Relationship of Fruit Quality with Plant Morphology and Fruit Chemical Compositions in 'Patavia' Pineapple

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Abstract : 'Patavia' cv. pineapple (*Ananas comosus* L. Merr.) (Smooth Cayenne Group) was studied at local pineapple plantation for fruit quality as a function of differences in morphological characteristics and chemical compositions. The fruit were categorized into three quality levels: First Class fruit quality (high juiciness for fresh fruit market); Second Class fruit quality (normal fresh fruit market); and Third Class fruit quality (factory processing market). Results revealed that the First Class fruit quality had the highest canopy width, leave weight, total weight and crown height. However, the Second and Third class fruit quality had the greatest stem height and leaf width. There were no differences in leaf number, leaf length, sucker number, fruit diameter, fruit length, peduncle length, peduncle diameter, eye depth, crown diameter, stem weight, sucker weight, fruit weight, peduncle weight or crown weight among treatments. The changes in fruit physical characteristics and some chemical compositions suggested that the Second and Third Class fruit also had the highest fruit firmness and TA. The First Class fruit quality had the greatest core diameter and pH as well as a yellow group 11 A fresh colors. However, there was no relationship of juiciness (translucency) or TSS on the classification.

Keywords : fruit quality, translucency, chemical compositions

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1. Introduction

The pineapple production area of Thailand in 2012 was 96,200 hectare whith total yields approximating 1.92 million metric tons. In while in Lampang province the production area was 3,000 hectare yielding yields about 52,010 metric tons (Office of Agricultural Economics, 2012). In this province, the main product of pineapple is directed to factory because growers were not aware of good cultural practices. A grower rarely has investments in factory equipment and marketing information because of the high cost, and is therefore subject to prices that are set by middlemen of the factories themselves. On the one hand price for fruit for processing is lower by a two to three fold margin than fresh or edible fruit. On the other, at present , there has been no recommended fruit quality standard classification, while growers are able identify their produces after harvest (Agricultural Information Center, 2011) and use the standard to improve next year's quality. The smooth cayenne pineapple fruit with light yellow or golden yellow to one-half-yellow surface had better shelf-life than that with more surface color and green fruit might not be adequately mature for optimum edible quality (Pantastico, 1975; Joomwong, 2006)

The texture of juicy pineapple affected the classification of fruit quality for the fresh consumption market in Thailand and therefore the price. In identifying the quality of a given pineapple, the juicy texture or honey flesh pineapple would receive a higher price than one with a normal texture due to demand by consumers. Currently, there are no known techniques or methods to produceing juicy texture or honey flesh because there are many factors involved, such as plant nutrition management, irrigation and environmental condition. Moreover, the plant spacing of pineapple could affect fruit quality and the translucency symptom (Veravudh, 1998). Joomwong and Sornsrivichai (2006) discovered that translucency in fruit was discovered approximately120 to 160 days after full bloom in all crop seasons.

To extend these studies further and to attempt a classification that would help growers to determine the disposition of their crop, this study investigates the relationship between the classified fruit quality and the morphological attributes, as well as, fruit chemical compositions of 'Patavia' pineapple varieties grown in Lampang Province.

2. Materials and Methods

Pineapple cv. 'Patavia' was grown at Huay Yang village, Amphur Muang, Lampang Province, Thailand, with 40 X 40 cm spacing. Pineapple fruit was harvested 130 days after full bloom and fruit quality classed into three groups used by growers and traders: 1) First Class (juicy or honey or gloden texture for prime fresh fruit consumption); 2) Second Class (for normal fresh fruit consumption); and 3) Third Class (for processing or factory). The number of replications of the collection of conversion was ten. The recorded data were morphological attributes and weight accumulation of each part (leaf, stem, sucker, fruit, peduncle and crown), and fruit physical characteristics: fresh color (The Royal Horticultural Society, 2007), fresh firmness. The pineapple fruit was used for chemical composition analysis consisting of total acid (TA) (A.O.A.C., 1990), total soluble solid (TSS) and juice pH. TA was analyzed from extracted juice after the determination of

TSS contents and reported as citric acid according to A.O.A.C. (1990). TSS was determined from extracted juice using a hand refractometer (ATAGO Company, Tokyo, Japan) and the pH was measured at room temperature using a pH meter (Sartorius professional meter PP– 50 operation manual pH meter, Germany).

All parameters were subjected to statistical analysis of variance (ANOVA). Statistical differences with *p*-values less than 0.05 were considered significant and the means were compared by DMRT.

3. Results and Discussion

The Second and Third Class pineapples had greater pant height and D-leaf width than the First Class. However, the First and Second Class of pineapple fruit gave larger canopy width than the Third Class. There were no effects on leaf number, sucker number and D-leaf length for the fruits (Tab.1).

It was found that the morphological attributes, i.e. fruit width, fruit length, peduncle length, peduncle diameter, eye depth and crown diameter were similar among the classes. Nevertheless, the crown height was found to be the taller in the First Class fruit (Tab. 2).

The change of weight accumulation showed that the First and Second Classes had the highest on leaf and total weight. However, there was no difference in the other parts (Tab.3).

The fruit physical characteristics and chemical compositions in terms of fresh color for the First, Second and Third Classes were yellow group 11 A, 5 C and 3 D, respectively. The firmness and TA of First Class fruit were the lowest. However, the First Class had the greatest on the core diameter and pH of the fruit juice (Tab. 4).

Table 1 Plant height, canopy width, leaf number, sucker number, D-leaf width and D-leaf length in 3 different fruit qualities of 'Patavia' pineapple.

Fruit quality	Plant height (cm.)	Canopy width(cm.)	Leaf number	Sucker number	D-leaf width (cm.)	D-leaf length (cm.)
First Class	96.2 [b]	125.30 [a]	62.50	2.70	3.87 [b]	79.76
Second Class	107 [a]	120.55 [ab]	56.55	2.55	4.18 [ab]	77.61
Third Class	97.67 [ab]	108.87 [b]	53.17	2.33	4.52 [a]	77.42
F-test	*	*	NS	NS	*	NS

*Means within the column followed by the same letter were not significantly different at p=0.05 by LSD. NS=Non significance

Table 2 Fruit morphological attributes in three different fruit quality of 'Patavia' pineapples.

Fruit quality	Fruit width (cm.)	Fruit length (cm.)	Peduncle length (cm.)	Peduncle diameter (cm.)	Eye depth (mm.)	Crown height (cm.)	Crown diameter (cm.)
First Class	11.66	13.93	25.51	2.11	10.50	16.07 [a]	3.89
Second Class	11.78	14.13	27.11	1.93	10.77	12.28 [b]	3.63
Third Class	12.05	14.08	27.42	2.00	11.78	13.17 [b]	3.53
F-test	NS	NS	NS	NS	NS	*	NS

*Means within the column followed by the same letter were not significantly different at p=0.05 by LSD. NS=Non significance

Table 3 Fresh weight of pineapple plant organs in 3 different fruit qualities.

Fruit quality	Fresh weight of pineapple organs							
	Leaves (kg.)	D-leaf (g.)	Stem (g.)	Sucker (g.)	Fruit (kg.)	Peduncle (g.)	Crown (g.)	Total (kg.)
First Class	1.64 [a]	43.00	296.50	163.40	1.48	124.50	121.50	3.96 [a]
Second Class	1.45 [ab]	41.11	271.11	160.78	1.35	116.11	114.67	3.43 [ab]
Third Class	1.20 [b]	40.83	270.83	154.17	1.28	110.83	113.33	3.07 [b]
F-test	*	NS	NS	NS	NS	NS	NS	*

*Means within the column followed by the same letter were not significantly different at p=0.05 by LSD. NS=Non significance

Table 4 Fruit physical characteristics and chemical compositions in three different fruit qualities.

Fruit quality	Fresh color	Firmness (kg.)	Core diameter (cm.)	Juiciness (%)	TSS (°Brix)	TA (%)	pH
First Class	Yellow Group 11 A	2.91 [b]	3.06 [a]	88.36	16.90	3.71 [b]	4.11 [a]
Second Class	Yellow Group 5 C	4.74 [a]	2.60 [b]	87.72	14.22	4.42 [ab]	3.69 [b]
Third Class	Yellow Group 3 D	4.18 [ab]	2.57 [b]	86.77	12.62	5.22 [a]	3.53 [b]
F-test	-	*	*	NS	NS	*	*

*Means within the column followed by the same letter were not significantly different at p=0.05 by LSD. NS=Non significance

The First and Second Class pineapple fruits (eating/fresh fruit quality) had greater canopy, leaf weight and total weight than the Third Class. However, the First Class fruit quality had lower TA and firmness, but a higher pH of the juice when compared with the Second and Third Classes. For

predicting a fruit quality standard for eating fresh fruit pineapple, the TSS may have to be above 14 ºBrix and the TA lower than 4.50 because Thai consumers of fresh fruit pineapple do not like a sour taste, but prefer sweet flavor. Therefore pineapple fruit with sour flavor is used for mainly processing. This experiment found that TSS content was similar for the three classes, First and Second Class fruit had lower TA than the Third Class. Analyses in soluble sugars of pineapple fruit revealed that TSS content in pineapple was positively correlated with total sugars and TA also indicates the sourness (Bartolome *et al*., 1996). Chuenboonngarm *et al.* (2007) reported that TSS content was one of the parameters contributing eating quality of pineapple could increase without decreasing fruit quality.

First Class pineapple quality had low TA and high pH. Paull and Chen (2004) reported that the juicy meat in pineapple increased the pH, and the amount of TSS / TA and fruit weight. A juicy fruit was associated with the accumulation of sugar in the crop before harvest (Paull and Reyes, 1996). In addition, Chen and Paull (2000) reported that sugar metabolizing enzyme activities and sugar accumulation were related to the occurrence of translucency in pineapple flesh, in which it effects quality class and is not based on genetic factors.

The First and Second class fruit quality had higher leaves and total weight than the Third class because a large plant affected the greater accumulation of carbohydrate. However, the First Class fruit quality possibly could be caused by water, nutrient and soil nutrients management. In Hawaii, it was found that the succulent meat depended on the season, occurring in the spring. A similar phenomenon was found in Australia. This could be related to heavy rain followed by dry weather (Bartholomew et al, 2002), However, Joomwong and Sornsrivichai (2006) reported that the juiciness of the fruit was not correlated with age or the harvest season.

The growing location might also have the effect on fruit quality in Smooth Cayenne pineapple cv. 'Patavia'. The rainy season fruit at mature green stage (160 days after full bloom) in the year 2009 was found to have greater TSS content and free sugar content in Ban-Sadet village growing location than those other 2 villages in Lampang Province, Thailand (Pongjanta *et al*., 2011)

4. Conclusion

Pineapple fruit with a First Class quality had the highest canopy width, leave weight, total weight and crown height than pineapple of the Second and Third Classes. Since First Class pineapple fruit quality should have golden yellow flesh, a large core and high juice pH, these post-harvesting observatory results from this experiment can be applied as an index for verifying the fruit quality of fresh pineapple fruit prior to the harvest.

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