STEM PROPAGATION OF NEW ORNAMENTAL PINEAPPLE HYBRID (OC5) FOR LANDSCAPING

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ABSTRACT

Pineapple (Ananas comosus) as ornamental use has increased in popularity in recent years and has been generating demand due to the exotic and colorful aspects of its small fruits. In RMK10 (2011-2015) OC5 hybrid was selected as a potential ornamental plant for the horticultural landscape. OC5 hybrid was derived from the crossing between the local variety 'Josapine' with two 'piping-leaf' varieties (53-116 and 59-656). In RMK11 (2016-2020), the study on OC5 pineapple hybrid was continued on the propagation aspect. Therefore, in the present study, the objective was to examine the best propagation technique using stems. The study was carried out under 50% shaded shelter at Flower and Orchid Complex, MARDI, Serdang, Selangor. Irrigation was applied daily. There were three techniques of stem propagation (T1: Quartering, T2: Stem sectioning, and T3: quartering and sectioning). The treatments were laid out in Randomized Complete Block Design and replicated seven times to make 21 observational plots altogether. Measured variables included a number of days when buds appeared, number of buds, number of buds survived, survival rate, number of days for buds to produce new leaves (plantlet), plantlet height, plantlet leaf number, and number of days for plantlets ready to be transplanted. The results revealed that number of buds showed a significant difference among treatments while other parameters did not show any significant difference. T1 (20), which was a quartering technique, and T2 (15), sectioning technique showed a higher number of buds, compared to T3 (6). Therefore, recommended technique from this study is stem quartering and stem sectioning technique which produced the higher number of buds.

Key words: Ornamental pineapple, stem propagation, landscape, quartering, sectioning

INTRODUCTION

Ananas comosus (Bromeliaceae) is an extremely important edible fruit in tropical and subtropical regions. In 2005, the world production of pineapple exceeded 16 million tons, accounting for the largest part of the world's export in tropical fruits (Heywood *et al*., 2011). Pineapple is the six most economically exploited tropical fruit in the world (Maita Eulalia Avila *et al.*, 2017). The genus Ananas has been explored for other potential uses such as fiber, used in the automotive industry, paper, and also a great ornamental plant (Everton Hillo *et al.*, 2012). Pineapple has strong potential to become an ornamental and landscape plant especially in a tropical hot climate country such as Malaysia. The uniqueness of its vegetative and reproductive morphological characteristics and hardy plant character makes pineapple suitable for outdoor decoration and landscaping. In the Tenth Malaysia National Plan, pineapple OC5 progeny has been selected as a potential ornamental plant for the horticulture landscape. The progeny was produced from hybridization between a local variety, 'Josapine' with genotype 'piping-leaf' (53-116 and 59-656). The bright red syncarp/ inflorescence of the OC5 are the major attraction of this new breeding line ornamental pineapple. Its attractive floret-like plant architecture makes it ideal for growing in pots as an ornamental plant for open area or patio decoration. OC5 plants are easy to grow, maintain and manageable which is also an important role to be considered for landscaping.

Expansion of ornamental pineapple cultivation is limited due to lack of sufficient planting materials. Production of proper materials is crucial as the performance of plants developed depend on material planted. Ornamental pineapple is commonly propagated from suckers or slips (Ranawana and Eeswara, 2008). Basal suckers arising from underground parts of the plant are commonly used. Slips arise from the fruiting stem and stem suckers arise from the stem. The crown which is on the top of the fruits also can be used. The time taken for the fruits initiation is depending on the type of planting material. Plants grown from basal suckers produce fruits in about 12-14months, whereas those from stem sucker about 16-18 months. Crown will take over two years to produce fruits (Anonymous, 2000). Both suckers and slips, larger planting material resulted in more vigorous plants. Mass propagation of ornamental pineapple is possible through tissue cultural techniques under in-vitro conditions but tissue culture propagation is not

popular because there is no sustainable demand for such material due to the small size of holding and irregular planting periods (Heekenda, 1993). In addition, propagation via tissue cultures is very costly.

There is an alternative mass propagation technique for ornamental pineapple using stem cuttings under in vivo conditions. Stem quartering and sectioning can be used for this purpose. The similar study has been conducted by Weerasinghe and Siriwardana (2006) and resulted 1000 plantlets in 16 months from single mother plant after several multiplication cycles. Therefore, this research was undertaken to evaluate the possibility of multiplying pineapple by using stem cutting under in vivo conditions with different cutting technique.

MATERIALS AND METHODS

The design of the experiment was a randomized complete block design (RCBD). The treatments were replicated seven times to make 21 observational plots altogether. This study was conducted under 50% shaded condition at the Flower and Orchid Complex. There were three techniques of stem cutting (T1: Stem quartering, T2: stem sectioning, and T3: quartering and sectioning). The experiment was set up on 3rd April 2019. Irrigation was applied by using drip daily.

Treatment

Stem cutting

T1: stem quartering

-The stem was cut horizontally into four segments

T2: Stem sectioning

-The stem was cut vertically into 5.08cm thickness

T3: Quartering and sectioning

-The stem was cut horizontally into four segments then each segment was cut into 5.08cm thickness vertically

Measurement

Number of days to axillary buds emergence

The number of days to axillary buds emergence was count when the first bud appears at the cutting.

Number of axillary buds and number of axillary buds survived

Numbers of axillary buds were observed every day and were count until the bud died or survive which produce the new leaves (sprouting).

Number of days on sprouting axillary buds

It was count when the bud produces two true leaves. At this stage, the bud was call as plantlets.

Survival rate (%)

The survival rate was calculated using the equation below:

$$\text{Survival rate (\%)} = \frac{\text{Number of buds survived} \times 100}{\text{Number of buds}}$$

Plantlets height (cm)

Plantlets' height was measured with a steel ruler from the base of the plantlet to the highest shoot. It was recorded every two weeks until the plantlets were transferred to the pot.

Plantlets leaf number and number of days for plantlets ready to be transplanted (8-10cm in height with 10-15 number of leaves)

Plantlets leaf number was count every two weeks and the number of days for plantlets ready to be transplanted was count when the bud produces two true leaves until the plantlet ready to transfer to the pot.

Data analysis

Data on the effect of technique type were analyzed by analysis of variance (ANOVA) using SAS software Analysis of variance (ANOVA) version 9.4. The differences among means were compared by the least significant difference (LSD).

RESULT

Number of days when axillary buds emergence, number of axillary buds and number of axillary buds survive

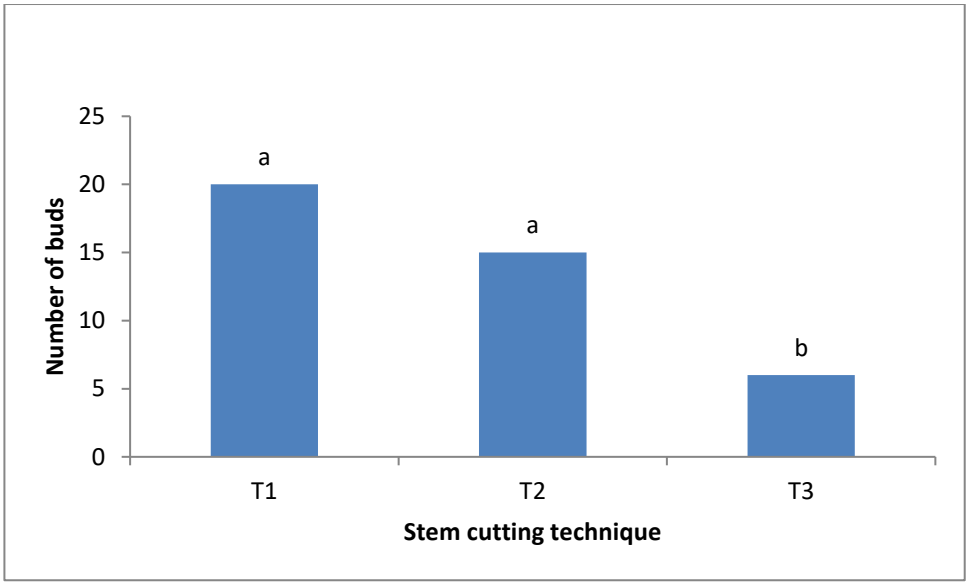
Analysis of variance for the number of buds indicated significant differences ($p<0.05$) among stem cutting technique while the number of days when buds appeared and the number of buds survived did not show a significant difference ($p>0.05$) (Table 1). The number of days when buds appeared ranged from 11 to 12 days and the number of buds survived ranged from 6 to 13 among stem cutting techniques. Stem quartering (20) and stem sectioning technique (15) has significantly given a higher number of buds compared to quartering and sectioning (6) technique (Fig 3).

TABLE 1: Number of days when axillary buds emergence, the number of axillary buds and number of axillary buds survived

Treatment	Number of days when buds appeared	Number of buds	Number of buds survived
Stem cutting technique			
Stem quartering (T1)	11a	20a	13a
Stem sectioning (T2)	11a	15a	13a
Quartering and sectioning (T3)	12a	6b	6a
Significant level	ns	***	ns

The number of days when buds appeared, the number of buds, and the number of buds survived followed by the same letter are not significantly different among stem cutting techniques, *p<0.05: **p< 0.05. ns: not significant

Fig 3: Mean number of buds



Mean with different letter for each density was significantly different at $p<0.001$.

Number of days for axillary buds to produce new leaves (plantlets) and survival rate (%)

All three types of stem cutting did not show a significant difference ($p>0.05$) in the number of days for buds to produce new leaves (plantlets) and survival rate (%) (Table 2). The number of days for buds to produce new leaves (plantlets) ranged from 19 to 23 days while the survival rate ranged from 68.88% to 98.5%.

TABLE 2: Number of days for buds to produce new leaves (plantlets) and survival rate.

Treatment	Number of days for buds to produce new leaves (plantlets)	Survival rate (%)
Stem cutting technique		
Stem quartering (T1)	19a	98.5a
Stem sectioning (T2)	21a	86.16a
Quartering and sectioning (T3)	23a	68.88a
Significant level	ns	ns

The number of days for buds to produce new leaves (plantlets) and survival rate followed by the same letter are not significantly different among stem cutting techniques,*p<0.05:**p< 0.05. ns: not significant

Plantlets height and plantlets leaf number

Analysis of variance for plantlets height and plantlets leaf number indicated significant differences (p<0.01) at every two weeks but not significant differences (p<0.01) among stem cutting techniques (Table 3). The interaction was not significant (p<0.01) between the stem cutting technique and week thus, the result will focus on the main effects of each factor. Plantlets' height ranged from 2.64 to 2.89 cm while the plantlets leaf number ranged from 6 to 7.

TABLE 3: Mean plantlets height and plantlets leaf number

Treatment	Plantlets height (cm)	Plantlets leaf number
Stem cutting technique		
Stem quartering (T1)	2.64a	6a
Stem sectioning (T2)	2.76a	6a
Quartering and sectioning (T3)	2.89a	7a
Week		
W2	0.85e	0d
W4	1.9d	4c
W6	2.43dc	6b
W8	2.77c	7b
W10	3.85b	10a
W12	4.79a	11a
Significant level		
Stem propagation technique (T)	ns	ns
Week (W)	***	***
T x W	ns	ns

Plantlets' height and plantlets leaf number followed by the same letter are not significantly different among stem cutting technique and week, *p<0.05:**p< 0.05. ns: not significant

Fig. 4 shows the linear response of plantlets height from week 2 until 12 weeks after sowing (WAS) and Fig. 5 shows the linear response of plantlets leaf number to increasing age for the entire stem cutting technique tested. Plantlets height significantly increased from 0.85cm on week 2 to 4.79cm on week 12. Plantlets leaf number significantly increased from 0 at week 2 to 11 in week 12.

Fig 4: Increment plantlets height at every two weeks until transplanted

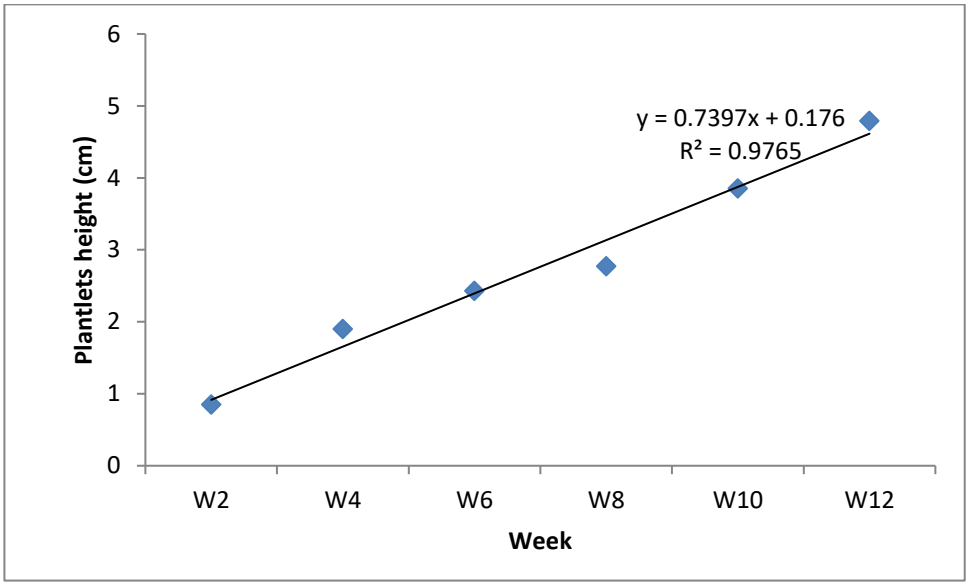
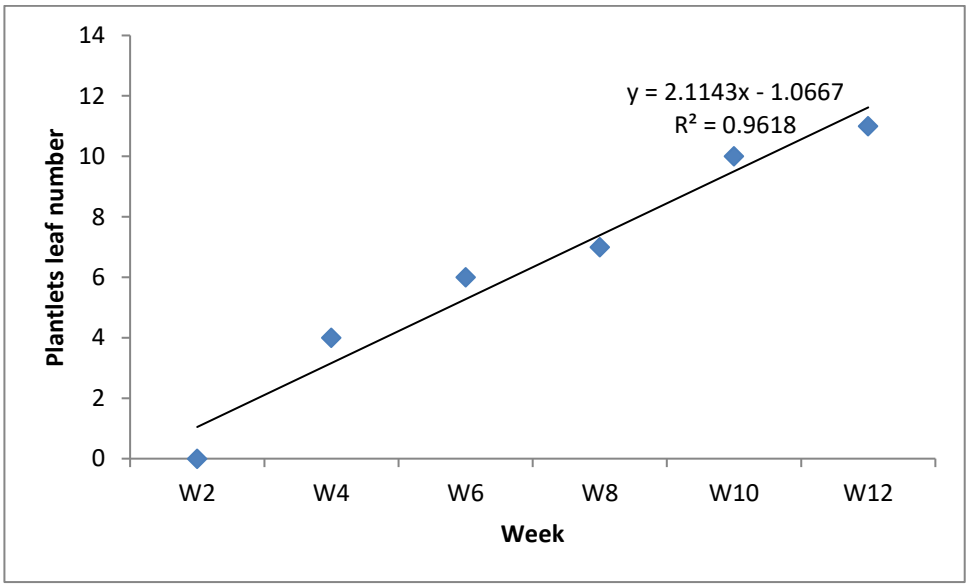


Fig 5: Increment plantlets leaf number at every two weeks until transplanted



Correlation coefficients between plantlets height and plantlets leaf number

In order to determine the relationship between plantlets' height and plantlets leaf number, the correlation between plantlets height and plantlets leaf number was analyzed. There was a significant positive correlation between plantlets height and plantlets leaf number (Table 4). This indicated that when plantlets height increased plantlet leaf numbers also increased.

TABLE 4: Correlation coefficient between plantlets height and plantlets leaf number

	Plantlets height (cm)	Plantlets leaf number
Plantlets height (cm)	--	0.8643***
Plantlets leaf number	0.8643***	--

***Significant at p <0.001

Number of days for plantlets ready to be transplanted

Plantlet were set to be transplanted at 10cm in height with 10 to 15 leaves. Stem quartering, stem sectioning and quartering and sectioning were 57, 55 and 65 respectively which were not significantly different (Table 5). Mariana and Van de venter. (1988), also reported that first generation of plant were removed 65 days after planting.

TABLE 5: Number of days for plantlets ready to be transplanted

Treatment	Number of days for plantlets ready to be transplanted
Stem cutting technique	
Stem quartering (T1)	57a
Stem sectioning (T2)	55a
Quartering and sectioning (T3)	65a
Significant level	ns

Number of days for plantlets ready to be transplanted followed by the same letter is not significantly different among stem cutting technique, *p<0.05: ns: not significant

The correlation coefficient between the number of days for buds to produce new leaves (plantlets) and number of days for plantlets ready to be transplanted

In order to determine the relationship between the number of days for buds to produce new leaves (plantlets) and a number of days for plantlets ready to be transplanted, the correlation between the number of days for buds to produce new leaves (plantlets) and the number of days for plantlets ready to be transplanted was analyzed. There was a significant positive correlation between the number of days for buds to produce new leaves (plantlets) and the number of days for plantlets ready to be transplanted (Table 6). This indicated that when the number of days for buds to produce new leaves (plantlets) increased the number of days for plantlets ready to be transplanted also increased.

TABLE 6: Correlation coefficient between the number of days for buds to produce new leaves (plantlets) and number of days for plantlets ready to be transplanted

	Number of days for buds to produce new leaves (plantlets)	Number of days for plantlets ready to be transplanted
Number of days for buds to produce new leaves (plantlets)	--	0.7042**
Number of days for plantlets ready to be transplanted	0.7042**	--

***Significant at p <0.05

DISCUSSION

Pineapple plants are usually propagated using vegetative planting material. There is a wide variety of types of vegetative material and both cultivar and environment affect the availability and quality of material used to plant commercial fields. The common types of material produced naturally by the plants, also referred to as conventional planting material, include: a) Crowns from the top of the fruit; b) Slips from the peduncle directly below the fruit (these pieces usually have a rudimentary (vestigial) fruit or knob at their base); c) Hapas, which develop in the transition zone between the stem and the peduncle (Py et al., 1984); d) Suckers, which originate several to many below the stem-peduncle transition zone (Domingo et.al, 2018). Advance in vivo methods such as stem sectioning, stem quartering and crown leaf budding are not commonly use in Malaysia. Among in vivo methods, the leaf-bud method seems to be more efficient in producing higher numbers of propagules. However, this method has drawbacks in that it is tedious, requires skill in trimming the leaf buds, and cannot be used on crowns of fresh fruits because the crown is an important accessory of the fruit. In addition, this method requires a much longer period for establishing plantlets than the other in vivo methods, e.g., the leaf-bud method takes about 6 months (Seow and Wee, 1970; Kotalawala, 1971). The propagation using stem simpler because it not highly technical and does not require specialised skills. It is also very cost effective and can be used to produce large scale uniform material in a relatively short period of time (Adelaja. 2000).

Macluskie (1939) propagated about five plants per piece by longitudinally dividing stems into quarter slices. Kotalawala (1971) produced 15 plantlets on a 30 cm stem or 24 plantlets on a 60 cm long stem using the stem-disc method (where the stems were transversely cut into disks of about 2.5 cm thick). Heenkenda (1993) propagated about four suckers per plant by decapitating the apical bud of plants. In this research, number of axillary bud by using stem stem quartering (20) and stem sectioning technique (15) has significantly given a higher number of buds compared to quartering and sectioning (6) technique. This may be due to bigger stem pieces by using stem quartering and stem sectioning (5.08cm) compared to combination of quartering and sectioning technique. Bigger stem pieces contain sufficient natural phytohormones and food reserved (Ranawana and Eeswara, 2008) for optimal growth of bud.

Other parameter which were number of buds survived and survival rate even though not significantly difference also showed a higher number at stem quartering and stem sectioning technique compared to combination of quartering and sectioning technique. Thus, the stem propagation by using stem quartering or stem sectioning was highly recommended. The method requires no skill labour, no chemical treatments, low cost and will increase number of planting material in short time.

CONCLUSION

The recommended technique from this study is stem quartering and stem sectioning technique which produced the higher number of buds.

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