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Effect of crop load on fruit development and fruit quality of pummelo var. Tabtimsiam

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Effect of crop load (number of fruit per tree) on fruit development and quality of 5-year-old of pummelo var. Tabtimsiam. The experiment was conducted at the local orchards of Mr. Wirat Soksang, located in the Klongnoi sub-district, Pakpanang district, Nakhon Si Thammarat province, Thailand from June, 2013 to July, 2014. The difference of fruit growth and development was shown at 4th months after fruit set. The crop load at 50 and 60 fruits per tree could develop as indicated fruit weight (g), peel weight (g), pummelo fresh (g), diameter of fruit (cm) and circumference (cm) was advanced significant difference compared to the crop load at 70 fruit per tree. The crop load at 50 60 and 70 fruits per tree did not effects to the peel thickness, and fruit quality as indicated of total soluble solid (^{o}Brix) and titratable acidity (%) of pummelo var. Tabtimsiam.

Keywords : crop load, fruit development, fruit quality, pummelo

Introduction

Tabtimsiam is the geographical indications (GI) product in Thailand and a popular new pummelo cultivar in the premium fresh-fruit marketplace. The external appearances of Tabtimsiam pummelo fruit and leaves should have the dark green color and cover with soft hair, the internal appearances of Tabtimsiam pummelo thin light pink peel with tight row of small dark pink to red pummelo fresh, juicy with a sour - sweet taste (Kaewtubtim and Issarakraisila, 2011). All of production for domestic consumption and exporting. Recently, the demand for this fruit has gradually increased in both domestic and international markets, especially in China, Taiwan, Malaysia, Singapore and Brunei. Nowadays, the price of Tabtimsiam pummelo from the hand of the farmer is 150-250 bath/fruit, the farmer's orchard expands to plantation increasing continuously for commercial purpose. The major problem of Tabtimsiam pummelo in the production area, the farmer remains a lot of numbers of fruit per tree, due to the price per fruit are very high. Sometime the number of fruit per tree has shown almost linear relationships to fruit size and fruit quality.

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The objectives of the study were assessed the optimum number of fruits per tree and fruit development, quality at the difference crop load (number of fruit per tree).

Materials and methods

Plant materials

The experiment was conducted in the Mr.Wirat Suksang orchard, Klongnoi sub-district, Pakpanang district, Nakhon Si Thammarat province, Thailand. Five-year–old field-grown Tabtimsiam pummelo trees were used in this study from June, 2013 to July, 2014. Plants under investigation were grown in the same location and were subject to rigorously similar cultural practices.

Treatments

A completely randomized design (CRD) with single tree plots replicated five times was used. The treatments included the difference crop load (number of fruit per tree) at 50, 60, and 70 fruits per tree.

Data recording and analysis

For very mouth were collected fruit weight (g), peel weight(g), pummelo fresh(g), diameter of fruit (cm) and circumference(cm), peel thickness, total soluble solid (^{o}Brix) and titratable acidity (%). The data analysis was used program-R and treatment means were statistically compared using Duncan's Multiple Range Test (DMRT).

Results

Fruit growth and development

The fruit growth and development as indicated of fruit weight, peel weight and pummelo flesh were differences at the 4th months after fruit set to 7.5th month. (Table 1, 2 and 3). The treatment with the lower crop load (50 and 60 fruits per tree) registered a higher fruit weight, peel weight (g) and pummelo flesh than the high crop load treatment (70 fruits per tree). The fruit size in term of fruit diameter and fruit circumference has showed relate to fruit weight, peel weight (g) and pummelo flesh, also the treatment with the lower crop load (50 and 60 fruits per tree) has a higher fruit diameter and fruit circumference than the high crop load treatment [(70 fruits per tree),Table 4 and 5]. The differences crop loads did not effected to the peel thickness after fruit set until to harvested (Table 6).

Fruit quality

The increased crop load from 50 to 70 fruits per tree did not show the significant difference among the treatments, the crop load at 50 60 and 70 fruits per tree has no effect to the fruit quality of pummelo cv. Tubtimsiam. The total soluble solid was increased when the fruit developed from the 1st month to 7.5th months and the titratable acidity has the values deceasing opposite with the total soluble solid when the fruit developed from the 1st month to 7.5th months (Table 7 and 8).

Table 1. Effect of crop load of pummelo cv. Tubtimsiam on fruit weight (g)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	182.95	335.50	824.00	1116.90 [a]	1791.70 [a]	1766.68 [a]	1882.50[a]	1882.30 [a]	1881.68 [a]
60 Fruit	177.02	332.50	801.50	1053.90 [a]	1633.40 [a]	1733.33 [a]	1862.00[a]	1862.50 [a]	1833.33 [a]
70 Fruit	176.17	332.25	771.30	932.40 [b]	1583.30 [b]	1612.50 [b]	1781.25[b]	1782.00 [b]	1782.50 [b]
F-test	ns	ns	ns	*	*	*	*	*	*
CV.(%)	11.13	10.38	13.9	17.91	12.62	14.2	5.67	8.7	14.2

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 2. Effect of crop load of pummelo cv. Tubtimsiam on peel weight (g)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	161.2	236.2	361.8	417.33 [a]	515.00 [a]	487.50 [a]	478.75 [a]	447.50 [a]	440.50 [a]
60 Fruit	162.3	232.0	331.9	390.68 [a]	504.15 [a]	479.18 [a]	445.50 [b]	443.75 [a]	441.18 [a]
70 Fruit	163.0	231.5	307.7	389.58 [b]	435.83 [b]	402.25 [b]	401.55 [b]	402.50 [b]	400.80 [b]
F-test	ns	ns	ns	*	*	*	*	*	*
CV.(%)	12.12	17.75	18.40	14.03	16.84	10.02	16.74	13.19	10.02

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 3. Effect of crop load of pummelo cv. Tubtimsiam on pummelo flesh(g)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	15.80	107.2	457.3	755.80 [a]	1276.7 [a]	1290.0 [a]	1517.5 [a]	1458.8 [a]	1440.0 [a]
60 Fruit	15.02	105.7	440.2	751.90 [a]	1147.5 [a]	1279.1 [a]	1498.7 [b]	1443.8 [a]	1479.1 [a]
70 Fruit	14.92	103.5	431.6	634.70 [b]	1129.2 [b]	1233.3 [b]	1347.2 [b]	1337.5 [b]	1333.3 [b]
F-test	ns	ns	ns	*	*	*	*	*	*
CV.(%)	12.02	12.28	19.41	31.97	22.97	6.59	6.87	10.33	6.59

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 4. Effect of crop load of pummelo cv. Tubtimsiam on fruit diameter (cm)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	6.69	9.77	13.32	14.97 [a]	16.50 [a]	17.10 [a]	18.05 [a]	17.85 [a]	17.10 [a]
60 Fruit	6.45	9.62	12.67	13.62 [a]	16.10 [a]	17.05 [a]	17.92 [a]	17.82 [a]	17.05 [a]
70 Fruit	6.32	9.45	12.65	13.00 [b]	15.85 [b]	16.97 [b]	16.82	16.52 [b]	16.97 [b]
F-test	ns	ns	ns	*	*	*	*	*	*
CV.(%)	4.42	6.01	9.52	9.53	8.67	12.21	3.82	4.38	12.48

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 5. Effect of crop load of pummelo cv. Tubtimsiam on fruit circumference (cm)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	25.17	29.00	41.2	44.9 [a]	51.77 [a]	52.47 [a]	55.37 [a]	54.75 [a]	54.47 [a]
60 Fruit	23.82	27.75	40.27	42.97 [a]	50.07 [a]	52.42 [a]	55.12 [a]	54.75 [a]	54.42 [a]
70 Fruit	23.42	27.34	39.8	41.7 [b]	44.75 [b]	45.15 [b]	46.50 [b]	47.43 [b]	47.50 [b]
F-test	ns	ns	ns	*	*	*	*	*	*
CV.(%)	11.40	16.94	9.96	9.90	8.46	12.12	3.73	14.83	12.18

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 6. Effect of crop load of pummel cv. Tubtimsiam on peel thickness (cm)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	1.30	2.10	2.12	1.40	1.50	1.20	1.05	1.22	1.13
60 Fruit	1.32	2.45	2.27	1.30	1.45	1.35	1.10	1.22	1.11
70 Fruit	1.35	2.34	2.35	1.21	1.27	1.27	1.15	1.22	1.15
F-test	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV.(%)	12.76	11.92	12.98	24.59	14.15	13.35	18.18	11.62	16.35

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 7. Effect of crop load of pummelo cv. Tubtimsiam on total solublesolid (^{o}Brix)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	8.50	9.40	9.95	10.25	10.25	10.50	11.50	11.00	10.50
60 Fruit	8.45	9.23	9.75	10.12	10.15	10.40	11.25	10.82	10.40
70 Fruit	8.20	9.21	9.56	10.00	10.77	10.22	11.00	10.60	10.22
F-test	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV.(%)	12.01	6.92	4.56	10.15	10.60	4.81	4.67	5.13	2.81

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Table 8. Effect of crop load of pummelo cv. Tubtimsiam on titratable acidity (%)

Treatment (Crop load)	Age of fruit (months)								
	1	2	3	4	5	6	6.5	7	7.5
50 Fruit	1.45	1.15	0.92	0.85	0.73	0.62	0.62	0.63	0.63
60 Fruit	1.46	1.15	0.93	0.85	0.75	0.60	0.65	0.69	0.65
70 Fruit	1.43	1.17	0.96	0.82	0.75	0.65	0.65	0.60	0.65
F-test	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV.(%)	15.65	11.94	16.44	9.53	11.83	15.73	15.73	17.59	13.43

Means with the same letter in each column are not significantly different ($p \leq 0.05$) tested by DMRT

Discussion

The fruit growth and development of pummelo var. Tumtimsiam was showed similar in the three crop loads (50 60 and 70 fruits per tree)

after fruit set to the 3th months, with an increase and difference in the fruit growth and development from the 4th months after fruit set until harvest. The treatment of low crop load presented an increase in the fruit growth and development in term of fruit weight, peel weight and pummelo flesh and fruit size in term of fruit diameter and fruit circumference has showed the treatment with the lower crop load registered a higher than the high crop load treatment. In accordance with has been found by various authors (Forshey and Elfving, 1977; Palmer *et al*., 1997; Wünsche *et al*.,2000, 2005; Wright *et a*l., 2006; Embree *et al*.,2007), the increase of crop load lead to lower mean fruit weight and higher proportion of smaller fruit. A increased crop load reduced the proportion of fruit harvested in the Premium size of pummelo var. Tumtimsiam. The Premium size should be has the fruit circumference over than 18 inches or 45.00 centimeters. The Premium size in this study was obtained in the low crop load was showed higher than in the high crop loads (Table 5). The concentration of total soluble solids, no differences were found in all treatments (Table 7), similar to the reported of Nudchanat Phakdee and Peerasak Chaiprasat, 2011, the total soluble solids no effect of crop load on postharvest quality of pummelo cv. Khao Taeng Gua. The titratable acidity was showed did not differences in all treatments of study during fruit growth and development period (Table 8).

Conclusion

This study shows that the crop load at 50 and 60 number of fruits per tree are the optimum crop load of pummelo var. Tabtimsiam at 5-year-old an increase in the fruit growth and development over than crop load at 70 number of fruits per tree. All crop load of this study was showed did not effects to the fruit quality.

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