



# Effect of Pre-Harvest Fruit Bagging on the Physical Qualities, Shelf Life and Yield of Litchi (*Litchi chinensis*)

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The experiment on "Effect on Yield and Quality of Litchi (*Litchi chinensis*) by Pre-Harvest fruit bagging" was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat During 2021-2022. The experiment was laid out in Randomized Block Design (RBD) with seven (7) treatments and three (3) replications. The treatments taken under the study were Control (T<sub>1</sub>), Non-woven Red (T<sub>2</sub>), Non-woven Blue (T<sub>3</sub>), Non-woven White (T<sub>4</sub>), Non-woven Green (T<sub>5</sub>), Non-woven Yellow (T<sub>6</sub>) and Polypropylene (T<sub>7</sub>). The maximum fruit weight (17.81g), fruit volume (20.00cc), fruit breadth (3.16cm), fruit length (3.56cm), aril weight (14.28g), peel weight (2.31g) and yield (0.44kg/bunch) were recorded in T<sub>4</sub> (Non-woven White). Sun burn (8%) and fruit cracking (5.66%) percentage was observed lowest in T<sub>4</sub>. During storage, highest shelf life was

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observed in  $T_4$  i.e. 10.50 days. Thus, it can be concluded that all the bags studied in the present experiment were found to be good both in qualitative and quantitative characters and also increased shelf life. But the most superior one among the selected bags was non-woven white bag in terms of morphological and shelf life characteristics.

**Keywords:** Fruit bagging; preharvest; litchi; yield; quality; shelf life.

## 1. INTRODUCTION

Litchi (*Litchi chinensis* Sonn.), which belongs to the family Sapindaceae and sub-family Nephelieae is one of the most important economically valued sub-tropical evergreen fruit crops and originated from China [1]. Litchi fruit has two species, one is *Litchi philippinensis* and another is *Litchi chinensis*. *Litchi philippinensis* is a wild type plant grown in some part of Philippines and are mainly used as rootstock for litchi cultivation [1].

Although litchi is originated from china, but now a days litchi is commercially grown in USA, Madagascar, South Africa, Australia, Israel, India, Philippines, Thailand, Indonesia, Taiwan, Vietnam, Pakistan, and Brazil [1]. During 18<sup>th</sup> Century, *Litchi chinensis* was introduced in India and has adapted well to the Eastern India, i.e. Chhattisgarh, Punjab, Bihar, Uttar Pradesh, Jharkhand, Uttarakhand, West Bengal, Himachal Pradesh and Tripura. India ranks 2<sup>nd</sup> in litchi production after China (Nath et al 2018).

Due to its enchanting red peel colour, excellent physico-chemical fruit quality and characteristic pleasant aroma and flavor, litchi has become popular now days. The bright red peel colour, sweet blended with acid, juicy and crispy aril the commercial value of Litchi in domestic and international market platform has increased tremendously. Fruit quality is considered to be one of the important factors which adversely affects the profit of litchi grower. Superior fruit quality with good keeping quality and free from insect pest infestation are the important characteristic for the marketing demands of litchi fruit industry in India. The major problems which are responsible for low economic potential in litchi cultivation are poor fruit set, fruit drop and inferior fruit quality.

1. One of the good agricultural practices (GAP) is pre-harvest fruit bagging which has emerged as one of the best technique in different region of the world. In fruit bagging, single fruit or fruit bunches are cover with suitable bagging material for a period of time on the tree to get excellent

results. It has become as a novel technique in normal practice, which is very easy, simple, cost effective, grower friendly, eco-friendly, safe, and beneficial for increase in production of highquality fruits. By employing appropriate bagging to litchi bunches, the physical losses and quality can be improved. Other factors which are also influenced by fruit bagging are physiological disorders, concentration of fruit nutrient, fruit quality, various enzymatic actions, concentration of phenolic compound, antioxidant activities, aroma volatiles and fruit firmness. The date of bagging, bagging material and the duration of bagging have a profound influence in the fruit quality and other parameters [2]. Hence a research study was done with the objective to find the effect of pre-harvest fruit bagging on the fruit quality and shelf life and Standardization of suitable bagging materials

## 2. MATERIALS AND METHODS

Litchi (*Litchi chinensis*) cv. 'Piyaji' was selected for the study. The Litchi fruits were bagged at 15 days after fruit set the treatments comprised of different colours of non-woven bagging materials such as Non-woven Red, Non-woven Blue, Non-woven White, Non-woven Green, Non-woven yellow and Polypropylene, with one un-bagged (control). Bagging for each treatment was replicated in three directions of the fruit tree and was laid out in a simple randomized design. Fruits bagged and un-bagged(control) fruits were harvested at commercial mature stage. Parameters like fruit weight, fruit volume, fruit breadth, fruit length, aril weight, peel weight, yield, shelf life, pericarp sunburn and fruit cracking percentage were evaluated. The level of significance for different variables was tested at 5% value of significance.

## 3. RESULTS AND DISCUSSION

The data presented in Table 1 fruit length was significantly influenced by the bagging treatments. The fruit length under different treatments were control (3.10cm), Non-woven

Red (3.36cm), Non-woven Blue (3.40cm), Non-woven White (3.56cm), Non-woven Green (3.30cm), Non-woven yellow (3.43cm) and Polypropylene (3.53cm). Highest fruit length of 3.56cm was recorded in white non-woven bagged fruits followed by polypropylene bagged fruits (3.53cm) whereas, the lowest fruit length of 3.10cm was observed in un-bagged fruits. Increased fruit length in bagged fruits might be due to rapid cell division and expansion under favourable micro-climate. The results obtained are endorsed with the findings of Debnath and Mitra (2008) and Senanan et al. [3] in litchi.

Fruit breadth under different treatments were (Control) 2.70cm,(Non-woven Red) 2.86cm, (Non-woven Blue) 2.80cm, (Non-woven White) 3.16cm, (Non- woven Green) 3.06cm, (Non-woven Yellow) 3.03cm and (Polypropylene) 3.13cm. The highest fruit breadth of 3.16cm was found in Non-woven White which was statistically at par with Polypropylene 3.13cm and Non-woven Green 3.06cm and lowest was found in Control i.e. 2.70cm. Earlier studies made by several workers also have similar findings like Debnath and Mitra (2008) and Senanan et al. [3] in litchi , Ghalib et al. [4] El- Kassas et al. [5] Harhash and Al-Obeed (2010), Kassem et al. [6] and Mostafa et al. [7] in datepalm.

The maximum fruit weight (17.81g) was recorded when fruits were bagged with white non-woven bags whereas the minimum fruit weight (14.09g) was noticed when fruits were not bagged. Similar findings were observed by Fumuro and Gamo [8] in persimmon and Debnath and Mitra (2008) in litchi fruits. This trend in fruit weight might be attributed due to the favourable microclimate created inside the bags which increased accumulation of assimilates leading to maximum fruit weight.

The data presented in Table 1, shows that fruits bagged with white non-woven bags had higher fruit volume (20.00 cc) while it was found lowest (14.33 cc) in unbagged fruits. Similar results have been obtained by Daniells and Farell [9] who reported that the higher fruit volume in banana fruits might be due to higher humidity and appropriate microclimate inside the bags, which results in proper growth and development of fruits.

Maximum value (14.28g) of fruit aril weight was obtained when fruits were bagged with white non-woven bags while the minimum fruit aril weight (9.73g) was observed in unbagged fruits. Similar results were obtained by Zhou et al. [10] in Canarium album, El-Kassas et al. [5] El-Shazly [11] in date palm fruits.

**Table 1. Fruit length, fruit breadth, fruit volume and fruit weight**

Treatment	Fruit length (cm)	Fruit breadth (cm)	Fruit volume (cc)	Fruit weight (g)
T1 (Control)	3.10	2.70	14.33	14.09
T2 (Non-woven Red)	3.36	2.86	15.66	15.11
T3 (Non-woven Blue)	3.40	2.80	17.33	15.02
T4 (Non-woven White)	3.56	3.16	20.00	17.81
T5 (Non- woven Green)	3.30	3.06	16.00	14.90
T6 (Non-woven Yellow)	3.43	3.03	16.67	14.76
T7 (Polypropylene)	3.53	3.13	18.67	16.39
S.Ed (±)	0.05	0.04	1.12	0.14
CD (P=0.05)	0.01	0.13	2.45	0.32

**Table 2. Peel weight, aril weight and yield**

Treatment	Peel weight(g)	Aril weight (g)	Yield (Kg/Bagging)
T1 (Control)	1.37	9.73	0.35
T2 (Non-woven Red)	2.23	11.08	0.38
T3 (Non-woven Blue)	2.06	11.88	0.37
T4 (Non-woven White)	2.31	14.28	0.44
T5 (Non- woven Green)	1.98	13.19	0.37
T6 (Non-woven Yellow)	2.08	12.70	0.37
T7 ( Polypropylene)	2.12	12.09	0.41
S.Ed (±)	0.17	0.69	0.09
CD (P=0.05)	0.38	1.53	0.01

**Table 3. Sunburn, fruit cracking and shelf life**

Treatment	Sun burn %	Fruit cracking %	Shelf life (Days)
T1 (Control)	14.00	11.00	8.06
T2 (Non-woven Red)	11.00	9.00	9.03
T3 (Non-woven Blue)	10.00	7.00	9.50
T4 (Non-woven White)	8.00	5.66	10.50
T5 (Non-woven Green)	12.00	9.00	9.17
T6 (Non-woven Yellow)	11.66	7.33	9.03
T7 (Polypropylene)	12.00	7.66	9.83
S.Ed ( $\pm$ )	1.05	1.21	0.27
CD (P=0.05)	2.32	2.66	0.60

Maximum peel weight was observed in Non-woven White i.e. 2.31g which was statistically at par with Non-woven Red (2.23g), Polypropylene (2.12g), Non-woven Yellow (2.08g), Non-Woven Blue (2.06g), Non-woven Green (1.98g). Minimum peel weight was recorded in T<sub>1</sub> (Control) i.e. 1.37g. Harhash & Al-Obeed (2010) reported that bagging treatment could lead to modifying nutrients and phytochrome metabolism in fruits during development which lead to the thicker skin in bagged fruits.

The maximum fruit yield of 0.44kg was found in non-woven white bagged fruits followed by polypropylene (0.41kg), whereas minimum yield of 0.35kg was found in control i.e. un-bagged fruits. Earlier studies made by several workers also have similar findings like Harhash & Al-Obeed (2010) and Kassem et al. [6] in date palm, Abdel Gawad-Nehad et al. [12] in mango and Senanan et al. [3] in litchi.

Minimum fruit cracking (5.66%) was observed in fruits with white non-woven bags and maximum observed in control group (11%). The declining trend in fruit cracking may have resulted due to reduced moisture stress inside the bags (Sanyal et al., 1990). Similar finding had been reported by Son and Kim [14] and Li Juan et al. [14] in grape, Yang et al. [15] in longan fruit, Ma et al. [16] in peach and Abd El-Rhaman [17] in pomegranate.

The least sunburn percentage of 8% was observed in fruits bagged with white non-woven bags and maximum sunburn percentage (14%) was found in un-bagged fruits. The reduction in pericarp sunburn inside the bagged fruits might be due to protection of fruits from direct sunlight during hot and scorching summer. These results are in conformity with the findings of Hong and Zhengming [18] as they found bagging protected the navel orange from sunburn.

Bagging also influence the shelf life of litchi fruit. The fruits harvested from the non-woven white

bags had highest shelf life of 10.50 days as the fruits from the bags were always dry, healthy and had no insect and disease infestation, less susceptible to decay %. Modified microenvironment around the fruits delayed the ripening in bagged fruits as compared to un-bagged ones resulting in the improvement in shelf life of litchi fruit. Similar results were also reported by Akter *et al.* [19] in mango.

#### 4. CONCLUSION

From the above discussion, it can be concluded that both the qualitative and quantitative parameters of litchi fruits were enhanced at the time of harvest and also during the storage period by pre-harvest fruit bagging using various bagging materials. However bagging of litchi fruits with white non-woven bags may be recommended to enhance the physical and physiological parameters of litchi fruits which can fetch high remuneration to the growers of litchi.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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