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Research Article

The Growth, Reproductive and Berry Phenology of Japan Grapes in Tropical Area of Thailand

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ABSTRACT

These studies of the reproductive growth and harvesting index of Japanese grapes cultivars in the tropical area, Chiang Mai, Thailand was carried out at altitude approximately 300 m above sea level. 'New Pione' and 'Gold Bailey A' grape cultivars were planted on the structure as T-shaped and uniform cane under the plastic roof at Division of Pomology, Faculty of Agriculture Production, Maejo University, Chiangmai, Thailand. The two cultivars were adapted to grow on the structure very well in high-temperature conditions. Also of reproduction period was especially for both cultivars that can be harvest 2nd corps per year (grapes in Japan only 1st crop). That both cultivars were not different the period time to promote the bud burst at 7-8 days after pruning and flower at full bloom at 15-21 days after bud burst. For the harvesting index of 'New Pione' cultivar was measure from full bloom to harvesting at berry ripening times were 96 days for the first crop and 97 days in the second crop respectively. While the harvesting index of 'Gold Bailey A' cultivar will be 99 days both first and seconds crops. However, the reproductive of both cultivars showed significantly difference was in both second corps such as 'New Pione' and 'Gold Bailey A' cultivar shown that in the second season was higher cluster weight, berry number, berry length, and total soluble solid than the first season and titratable acids in the second season was lower than the first season. For 'Gold Bailey A' cultivar shown that Therefore, this study demonstrates the possibility of producing more than one crop per year in tropical areas.

Keywords: New Pione, Gold Bailey A, T-shaped training, two times harvesting

INTRODUCTION

Grapes are one of the most important and famous in the world. Most grapes are cultivated in the temperate area [2], nowadays grape was distributing to sub-tropical and also in the tropical area more than 94 countries, and the total global production of grapes is over 67 million tons [1]. Therefore, in viticulture, the chilling requirement for bud break or bud burst is satisfied by low exposure of the buds to low temperatures [3]. Nevertheless, in subtropical and tropical areas, not enough chilling unit there will be leads to delayed and erratic bud burst [4]. Therefore, grapes are usually grown in high-altitude areas, and this is a major impediment to their economical production. Furthermore, apical dominance, low soil fertility, and susceptibility to fungal diseases restrict the production of grapes in sub-tropical and tropical areas. Currently, the discovery of numerous

dormancy-breaking agents and methods as well as the development of heat-resistant species and the use of grafting on rootstock have enabled the production of grapes with high adaptability to environmental conditions, high productivity, and high disease resistance. Therefore, in recent decades, grape cultivation areas have increased between the tropics and in adjacent areas of the sub- tropics [5-6].

Although grape growth is continuous in tropical areas compared with temperate regions, achieving highly effective control of nutrition, tree vigor, diseases, and insect pests are significant challenges in viticulture [7]. Canopy management influences many aspects of grape growth, productivity, and fruit quality.

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Several studies have determined that canopy management techniques (such as those related to vine spacing, vine vigor and tolerant, and also leaf removal) [8, 9] and improved training systems can be used to change the microclimate (i.e., the amount of sunlight, temperature, humidity, evaporation, and wind speed) for improving the berry quality and reducing disease incidence [8; 10; 11; 12].

In Thailand, the grape cultivation areas are 4,500 ha, and the annual grape production exceeds 80,000 t [1]. In most of the traditional grape-growing areas, vines have been trained on overhead arbors by using trellis-training systems. However, recent studies have shown that mismanagement increases the incidence of diseases and insect pests in addition to reducing berry quality [9-10], leading to an increase in labor intensity and management costs. Moreover, in tropical areas, grapes are evergreen, and vines are grown continuously to sustain high growth rates; therefore, the vines often show reduced productivity or become unproductive after a few years [5]. The preceding discussion indicates the necessity of improved canopy management techniques for manipulating vine vigor and canopy structure in a vineyard. In this study, 'New Pione' and 'Gold Bailey A' cultivars were used for evaluating new training "fishbone systems" with T-shaped for grape cultivation in the tropical zone (Figure 1).

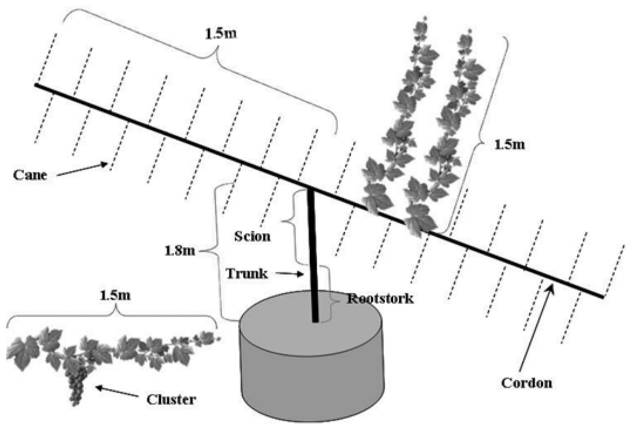
MATERIALS AND METHODS

This study was conducted in an experimental plastic-covered tunnel (Plastic roof), which is particularly suitable for the forcing culture of table grapes in vineyards; the vineyards were covered with plastic films to prevent rain and dew from adversely affecting the produce in the wet and winter season. Therefore, it was possible to have two crop cycles per year through controlled can pruning (for production). The current study site was located at an altitude lower than 300 m above sea level at Division of Pomology, Faculty of Agricultural Production, Maejo University, Chiang Mai province, Thailand, which is located in northern Thailand. Its geographical coordinates are 18.894457°N and 99.016123°E. The new training systems were evaluated for two successive growing seasons during the planting period extending from September 2014 to November 2015. The plants considered were 'New Pione' grape cultivar (4x-Muscat of Alexandria and a tetraploid hybrid of Kyoho) and 'Gold Bailey A' (a hybrid with a mixed genetic heritage, created by crossing Muscat of Hamburg with Bailey), and both were grafted onto 'Couderc' rootstock (air-layering propagation). The vines were individually planted in 200L concrete pots. A sub-state was mixed consisting of loam soil, sand, rice hulls, and cow manure (2:2:2:1 in volume) was used, and the vines were trained using T-shaped training (Figure 1). Moreover, the dimensions of the training space were 3 m (between rows) × 3 m (between vine) × 1.8 m (height of structure) (3 m × 3 m = 9 m2/vine), and approximately 40 canes were used per vine in the aforementioned spacing. Canopy management practices were imposed either singly or in different combinations. Irrigation management involved watering with mini sprinkler each pot with 15L of water twice a week and applying 5L of hydroponic liquid fertilizer per pot once a week. (A 100L of the hydroponic liquid fertilizer consisted of 60 g KNO3, 118 g Ca(NO3)2·4H2O, 49.2 g MgSO4·5H2O, 15 g NH4H2PO4, 3 g EDTA-Fe, 0.5 g H3BO3, 0.3 g MnSO4·5H2O, 22 mg ZnSO4·7H2O, 5 mg CuSO4·5H2O, and 0.5 mg Na2MoO4·2H2O).

For include to break dormancy after two weeks was donning the water stress (stop water two weeks), and the canes were pruned and remind the bud spurs approximately five buds. Subsequently, to control the bursting of dormant buds, a combination of leaf removal, 2.5% of hydrogen cyanamide was spraying, and watering immediately on the roots after spay hydrogen cyanamide to presence buds burning. Furthermore, one week after budburst, bunches were manually removed, and three new shoots as the most vigorous bunches were left on each cane. The panicles (2–3 cm) were treated with 3 mg L−1 of gibberellic acid (GA3) to extend the cluster elongation, and berry thinned one cluster per shoot. (keeping about two shoots per cane)

Moreover, after fruit set 1 and 10 days (after full bloom), the young clusters were treated with 25 mg/l of GA3 solution twice the time for berry enlargement. Three days after full bloom, 4-mm-wide berries were obtained. Berries were thinned for 1–2 weeks after full bloom, and 40–50 berries were obtained per cluster. The second crop was planted two weeks after harvest. To studies, the berries' growth at different developmental stages, an experiment involving two species, six replicates, and one vine canopy per replicate were designed. The treatments were completely randomized design (CRD) throughout the experimental unit, and each replicate was used for data collection. In addition, measurements were conducted every ten days from 5 days after full bloom until berry ripping and harvesting time.

FIGURES 1: Schematic Of The Canopy “Fishbone Training System” On T-Shaped.



Cluster and berry were samplings, measuring, and analyzing. The number of canes per vine and the cluster weight were obtained by measuring the individual yield of all canopy and cane in each experimental unit, and they were used to estimate the yield. In addition, 45 berries with five replications showing average growth and maturation were sampled from each vine at full ripeness (16 °Brix up). The sampled berries of each vine were randomly divided into three groups as replications for measuring the mean berry weight, berry length, and berry diameters (in millimeters). The skins of all samples were immediately peeled by hand, and the samples were

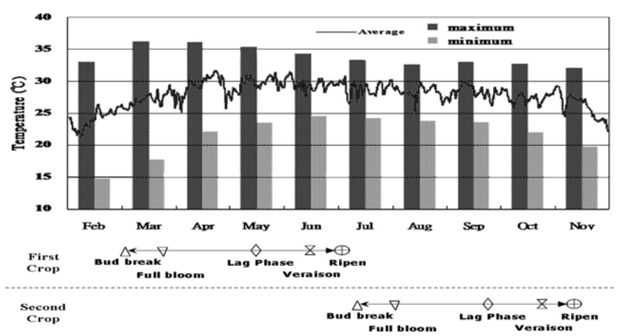
stored at 5 °C for anthocyanin analyses. Anthocyanins were extracted from 0.5 g of the frozen skin samples by using 25 mL of 50% acetic acid three times for 5 min. The optical density at 530 nm was determined using a spectrophotometer (Hitachi U-1500). The flesh filtrate was used to obtain juice samples. The total soluble solids and titratable acidity (TA) in the juice samples were determined using an ATAGO Digital Brix Refractometer (°Brix) and through titration with 0.1 N NaOH, respectively.

Complete randomized design with three replicates (three vines per replication) was used in the experiment. Each experimental unit comprised nine vines. Analysis of variance was conducted using SAS (version 9.1; SAS Institute, Cary, NC).

TABLE 1: Comparison Of Harvesting Index In A Different Season Of 'New Pione' And 'Gold Bailey A' Grapes Cultivars

Cultivar	Cane Pruning	Bud-Burst	Full Bloom	Veraison Stage	Lag Phase	Harvest Time	Harvesting Index (day)
'New Pione'	26/ Feb.	5/Mar.	26/ Mar.	1-May	1/Jun.	28/ Jun.	96
	3-Jul	12-Jul	27-Jul	29/ Aug.	27/ Sep.	5/Nov.	97
Muscat Bailey A	26/ Feb.	8/Mar.	29/ Mar.	28/ Apr.	11/ Jun.	3-Jul	99
	8-Jul	16-Jul	30-Jul	27/ Aug.	2/Oct.	11/ Nov.	99

FIGURES 2: Comparison of The Active Temperatures and Reproductive Growth Between Two Successive Growing Seasons During the Harvesting Index Investigation.



Studies on berry development of 'New Pione' and 'Gold Bailey A cultivars: Changes in the longitudinal and transverse diameters of the grape berries are shown in Figure 3. Both species are expected to show a double-sigmoid curve, and the results obtained are consistent with those of Keller [16]. Grape berries advance through several distinct stages of development during their growth, and their development sequence is as follows: rapid berry growth, lag phase, second rapid berry growth, and fruit ripening. Nevertheless, the second rapid berry growth was not quite obvious compared with general berry growth in temperate zones. The causes of slow berry growth are unknown, but they probably include environmental conditions and the extensibility of the berry cells [15].

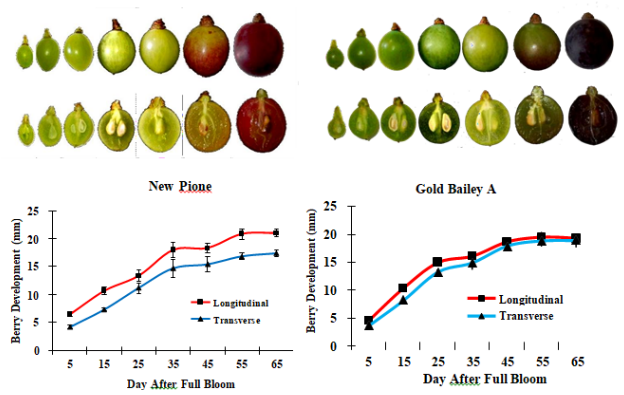


TABLE 2: Cluster Weight (Cw), Berry Number (Bn), Berry Length (Bl), Berry Diameter (Bd), Total Soluble Solids (Tss), Titratable Acids (Ta), And Anthocyanins In 'New Pione' And 'Gold Bailey A' Grape Cultivar During Two Successive Seasons.

Season	Cultivar	CW (g)	NF (berry)	BL (mm)	BD (mm)	TSS (°Brix)	TA (g 100m l−1)	Anthocyanins (nm)
	New Pione	179.9 b	42b	21.5b	18.3	15.1b	3.0b	0.3b
First								
	Gold Bailey A	210.4 a	45a	19.8d	18.7	16.4a	4.1a	1.5a
	New Pione	197.2 a	47a	23.3a	18.2	17.0a	2.9c	0.3b
Second								
	Gold Bailey A	216.8 a	46a	20.2c	18.8	17.4a	4.0a	1.6a
F-test		*	*	**	ns	*	*	**
LSD		38.2	4	1.04	0.93	2.3	1	0.373

Explanation: Means followed by the same letter are significantly different at **= P ≤ 0.01, * = P ≤ 0.05 and ns = no significantly different.

CONCLUSIONS

The phenology of grape is highly determined by the weather. These studies demonstrate the grape growth is continuous in tropical areas will grow faster when compared with temperate areas. Furthermore, experimental indicate that using the plastic-covered tunnel is particularly suitable for the forcing culture of table grapes; it helps to control water stress and pruning time for grow these varieties of grapes throughout the year in tropical zones. Otherwise, the canopy management T- shaped with “fishbone system” influences many aspects of grape growth, uniform cane, productivity, and berry quality the statistical analysis showed significant differences in cluster weight, berry number, berry length and berry quality between two successive growing seasons by using a T-shaped Training system in tropical areas. The results of this study are expected to contribute to the improvement of the management of vine protected culture in tropical zones. The temperature also was be effected for berry quality, especially the second season that berry was be ripening or harvesting time in cool time. However, the results of this study are expected to contribute to the improvement and success of the management and cultivation of two crops per year of two cultivars of Japanese grape in the tropical area of Thailand.

RESULTS AND DISCUSSION

Comparison of the reproductive of ‘New Pione’ and ‘Gold Bailey A’ grapes cultivars. T-shaped training system. In the present investigation, two growing cycles (from the pruning of the first crop to berry ripening of the second crop) of two species were subdivided into five distinct phenological stages (Table 1). In addition, of reproduction period was especially for both cultivars that can be harvest 2nd crops per year. The data were indicated that the first crop of ‘New Pione’ cultivars took about 122 days from cane pruning to berry ripening, and the second crop took about 131 days. For the cultivar of ‘Gold Bailey A’, shown the numbers of days were 127 and 137, respectively. That both cultivars were not different from the period time to promoted of budburst at 7-8 days after pruning and flower at full bloom at 15-21 days after bud burst, for the harvesting index of ‘New Pione’ cultivar was measure from full bloom to harvesting at berry ripening times were 96 days for the first crop and 97 days in the second crops respectively. While the harvesting index of ‘Gold Bailey A’ cultivar will be 99 days both first and seconds crops (Table 1). However, the reproductive of both cultivars showed no significant difference was in both second corps. Meteorological parameters are among the most crucial factors influencing phenological changes in vine [13-14]. Therefore, a comparison of the effective temperatures and phenological observations from bud burst to berry ripening between seasons (Figure 2) revealed that both phenological cycles did not exhibit any differences in the development phase. Moreover, the average temperature of meteorological parameters was determined to be between 25 and 30 °C for two growth seasons in 2015, and the daily minimum temperature was seldom lower than 15°C. Dokoozlian reported that the optimal temperature for berry growth was between 20 and 25 °C and that temperatures exceeding 35 °C reduced the growth rate [15]. At optimal temperatures, the vines were evergreen and grew rapidly and continuously in the study area. The average sums of active temperatures of the two seasons were 3526 and 3549 °C for ‘New Pione’ cultivar and 3674 and 3577 °C for ‘Gold Bailey A’ grape (data not are shown). Similar results were obtained in the study reported in [14]. The vine phenology, similar to many other species, is substantially determined by the temperature.

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