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EFFECT OF BUNCH COVERS ON FRUIT CHARACTERS OF BANANA c.v. DWARF CAVENDISH

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Abstract: An experiment was conducted to study the post harvest bunch characters of Dwarf Cavendish banana as influenced by bunch covers of different coloured polythene materials at Sam Higginbottom University of Agriculture, Technology and Sciences during 2005-2011. Polythene covers with red, blue, white non-transparent, transparent, black polythene were tied with the opening at one side when the first female bract opened. The results revealed that transparent covers enhanced the maturity of bunches eight days earlier followed by black polythene covers which were six days earlier compared to control. Bunch covering with transparent covers increased fruit length (15.93 cm), fruit girth (13.1 cm), and fruit weight (120.22 g) and bunch weight (19.9 kg) at 90 per cent maturity. Peel colour was excellent (uniform yellow) in the bunches covered with transparent polythene covers as compared to dark green peel colour in uncovered fruits. The fruits were pale yellow in colour in the fruits covered by black polythene. Fruits harvested from the bunch, covering with transparent covers revealed higher TSS (20.53°Brix), low acidity (0.3%), higher total sugars (18.57%) as against 18.7°Brix, 0.35 per cent acidity, and 17.27 per cent sugars in uncovered fruits. Bunch covering eliminated fruit blemish, enhanced fruit maturity with uniform fruit filling and scored high in overall acceptability as against control.

Keywords: Banana, Dwarf Cavendish, bunch covers, Fruit characters, Quality characters, sensory characters

INTRODUCTION

Among the large variety of fruits produced in India, banana is one of the most preferred and widely consumed fruits. Banana ranks third in area with 8.89 lakh ha next to mango and citrus and it stands first in total fruit production (31.7 MT). Globally, India is the largest producer with 11 per cent of the total global area under banana and contributing 25 per cent in World pool of banana production (National Horticultural Board Data base, 2019). In recent years, export oriented production of banana is receiving attention in India and package programmes to boost production have been launched in several states as there is a great demand in domestic as well as world market . India is exporting fresh banana to nearly fifty countries of the World and earning good foreign exchange from the world market.. Out of around 350 varieties of banana grown in India, Robusta, Rasthali, Poovan and Dwarf Cavendish etc are known for their suitability for canning, dehydration and for long distance transport and export to abroad. In Global commerce, by far the most important cultivar is Cavendish which accounts for the majority of banana exports (Castle, 2009). In spite of leading role played by India in the production of banana, its share in the International trade is only meager i.e. 1 per cent. Banana being highly perishable fruit suffers from heavy post harvest losses often to the extent up to 20- 30 per cent. (Chadha, 1996; and Liu and Jia, 2008). In tropical countries

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like India, Cavendish group of bananas undergo a condition known as "Green ripe" wherein the peel remains green due to non degradation of chlorophyll, while the pulp becomes ripe which is an undesirable feature for export (Zhang *et al*. 1993). In International market, the importers do not prefer those fruits with blackened skin in patches, external injuries like incidence of pests and diseases, sun burn leading to blemished fruits. (Padmanaban *et al*. 2007). This can be manipulated by various pre and post harvest techniques *viz*., proper cultural practices, ideal stage of harvesting, special cultural operations like bagging with bunch covers, proper packaging, transport, post harvest treatments and modifying the temperature in the storage environment.

The present investigation was therefore carried out to study the effect of different polythene bags on some fruit, quality and sensory characters of banana c.v. Dwarf Cavendish

MATERIALS AND METHODS

The experiment was carried out in a standing crop banana C.V. Dwarf Cavendish at a farmer's field in Ashrawal village, Allahabad district during winter months of 2005-2011where the average temperatures was around 16-18^{o}C. Bunches were covered after the opening of first female bract with transparent, blue, red, black, white polythene bags of 200 gauge thickness and 1.5 m x 1 m size. Each treatment was replicated thrice. The treatments and replications were allotted randomly following RBD.

Harvesting of bunches were begun after 116 days (90 % maturity). The bunches were harvested carefully using a sharp knife, transported carefully with least damage to the laboratory for observation on post harvest fruit and bunch characters. The observations recorded are detailed as following.

Observations Recorded

Fruit characters

1. **Fruit length**: The distance from the top of pedicel to tip of the fruit was measured using a thread and expressed in centimeters.
2. **Fruit weight**: The fruits were individually weighed using digital electronic balance and the mean is expressed as grams.
3. **Bunch weight**: Total bunch after harvesting, was weighed on the common balance and expressed in kilograms.
4. **Pulp to peel ratio**: Pulp-peel ratio of individual fruits was recorded by dividing the weight of the pulp with the weight of the peel of fully ripe fruits.

Quality characters

1. **Green life**: This is well defined period after harvest, during which fruits remain green (till the fruit becomes full yellow) and firm. It is also referred to as the pre climacteric life or green life (Peacock, 1966).
2. **Yellow life**: Yellow life (Shelf life) was assessed by regular visual inspection of fruits. Shelf life was calculated as the period (in days) between commencement of ripening and end of saleable life (i.e. saleable quality) or edible life (of fruit) on the shelf (Dadzie and Orchard, 1997).
3. **Physiological loss in weight** (PLW): The initial weight of fresh fruits was recorded individually. The final weight was taken as and when fruits reached the stage of yellow flecked with brown in each treatment. PLW was calculated at the end of full ripening stage on weight/weight basis by adopting the following formula and the mean expressed in per cent age.

$$PLW\% = \frac{Initial\ weight\ of\ the\ fruit - Final\ weight\ of\ the\ fruit}{Initial\ weight\ of\ the\ fruit} \times 100$$

4. **Total Soluble Solids** (TSS): TSS of the fruits were determined using a Erma hand refractometer. A small quantity of ripe fruit was squeezed using a muslin cloth and a drop of juice was put on the refractometer for observation and the corresponding value was presented as per cent age.
5. **Acidity**: The acidity of the fruit pulp was estimated as per the procedure of AOAC (1960) using 0.1N Sodium hydroxide (NaOH) and expressed as per cent citric acid.
6. **Total sugars and reducing sugars**: Total sugars and reducing sugars were estimated by Lane and Eyon (1923) titrimetric method using Fehling's solution and expressed in per cent.

7. **Sugar Acid ratio**: Sugar –acid ratio was calculated by dividing total sugars with acidity and expressed in ratio.
8. **Peel colour**: Colour reference chart developed by United fruits sales corporation, USA was used. The chart describes seven stages of banana ripeness on the basis of appearance (Armstrong, 1982).
    1. Mature green
    2. Green with trace of yellow
    3. More green than yellow
    4. More yellow than green
    5. Green tip only
    6. All yellow
    7. Yellow flecked with brown

Sensory observations

A total of ten panelists were involved in the sensory studies coded single sample of treated fruits were presented to each panelist. Panelists were requested to assess samples on the basis of skin colour appearance, texture, taste, flavor and over all acceptability using 5 point hedonic rating scale (5-excellent, 4-very high, 3- high, 2-low and1- very low). All panelists were instructed on basic taste test procedure i.e. to make their own assessments.

Statistical analysis

The data recorded were subjected to appropriate statistical tools by analysis of variance. The significance was tested by F test. The S E (d) and critical difference at 5 % probability level were worked out. All the statistical designs were analyzed by using computer soft ware programme, Windostat version 8.6 developed by Indostat services, Hyderabad.

RESULTS AND DISCUSSION

The present experiment was conducted to study the performance of different coloured polythene covers on post harvest characters of banana cv. Dwarf Cavendish like blue, pink, white, black and colour less transparent polythene. These covers were tied after the opening of first hand in a bunch.

Fruit length

The results on the finger length as influenced by the use of different bunch covers in successive years are presented in Table 1.

The fruits harvested at 90 % maturity when observed, the fruits covered with transparent polythene showed highest fruit length (15.76 cm) followed by fruits covered by black polythene

Table 1: Effect of different bunch covers on fruit length, fruit girth and fruit weight of banana c.v.Dwarf Cavendish

Types of bunch covers	*Fruit length (cm)*			*Fruit girth (cm)*			*Fruit weight (g)*		
	I Year	*II Year*	*Cumulative mean*	*I Year*	*II Year*	*Cumulative mean*	*I Year*	*II Year*	*Cumu-lative mean*
1. Blue polythene	15.16	15.50	15.33	12.63	12.66	12.64	109.86	112.15	111.00
2. Red polythene	15.30	15.40	15.35	12.63	12.70	12.66	108.30	108.44	108.37
3. White non trans--parent polythene	14.46	14.93	14.69	12.26	12.26	12.26	104.16	105.30	104.73
4. Transparent poly-- thene	15.76	15.93	15.84	13.03	13.10	13.06	118.77	120.22	119.50
5. Black polythene	15.50	15.66	15.58	12.70	12.73	12.71	116.61	116.62	116.62
6. Control	14.73	14.76	14.74	12.30	12.23	12.26	104.91	105.10	105.00
CD at 0.05%	0.80	1.03	-	0.50	0.40	-	17.89	4.66	-
SEM	0.13	0.15	-	0.08	0.08	-	2.22	1.58	-
F- test	S	NS		S	S		S	S	

(15.5cm). There was a similar trend observed in the second year for the transparent polythene (15.93) cm cover followed by black polythene (15.66 cm) and the least being 14.73 cm in the 1st year and 14.76 cm in the 2nd year in control treatment. The fruit length for the bunches covered by blue, red, white non transparent polythene were on par with each other in both the years (2005 and 2006).

The beneficial effect of bunch covers on increase in banana finger length over control was reported by Robinson and Nel, (1984); Daniells *et al.* (1992) Debnath *et al.* (2001) Weerasinghe and Ruwanpathirana (2002); Purnima *et al,* 2001

Fruit girth

The colour of bunch cover significantly influenced the fruit girth (Table 1). The highest fruit girth 13.03cm and 13.1cm were recorded in the bunches covered by transparent polythene cover in the first and second years respectively and the lowest was observed in control. Pooled data of first and second year trials for the fruit girth in the bunches covered by black (12.71cm), blue (12.64 cm), red (12.66), white non transparent (12.26) were found to be non significant.

These results do agree with the findings of Weerasinghe and Ruwanpathiran (2002); Chillet and Jannoyer (1996). Hasan *et al.* (2007) also found significant increase in fruit girth in covered bunches as against control.The fruit diameter and fruit size was increased when date palm bunches were bagged with blue colour polythene bag as compared with unbagged. (Harhash and Al Obeed 2010).

Fruit weight

It was observed that there was no significant difference found among the bunch cover treatments and the control in the 1st year (Table 1). However, the fruit weight was significantly influenced the bunch cover treatments in the 2nd year. Highest fruit weight (119.50 g) was observed in the transparent polythene cover followed by black polythene 116.62 g and the least was with control treatment (105.00 g).

The pooled data of both 1st and 2nd years for fruit weight were presented in (Table 1.).Blue polythene recorded fruit weight of 111 g, red polythene recorded 108.37g and white polythene recorded the least weight (104.73g). The increase in the covered banana bunches were also observed by Reddy (1989); Chillet and Jannoyer (1996); Weerasinghe and Ruwanpathirana (2002); and Harhash and Al Obeed (2010). The increase in length, girth and weight of banana fruit could be attributed to the favorable micro climate created inside the bunch covers.

Bunch weight

Bunch weight was significantly influenced by colour of bunch cover in both the years (Table 2). Bagging bunches with different covers significantly increased the weight of bunch over the control (Uncovered bunches).The bunches covered by transparent polythene recorded highest bunch weight (20.07 kg) followed by black polythene (19.41 kg) which were on par with each other. Whereas, other polythene covers *viz*, blue (17.18 kg), red (17.18 kg), white non transparent (16.55 kg) were found on par with each other. The unbagged bunches recorded bunch weight of 16.77 kg. An increase in bunch weight due to bunch cover was also reported by Daniells *et.al* (1992); Choudhary *et al* (1996); Johns (1996); Weerasinghe and Ruwanpathirana (2002) Mahmoud *et al* (2018).

Table 2: Effect of bunch covers on bunch weight of banana c.v. Dwarf Cavendish

Types of bunch covers	*Bunch weight (Kg)*		
	I Year	*II Year*	*Cumulative mean*
1. Blue polythene	17.77	17.78	17.78
2. Red polythene	17.76	17.80	17.78
3. White non trans--parent polythene	16.53	16.57	16.55
4. Transparent poly-- thene	20.24	19.90	20.07
5. Black polythene	19.52	19.31	19.41
6. Control	16.88	16.66	16.77
CD at 0.05%	1.49	1.24	-
SEM	0.37	0.33	-
F-test	S	S	

The increase in fruit length, fruit girth, fruit weight, bunch weight might be due to rise in atmospheric temperature inside the bunch covers. The warmth created inside (3 to 6°C) the covered bunches accelerate the development of fruits and promoted even fruit filling. (Johns and Scott, 1989).In the present investigation also, a rise in 4 to 5 °C temperature inside the bunch covers was noticed.

Pulp peel ratio

The effects of different bunch cover treatments on pulp to peel ratio are furnished in Table 4 .The results were found significant. The pulp to peel ratio ranged from 1.51 to 1.83. The highest pulp peel ratio was observed in transparent polythene cover 1.78 and 1.83 for the first and second years respectively which was followed by black polythene 1.75 and 1.77 for the first and second years respectively. However, there was no significant difference found between blue polythene (1.72), red polythene (1.7) and black polythene covers (1.76). The least pulp and peel ratio was found in control (1.52) and white polythene (1.51). Increase in pulp weight in covered bunches when compared with control was also observed by Hasan *et al* (2007). The increase in pulp weight and pulp peel ratio with bunch cover treatment might have been due to more supply of photosynthates, faster conversion of carbohydrates and efficient nitrate reductase activity owing to higher temperature around the bunches.

Peel colour

The peel colour of the fruits covered with different coloured polythene covers differed significantly at harvest. (Table 3). On full ripening, the fruits covered with transparent polythene developed attractive yellow scoring 6.0 and in others, the fruits were yellow with green tip scoring between 4.33 to 5.33 and in control the fruits remained green with traces of yellow. While the bunches covered by black polythene, the fruits appeared pale yellow.

The external skin colour of bunch covered fruits at harvest was exceptionally uniform, clear without any blemishes and incredibly attractive with free of blemishes. The fruits covered with transparent covers developed very attractive with uniform yellow fruits than control and black polythene covered fruits. This has been ascribed to availability of filtered sunlight inside the bag, which has allowed the skin to synthesize chlorophyll (Heenan, 1973; Stover and Simmonds,1987; Choudhury *et al*.1996. Smith (1947) also stated that bunch covers promoted even fruit filling besides controlling blemishes caused by rust thrips.

The total inhibition of light penetration on developing bunches through black covers has resulted into chlorophyll less pale yellow coloured fruits at unripe stage which has the advantage of overcoming 'green ripe' problem in Cavendish group of bananas in Tropical countries (Zhang *et al*.1993). Similar results were obtained for Nayak (1999) in Robusta banana.

Days to maturity

The results on the effect of different bunch covers on days to maturity are furnished in Table 3. The treatment with transparent polythene cover attained maturity earlier 8.67 days earlier than uncovered bunches in the first year and 9.33 days earlier in the second year. Days taken for maturity in control (uncovered bunches) was 127 days and 127.66 days in two consecutive years, while, in other treatments, days taken to maturity was less than control and it ranged from 120.33 to 122.66 days. Treatment with white non transparent polythene cover showed results which were on par with control (127.33 and 127.0 days respectively for the first and second years).

In general, maturity after shooting was earlier in bunches covered with polythene covers than uncovered ones. Bhaktavatsalam, (1968) also reported that bunch covers not only eliminate the fruit blemishes effectively but also hastened maturity by 15 days in hill banana. Similar findings were reported by Reddy, (1988) in banana C.V. Robusta. Daniells *et al* (1992) reported that bunch covers reduced the time from bunch emergence to harvest by 5-11 days. Debnath *et al*. (2001) also reported that transparent polythene cover reduced the interval by 15 days compared to uncovered bunches.

The bunch cover raised average temperature around bunches. This might cause a reduction in

Table 3: Effect of different bunch covers on days to maturity and peel colour of banana c.v. Dwarf Cavendish

Types of bunch covers	*Days taken to maturity*			*Peel colour*		
	I Year	*II Year*	*Cumulative mean*	*I Year*	*II Year*	*Cumulative Mean*
1. Blue polythene	120.66	122.66	121.66	5.33	5.00	5.16
2. Red polythene	122.66	121.00	121.83	5.66	5.30	5.48
3. White non trans--parent polythene	127.33	127.00	127.16	5.00	4.30	4.65
4. Transparent poly-- thene	118.33	118.33	118.33	6.00	6.00	6.00
5. Black polythene	120.33	122.00	121.16	6.00	6.00	6.00
6. Control	127.00	127.66	127.33	2.66	2.33	2.49
CD at 0.05%	1.51	1.84	-	1.20	0.74	-
SEM	0.84	0.84	-	0.37	0.38	-
F-test	S	S		S	S	

Table 4: Effect of different bunch covers on Green life, Yellow life and Pulp-peel ratio of banana c.v. Dwarf Cavendish

Types of bunch covers	*Green life (Days)*			*Yellow life (Days)*			*Pulp- Peel ratio*		
	I Year	*II Year*	*Cumulative mean*	*I Year*	*II Year*	*Cumulative mean*	*I Year*	*II Year*	*Cumulative mean*
1. Blue polythene	34.66	32.66	33.66	4.33	4.00	4.16	1.71	1.72	1.72
2. Red polythene	35.00	32.66	33.83	4.33	4.00	4.16	1.72	1.69	1.70
3. White non trans--parent polythene	34.33	32.33	33.33	4.00	3.66	3.83	1.52	1.51	1.52
4. Transparent poly-- thene	35.33	33.66	34.49	5.00	4.66	4.83	1.78	1.83	1.80
5. Black polythene	35.00	33.33	34.16	4.66	4.33	4.49	1.75	1.78	1.76
6. Control	34.33	32.33	33.33	4.00	3.66	3.83	1.52	1.53	1.53
CD at 0.05%	5.12	3.80	-	0.72	1.18	-	0.06	0.23	-
SEM	0.72	0.47	-	0.12	0.15	-	0.03	0.04	-
F- test	NS	NS		S	NS		S	S	

Note: S-Significant ; NS- Non significant

shooting to harvest interval possibly due to better and advanced filling of fingers by assimilates with the creation of optimum favorable microclimate condition inside the cover.

Green life and Yellow life

The influence of bunch covers on green life and yellow life is presented in Table 4. The green life and shelf life of bunch covered banana was assessed under ambient condition of storage and found that there was no significant difference observed between bunch covered and uncovered fruits. The green life of the fruits varied narrowly from 34.33 to 35.33 in the first year and in the second year it varied from 32.33 to 33.66. There was significant difference on yellow life in the

first year but the treatments and the control were on par with each other in the second year. Highest yellow life (5 days) was found in transparent polythene treatment in the first year and the least being with control and white non transparent polythene (4 days each).

Green life of banana bunch covered by transparent polythene cover was observed to be

Table:5. Effect of bunch covers on PLW, TSS, Acidity and Sugar Acid ratio of banana c.v. Dwarf Cavendish

Type of bunch covers	*PLW*			*TSS*			*Acidity*			*Sugar Acid ratio*		
	I Year	*II Year*	*Cumul-ative mean*	*I Year*	*II Year*	*Cumu-lative mean*	*I Year*	*II Year*	*Cumul-ative mean*	*I Year*	*II Year*	*Cumu-lative mean*
1. Blue polythene	11.46	13.40	12.43	19.70	19.67	19.68	0.30	0.31	0.31	31.33	57.06	44.2
2. Red polythene	10.50	12.30	11.40	19.57	19.63	19.60	0.31	0.33	0.32	47.49	52.73	50.11
3. White non transparent polythene	6.20	9.67	7.93	18.33	18.57	18.45	0.29	0.32	0.31	47.78	51.17	49.47
4. Transparent polythene	13.72	15.76	14.74	20.50	20.53	20.51	0.31	0.30	0.31	53.45	61.66	57.55
5. Black polythene	14.69	16.73	15.71	20.27	20.27	20.27	0.31	0.31	0.31	50.59	59.03	54.81
6. Control	8.23	9.23	8.73	18.58	18.70	18.64	0.34	0.35	0.35	44.31	46.16	45.38
CD at 0.05%												
SEM	2.82	3.97	-	0.54	1.27	-	0.05	0.06	-	19.02	7.87	-
F - test	0.79	0.79	-	0.19	0.22	-	0.01	0.01	-	2.66	1.50	-
	S	S		S	S		NS	NS		NS	S	

Table 6: Effect of different bunch covers on reducing and Non-reducing sugars and Total sugars of banana c.v. Dwarf Cavendish

Types of bunch covers	*Reducing sugars*			*Non-reducing sugars*			*Total sugars*		
	I Year	*II Year*	*Cumu-lative mean*	*I Year*	*II Year*	*Cumu-lative mean*	*I Year*	*II Year*	*Cumu-lative mean*
1. Blue polythene	10.48	14.21	12.34	3.95	3.43	3.69	14.43	17.64	16.03
2. Red polythene	10.74	13.64	12.19	3.79	3.73	3.76	14.53	17.37	15.95
3. White non trans--parent polythene	10.41	12.84	11.62	3.41	3.65	3.53	13.82	16.48	15.15
4. Transparent poly-- thene	12.26	15.28	13.77	4.13	3.41	3.77	16.39	18.57	17.48
5. Black polythene	11.80	14.68	13.24	3.72	3.40	3.56	15.52	18.07	16.79
6. Control	11.79	12.24	12.02	3.41	4.04	3.72	15.19	16.27	15.73
CD at 0.05%	2.26	1.49	-	0.73	1.34	-	1.78	1.12	-
SEM	0.33	0.29		0.11	0.17		0.35	0.24	-
F -test	NS	S	-	NS	S	-	S	S	-

higher by one day (35.33 days) than uncovered bunch (34.33 days). This might be due to the harvesting of fruits based on their external appearance i.e. disappearance of angles and better fruit filling.

Mary and Sathiamoorthy (2002) also found that there is no significant difference in green life of treated and untreated ones as bunches covered with polythene sleeves would be more matured causing reduction in green life.

Physiological loss in weight

The effect of bunch covers on Physiological loss in weight is presented in Table 5. Highest PLW was recorded in the bunch covered by transparent polythene cover (13.72%) followed by black polythene cover (14.69%). Among all the treatments white polythene recorded lowest PLW (6.2 %) and PLW in control is less i.e. 8.23 per cent. Thus there was a significant difference between the treatments and the control.

The use of bunch covers resulted in higher weight loss than control. This might have been due to sudden shift from a humid situation inside the bunch cover to low humidity in storage atmosphere. (Mary and Sathiamoorthy, 2002). These results are in contradictory to the findings of Parmar and Chundawat, 1984 in banana C.V. Basrai.

Total soluble solids

The effect of bunch covers on total soluble solids is presented in Table 5. Transparent polythene covered fruits showed highest TSS (20.51°Brix) followed by black polythene covered fruits (20.27°Brix). Same trend was followed in both the years. The bunch covered fruits recorded higher level of TSS than the uncovered fruits except white polythene covers. This might be ascribed to higher level of temperature around the fruits inside the cover, which favored the conversion of starch into sugars and in white polythene as it reflects light it has little effect on raising temperature where the conversion of starch to sugars is obstructed. Similar trend was followed in the second year also. The increase in TSS in bunch covered fruits was also reported by Parmar and Chundawat (1984), Sauco et al (1996); Mary,(1997); Choudhury *et al* (1997); and Hasan *et al.* (2007).However, Weerasinghe and Ruwanpathirana (2002) did not observe any significant difference between the bagged and unbagged bunches. This might be due to the increase in water content within the fruits due to the increased levels of relative humidity.

Titrable acidity

It is evident from the Table 5.that there was no significant difference between covered banana bunches and uncovered bunches in acidity. Highest titrable acidity (0.35) was obtained in control which was on par with other coloured polythene covers blue colour (0.31), red (0.32), white (0.31), black (0.31) and transparent (0.31).

Reducing sugars, Non reducing sugars and Total sugars

There was no significant variation found between the treatments and also with control as they were on par with each other in non reducing sugars in the 1st year (Table 6). But in the 2nd year of trial, there was significant variation found between control (12.24 %) and bunch covers with blue (14.21%), black (14.67%) and transparent polythene (15.27%). However the total sugars were higher in transparent polythene (17.48 %), black polythene (16.79 %) and control (15.73%) than the other treatments. An increased total sugar in the polythene cover treated fruits was also reported by Choudhury *et al* (1997); and Hasan *et al.* (2007).

Sugar Acid Ratio

The effect of bunch covers on sugar acid ratio is presented in Table 5. The highest sugar acid ratio was noticed in bunches covered by transparent polythene (57.55) followed by black polythene (54.81). However, sugar acid ratio of control (45.38) was on par with that of treatments except blue polythene cover in 1st year where the ratio was very low (31.33). But in 2nd year it was on par with control (57.06). High sugar acid ratio in the covered bunches was also reported by Choudhury *et al.* (1996) and Dhua *et al.* (1998).

Sensory attributes

The effect of bunch covers on sensory characters is presented in Table 7. Being free of skin

Table 7: Effect of different bunch covers on sensory characters of banana c.v. Dwarf Cavendish

Type of bunch covers	*Colour*			*Flavor*			*Texture*			*Taste*			*Over all acceptability*		
	I Year	*II Year*	*Cumul-ative mean*	*I Year*	*II Year*	*Cumul-ative mean*	*I Year*	*II Year*	*Cumul-ative mean*	*I Year*	*II Year*	*Cumul-ative mean*	*I Year*	*II Year*	*Cumul-ative mean*
1. Blue polythene	4.67	4.67	4.67	4.33	4.33	4.33	2.80	2.80	2.80	4.33	4.33	4.33	3.67	4.00	3.84
2. Red polythene	4.67	4.67	4.67	4.67	4.33	4.50	2.66	2.70	2.68	4.67	4.33	4.50	3.33	4.00	3.66
3. White non transparent polythene	3.67	3.33	3.50	4.00	3.67	3.83	3.33	3.67	3.50	4.00	3.67	3.84	3.00	3.33	3.16
4. Transparent polythene	5.00	5.00	5.00	5.00	4.67	4.84	2.56	2.70	2.63	4.67	4.67	4.67	5.00	4.67	4.83
5. Black polythene	3.33	3.33	3.33	3.67	3.33	3.50	2.33	2.20	2.25	3.67	3.33	3.50	2.67	2.67	2.67
6. Control	3.70	4.00	3.85	3.67	3.67	3.67	3.80	3.67	3.73	3.67	3.67	3.67	3.00	3.33	3.16
	0.99	0.88	-	0.86	1.10	-	0.88	0.86	-	0.88	0.99	-	0.64	0.94	-
	0.19	0.19	-	0.15	0.16	-	0.17	0.16	-	0.15	0.16	-	0.20	0.18	-
CD at 0.05%	S	S		NS	S		S	S		S	S		S	S	
SEM															
F- test															

blemishes, bunch covered fruits scored higher sensory scores than non covered fruits especially in terms of skin colour appearance. Among the bunch covered fruits, transparent polythene covered fruits scored excellent (5.0) for skin colour followed by blue polythene (4.67) and red polythene (4.67). Colour appearance was good in black (3.33) and colour of white non transparent and control was very good (3.5 and 3.85 respectively).Taste and flavor were also high in bunches covered by transparent polythene in both the years scoring excellent (4.67 and 4.84 respectively for taste and flavor). The other coloured bunches scored good (4.33 and 4.50). Score was between good and medium for control (3.67), black polythene (3.67) and white non transparent (3.84).Transparent polythene and black bags showed soft textured fruits scoring 2.56 and 2.24 respectively and all other coloured bags recorded between soft and firm. The control recorded between firm and hard (3.42).

Among the treatments, transparent covers scored the highest score for skin colour (5.0), flavor (4.84), texture (2.56), taste (4.67) and over all acceptability (4.83) followed by black polythene cover.

Among the different polythene covers used the lowest cost incurred Rs .3 per cover for transparent polythene cover and others for Rs. 5 per cover. Black polythene was little higher i.e. Rs. 10 per cover.

In the present study, after conducting field trial on banana bunch covering at Allah bad Conditions during winter season with average temperatures around 18^{o}C, it is suggested that transparent polythene can be successfully used to cover banana bunches to raise the temperature around the bunches. This may favor fruit development by better fruit filling which might not occur in North Indian conditions like Allahabad when bunches are not covered. Banana bunch covering not only increases the fruit yield but also improves the colour appearance of the fruit which is desired in the international market.

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