NEW TECHNOLOGY FOR MASS PROPAGATION MD2 PINEAPPLE PLANTING MATERIAL IN MALAYSIA

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ABSTRACT

Pineapple has been identified as a new source of wealth. Pineapple variety MD2 is currently the most popular variety where it is being traded globally mainly due to its excellent taste, sweetness, attractive golden flesh with golden skin color and its perfect cylindrical shape. While the pineapple industry is growing rapidly, there is a big issue which is critical supply shortage of MD2 pineapple planting material. This issue occurs due to very high demand for the planting materials to expand MD2 pineapple farms. Current available research for pineapple propagation techniques are still unable to solve the shortage of MD2 pineapple planting material beside tissue culture technique. MD2 pineapple were originally developed in Hawaii and were initially imported to Malaysia from Philippines using tissue culture planting material. This resulted in various 'forms' of MD2 with fruit shapes ranging from cylindrical to conical and fruits with multiple crowns due to somaclonal variation. Studies have been carried out with the objective to determine new MD2 pineapple propagation technique and system capable of producing mass true-to-type planting materials in a short time without being influenced by global climate changes. Results show that crown leaf budding and stem sectioning are the best techniques for producing 30-50 planting materials from one motherplant with success rates at 95-100% and 93-95%, respectively. The best media in the system for these two techniques show layering sand:peatmoss is the best planting media with success rates of 95-100% and 90-95%, respectively. Therefore, two technologies which are crown leaf budding in closed self-watering propagation chamber system and stem sectioning in open self-watering propagation system

have been developed that may address the supply shortage of MD2 pineapple planting materials in Malaysia as well as to produce true-to-type MD2 pineapple.

Keywords: MD2, planting material, propagation technique, self-watering system, chamber

INTRODUCTION

Pineapple is one of the most popular tropical fruits in the world. Pineapple variety MD2 is currently the most popular variety where it is being traded globally mainly due to its excellent taste, sweetness, attractive golden flesh with golden skin color and its perfect cylindrical shape. In Malaysia, pineapple industry is one of the biggest industry in agriculture but due to climate change and high demand of planting materials to support the rapid expanding rate of pineapple plantation causing critical shortage of MD2 planting materials. According to Malaysia Pineapple Industrial Board, in 2020, Malaysia must expand pineapple plantation until 23,000 thousand hectares to meet the demand of fresh MD2 fruit for local and export market about 700,000MT. Current situation of Malaysia pineapple industry, for local and export market fresh fruit supply, we still have shortage about 308,286MT which approximately another 10,000 hectares MD2 pineapple should be planted and it means 414 million MD2 pineapple planting materials need to meet the national required.

MD2 pineapple were originally developed in Hawaii and were initially imported to Malaysia from Philippines using tissue culture planting material. From previous study, tissue culture technique for MD2 pineapple resulted in various 'forms' of MD2 with fruit shapes ranging from cylindrical to conical and fruits with multiple crowns due to somaclonal variation (Noor Baiti,2017). In addition, the planting materials of MD2 are expensive costing RM 2.00 each. Therefore, planting material costs alone may reach up to RM 80,000 for a one-hectare production (40,000 plants per hectare). Moreover, these off-type fruits fetch low prices and cannot be exported, resulting in significant financial losses to farmers. Surveys done at local commercial farms showed that 40-50% of MD2 fruits are conical in shape instead of cylindrical using tissue culture planting materials (Norsyuhaida,2014). Therefore, it is really crucial to develop new technique that can produce 100% true-to-type MD2 pineapple.

According to the Malaysian Pineapple Industry Board (MPIB), 70 million pineapple planting materials are required each year to ensure global competitiveness in pineapple production especially for MD2 variety. However, existing propagation techniques can only produce 3-4 planting materials from a single mother plant, sufficient only for replanting and expansion of existing farms (Rosimah,2017). In Malaysia, various pineapple propagation techniques have been applied such as tissue culture, vegetative propagation and hormone induction to produce multiple planting materials from a single plant. Each technique has its own advantages and disadvantages. For example, while tissue culture can mass produce planting materials, this technique is expensive with initial costs to set up laboratories, purchasing of various chemicals and developing technical skills combined with problems of somaclonal variation. Currently, more than three quarters of the industrial players in the Malaysian pineapple industry are smallholder farmers. Therefore, the development of a low-cost technique while still able to mass produce planting materials in a short period of time without somaclonal variation is crucial. Besides that, local climatic changes such as extended periods of dry and rainy season also affect the existing production system of planting materials. Therefore, the objective of this study is to determine new MD2 pineapple propagation technique and system capable of producing mass true-to-type planting materials in a short time without being influenced by global climate changes.

MATERIALS AND METHODS

1) Development of closed and opened MD2 pineapple mass propagation systems with costing.
2) Comparison of different propagation techniques of MD2 pineapple planting materials.
3) Comparison of different propagation media of MD2 pineapple planting materials.
4) Development of standard operating procedures for disease-free propagation systems.

RESULTS AND DISCUSSION

Techniques that showed a high percentage of success rate were crown leaf budding in closed system, quartering in closed system, quartering in opened system and stem sectioning in opened system with 98-100%, 93-95% 90-93% and 93-95% success rate, respectively (Table 1). However, the best techniques are also selected based on the number of planting materials that can be produced from one motherplant because our objective was to determine technique that can mass propagate planting materials. Therefore, the crown leaf budding in closed system and stem sectioning in opened system were determined as the best techniques with a high success rate and high number of planting materials produced from one motherplant.

Table 1. Number of planting materials per motherplant and success rate using different propagation techniques

Technique	No. of planting materials	Success rate (%)
Crown leaf budding in closed system	**30-50**	**98-100**
Quartering in closed system	4-6	93-95
Stem sectioning in closed system	30-50	60-70
Crown leaf budding in opened system	30-50	80-83
Quartering in opened system	4-6	90-93
Stem sectioning in opened system	**30-50**	**93-95**

Four types of media were examined to obtain the best planting media in the system for crown leaf budding (CLB) technique and stem sectioning (SS) technique. Based on Table 2, layering sand:peatmoss media showed a high success rate of 95-100% for crown leaf budding in closed self-watering propagation chamber technique and a success rate of 90-95% for stem sectioning in open self-watering propagation system. Low success rates, 15-25% were observed in peatmoss due to high humidity which caused fungal contamination. Contaminated planting materials died even before it could germinate on the media. The purpose of the media study was to determine media that not or have minimal influenced by climate change.

Table 2. Success rate of crown leaf budding technique and stem sectioning using different planting media

Media	CLB[1] success rate (%)	SS[2] success rate (%)
Layering sand:peatmoss	**95-100**	**90-95**
Soil:sand:peatmoss	85-90	70-80
Soil	75-85	65-75
Peatmoss	35-45	15-25

[1]CLB: Crown leaf budding; [2]SS: Stem sectioning

Both techniques crown leaf budding in closed system and stem sectioning in opened system, have their own advantages and disadvantages. Therefore, the comparison of production cost of each technique may facilitate the recommendation to producers or specific target groups based on their financial capabilities (Table 3). The closed self-watering propagation chamber system is a technology that uses MD2 pineapple crown as source of planting material. This system is expensive because it requires a specific chamber to control the environmental system. The success rate is high. However, training is required to operate the system due to its high skill requirement. The system can be operated by any gender. Moreover, a small work space is required, and it can produce a high number of planting material (10,000 suckers/20 sqft) because the size of the crown leaf is smaller compared to stem section. Meanwhile, the opened self-watering propagation system is a technology developed for producers with low financial capabilities. Even though this system has lower success rate compared to the crown leaf budding system, the skill requirement is medium rate and it is easy to implement. However, the system is more suitable for male workers because it requires high energy consumption. Work space is twice as large as the crown leaf budding system due to the large utilization of planting materials and wider planting distance used. From all the result we determined, we meet the objective to determine new MD2 pineapple propagation technique and system capable of producing mass true-to-type planting materials in a short time without being influenced by global climate changes. These new technique and system solved all issues and finding from previous research such as somaclonal variation occurs from tissue culture technique while with these technology, it will be 100% true-to-type because of vegetative propagation. Crucial shortage of planting materials also solved by mass production of planting material around 30-50 planting materials that can obtain from one motherplant compare to previous study that can only produce 3-4 planting materials from one motherplant.

Table 3. Comparison of two selected propagation systems

	Self-Watering Propagation Chamber System	Opened Self-Watering Propagation System
Technique	Crown leaf budding	Stem sectioning
Cost	RM 20,000 – RM 50,000	RM 10,000 – RM 30,000
Success rate	98-100%	93-95%
Source	Crown	Stem
Skill	High	Medium
Worker	Any gender	Man
Work place	Small	Big
Suckers/20 sqft	10,000	5,000

CONCLUSION

Two technologies have been developed for the mass production of MD2 planting materials crown leaf budding in closed self-watering propagation chamber system and stem sectioning in open self-watering propagation system. These propagation systems may address the supply shortage of MD2 planting materials. In addition, the resulting plants are true-to- type and can be propagated in a short time frame with inexpensive cost. Therefore, the objective of this study which is to determine new MD2 pineapple propagation technique and system capable of producing mass true-to-type planting materials in a short time without being influenced by global climate changes are met. Policy implication from this finding is we can overcome the critical shortage of MD2 pineapple planting material due to climate change with invite producers, farmers and researchers to courses, demo or seminars under supervision of Malaysia Agriculture Department to further discuss and expand information about this new propagation techniques and systems.

REFERENCES

Norsyuhaida A.S., Noor Baiti A.A., Azlan Azizi M.N., Mohd Nizam Z., Noor Syahira N., Salehudin R., Mohd Ridzuan M.D., Johari S., Razali M., Rosimah J., Fatkhiah A.M., Azaini A., Mohd Fareez A. and Mohd Fauzi H. (2017). *Advance in propagation techniques for pineapples production in Malaysia.* Paper presented at HARI INOVASI MARDI 2017, held at MAEPS Serdang, Selangor, 18-19 Sept 2017.

Norsyuhaida A.S., Noor Baiti A.A., Azlan Azizi M.N., Noor Syahira N., Johari S., Razali M., Rosimah J., Fatkhiah A.M., Azaini A., Mohd Fareez A. and Mohd Fauzi H. (2017). *Teknologi sistem terkini pembiakan bahan tanaman pelbagai tanaman di Malaysia.* Paper presented at Persidangan Kebangsaan Pemindahan Teknologi 2017, held at Berjaya Waterfront Hotel,Johor 14-16 November 2017.

Norsyuhaida A.S., Noor Baiti A.A., Azlan Azizi M.N, Mohd Nizam Z., Salehudin R., Joanna Cho L.Y, Johari S., Razali M., Rosimah J.l, Fatkhiah A.M., Azaini A., Mohd Fareez A., and Mohd Fauzi H. (2017). *Teknologi pembiakan bahan tanaman*. Paper presented at AGORA-5 SELATAN, held at Kluang, Johor, 27 Ogos 2017.

Rosimah J., Norsyuhaida A.S., Noor Baiti A.A., Azlan Azizi M.N., Noor Syahira N., Johari S., Razali M., Fatkhiah A.M., Azaini A., Mohd Fareez A. and Mohd Fauzi H. (2017). *Teknologi terkini pembiakan bahan tanaman pelbagai varieti nanas di Malaysia.* Paper presented at Persidangan Kebangsaan Pemindahan Teknologi 2017, held at Berjaya Waterfront Hotel,Johor 14-16 November 2017.

Noor Baiti, A.A., Nurul Shamimi, A.G., Norsyuhaida, A.S., Johari, S., Rozlaily, Z., Mohamad Zaki, R. and Jasni, I. (2017). *Flowering and plant characteristics of MD2 pineapple population.* Paper presented at 12th Malaysia International Genetic Congress (MiGC12), held at Bangi-Putrajaya Hotel, Selangor, Malaysia, 25-27 September 2017.

Norsyuhaida A.S., Zabedah M., Hartinee A., Salehudin R., Mohd Ridzuan M.D., Rosimah J., Fatkhiah A.M., Azaini A., Mohd Fareez A. and Mohd Fauzi H. (2015). *MD2 & Maspine: Kesan pelbagai teknik pembiakan nanas terhadap penghasilan bahan tanaman.* Paper presented at Confertech, held at Riverside Majestic Hotel Kuching, Sarawak, 7-9 April 2015.

Norsyuhaida A.S., Zabedah M., Hartinee A., Salehudin R., Mohd Ridzuan M.D., Rosimah J., Fatkhiah A.M., Azaini A., Mohd Fareez A. and Mohd Fauzi H. (2015). *Technology breakthrough: Mass propagation of true-to-type MD2 pineapple planting materials.* Paper presented at Hari Inovasi MARDI Dan MSTE 2015, held at MAEPS Serdang, Selangor, Malaysia, 25-27 August 2015.

Norsyuhaida A.S., Zabedah M., Hartinee A., Salehudin R., Mohd Ridzuan M.D., Rosimah J., Fatkhiah A.M., Azaini A., Mohd Fareez A. and Mohd Fauzi H. (2015). *Technology breakthrough: Mass propagation of true-to-type MD2 pineapple planting materials.* Paper presented at Malaysia Agriculture Inovation Show (MAGIS 2015), held at MAEPS Serdang,Selangor, Malaysia, 20-22 Oktober 2015.

ABSTRAK

Nanas telah dikenalpasti sebagai sumber kekayaan baharu. Ketika industri nanas sedang berkembang dengan pesat, terdapat kekurangan bekalan bahan tanaman nanas MD2 yang kritikal. Ini mungkin disebabkan oleh permintaan bahan tanaman yang sangat tinggi bagi meluaskan ladang penanaman nanas MD2 lalu menyebabkan harga bahan tanaman nanas meningkat. Teknik penanaman nanas sedia ada masih belum dapat mengatasi kekurangan bahan tanaman MD2. Kajian telah djalankan untuk menentukan teknik pembiakan yang terbaik dan dua sistem baharu telah dibangunkan dengan mengambil kira kos. Keputusan menunjukkan bahawa teknik tunas daun jambul dan pembahagian batang merupakan teknik yang terbaik untuk menghasilkan 30-50 bahan tanaman dari satu pokok induk dengan kadar kejayaan masing-masing adalah 95-100% dan 93-95%. Kajian media bagi kedua-dua teknik ini juga menunjukkan media layering pasir:peatmoss adalah media penanaman terbaik dengan kadar kejayaan masing-masing adalah 95-100% dan 90-95%. Oleh itu, dua teknologi iaitu tunas daun jambul dalam sistem pembiakan kebuk pengairan kendiri tertutup dan pembahagian batang dalam sistem pembiakan pengairan kendiri terbuka telah dibangunkan bagi mengatasi kekurangan bekalan bahan tanaman MD2 dan juga bagi menghasilkan tanaman tulen nanas MD2.