Response of Pineapple Yield and Quality on Pinching of Crown Leaves Combined With Bagging of Fruits

ABSTRACT

The experiment was carried out during 2014-2016 at Horticulture farm under the Department of Horticulture and Post Harvest Technology, Institute of Agriculture, Visva Bharati, Sriniketan to study the 'Response of pineapple yield and quality on pinching of crown leaves combined with bagging of fruits'. The experiment comprised of 9 treatment combinations of pinching of leaves with different types of bagging materials that is T_1:control, T_2: pinching of 3 crown leaves; T_3: pinching of 6 crown leaves; T_4: pinching of 3 crown leaves + bagging with thin jute bag; T_5: pinching of 3 crown leaves + bagging with perforated black polythene; T_6: pinching of 3 crown leaves + bagging with news paper; T_7: pinching of 6 crown leaves + bagging with thin jute bag; T_8: pinching of 6 crown leaves + bagging with perforated black polythene; T_9: pinching of 6 crown leaves + bagging with news paper . Entire experiment was done by using RBD with three replications. Observations was recorded on yield and quality attributes namely, fruit length without crown (cm), crown length (cm), fruit weight without crown (g), crown weight (g), estimated yield without crown (t/ha), fruit juice content (g), TSS (^oB), acidity (%), TSS: acidity ratio, reducing sugar (%) and total sugar (%). Results denoted that the fruit size, fruit weight, estimated yield was found best with the treatment T_9 (6 crown leaves pinching with newspaper bagging) and all the fruit quality parameter like TSS, acidity, ascorbic acid, reducing and non reducing sugar, orgenoleptic score was also found superior in T_9 (6 crown leaves pinching with newspaper bagging. these result is may be due to the fact that bagging keeps the temperature lower than external environment and helps to arouse proper development and growth and pinching of leaves consequently increases the weight of fruit and also make it convenient for handling and markinteng.

'Keyword': bagging, pineapple, pinching, quality and yield

Pineapple [*Ananas comosus* (L.) Merr.] is one of the commercial fruit crop of India which belongs to family **B**romeliaceae [1]. It deserves to be called as the 'heavenly fruit' owing to its pleasant flavour and exquisite taste which make it one of the choicest fruits throughout the world. The quality of pineapple can also be improved by different cultural practices by mulching, bagging, leaf pinching etc. Bagging is procedure of covering the crop by cloth, paper, plastic or jute-bags etc. It is not only done for better protection from insect pests and environmental hazards [2] but it is mainly done to control the temperature around the fruit and from favourable microclimate for fruit maturation through synthesis of bromelain. Bromelain is the proteolytic enzymes associated with the Bromeliaceae plant family mainly Ananas comosus [3, 4]. Furthermore bagging enhances the color and aroma of fruits. In addition to fruit quality bagging improves fruit size and fruit weight [5, 6]. Moreover, bagging helps in providing protections from mechanical injuries and sun burns, latex burns and

fungal spots on the fruits [7, 8]. Another cultural practices followed in pineapple is pinching. Pinching of pineapple leaves is done to improve the quality of fruit and to reduce the crown size which will make easier for transportation and fetches more prices. Pinching is not very much accepted by the people of India as well as world because pinching is difficult in pineapple because of its spiny leaves structure and farmers are still not known with its results. Since fruit bagging and pinching of crown leaves is one of the major intercultural operations but as this is a new technique, farmer are not familiar about the information that bagging and pinching helps to develop the fruit yield and quality of pineapple. Therefore to collect the more information and knowledge about bagging and pinching of pineapple, it was important to execute present investigation.

MATERIAL AND METHODS

Healthy plants of pineapple (cv. Kew) were selected from the Horticulture Farm, Department of Horticulture and Post Harvest Technology, Palli Siksha Bhavana (Institute of Agriculture), VisvaBharati, Sriniketan, Red and Lateritic zone of West Bengal.The experiment comprised of 9 treatment combinations of pinching of leaves with different types of bagging materials replicated 3 times. There were 25 numbers of plants per replication. Bagging was done after plant completes the flowering phase. The plants were bagged individual with different types of bags and tied with thread after pinching leaves as per treatments. Three different types of bags are used viz. newspaper bag, thin jute bag and perforated black polythene bag which was combined with crown pinching (three and six crown leaf pinching). Hole was made on bags before bagging to retain the transpiration and to control the microclimate of fruit.

Table 1. Treatment details

Notation	Treatments
T_1	Control
T_2	Pinching of 3 crown leaves
T_3	pinching of 6 crown leaves
T_4	Pinching of 3 crown leaves + Bagging with thin jute bag
T_5	Pinching of 3 crown leaves + Bagging with perforated black polythene
T_6	Pinching of 3 crown leaves + Bagging with news paper
T_7	Pinching of 6 crown leaves + Bagging with thin jute bag
T_8	Pinching of 6 crown leaves + Bagging with perforated black polythene
T_9	Pinching of 6 crown leaves + Bagging with news paper

Whole experiment was done by using Randomized Block Design (RBD) with three replications. Observations was recorded on yield and quality attributes, fruit length without crown (cm), crown length (cm), fruit weight without crown (g), crown weight (g), estimated yield without crown (t/ha), fruit juice content (g),

TSS (^{o}B), acidity (%), TSS: acidity ratio, reducing sugar (%) and total sugar (%). All the yield and quality parameters of fruits were analyzed as per standard methods given in [9].

RESULTS AND DISCUSSION

1. Fruit length

From the result depicted on Table 2, it was revealed that the treatments varied significantly with respect to different treatment. In first year the maximum fruit length with crown was acquired with the treatment T_9 (31.49 cm). In second year maximum fruit length with crown was recorded at T_6 (31.60 cm). It is also absorbed that the utmost crown weight was recorded at T_9 (11.80 cm) which was closely followed by T_8 (11.63 cm) and least was recorded with T_6 (14.09 cm). According to the statistical analysis of observations presented at same Table 2, it was noted that the highest fruit length without crown was recorded at T_9 (19.21cm pooled mean) and lowest was recorded at T_1 (15.11cm pooled mean). Along with fruit length maximum fruit circumference was recorded at T_9 (33.91cm).

The bagged fruits with newspaper and crown leaves pinching were found with the highest fruit weight, the highest length and the highest breadth. They reported that the efficiency of bagging has accelerated the growth of fruits and at the same time increased the fruit size and weight of guava. [10] report revealed that the highest 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 noted with the treatment T_2 (Paper bag).

The increment in fruit length and fruit circumference is may be due to the reason that bagging claims to control and maintain the microclimate and temperature of the fruits [11, 12] also protect the fruits from the sunburn and pest and diseases [13, 14] which ultimately helps to improve the growth parameters of the fruit.

2. Fruit weight

Data depicted in the Table 3, it was noted that fruit weight with crown varied significantly among different treatment. From the 2 years mean data it has been observed that the utmost fruit weight with crown was recorded with treatment T_9 (1418.0 g) but maximum crown weight was acquired with the treatment T_2 (302.7 g).

Data reviewed from Table 3, exhibited that the highest fruit weight without crown was observed with the treatment T_6 (1117.5 g) and lowest was recorded with T_1 (1016.4 g). It has been also noted that the juice content was observed with maximum in treatment T_9 (698.4 g) and T_1 (612.3 g) was observed minimum.

The increase in fruit weight (with and without crown), crown weight and juice content was highly beneficial with the newspaper bagging of fruit along with pinching of 6 and 9 crown leaves. Increased in fruit weight in present study might be due to the paper bag afford better environment because it has capacity to resist the heat, which keeps the temperature lower than external environment and helps to arouse proper development and growth consequently increases the weight while control microclimate and growth is an apparent reason of gaining the fruit weight at the same time as control microclimate and pathogen free environment is another factor of suitable development and optimizing weight in appropriate way. This statement was also supported other researcher [15, 16, 17]. At the same time pinching of 6 crown leaves helps to increase the weight of the fruit is may be due to the fact that the leaf has higher synthesis of assimilation of carbohydrate and photosynthesis, which pinching of crown leaves the translocation of photosynthetic products will retain more in fruits, may be because of that the fruit weight and quality improves better.

3. Estimated Yield

Statistical analysis of estimated yield presented in the Table 4, revealed that in both years T_9 (54.46 t/ha pooled mean) has shown utmost estimated mean yield with crown. At the same time pooled mean of maximum estimated yield without crown was observed in T_6 (42.90 t/ha).

Pinching of 3 or 6 leaves crown along with newspaper bagging of fruit has sown significant effect on estimated yield with crown and without crown among the other treatments. This result is may be due to that newspaper bag is thermo insulator which acts as heat controller and also provides appropriate microclimate for growth and development of fruit [11, 12]. Results also indicated that the bagging facilitate in reduction of damaged caused by bird and mechanical during fruit growth [18]. It can be also observed from the above discussed results that bagging help in increasing fruit length, fruit circumference as well as fruit weight with ultimately helps in increasing estimated yield. Present finding is also supported by other author where they observed bagging affects the size and the weight of pomegranate [19, 20].

4. Biochemical characteristics

Analysis of data on TSS is presented in the Table 5, evident that the pooled value of TSS was observed highest with the treatment T_9 (14.37^{o}B). The pooled value of two years data was found minimum amount of acidity in T_9 (0.51%) and maximum in treatment T_1 (0.70%). In addition to that the highest TSS:acidity ratio

was observed with the treatment T_9 (27.87 pooled mean) and minimum was noted with T_1 (17.46) and T_2 (18.90) was found *at par* with each other.

It is clear from the Table 5, that the utmost ascorbic acid was observed with the treatment T_6 (57.2mg/100g) which was found similar with the treatment T_9 (55.4mg/100g) and least ascorbic acid was found with the treatment T_1 (32.7mg/100g).

Data pertaining the total sugar and reducing sugar was summarized in Table 6, expressed that in both the year all the treatments has been significantly varied with each other. The highest total sugar and reducing sugar was recorded with the treatment T_9 (12.81% and 4.21 % respectively pooled mean). Whereas, non-reducing sugar was found non-significant amongst all the treatments.

Table 6, expressed the most excellent organoleptic score was recorded with the treatment T_9 (9.14) and T_6 (9.51) was found *at par* with T_9 and reduced organoleptic score was recorded with the treatment T_1 (6.87).

With reference to the Table 5 and 6, it is clear that treatment having 3 or 6 leaves pinching and newspaper bagging (T_9 and T_8) has shown incredible best result as compared to other treatment. It is may be due to bagging slowly increased the temperature in newspaper bagging that added beneficial to preserve the temperature around the pineapple fruits which helps improve TSS. [10] In pineapple fruit found same result after bagging that there is improvement in TSS. Found similar result in apple [14] and guava [21].

Newspaper bag are defy to light and temperature which supply proper aeration which bound the titrable acidity. Several research studies it was reported that the acidity is also exaggerated by bagging [22], he found that there is non-significant result but the acidity is steadily decreased in bagged fruits. [23] Also reported low acidity in bagged fruit than un bagged one, this might be possible when bagging postponed the ripening process and transpiration feature as a result the fruit produces less titrable acid. It is also studied that malic acid degrades first followed by citric acid, ultimately reducing titratable acidity [24, 25]. The possible reason might be the change in the microenvironment caused by the bagging treatments on the tree which ultimately led to slow down the metabolic activities during storage. Degradation of AA proceeds both aerobic and anaerobic pathways [26, 27] and depends upon many factors such as exposure to light [28], storage temperature and storage time [29, 30].

TSS:acid ratio is combined parameters of TSS and acidity in percentage when TSS is superior than acidity it directly increases the parameters of TSS-acidity vice versa. But acidity is inversely proportion to TSS:acidity

ratio. Bagging increase the TSS: acidity ratio, which is verified in research carried by Meena *et al*., 2016 on bagging of guava.

As fruit bagging with newspaper helped to advance the physico-chemical quality and micro environment of fruits. Decrease in ascorbic acid and increase in TSS and reducing sugar is may be due to the fruits become mature, acids are converted into sugars which makes fruits sweeter, but due to the presence of low concentration of O_2 in the bag hindered the acid to sugar conversion process. This might be the cause for lowering the sugar content in bagged fruits. Also justified in guava [31, 32].

It is also may be due to the light transmission rate and photosynthesis was more or less reduced with the different kinds of bags, at the same time fruit transpiration rate and the liquid flowing rate toward the fruit were declined, therefore the input of absorption rate to fruit was directly or indirectly reduced because of the high humidity in the micro-environment of bags [33, 34, 35].

Treatment having newspaper bagging with 6 leaves pinching has also recorded with best organoleptic score it is may be due to the better retention and development of total sugar, acidity, ascorbic acide etc. which is ultimately helping in improving the eating quality or taste of fruits [36, 37 and 38].

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CONCLUSION

After an investigation we came into a conclusion that the Crown leaf pinches and fruit bagging showed significant effect on fruit physical as well as biochemical parameters. Fruit size was better with minimum crown length under 6 leaves pinching moreover newspaper bagging also increased in fruit size when combined with leaf pinching. Fruit size, fruit weight, estimated yield and majority all the fruit quality parameter found best in T_9 (6 crown leaves pinching with newspaper bagging).

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Table 2: Effect of pinching and bagging on fruit length with crown (cm), crown length (cm), fruit length without crown (cm) and fruit circumference (cm) of pineapple

Treatment	Fruit length with crown (cm)			Crown length (cm)			Fruit length without crown (cm)			Fruit circumference (cm)		
	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean
T_1	29.27	28.38	28.79	14.11	13.37	13.74	15.19	15.02	15.11	28.25	28.12	28.18
T_2	30.72	29.65	30.20	14.15	13.60	13.89	16.56	16.05	16.31	28.57	28.27	28.43
T_3	29.56	28.67	29.12	12.20	12.02	12.12	17.38	16.66	17.02	29.28	29.01	29.15
T_4	31.02	30.09	30.61	13.35	13.20	13.28	17.69	16.92	17.31	30.14	30.04	30.10
T_5	29.98	29.11	29.56	12.90	12.35	12.63	17.11	16.77	16.95	29.06	28.89	28.98
T_6	32.48	31.60	32.07	13.65	14.52	14.09	18.87	17.10	17.99	33.22	32.97	33.09
T_7	30.23	29.48	29.86	12.41	12.31	12.36	18.03	17.21	17.64	32.49	32.13	32.32
T_8	29.12	28.26	28.71	11.75	11.50	11.63	17.35	16.74	17.05	30.92	30.16	30.55
T_9	31.49	30.54	31.02	11.92	11.67	11.80	19.52	18.88	19.21	34.13	33.68	33.91
CD(P=0.5 %)	**1.33**	**1.23**	**1.31**	**0.72**	**0.71**	**0.65**	**1.20**	**1.11**	**1.15**	**1.48**	**1.43**	**1.62**
SEm±	**0.44**	**0.41**	**0.42**	**0.23**	**0.23**	**0.22**	**0.39**	**0.35**	**0.37**	**0.46**	**0.42**	**0.52**

Table 3: Effect of pinching and bagging on Fruit weight with crown (g), crown weight (g), Fruit weight without crown (g) and juice content (g) of pineapple

Treatment	Fruit weight with crown (g)			Crown weight (g)			Fruit weight without crown (g)			Juice content (g)		
	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean
T_1	1307.2	1293.8	1300.6	282.3	285.4	284.1	1024.6	1008.2	1016.4	610.4	612.3	611.4
T_2	1340.1	1342.6	1341.3	289.7	302.7	296.4	1050.2	1039.6	1044.8	621.7	615.8	618.8
T_3	1354.6	1338.2	1345.1	271.2	268.3	269.8	1083.4	1069.8	1073.0	640.3	642.2	641.0
T_4	1345.0	1327.7	1336.5	275.4	278.2	277.1	1069.3	1059.4	1064.4	625.6	617.6	621.7
T_5	1325.3	1310.5	1317.7	265.6	274.1	269.9	1059.8	1036.5	1048.1	615.2	619.1	617.2
T_6	1418.7	1395.2	1406.8	292.1	286.8	289.6	1126.4	1108.4	1117.5	673.5	660.2	666.9
T_7	1376.8	1357.9	1367.4	273.8	281.2	277.5	1103.1	1076.6	1089.9	652.8	647.5	650.2
T_8	1359.6	1343.4	1352.0	267.3	263.5	265.4	1092.5	1079.8	1086.2	645.1	647.3	646.5
T_9	1426.9	1410.0	1418.0	272.5	269.4	270.9	1154.3	1040.7	1047.6	690.0	698.4	694.3
CD(P=0.5 %)	**34.27**	**33.47**	**35.61**	**8.23**	**7.92**	**8.19**	**21.63**	**22.50**	**20.24**	**19.29**	**15.23**	**18.72**
SEm±	**11.42**	**11.15**	**11.20**	**2.85**	**2.65**	**2.74**	**7.20**	**7.60**	**6.64**	**6.41**	**5.70**	**6.25**

Table 4: Effects of pinching and bagging on estimated yield with crown (t/ha) and estimated yield without crown (t/ha) of pineapple

Treatment	Estimated yield with crown (t/ha)			Estimated yield without crown (t/ha)		
	First year	Second year	Mean	First year	Second year	Mean
T_1	50.19	49.68	49.93	39.4	38.71	38.90
T_2	51.45	51.55	51.5	40.32	39.92	40.12
T_3	52.01	51.38	51.69	41.60	41.08	41.34
T_4	51.64	50.98	51.31	41.06	40.68	40.84
T_5	50.88	50.32	50.6	40.69	39.80	40.24
T_6	54.47	53.57	54.02	43.25	42.56	42.90
T_7	52.86	52.14	52.37	42.35	41.34	41.84
T_8	52.20	51.58	51.89	41.95	41.46	41.70
T_9	54.79	54.14	54.46	44.32	39.96	42.14
CD(P=0.5%)	**1.87**	**1.64**	**1.82**	**1.81**	**1.65**	**1.79**
SEm±	**0.63**	**0.54**	**0.60**	**0.60**	**0.55**	**0.60**

Table 5: Effect of pinching and bagging on TSS (°Brix), acidity (%), TSS: acidity and ascorbic acid (mg/100g) of pineapple

Treatment	TSS (°Brix)			Acidity (%)			TSS:acidity			ascorbic acid (mg/100g)		
	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean
T_1	12.01	12.41	12.21	0.71	0.68	0.70	16.92	18.27	17.46	32.2	33.2	32.7
T_2	12.45	12.53	12.49	0.67	0.65	0.66	18.60	19.29	18.90	37.7	38.9	38.4
T_3	13.26	13.35	13.31	0.64	0.63	0.64	20.73	21.20	20.94	42.5	44.0	43.3
T_4	12.71	12.67	12.71	0.60	0.57	0.58	21.20	22.23	21.73	52.1	53.5	52.8
T_5	12.43	12.59	12.50	0.62	0.59	0.61	20.05	21.34	20.67	44.8	45.4	45.2
T_6	13.86	13.81	13.83	0.56	0.53	0.54	24.81	26.07	25.46	56.6	57.8	57.2
T_7	12.72	12.79	12.76	0.61	0.59	0.60	20.82	21.70	21.25	47.2	47.0	47.2
T_8	12.94	12.82	12.88	0.65	0.62	0.63	19.94	20.64	20.34	45.8	46.5	46.1
T_9	14.23	14.50	14.37	0.53	0.50	0.51	26.93	28.89	27.87	54.7	56.4	55.4
CD(P=0.5 %)	**0.58**	**0.57**	**0.62**	**0.04**	**0.05**	**0.04**	**1.97**	**1.85**	**2.11**	**2.32**	**2.01**	**2.27**
SEm±	**0.18**	**0.18**	**0.20**	**0.01**	**0.02**	**0.01**	**0.65**	**0.63**	**0.68**	**0.22**	**0.68**	**0.71**

Table 6: Effect of pinching and bagging on total sugar (%) and reducing sugar (%) of pineapple

Treatment	Total sugar (%)			Reducing sugar (%)			Non-reducing sugar (%)			Organoleptic score		
	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean	First year	Second year	Mean
T_1	10.70	10.51	10.62	2.61	2.50	2.56	8.01	8.03	8.02	6.92	6.80	6.87
T_2	11.65	11.39	11.53	3.03	2.97	3.01	8.60	8.44	8.53	7.11	7.23	7.17
T_3	12.33	12.20	12.27	3.19	3.11	3.16	9.17	9.08	9.13	7.39	7.20	7.30
T_4	11.61	11.52	11.55	3.47	3.32	3.40	8.20	8.23	8.22	8.10	8.32	8.22
T_5	11.54	11.59	11.57	3.25	3.11	3.19	8.31	8.51	8.42	7.60	7.51	7.55
T_6	12.62	12.57	12.60	4.02	3.94	3.98	8.57	8.66	8.62	9.24	9.05	9.14
T_7	11.80	11.71	11.76	3.36	3.25	3.31	8.46	8.45	8.46	8.39	8.28	8.33
T_8	11.90	11.74	11.83	3.01	2.90	2.96	8.92	8.87	8.90	7.70	7.66	7.69
T_9	12.89	12.70	12.81	4.23	4.19	4.21	8.70	8.52	8.62	9.31	9.72	9.51
CD(P=0.5%)	**0.78**	**0.76**	**0.82**	**0.51**	**0.48**	**0.52**	**NS**	**NS**	**NS**	**0.59**	**0.63**	**0.61**
SEm±	**0.26**	**0.26**	**0.28**	**0.16**	**0.16**	**0.17**	**NS**	**NS**	**NS**	**0.19**	**0.22**	**0.20**

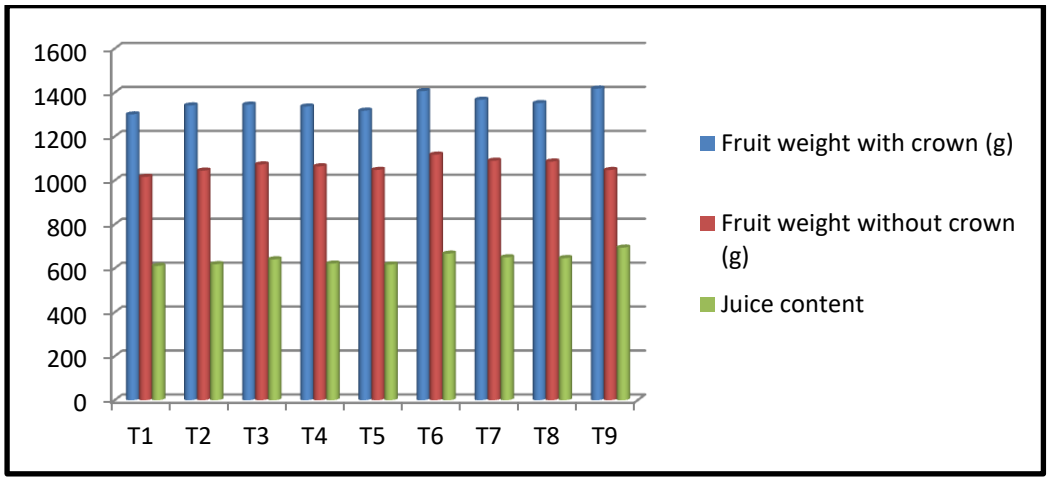

Fig. 1: Effects of pinching and bagging on fruit weight with crown, fruit weight without crown and juice content of pineapple

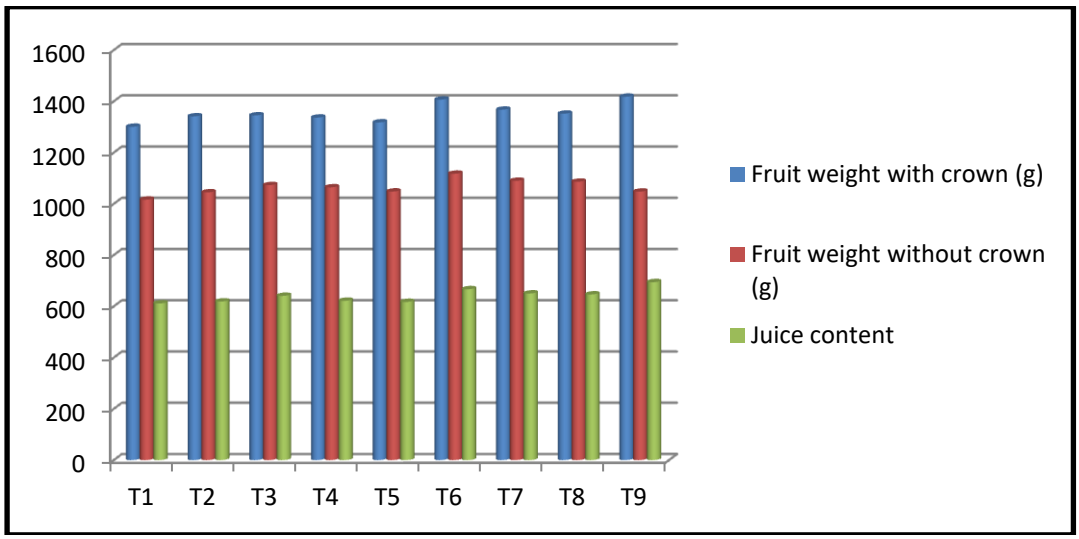

Fig. 2: Effects of pinching and bagging on fruit weight with crown, fruit weight without crown and juice content of pineapple

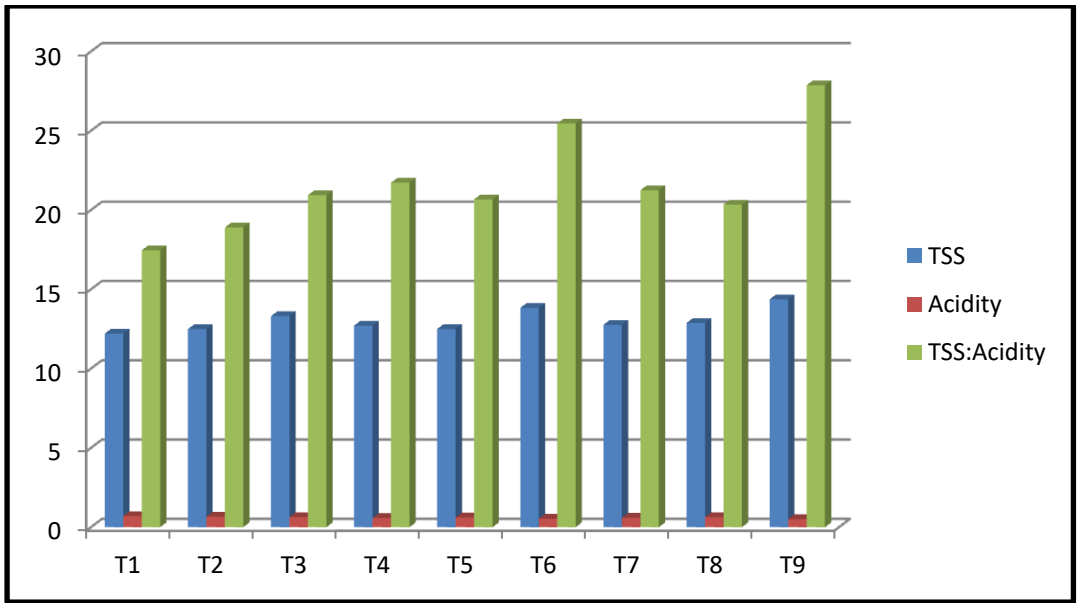

Fig. 3: Effects of pinching and bagging on TSS, acidity and TSS:Acid ratio of pineapple

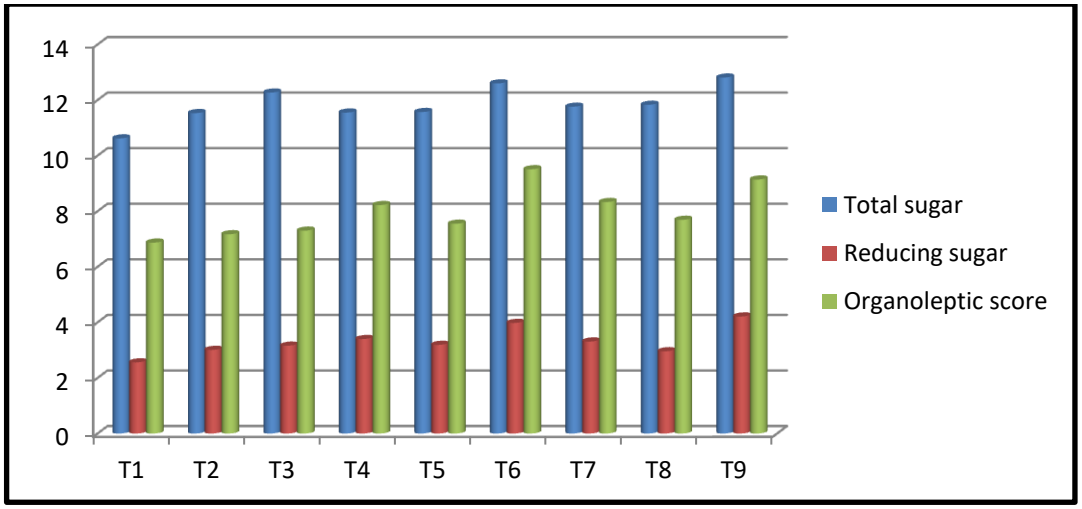

Fig. 4: Effects of pinching and bagging on total sugar, reducing sugar and organoleptic score of pineapple