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Original Research Article

Effect of Fruit Bagging on Physico–Chemical Properties of Pineapple cv. Mauritius

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A B S T R A C T

The present experiment titled "Effect of fruit bagging on physic-chemical properties of pineapple cv. Mauritius" was conducted during the year 2016 at Horticultural Farm of Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal, located in the humid subtropical region of West Bengal. The objective of the experiment was to study the effect of bagging on physic-chemical properties of Pineapple cv. Mauritius. The research was carried out with 5 treatments i.e. T_1 (Jute bag); T_2 (Paper bag); T_3 (Transparent polythene bag); T_4 (Black polythene) and T_5 (Control- No bagging) replicated four times. In fruit physical parameter result the fruit length with crown was found maximum (25.43 cm) in T_2 (Paper bag) and the minimum (22.33 cm) was observed in T_3 (Transparent polythene bag), Fruit length without crown (cm) was recorded maximum (18.24 cm) in T_4 (Black polythene) and minimum result was found in Control (15.80 cm). Highest (677.89 g) fruit weight without crown was obtained in T_2 (Paper bag) whereas lowest (462.03 g) was reported in transparent polythene bag. Meanwhile in fruit chemical parameter total sugar (%) was reported maximum (8.69) in and minimum was observed in Control (5.29); maximum T.S.S (ºBrix) was observed highest (14.22) in T_2 (Paper bag) and lowest was observed in Control (12.35). Overall by considering the results it was reported that T_2 (Paper bag) was better option for fruit bagging of pineapple cv. Mauritius for prominence effect on yield and quality.

Keywords

Bagging, micro-climate, proper aeration, control temperature, humidity

Introduction

Pineapple (*Ananas comosus* (L.) Merr.), belonging to the family Bromoliaceae, is one of the most important commercial fruits of the world. Its pleasant characteristic like aroma and taste make it the choicest fruit for fresh consumption and processing. Pineapples are used for manufacturing juice, jam and squash and also preferred in canning industry. The fruit core is used for preparing candy. Coagulated milk products are also manufactured by using the non-traditional pineapple enzymic complex (Cattaneco *et al.*, 1994). Pineapple is a plant of humid tropics and it grows well near the sea coast as well as in the interior plains up to an elevation of 1000 m above mean sea level. The crop needs a sunny climate but the temperature is considered as the limiting factor for its best growth and development. It cannot tolerate frost and plants are sensitive to temperature below10ºC and above 36ºC. The ideal temperature range for the crop is 15-32ºC. Pineapple fruit are rich in chemical properties. Two-third of sugars

present in Pineapple is in the form of sucrose and rest is glucose and fructose. About 87% of total acid is present as citric and rest as maleic acid. Along with acid it contains some useful minerals such as calcium (0.02%), phosphorus (0.01%) and iron (0.9%). Ripe fruits do not contain starch (Gortner *et al.,* 1967). It contains a protein digesting enzyme, bromelain. Ripe pineapple fruits contain relatively higher amounts of glycine, alanine, methoionine, and leucine than lysine, proline, histidine and arginine (Gortner *et al.,* 1967). The major pigment found in ripe fruits is carotene. The presence of 157 volatile constituents have been discovered in the green to ripe stages of pineapple fruit, of which ethyl acetate and butane -2-3- diol di-acetate are reported to be the major constituents of ripe fruits (Katsumi *et al.,* 1992).

Sun scald is major problem of pineapple and it results when plant leans or falls over to one side, thus exposing one side of the fruit to direct sunlight. The cells of the exposed surface get damaged. Later fruit surface assumes a brownish to black colour and cracks may appear between fruit lets. Affected fruits soon rot and become infested with pests. Incidence of fruit fly attack is also found to cause loss of huge quantities of pineapple. Chances of loss in quality due to mechanical injury are also very high in pine apple. Bagging is an important procedure of covering the fruits by cloth, paper, plastic or jute-bag for its protection purpose. It also enhances the colour and aroma. It mainly controls the temperature around the fruit and form favourable micro-climate which help in maturation by synthesis of proper enzymes. Proper transpiration and respiration also results in better fruit quality by raising total sugars, T.S.S, carotenoids, etc. In addition to fruit quality it also improves fruit size and fruit weight. Bagging also helps in providing protection from mechanical injuries (scars and scratches) and prevents from fruit fly damage, sun burns, latex burns and fungal spots on the fruits. Although laborious, it is cheaper, safer, easier to do, and gives more reliable estimate of the projected harvest.

Materials and Methods

The experiment was conducted at the Horticultural Farm, Palli Siksha Bhavan, Visva-Bharati, Sriniketan, West Bengal. The experimental field is situated at about 23° 42' 30' E longitude with an average altitude of 40m above mean sea level. The experiment comprise of 5 treatment combination of different types of bagging materials replicated 4 times as per following details:

T_1: Jute bags; T_2: Paper bags; T_3: Transparent polythene bags (20 micron, perforated polythene); T_4: Black polythene bags (20 micron, perforated polythene); T_5: Control (No bagging).

Bagging is done after completion of flowering. The plants were bagged individually with different types of bags in green net house and tied with thread. Bagging was done in the month of March-April, 2016 an the transparent and black plastic bag were punched out and hole were made in it for maintaining the transpiration and for controlling the microclimate of fruits. The present design was carried out through Randomized Block Design (RBD) with 5 Treatments and 4 replications. The planting was done in two row system with three in each row. Observations recorded are fruit length with crown (cm), fruit length without crown (cm), fruit circumference (cm), no. of eyes in length, no. of eyes in circumference, no. of eyes in 25 cm^2, fruit weight with crown (g), fruit weight without crown (g), eye index, T.S.S (ºBrix), acidity

(%), T.S.S acid ratio, total sugar (%), reducing sugar (%), non-reducing sugar (%).

The observation recorded on different parameters were analysed in simple Randomised Block Design as suggested by Gomez and Gomez (1983) and significance of variance were tested by Error Mean Square using Fisher Snedecor 'F' test of probability of 0.05% level of significance.

Results and Discussion

Physical parameters

Fruit length with crown

It is clear from the statistical analysis recorded on fruit length with crown was significant which is given in table no. 1. Maximum fruit length with crown was found in T_2 (Paper bag) was (25.43), which is *at par* with T_4 (Black polythene bag); T_1 (Jute bag). Minimum (22.33 cm) fruit length with crown was observed in T_3 (Transparent polythene bag). Bagging with paper bag is beneficial as paper bag is thermo insulator act as heat controller which provides appropriate microclimate for growth and development, (Xu *et al.,* 2008) also found increment in fruit width and lengths of earlier two times of bagging were larger than that of non-bagging.

Fruit length without crown

The statistical analysis of the data recorded on fruit length without crown in table no. 1 encompasses significant. Maximum (18.24 cm) fruit length with crown was found in T_4 (Black polythene bag). Minimum (15.80 cm) fruit length without crown was observed in T_3 (Transparent polythene bag). Increase in size or length of fruit is caused by rapid cell division and cell expansion due to proper anthesis in suitable microclimate. Black polythene bag penetrate the light and cause cooler microclimate than outer environment and stimulate the cell expansion and cell division. Individual fruit size in 'Xiangtian' olive was improved by Shengda^{TM} bags in China (Zhou *et al.,* 2012).

Fruit circumference

Perusal of observations on the fruit circumference in table no. 1 encompasses significant. Maximum (32.78 cm) fruit circumference was found in T_2 (Paper bag), which was *at par* with T_4 (Black polythene bag). Minimum (29.14 cm) fruit circumference was observed in T_5 (Control). Paper bag are thermo insulator thus it resist the heat and maintain the microclimate in which transverse division take place. Yang *et al.,* (2009) reported that bagging promoted longan fruit development, resulting in larger-sized fruit with good circumference.

Fruit weight with crown

In current research it was analysed that fruit weight with crown in table no. 1 had found significant. The evaluation which was found best (772.27 gm) was in T_2 (Paper bag). Minimum fruit weight with crown (587.63 gm) was reported in T_3 (Transparent polythene bag). Paper bag provide better environment because it resist the heat, keep the temperature lower than outer environment which stimulate proper development and growth hence increase the weight. Fruit development and growth is an obvious reason of gaining weight while control microclimate and pathogen free environment is another factor of proper development and optimizing weight in appropriate way. Muchui *et al.,* (2010) reported that the increasing of temperature (0.5°C) in the bagging bag increased the rate

of fruit development and produced greater fruit size and weight equal to 10-16%. Mahardika and Susanto (2003) reported that edible portion of cultivar Nambangan approximately half of the fruit weight. Whereas (Watanawan *et al.,* 2008) also evaluate that paper bags affect the size of fruits in better aspect.

Fruit weight without crown

The statiscal evaluation of data which was explaining the fruit weight without crown in table no. 1 was significant. It was maximum (677.89gm) in T_2 (Paper bag). Minimum result (462.03) was observed in T_3 (Transparent polythene bag). Paper bagging influenced the weight of fruit by providing the favourable microclimate and pathogen free environment, it is thermo resistor which control the temperature and help in cell division and cell expansion which may develop the fruit weight (Muchui *et al.,* 2010).

Number of eyes in length

In present experiment it is found that number of eyes in length in table no. 2 showed non-significant result. Therefore maximum (7.24) was found in T_4 (Black polythene bag). Minimum (6.36) number of eyes in length was observed in T_1 (Jute bag). As number of eyes in pineapple are mainly ovaries which develop into berries and which coalesce into a large, compact, multiple fruit. It is govern by genetically and by the help of pollinations.

Number of eyes in circumference

In this experiment it was observed that number of eyes in circumference in table no. 2 concluded non-significant result. Thus maximum result (25.36) was found in T_2 (Paper bag), which was *at par* with T_3 (Transparent polythene bag); T_4 (Black polythene bag). Minimum (22.39) number of eyes in length was observed in T_1 (Jute bag). As number of eyes in pineapple are mainly reproductive ovaries which emerges into berries and develops into a large multiple fruit. It is govern by genetically.

Number of eyes in 25 cm^2

Significant variations were in number of eyes in 25 cm^2 in table no. 2. Observed maximum number of eyes in 25 cm^2 (10.93) was reported in T_5 (Control). Minimum (7.85) number of eyes in 25cm^2 was observed in T_2 (Paper bag). The decrease in number of eyes in paper bagged fruits may be because of the higher circumference observed in these causing lesser number of eyes to be present in the area of 25 $cm^{2.}$

Eye index

Present experiment evaluated that eye index in table no. 2 had found significant. Maximum (4.05) eye index was found in T_1 (Jute bag). However minimum eye index (3.60) was observed in T_5 (Control).

Eye index is a combined factor of four parameter it depends on fruit length without crown per number of eyes in length and fruit circumference per number of eyes in circumference. As if fruit length and fruit circumference will increase therefore eye index will also raise vice-versa and eye index is inversely proportional to the number of eyes of both length and circumference.

T.S.S

The present experiment showed that T.S.S after bagging of fruit had statistical signified result in table no. 3. Maximum (14.22) T.S.S is found in T_2 (Paper bag).

Table.1 Effect of fruit bagging on fruit length with and without crown, fruit circumference and fruit weight with and without crown

Treatment	Treatment Details	Fruit length with crown in cm	Fruit length without crown in cm	Fruit circumference in cm	Fruit weight with crown in gm	Fruit weight without crown in gm
T_1	Jute bag	24.09	16.90	31.62	680.27	566.41
T_2	Paper bag	25.43	17.03	32.78	772.27	677.89
T_3	Transparent polythene bag	22.33	15.80	29.51	587.63	462.03
T_4	Black polythene bag	24.87	18.24	32.66	704.05	603.42
T_5	Control	23.21	15.81	29.14	640.98	555.82
$CD_{0.05}$		**0.82**	**1.06**	**1.15**	**17.69**	**9.45**
SE(± mean)		**0.30**	**0.36**	**0.39**	**5.98**	**3.19**
CV		**7.85%**	**4.31%**	**2.46%**	**1.84%**	**1.15%**

Table.2 Effect of fruit bagging on number of eyes in length, circumference, 25 cm^2 and eye index

Treatment	Treatment Details	No. of eyes in length	No. of eyes in circumference	No. of eyes in 25 cm^2	Eye index
T_1	Jute bag	6.36	22.39	9.19	4.05
T_2	Paper bag	7.02	25.36	7.85	3.81
T_3	Transparent polythene bag	6.39	25.29	9.92	3.63
T_4	Black polythene bag	7.24	25.00	8.56	3.91
T_5	Control	6.64	23.88	10.93	3.60
$CD_{0.05}$		**NS**	**NS**	**0.55**	**0.11**
SE(± mean)		**0.06**	**0.41**	**0.19**	**0.04**
CV		**1.85**	**3.40**	**4.01**	**12.10**

Table.3 Effect of fruit bagging on T.S.S. in brix, Acidity in percentage and T.S.S. – Acidity ratio

Treatment	Treatment Details	T.S.S in brix◦	Acidity in %	T.S.S – Acidity ratio
T_1	Jute bag	13.21	0.63	20.46
T_2	Paper bag	14.22	0.63	22.57
T_3	Transparent polythene bag	13.10	0.68	19.26
T_4	Black polythene bag	13.49	0.65	20.81
T_5	Control	12.35	0.88	14.03
$CD_{0.05}$		**0.72**	**0.02**	**1.21**
SE(±mean)		**0.26**	**0.01**	**0.42**
CV		**5.32**	**2.26**	**15.51**

Table.4 Effect of fruit bagging on reducing sugar, non-reducing sugar and total sugar

Treatment	Treatment Details	Reducing sugar in %	Non reducing sugar in %	Total sugar in %
T_1	Jute bag	2.46	5.41	7.87
T_2	Paper bag	2.89	5.81	8.69
T_3	Transparent polythene bag	2.21	4.80	7.00
T_4	Black polythene bag	2.68	4.86	7.29
T_5	Control	1.52	3.36	5.29
$CD_{0.05}$		**0.17**	**0.35**	**0.35**
SE(±mean)		**0.06**	**0.11**	**0.12**
CV		**4.64**	**5.99**	**3.35**

Table.5 Effect of fruit bagging on days to harvest and duration of harvest

Treatment	Treatment Details	Days to first harvest	Duration of harvest
T_1	Jute bag	57.29	5.17
T_2	Paper bag	59.32	4.42
T_3	Transparent polythene bag	66.12	3.51
T_4	Black polythene bag	70.56	8.40
T_5	Control	76.77	7.23
$CD_{0.05}$		**1.33**	**NS**
SE(±mean)		**0.53**	**0.29**
CV		**12.33**	**17.56**

Minimum T.S.S (12.35) had reported in T_3 (Transparent polythene bag). Bagging control the temperature and make it favourable for the proper growth and as temperature slowly increased in paper bagging that is more beneficial as it is thermo insulator to maintain the temperature around pineapple fruits as temperature is major factor which effects the quality of fruits thus improve T.S.S. Dutta *et al.,* (2012) found same result after bagging that there is improvement in T.S.S is found. Sharma *et al.,* (2013) also found significant improvement of T.S.S his research, (Singh *et al.,* 2007) also found that newspaper bagging increase the T.S.S. in his research on bagging.

Acidity in percentage (%)

The statistical investigation of data which is explaining the acidity of fruit is significant which is showed in table no. 3. Maximum (0.88) acidity is reported in T_5 (Control) while minimum (0.63) is observed in both T_2 (Paper bag); T_1 (Jute bag). Paper bag are resist light and temperature and provide proper aeration which limit the titrable acidity. In many other researches it was reported that acidity is also affected by bagging is reported in research conducted by (Dutta *et al.,* 2012) he found that there is non-significant result but the acidity is gradually decreased in bagged fruits. Singh *et al.,* (2007) also reported low acidity in bagged fruit than un-bagged one, this might be happen because bagging delayed the ripening process and transpiration feature thus fruit produces less titrable acid.

T.S.S – Acid ratio

The statistical observation of data explaining the T.S.S - Acid ratio is observed significant is showed clearly in table no. 3. Maximum (22.57) result was reported in T_2 (Paper bag). Meanwhile minimum result was observed in T_5 (Control). T.S.S – Acid ratio is combined parameter of T.S.S and acidity in percentage when T.S.S is higher than acidity it directly increases the parameter of T.S.S – Acid ratio vice versa. But acidity is inversely proportion to T.S.S – Acid ratio. As bagging increase the T.S.S- acid ratio this statement had justified in research carried by (Meena *et al.,* 2016).

Reducing sugar in percentage (%)

In present research of perusal observation of reducing sugar in (%) is reported statistical significant which is clearly showed up in table no. 4. Maximum (2.89) result was concluded in T_2 (Paper bag), which was *at par* with T_4 (Black polythene bag). While minimum (1.52) is observed in T_5 (Control). Temperature and solar radiation are the environmental variables which mainly give variation in sugar accumulations. It also effects the rate of respiration and helps in steady control. The transparent polythene bag readily absorb the light and raise the micro-climate temperature instantly under bagging. The outer temperature causes early maturation and demolition of sugar accumulation after ripening. Zhou and Guo, (2005) found increase in soluble sugar in grapes after bagging. Meena *et al.,* (2016) also revealed the same result after bagging of guava.

Non reducing sugar in percentage (%)

Perusal investigation on non-reducing sugar data is reported statistically significant which is demonstrated in table no. 4. The highest (5.81) is found in T_2 (Paper bag) which is par with T_1, (Jute bag). Along with this minimum observation is announced in T_5, (Control). Effect of bagging is found in research carried by (Zhou and Guo, 2005; Meena *et al.,* 2016; Watanawan *et al.,* 2008)

in grapes, guava and mango is same that there is improvement of non-reducing sugar after bagging because it might control the temperature and the light with various wavelength which is one of the environmental factor of ripening and maturation. Paper bag are thermo resistor and also reduce the penetration of light and provide affordable microclimate and temperature where as transparent polythene is capable of absorb the light and also raise the temperature and increase the humidity of surrounding which mainly detoriate the non-reducing sugar.

Total sugar in percentage (%)

In present research the data collected upon of total sugar is observed statistically significant which is presented in table no. 4. The highest total sugar (8.69) is announced in T_2 (Paper bag). The lowest total sugar is observed in T_5 (Control).

As bagging is important procedure of covering the fruit with paper. It effect many of properties which enhance the quality here paper bag is found best because it create a micro climate in which temperature raise but not so simultaneously it ensure the temperature raising slowly which effect the fruit in a beneficial way by improving the aroma and total sugar this can be justified by several research i.e (Zhou and Guo, 2005); (Meena *et al.,* 2016); (Watanawan *et al.*, 2008) in grapes, guava, and mango.

Their research result clarified that different bagging material improve the total sugar and many other chemical quality, morphological quality and physical properties. Paper bag followed by black polythene bag provide better microclimate as paper bag are thermo insulator and black polythene does not allow the light or long wave length to enter into it hence give better environment.

Day first to harvest

In the current examination of fruit bagging on pineapple days to first harvest ranges from 57.29 to 76.77 was statistically significant and listed in table no. 5 in which maximum days reported in T_5 (Control) whereas minimum days was obtained in T_1 (Jute bag). Days to first harvest means day of bagging upto harvest as control had no bagging so the fruit are in open condition that why it took maximum time for maturation, meanwhile jute bag are porous in nature it provide proper aeration and control temperature which give better environment for growth and development and thus decrease the time period of maturation i.e fruit mature early. Paper bag are good heat insulator therefore it gave control temperature and microclimate for the growth and development.

Duration of harvest

Statistically evaluated observation of duration of harvest was reported non-significant in perusal research which is represented in table no 5. Maximum after effect was noticed in T_5 (Control) and minimum was marked in T_3 (Transparent polythene bag).Duration of harvest determined the time period of harvest in which whole treatment ripe, it may also described the period of ripening after the fruit mature for table purpose. Transparent polythene bag gave minimum result because it provide more heat and raise the temperature of microclimate in which fruit are developing as result more rate of transpiration, rapid ethylene production thus took less time period for ripening the whole fruit crop. Whereas control took more time because it is in open condition.

Fruit bagging with different types of material such as jute bag, paper bag,

transparent polythene bag and black polythene bag on pineapple cv. Mauritius significantly affected the physico-chemical properties of fruits. Maximum fruit length with crown, fruit circumference; number of eyes in circumference, number of eyes in 25 cm^2 and eye index; fruit weight with crown and without crown was reported in T_2 (Paper bag). T_4 (Black polythene bag) scored better in maximum fruit length without crown and number of eyes in length. The fruit quality analysis, T.S.S, T.S.S – Acid ratio, reducing sugar, non-reducing sugar and total sugar also proved the superiority of T_2 (Paper bag) over other treatments. The minimum acidity recorded by T_2, (Paper bag) also made the fruits more palatable. Therefore after considering the observed results it can be concluded that T_2 (Paper bag) is the best bagging material in pineapple cv. Mauritius.

References

Cattaneo, T. M. P., Nigro, F., Messina, G and Giangiacomo, R. (1994) *Milchwissenschaft*, 49, 269 -272

Datta, P., Majumder, P. (2012). Influence of bagging on fruit quality and mineral composition of Himsagar mango grown in new alluvial zones of West Bengal. *Advances in Horticultural Science*, 26, 158-162.

Debnath, S. and Mitra, S. K. (2008). Panicle bagging for maturity regulation, quality improvement and fruit borer management in litchi (*Litchi chinensis*). *Acta Horticulturae*, 773, 201–208.

Gortner, W.A., Dull, G.G and Krauss, B.H. (1967) *Hortscience*, 2, 141.

Katsumi, U., Yukio, H., Kazwaki, N., Akihiro, S and Takayuki, S. (1992) *J, Agric, Food Chem.*, 40, 599

Mahardika, I.B.K. and S. Susanto, (2003). Changes in fruit quality of several cultivars of pummel during maturation period. *Hayati*, 10, 106-109.

Meena, K. R., Maji, S. (2016). Effect of Bagging on Fruit Quality of Guava. *International Journal of Bio-resource and Stress Management*, 7(2), 330-333.

Mortan, J.F., 1987. Pineapple. In: Fruits of warm climates. Florida Flair Books, Miami.

Muchui, M. N., Mathooko, F. M., Njoroge, C. K., Kahangi, E. M., Onyango, C. A. and Kimani, E. M. (2010). Effect of perforated blue polyethylene bunch covers on selected postharvest quality parameters of tissue-cultured bananas (*Musa* spp.) cv. Williams in Central Kenya. *Journal of Stored Products and Postharvest Research*, 1, 29–41.

Sharma, R. R., Pal, R. K., Asrey, R., Sagar, V. R., Dhiman, M. R. and Rana, M. R. (2013). Pre-harvest fruit bagging influences fruit color and quality of apple cv. Delicious. *Agricultural Sciences*, 4, 443–448.

Singh, B. P., Singh. R. A., Singh, G. and Killadi, B. (2007). Response of bagging on maturity, ripening and storage behav- iour of winter guava. *Acta Horticulturae,* 735, 597–601.

Watanawan, A., Watanawan, C. and Jarunate, J. (2008). Bagging 'Nam Dok Mai #4' mango during development affects colour and fruit quality. *Acta Horticulturae*, 787, 325–328.

Xu, C. X., Chen, H. B., Huang, R. Y. and HE, Y. J. (2008). Effects of bagging on fruit growth and quality of carambola. *Acta Horticulturae*, 773, 195–200.

Xu, H. X., Chen, J. W. and Xie, M. (2010). Effect of different light transmittance paper bags on fruit quality and anti-oxidant capacity in loquat. *Journal of the Science of Food and Agriculture*, 90, 1783–1788.

Zhou, J., Zhong, G., Lin, Z. and Xu, H. L. (2012). The effects of bagging on fresh fruit quality of *Canarium album*. *Journal of Food, Agriculture and Environment*, 10, 505–508.

Zhou, X. B. and Guo, X. W. (2005). Effects of bagging on the fruit sugar metabolism and invertase activities in 'Red Globe' grape during fruit development. *Journal of Fruit Science*, 26, 30–33.