48	11.33 (19.67)	11.56 (19.87)	11.19 (19.54)	11.15 (19.50)	12.54 (20.74)	12.15 (20.40)	11.85 (20.13)	11.27 (19.62)	10.98 (19.35)	10.44 (18.85)	11.45 (19.77)	
42	11.28 (19.62)	11.53 (19.85)	11.15 (19.51)	11.12 (19.48)	12.42 (20.63)	12.11 (20.36)	11.76 (20.06)	11.24 (19.59)	10.93 (19.31)	10.45 (18.86)	11.4 (19.73)	
36	11.24 (19.59)	11.49 (19.81)	11.14 (19.49)	11.1 (19.46)	12.32 (20.55)	12.06 (20.32)	11.7 (20.00)	11.22 (19.57)	10.86 (19.24)	10.78 (19.16)	11.39 (19.72)	
30	11.21 (19.56)	11.44 (19.77)	11.12 (19.48)	11.08 (19.45)	12.23 (20.47)	11.99 (20.26)	11.66 (19.97)	11.18 (19.53)	10.81 (19.20)	10.45 (18.86)	11.32 (19.65)	
24	11.19 (19.54)	11.4 (19.73)	11.09 (19.45)	11.06 (19.43)	12.17 (20.42)	11.94 (20.22)	11.55 (19.86)	11.14 (19.50)	10.74 (19.13)	10.46 (18.87)	11.27 (19.62)	
18	11.15 (19.51)	11.35 (19.68)	11.06 (19.43)	11.04 (19.4)	12.09 (20.35)	11.87 (20.15)	11.52 (19.84)	11.09 (19.45)	10.68 (19.07)	10.45 (18.86)	11.23 (19.57)	
12	11.12 (19.48)	11.29 (19.63)	11.03 (19.40)	11.00 (19.37)	12.02 (20.29)	11.74 (20.03)	11.48 (19.80)	11.06 (19.43)	10.62 (19.02)	10.45 (18.86)	11.18 (19.53)	
6	11.1 (19.46)	11.24 (19.59)	11.01 (19.38)	10.97 (19.34)	11.98 (20.25)	11.64 (19.95)	11.43 (19.76)	11.04 (19.41)	10.55 (18.95)	10.44 (18.85)	11.14 (19.49)	
Mean	11.2 (19.55)	11.41 (19.74)	11.1 (19.46)	11.07 (19.43)	12.22 (20.46)	11.94 (20.21)	11.62 (19.93)	11.16 (19.51)	10.77 (19.16)	10.49 (18.90)		
S.Em±					CD at 5 %							
Materials (M)					0.127							0.354
Days (D)					0.113							0.317
Interaction (MXD)					0.359							0.100

Table 1.4.3: Effect of bagging materials and days on reducing sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)											
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean	
48	11.34 (19.68)	11.57 (19.89)	11.21 (19.56)	11.17 (19.52)	12.56 (20.76)	12.17 (20.41)	11.87 (20.15)	11.3 (19.64)	11.01 (19.38)	10.45 (18.86)	11.47 (19.79)	
42	11.3 (19.64)	11.54 (19.86)	11.17 (19.52)	11.13 (19.49)	12.44 (20.65)	12.13 (20.38)	11.78 (20.07)	11.26 (19.61)	10.95 (19.33)	10.45 (18.86)	11.42 (19.74)	
36	11.25 (19.60)	11.50 (19.82)	11.14 (19.50)	11.11 (19.47)	12.34 (20.57)	12.07 (20.33)	11.72 (20.02)	11.23 (19.58)	10.87 (19.25)	10.62 (19.01)	11.39 (19.72)	
30	11.23 (19.57)	11.45 (19.78)	11.12 (19.48)	11.09 (19.45)	12.24 (20.48)	12.01 (20.27)	11.68 (19.98)	11.20 (19.55)	10.83 (19.21)	10.45 (18.86)	11.33 (19.66)	
24	11.20 (19.55)	11.41 (19.74)	11.09 (19.45)	11.07 (19.44)	12.19 (20.43)	12.12 (20.37)	11.56 (19.87)	11.16 (19.52)	10.77 (19.16)	10.46 (18.87)	11.30 (19.64)	
18	11.16 (19.52)	11.36 (19.70)	11.04 (19.41)	11.05 (19.41)	12.10 (20.36)	11.89 (20.17)	11.53 (19.85)	11.10 (19.46)	10.70 (19.10)	10.45 (18.86)	11.07 (19.36)	
12	11.13 (19.49)	11.30 (19.64)	11.04 (19.41)	11.02 (19.38)	12.03 (20.29)	11.75 (20.05)	11.49 (19.81)	11.07 (19.44)	10.64 (19.04)	10.45 (18.86)	11.19 (19.54)	
6	11.11 (19.47)	11.25 (19.60)	11.01 (19.38)	10.98 (19.35)	11.99 (20.26)	11.66 (19.96)	11.44 (19.77)	11.05 (19.41)	10.57 (18.97)	10.45 (18.86)	11.15 (19.50)	
Mean	11.22 (19.56)	11.42 (19.75)	11.09 (19.46)	11.08 (19.44)	12.24 (20.47)	11.98 (20.24)	11.63 (19.94)	11.17 (19.53)	10.79 (19.18)	10.47 (18.88)		
S.Em±					CD at 5 %							
Materials (M)					0.897							1.321
Days (D)					0.802							1.214
Interaction (MXD)					0.254							0.813

Table 1.5.1: Effect of bagging materials and days on non reducing sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)											
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean	
48	2.2 (8.53)	2.11 (0.00)	2.02 (7.65)	1.94 (7.94)	1.87 (7.83)	2.1 (7.68)	2.23 (6.60)	2.08 (8.21)	1.94 (8.12)	2.39 (8.07)	2.09 (7.06)	
42	2.14 (8.42)	2.05 (8.35)	2.02 (0.00)	1.93 (7.89)	1.87 (7.77)	1.99 (7.57)	2.23 (7.19)	2.01 (8.08)	1.97 (8.01)	2.38 (8.20)	2.06 (7.15)	
36	2.12 (8.37)	1.97 (8.23)	2.02 (8.18)	1.9 (0)	1.87 (7.77)	1.93 (7.44)	2.17 (7.07)	2 (7.68)	2.04 (7.96)	2.39 (8.26)	2.04 (7.10)	
30	2.02 (8.17)	1.93 (8.06)	1.98 (8.16)	1.91 (8.00)	1.84 (0.00)	1.81 (7.11)	2.04 (7.07)	1.94 (7.43)	2.06 (7.99)	2.4 (8.32)	1.99 (7.03)	
24	1.97 (8.07)	1.88 (7.99)	1.96 (8.17)	1.89 (7.99)	1.79 (7.86)	1.37 (8.33)	1.97 (0.00)	1.92 (7.34)	2.09 (7.98)	2.36 (8.42)	1.92 (7.21)	
18	1.93 (7.98)	1.85 (7.88)	5.27 (8.09)	1.86 (7.93)	1.74 (7.87)	1.57 (8.11)	1.79 (8.59)	1.93 (0.00)	2.14 (7.20)	2.39 (8.52)	2.25 (7.22)	
12	1.9 (7.92)	1.82 (7.82)	1.91 (8.04)	1.83 (7.94)	1.68 (7.87)	1.51 (7.98)	1.67 (8.58)	1.93 (8.29)	2.19 (0.00)	2.39 (8.59)	1.88 (7.30)	
6	1.88 (7.87)	1.77 (7.75)	1.88 (12.07)	1.83 (7.89)	1.53 (7.80)	1.51 (7.74)	1.63 (8.47)	1.6 (8.15)	2.23 (8.01)	2.38 (0.00)	1.82 (7.58)	
Mean	2.02 (8.17)	1.92 (7.01)	2.38 (7.54)	1.89 (6.95)	1.77 (6.85)	1.72 (7.74)	1.97 (6.70)	1.93 (6.90)	2.08 (6.91)	2.39 (7.30)		
S.Em±					CD at 5 %							
Materials (M)					0.168							0.470
Days (D)					0.150							0.412
Interaction (MXD)					0.476							1.329

Table 1.5.2: Effect of bagging materials and days on non reducing sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	2.18 (8.48)	2.11 (8.35)	2.02 (8.18)	1.94 (8.01)	1.86 (7.85)	2.08 (8.30)	2.24 (8.61)	2.08 (8.29)	1.97 (8.07)	2.37 (8.86)	2.09 (8.30)
42	2.15 (8.43)	2.04 (8.20)	2.01 (8.16)	1.93 (7.98)	1.89 (7.90)	2.01 (8.16)	2.23 (8.59)	2.02 (8.16)	1.98 (8.10)	2.36 (8.84)	2.06 (8.25)
36	2.13 (8.39)	1.98 (8.08)	2.00 (8.13)	1.9 (7.93)	1.89 (7.89)	1.9 (7.93)	2.15 (8.44)	1.99 (8.11)	2.05 (8.23)	2.03 (8.13)	2 (8.13)
30	2.01 (8.15)	1.92 (7.96)	1.97 (8.06)	1.89 (7.90)	1.85 (7.81)	1.82 (7.76)	2.05 (8.23)	1.96 (8.04)	2.08 (8.29)	2.36 (8.84)	1.99 (8.10)
24	1.96 (8.05)	1.87 (7.87)	1.94 (8.01)	1.88 (7.88)	1.81 (7.72)	1.69 (7.47)	1.96 (8.04)	1.94 (8.00)	2.13 (8.39)	2.36 (8.83)	1.95 (8.03)
18	1.93 (7.99)	1.82 (7.76)	1.92 (7.96)	1.85 (7.82)	1.73 (7.57)	1.55 (7.15)	1.79 (7.68)	1.93 (7.99)	2.18 (8.50)	2.36 (8.84)	1.91 (7.93)
12	1.89 (7.91)	1.8 (7.70)	1.89 (7.91)	1.84 (7.80)	1.63 (7.34)	1.51 (7.07)	1.67 (7.42)	1.91 (7.95)	2.22 (8.57)	2.35 (8.82)	1.87 (7.85)
6	1.87 (7.87)	1.77 (7.65)	1.87 (7.85)	1.83 (7.78)	1.48 (6.98)	1.52 (7.08)	1.61 (7.30)	1.88 (7.88)	2.25 (8.63)	2.37 (8.86)	1.85 (7.79)
Mean	2.02 (8.16)	1.91 (7.95)	1.95 (8.03)	1.88 (7.89)	1.77 (7.63)	1.76 (7.61)	1.96 (8.04)	1.96 (8.05)	2.11 (8.35)	2.32 (8.75)	
					S.Em±			CD at 5 %			
Materials (M)					0.293			0.817			
Days (D)					0.261			0.730			
Interaction (MXD)					0.826			0.231			

Table 1.5.3: Effect of bagging materials and days on non reducing sugar (%) of litchi fruit cv. Rose Scented

Bagging Days before harvest	Bagging materials (M)										
	Brown paper bag	Black polythene bag	News paper bag	Muslin cloth bag	Single parchment paper	Double parchment paper	Triple parchment paper	Cellophane bag	Net bag	Unbagged	Mean
48	2.19 (8.51)	2.11 (0.00)	2.02 (7.65)	1.94 (7.92)	1.87 (7.83)	2.09 (7.70)	2.24 (7.03)	2.08 (8.22)	1.96 (8.12)	2.38 (8.08)	2.09 (7.11)
42	2.15 (8.42)	2.04 (8.35)	2.02 (0.00)	1.93 (7.87)	1.88 (7.79)	2.00 (7.57)	2.23 (7.17)	2.010 (8.06)	1.98 (8.02)	2.37 (8.21)	2.06 (7.15)
36	2.12 (8.38)	1.97 (8.21)	2.01 (8.18)	1.90 (0.00)	1.88 (7.77)	1.92 (7.39)	2.16 (7.07)	1.99 (7.68)	2.04 (7.98)	2.21 (8.28)	2.02 (7.09)
30	2.02 (8.16)	1.93 (8.07)	1.97 (8.16)	1.90 (8.00)	1.84 (0.00)	1.82 (7.04)	2.04 (7.07)	1.95 (7.42)	2.07 (7.99)	2.38 (8.36)	1.99 (7.03)
24	1.97 (8.06)	1.88 (7.98)	1.95 (8.15)	1.88 (7.99)	1.80 (7.85)	1.53 (8.32)	1.97 (0.00)	1.93 (7.32)	2.11 (7.96)	2.36 (8.46)	1.94 (7.21)
18	1.93 (7.98)	1.84 (7.87)	3.60 (8.08)	1.86 (7.93)	1.74 (7.88)	1.56 (8.13)	1.79 (8.60)	1.93 (0.00)	2.16 (7.54)	2.38 (8.54)	2.08 (7.26)
12	1.9 (7.92)	1.81 (7.79)	1.90 (8.02)	1.84 (7.92)	1.66 (7.88)	1.51 (7.95)	1.67 (8.58)	1.92 (8.29)	2.21 (0.00)	2.37 (8.61)	1.88 (7.30)
6	1.88 (7.87)	1.77 (7.73)	1.88 (10.02)	1.83 (7.89)	1.50 (7.80)	1.52 (7.75)	1.62 (8.45)	1.74 (8.16)	2.24 (8.04)	2.38 (0.00)	1.84 (7.37)
Mean	2.02 (8.16)	1.92 (7.00)	2.17 (7.28)	1.89 (6.94)	1.77 (6.85)	1.74 (7.73)	1.97 (6.75)	1.94 (6.89)	2.10 (6.96)	2.35 (7.32)	
					S.Em±			CD at 5 %			
Materials (M)					0.842			0.234			
Days (D)					0.753			0.209			
Interaction (MXD)					0.238			0.662			

Conclusion

- The highest content of acidity was recorded in unbagged fruits (4.27 %) as compared to bagging treatments. However, lowest value for acidity content was recorded when fruits were bagged 48 days before normal harvest (3.87 %) with triple parchment paper bag (3.54 %).
- The lowest mean value (18.72 °Brix) of total soluble solids was recorded in unbagged fruits as compared to other treatments. Fruits bagged 6 days before normal harvest shows least value. Whereas, it was highest in fruits bagged 48 days prior to harvest. The interaction effect showed that fruit bagged 48 days prior to harvest with triple parchment paper bag had highest value of total soluble solids (22.46 °Brix).
- The fruits bagged 48 days prior to normal harvest recorded significantly higher percentage of total sugar and reducing sugar as compared to fruits bagged 6 days before normal harvest. The fruits bagged with single parchment paper bag showed higher percentage of total sugar and reducing sugar and it was lowest with unbagged fruits.

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