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Impact of Pre-Harvest Fruit Bunch Bagging on Yield and Quality of Different Litchi (*Litchi chinensis* Sonn.) Cultivars

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ABSTRACT

Pre-harvest bagging practice enhances harvest timing, minimizes insect infestations, reduces chemical residues, and supports organic cultivation. A study was carried out at the Instructional Farm of UBKV, Pundibari to evaluate the effects of bagging on three litchi cultivars (Calcuttia, Elaichi, and China) using six coloured bags (transparent, yellow, green, blue, red, and black with 5% perforations) and an un-bagged control in a factorial randomized block design with four replications. The Elaichi cultivar showed the best performance with reduced fruit drop (27.71%) and maximum fruit retention (64.70%). Un-bagged fruits had the highest cracking rate (5.47%) and infestation (10.76%), while bagged fruits were free from these issues. Blue-coloured bags yielded the best results, achieving maximum fruit weight (17.38 g), diameter (3.11 cm), length (3.78 cm), juice yield (7.73 ml), TSS (21.04 °B), total sugar (16.31%), reducing sugar (13.74%), ascorbic acid (32.01 mg/100 g), and anthocyanin content (29.22 mg/100 g). Bagging proved effective in improving fruit quality and reducing losses, particularly during the rainy season.

Keywords: Bagging, Cracking, Fruit, Insect, Infestation, Litchi, Pre-Harvest, .

INTRODUCTION

Litchi (*Litchi chinensis* Sonn.), the queen of subtropical fruit is a member of the Sapindaceae family, prized for its flavour, quality and vivid red hue. Bihar, West Bengal, and Jharkhand account for 66% of the overall output making them the major production centers (Sahni *et al,* 2020). Poor fruit set, low retention, fruit cracking, and pest infestations all contribute to its low average output, despite its potential (Das and Rahman, 2018). The leathery-rinded fruit usually produced in clusters comes in a variety of shapes and colours usually ranging from pink to red flowers (Malotra *et al,* 2018). The 24 Parganas of West Bengal, Murshidabad, Malda, and Nadia are important agricultural locations for popular cultivars like Shahi, Bombai, and Bedana. Proteins, minerals (calcium, phosphorus), vitamins (B1, C), and bioactive substances with anti-cancer and antioxidant qualities are all abundant in litchi (Singh *et al,* 2019). Its pulp comprises 60% juice, contributing to its high nutritional and commercial value (Nath *et al,* 2016).

Yield and financial returns are severely constrained by the fruit's short shelf life, erratic flowering, excessive fruit loss, and temperature sensitivity. To reduce these problems, novel approaches have been investigated such as pre-harvest fruit bagging. Fruit bagging, a physical protection technique, has demonstrated encouraging outcomes in terms of improving litchi quality and output. Bagging enhances internal quality (nutritional retention) and outward appearance (coloration and blemish reduction) by changing the microenvironment (Fan and Mattheis, 1998). Fruits are also shielded against pests, illnesses, mechanical harm, and pesticide residues by it. Fruit has improved in size and weight and matured 12 days earlier thanks to bagging procedures that use biodegradable cellophane paper bags (Debnath and Mitra, 2008).

Bagging contributes to quality improvement by increases the colour of the peel and lessens cracking, encourages organic farming and reduces pesticide residues. Harvesting is spaced out and handling is made easier, provides protection from sunburn, insect damage, and other environmental dangers (Fan and Mattheis, 1998; Shah *et al*, 2020). Bagging of the fruits is a labour-intensive method that has been successful in resolving important agricultural issues, making it a

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Table 1: Effect of fruit bunch bagging on fruit drop and fruit retention in litchi.

Bagging (B)	Fruit Drop (%)			Mean	Fruit Retention (%)			Mean
	Cultivars (C)				Cultivars (C)			
	Calcuttia	Elaichi	China		Calcuttia	Elaichi	China	
B_0 (Control)	36.83 (37.35)	38.83 (38.54)	35.30 (36.43)	36.99 (37.44)*	63.17 [7.89]	61.17 [7.85]	64.70 [8.07]	63.01 [7.97]#
B_1 (Transparent)	21.15 (27.32)	23.74 (29.13)	20.92 (27.20)	21.94 (27.89)	78.85 [8.91]	76.26 [8.76]	79.08 [8.92]	78.06 [8.86]
B_2 (Yellow)	23.41 (28.94)	28.38 (32.10)	21.83 (27.84)	24.54 (29.62)	76.59 [8.78]	71.62 [8.49]	78.17 [8.87]	75.46 [8.71]
B_3 (Green)	21.18 (27.37)	25.33 (30.20)	18.85 (25.73)	21.79 (27.77)	78.82 [8.91]	74.67 [8.67]	81.15 [9.04]	78.21 [8.87]
B_4 (Blue)	18.06 (25.14)	22.62 (28.39)	17.37 (24.57)	19.35 (26.03)	81.94 [9.08]	77.38 [8.82]	82.63 [9.12]	80.65 [9.01]
B_5 (Red)	26.15 (30.74)	29.02 (32.57)	26.59 (31.04)	27.25 (31.45)	73.85 [8.62]	70.98 [8.45]	73.41 [8.60]	72.75 [8.56]
B_6 (Black)	22.69 (28.42)	26.06 (30.68)	23.83 (29.13)	24.20 (29.41)	77.31 [8.82]	73.94 [8.63]	76.17 [8.75]	75.80 [8.73]
Mean	24.21 (29.32)	27.71 (31.66)	23.53 (28.85)	25.15 (37.44)	63.17 [8.73]	61.17 [8.52]	64.70 [8.77]	74.85 [8.67]
	Bagging (B)	Cultivars (C)	B × C		Bagging (B)	Cultivars (C)	B × C	
SEm±	0.55	0.36	0.95		0.05	0.03	0.08	
CD at 5.0 %	1.55	1.01	NS		0.14	0.09	NS	

*Figures in parentheses indicates arc sign transformed values.
#Figures in parentheses indicates square root transformed values.

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feasible strategy for raising litchi quality and productivity in India. The current experiment was conducted with the aim of examining the impact of fruit bunch bagging with various coloured bags on the fruit yield and quality of different litchi cultivars, taking into account its significance and cultivation bottleneck.

MATERIALS AND METHODS

Experimental set-up

The experiment was carried out at the Uttar Banga Krishi Viswavidyalaya's Department of Pomology and Post Harvest Technology's Instructional Farm, located in Pundibari, Cooch Behar, West Bengal-736165, Faculty of Horticulture. The area is 43 meters above mean sea level and falls within the Terai agro-climatic zone of West Bengal. It is situated at 26°39'83" N latitude and 89°38'64" E longitude (according to the geographic coordinate system). High humidity and a lot of rainfall are characteristics of the subtropical humid climate found in this area.

Methodology

Three cultivars (Calcuttia, Elaichi, and China) were examined using 21 treatment combinations of six different coloured bags (transparent, yellow, green, blue, red, and black bags with 5% perforations) and one unbagged control. A factorial randomized block design was used to arrange these possibilities, which were replicated four times. Each replication featured two bunches that were bagged. Seven days after the fruit set, the litchi panicles were packed in a variety of coloured cellophane paper bags. In order to provide the appropriate ventilation required for fruit development, 5% of each bag was perforated by creating holes (4 mm) in each bag. Using the necessary precautions to prevent shock to the young fruitlets and panicle breakage during bag tying, fruits were gathered from several treatments at the proper stage of development.

Observations Recorded

The observations were recorded by randomly selected fruits from each bag. During the course of the experiment, the observations like fruit drop (%), fruit cracking (%), fruit retention (%), number of infested fruits by fruit borer (*Conopomorpha sinensis*) per panicle (%), fruit weight (g), weight of aril (g), weight of seed (g), fruit length and diameter (cm), total soluble solids (TSS) content (°Brix), total sugar (%), reducing sugars (%), non-reducing sugars (%), titratable acidity (%), ascorbic acid (mg/100) and anthocyanin contain of fruit peel (mg/100ml) were taken.

Table 2: Effect of fruit bunch bagging on fruit cracking and infestation in litchi

Bagging (B)	Fruit Cracking (%)			Mean	Infested fruits (%)			Mean
	Cultivars (C)				Cultivars (C)			
	Calcuttia	Elaichi	China		Calcuttia	Elaichi	China	
B_0 (Open)	0.00 [0.71]	16.40 [3.98]	0.00 [0.71]	5.47 [1.80]#	16.82 (17.68)	0.00 (0.00)	15.48 (16.89)	10.76 (11.52)*
B_1 (Transparent)	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
B_2 (Yellow)	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
B_3 (Green)	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
B_4 (Blue)	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 [0.71]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
B_5 (Red)	0.00 [0.71]	4.36 [1.87]	0.00 [0.71]	1.45 [1.10]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
B_6 (Black)	0.00 [0.71]	7.88 [2.89]	0.00 [0.71]	2.63 [1.44]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Mean	0.00 [0.71]	4.09 [1.65]	0.00 [0.71]	1.36 [1.02]	2.40 (2.53)	0.00 (0.00)	2.21 (2.41)	1.54 (1.65)
	Bagging (B)	Cultivars (C)	B × C		Bagging (B)	Cultivars (C)	B × C	
SEm±	0.17	0.08	0.20		1.79	1.17	3.10	
CD at 5.0 %	0.33	0.23	0.57		5.06	NS	NS	

*Figures in parentheses indicates arc sign transformed values.
#Figures in parentheses indicates square root transformed values.

Table 3: Effect of fruit bunch bagging on weight of fruit, fruit length and fruit diameter in litchi

Bagging (B)	Weight of Fruit (g)			Mean	Fruit Length (cm)			Mean	Fruit Diameter (cm)			
	Cultivars (C)				Cultivars (C)				Cultivars (C)			Mean
	Calcuttia	Elaichi	Calcuttia		China	Elaichi	Calcuttia		China	Elaichi	China	
B_0 (Open)	17.84	13.75	3.20	3.68	3.43	3.44	3.20	3.68	3.43	3.44	3.39	3.36
B_1 (Transparent)	20.34	15.68	3.45	3.65	3.74	3.61	3.45	3.65	3.74	3.61	3.27	3.13
B_2 (Yellow)	20.03	15.39	3.39	3.53	3.68	3.53	3.39	3.53	3.68	3.53	3.29	3.19
B_3 (Green)	20.62	16.04	3.48	3.79	3.76	3.67	3.48	3.79	3.76	3.67	3.26	3.11
B_4 (Blue)	21.10	16.57	3.68	3.86	3.81	3.78	3.68	3.86	3.81	3.78	3.22	3.06
B_5(Red)	18.55	14.48	3.35	3.47	3.58	3.46	3.35	3.47	3.58	3.46	3.33	3.30
B_6 (Black)	19.06	14.72	3.42	3.53	3.68	3.54	3.42	3.53	3.68	3.54	3.32	3.23
Mean	19.65	15.23	3.42	3.64	3.67	3.58	3.42	3.64	3.67	3.58	3.30	3.20
	Bagging (B)	Cultivars (C)	Bagging (B)		Cultivars (C)	B × C	Bagging (B)		Bagging (B)	Cultivars (C)	B × C	
SEm±	0.08	0.12	0.03		0.04	0.07	0.04		0.03	0.04	0.07	
CD at 5.0 %	0.22	0.33	0.08		0.12	NS	0.11		0.08	0.12	NS	

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Table 4: Effect of fruit bunch bagging on total soluble solid and total sugar in litchi

Bagging (B)	Totals Soluble Solid (°Brix)			Mean	Total Sugar (%)			Mean
	Cultivars (C)				Cultivars (C)			
	Calcuttia	Elaichi	China		Calcuttia	Elaichi	China	
B_0 (Open)	17.50	17.53	17.50	17.51	14.27	14.11	14.25	14.21
B_1 (Transparen)	20.06	18.58	19.19	19.27	15.73	15.25	15.16	15.38
B_2 (Yellow)	19.01	19.00	18.10	18.70	15.51	15.22	15.07	15.27
B_3 (Green)	21.00	20.43	20.38	20.60	16.05	15.80	16.05	15.97
B_4 (Blue)	21.01	21.04	21.07	21.04	16.36	16.34	16.22	16.31
B_5(Red)	17.98	17.70	17.68	17.78	14.39	14.39	14.53	14.44
B_6 (Black)	18.15	18.10	18.01	18.09	14.92	14.61	14.76	14.76
Mean	19.24	18.91	18.85	19.00	15.32	15.10	15.15	15.19
	Bagging (B)	Cultivars (C)	B × C		Bagging (B)	Cultivars (C)		B × C
SEm±	0.09	0.13	0.23		0.05	0.07		0.13
CD at 5.0 %	0.25	0.38	0.65		0.14	0.21		NS

Table 5: Effect of fruit bunch bagging on reducing sugar and non-reducing sugar in litchi

Bagging (B)	Reducing Sugar (%)			Mean	Non-Reducing Sugar (%)			Mean
	Cultivars (C)				Cultivars (C)			
	Calcuttia	Elaichi	China		Calcuttia	Elaichi	China	
B_0 (Open)	10.95	10.76	10.92	10.88	3.32	3.35	3.33	3.33
B_1(Transparent)	12.71	12.27	12.16	12.38	3.01	2.98	3.00	3.00
B_2 (Yellow)	12.42	12.15	12.01	12.19	3.09	3.07	3.06	3.08
B_3 (Green)	13.15	12.92	13.16	13.08	2.91	2.89	2.89	2.89
B_4 (Blue)	13.53	13.51	13.37	13.47	2.83	2.83	2.85	2.84
B_5(Red)	11.13	11.21	11.31	11.22	3.25	3.19	3.22	3.22
B_6 (Black)	11.76	11.49	11.58	11.61	3.17	3.12	3.18	3.16
Mean	12.23	12.04	12.07	12.12	3.08	3.06	3.08	3.07
	Bagging (B)	Cultivars (C)	B × C		Bagging (B)	Cultivars (C)		B × C
SEm±	0.05	0.07	0.13		0.01	0.01		0.02
CD at 5.0 %	0.14	0.21	NS		NS	0.03		NS

RESULTS AND DISCUSSION

Fruit drop and retention

The different colour bags showed positive effect on fruit drop and retention in litchi (Table 1). Among the different colour bags, the lowest fruit drop and the highest fruit retention were recorded when fruit bunches were bagged with blue colour bags. The litchi cultivars also exhibited significant variations on fruit drop and retention of litchi. The highest fruit drop and the maximum fruit retention were recorded in litchi cultivar Elaichi (27.71 %) and China (64.70 %), respectively. In comparison to the unbagged fruits, Son and Kim (2010) discovered that bunch bagging grapes 7 to 9 weeks after full bloom decreased the rate of fruit drop (breaking). According to Shah *et al* (2020), in litchi cv. Rose, fruit that was packaged using white polypropylene bags with 5% perforation, 30 days prior to harvest had the best fruit retention. Debnath and Mitra (2008) found that bagging the fruits a week after fruit set greatly enhanced the amount of litchi fruit retained per panicle. Additionally, bagging improved fruit retention in off-season longan cv. Chuliang, according to Yang *et al* (2008).

Fruit cracking (%) and infested fruit (%)

It was evident from the data (Table 2) that no fruit cracking as well as no infested fruit were recorded in most of the bagged fruit, only in control 5.47 % cracked fruit and 10.76 % infested fruits were seen. The litchi cultivars also exhibited significant variations on cracked fruit percentage and non-significant variation on infested fruit percentage of litchi. Lal (2019) stated that fruit bunch bagging prior to

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Table 6: Effect of fruit bunch bagging on titratable acidity and ascorbic acid in litchi

Bagging (B)	Titratable Acidity (%)			Mean	Ascorbic Acid (mg/100g)			Mean
	Cultivars (C)				Cultivars (C)			
	Calcuttia	Elaichi	China		Calcuttia	Elaichi	China	
B_0 (Open)	0.52	0.52	0.52	0.52	23.10	23.03	23.00	23.04
B_1(Transpare)	0.45	0.45	0.44	0.45	30.25	30.68	30.53	30.48
B_2 (Yellow)	0.47	0.47	0.46	0.46	29.98	29.78	29.75	29.83
B_3 (Green)	0.44	0.44	0.43	0.44	31.23	31.68	30.63	31.18
B_4 (Blue)	0.42	0.42	0.42	0.42	32.00	32.03	32.00	32.01
B_5(Red)	0.50	0.45	0.46	0.47	25.58	25.35	25.25	25.39
B_6 (Black)	0.49	0.48	0.47	0.48	26.50	26.20	28.40	27.03
Mean	0.47	0.46	0.46	0.46	28.37	28.39	28.51	28.42
	Bagging (B)	Cultivars (C)	B × C		Bagging (B)	Cultivars (C)	B × C	
SEm±	0.01	0.01	0.01		0.11	0.16	0.28	
CD at 5.0 %	NS	0.02	NS		NS	0.46	0.79	

Table 7: Effect of fruit bunch bagging on anthocyanin content of fruit peel in litchi

Bagging (B)	Anthocyanin Content (mg/100ml)			Mean
	Cultivars (C)			
	Calcuttia	Elaichi	China	
B_0 (Open)	13.11	14.57	20.68	16.12
B_1(Transparent)	26.86	26.19	23.36	25.47
B_2 (Yellow)	24.60	25.33	22.28	24.07
B_3 (Green)	28.83	28.23	23.84	26.96
B_4 (Blue)	30.74	30.01	26.92	29.22
B_5(Red)	21.13	23.04	21.10	21.76
B_6 (Black)	23.01	24.57	21.86	23.15
Mean	24.04	24.56	22.86	23.82
	Bagging (B)	Cultivars (C)	B × C	
SEm±	1.55	2.37	4.10	
CD at 5.0 %	NS	6.69	NS	

harvesting produced high-quality litchi fruit with minimal cracking and borer infestation. Shah *et al* (2020) also obtained similar results. They found that using a white polypropylene bag with a 5% perforation to bag a bunch of litchi fruit decreased fruit cracking by 93.93% and borer infestation by 92.81%. Fruit cracking ranged from a minimum of 7.69% in a white polypropylene bag with 5% perforation to a maximum of 12.79% when the fruit was not bagged. Yang *et al* (2008) also found similar patterns of fruit cracking in fruit bagging in Longan.

Weight of fruit, fruit length and fruit diameter

The different colour of bags showed a significant effect on weight of fruit, fruit length and fruit diameter in litchi (Table 3). Among the different colour bags, the maximum weight of fruit, fruit length and fruit diameter were recorded when fruit bunches were bagged with blue colour bags (B_4). The maximum weight of fruit was recorded in Calcuttia (C_1) 19.65 g and minimum weight of fruit (14.45 g) was obtained in open condition. The maximum fruit length and diameter were recorded in litchi cultivar China (3.67) and (3.18), respectively. According to Lal (2019), bagging increased the weight of litchi fruit by 14.49%. Similar findings were made by Abdel *et al* (2017) who found that unbagged fruits had the lowest weight and that fruits bagged with agril blue bags had the greatest fruit weight in mango cv. Keitt, followed by agril green bags. Additionally, fruit length was increased by bagging, with fruits bagged with agril white bags showing the largest increase, followed by those bagged with red bags. Furthermore, mangoes bagged using agril green bags first, then blue bags, showed an improvement in fruit diameter. Shah *et al* (2020) also discovered that fruits bagged with white polypropylene bags with 5% perforation had a maximum weight of 21.53 g, whereas unbagged fruits

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had a minimum weight of 19.95 g. When litchi was packed in pink polypropylene bags with no holes, the largest fruit diameter (3.45 cm) was measured. Yang *et al* (2008) reported that bagging in longan increased the size of the fruit.

Total soluble solid and total sugar

The different colour bags showed a significant effect on total soluble solid and total sugar content in litchi (Table 4). Among the different bags, the highest total soluble solid and the total sugar were recorded from the fruit bunches which were bagged with blue colour bags. The highest totals soluble solid and total sugar was recorded in litchi cultivar Calcuttia as 19.24 and 15.32, respectively. The maximum TSS was recorded on C_3B_4 (21.07 °B) followed by C_2B_4 (21.04 °B). The TSS was significantly altered by bagging Litchi berries claimed Kholiya *et al* (2019). Fruit that was not bagged had the lowest TSS (18.75 °B) followed by fruit that was bagged in double parchment paper bags (20.96 °B) and fruit that was packed in triple parchment paper bags (21.03 °B). They also reported that fruits that were not bagged had the lowest total sugar content (20.99%), while fruits that were packaged in a single parchment paper bag had the highest (21.99%), followed by fruits that were bagged in double parchment (21.75%). Litchi fruit packed in white polypropylene bags with 10% perforation had the highest TSS (18.76°B), whereas pink polypropylene bags without perforation had the lowest (17.72°B) Shah *et al* (2020). They also found that the fruits with the greatest total sugar (13.25%) were those that were wrapped in white polypropylene bags with 5% perforation whereas the fruits without bags had the lowest (11.92%). Pre-harvest bagging in litchi, increased TSS value was also reported by Debnath and Mitra (2008) and Lal (2020).

Reducing sugar and non-reducing sugar

The different bags showed a significant effect on reducing sugar but non-significant on non-reducing sugar of litchi fruit (Table 5). Among the different colour bags, the highest reducing and non-reducing were recorded from fruit bunches which were bagged with blue colour bags and green colour bags respectively. The highest reducing sugar (12.23) and non-reducing sugar (3.08) were recorded in litchi cultivar Calcuttia. The maximum reducing sugar value were recorded on C_1B_4 (13.53 %) followed by C_2B_4 (13.51 %). According to Shah *et al* (2020), litchi fruits that are bagged with white polypropylene bags (5% perforation) had the highest amount of reducing sugar (11.41%) and non-reducing sugar (1.84%), while unbagged fruit had the lowest amount for the same parameter (10.14%). The litchi fruit coated with a single piece of parchment paper had the highest decreasing sugar (20.49%), whereas the fruit that was not bagged had the lowest (18.86%). Additionally, they stated that fruits packaged with brown paper bags had the highest non-reducing sugar content (8.16%), while fruits bagged with triple parchment paper had the lowest (6.75%).

Titratable acidity and ascorbic acid

The perusal of the data on titratable acidity and ascorbic acid content of litchi fruit with bunch bagging by different colour bags in different cultivar are presented in (Table 6). Among the different colour bags, the lowest titratable acidity and highest ascorbic acid were recorded when fruit bunches were bagged with blue colour bags followed by green colour. The lowest titratable acidity was recorded in both litchi cultivar Elaichi and China (0.46 %), whereas highest ascorbic acid content was found in China (28.51 mg). The maximum ascorbic acid content was recorded in C_2B_4 (32.03 mg). The highest levels of ascorbic acid (57.26 mg/100 g) and acidity (0.48 %) were found in bagged litchi fruits, whereas the lowest levels were found in unbagged fruits (48.62 mg/100 g) and acidity (0.35 %), according to Lal (2020). Shah *et al* (2020) found that among the different bagging materials, fruits bagged with white polypropylene bags with 0% perforation had the highest ascorbic acid (22.59 mg/100 g) and the lowest acidity (0.38%), while fruits that were not bagged had the highest acidity (0.53%) and the lowest ascorbic acid (20.76 mg/100 g). Abdel *et al* (2017) found that when mango fruit cv. Keitt was bagged using different materials, the fruits bagged with agrail red bags had the highest vitamin content in their fruit juice (48.07 mg/100 ml and 49.14 mg/100 ml), while the fruits that were not bagged had the lowest levels (47.96 mg/100 ml and 48.05 mg/100 ml).

Anthocyanin content of fruit peel

The different colour bags showed non-significant effect on anthocyanin content of the peels of litchi fruit (Table 7). Among the different colour bags, the highest anthocyanin content was recorded when fruit bunches were bagged with blue colour bags (29.22 mg/100 ml). The highest anthocyanin content was recorded in litchi cultivar Elaichi (24.56 mg/100 ml) followed by Calcuttia (24.04 mg/100 ml). The maximum anthocyanin content in fruit peel was recorded in C_1B_4 (30.74 mg/100 ml). In line with Debnath and Mitra's (2008) findings on litchi, Shah *et al* (2020) found that the peel has the highest

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anthocyanin content (23.66 mg/100 g), and that the anthocyanin concentration was highest in litchi fruits bagged with a white polypropylene bag with 5% perforation and lowest in unbagged fruits (21.59 mg/100 g).

CONCLUSION

Fruit bunch bagging is an easy, safe, and environmentally friendly technique that has various advantages, including a lower frequency of insect pests and physiological illnesses (fruit cracking, sun burn). Pre-harvest fruit bagging enhanced the physical and biochemical characteristics of the fruit as well as its retention. One effective way to keep the environment and the fruits physically apart is to bag them. Bagging alters the micro environment for fruit growth and lessens the direct involvement of light. Compared to fruits that were unbagged or open due to early development, the microclimate within the CP (cellophane paper) bag (which has a different colour) produced an earlier buildup of the necessary heat unit. The anthocyanin synthesis may have been accelerated by the altered microclimate inside the bag, resulting in a greater anthocyanin concentration at maturity compared to the fruits that were not bagged. Pre-harvest fruit bagging (7 days after fruit set) in litchi with blue bags with 5% perforation may be advised to improve the physical and biochemical qualities for high-quality fruit production and reduce the use of pesticides in the sub-Himalayan Terai region of West Bengal, according to the current study.

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