

EFFECT OF SELECTED VASE SOLUTIONS ON POSTHARVEST  
QUALITIES OF GERBERA CUT FLOWER (*Gerbera hybrida*)

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**PERPUSTAKAAN  
UNIVERSITI MALAYSIA SABAH**

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF BACHELOR OF  
AGRICULTURAL SCIENCE WITH HONOURS

HORTICULTURE AND LANDSCAPING PROGRAMME  
FACULTY OF SUSTAINABLE AGRICULTURE  
UNIVERSITI MALAYSIA SABAH  
2017



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## UNIVERSITI MALAYSIA SABAH

## BORANG PENGESAHAN TESIS

JUDUL: Effect of Selected Vase ~~form~~ Solutions on Postharvest Qualities of  
Gerbera Cut Flower (Gerbera hybrida)

UJAZAH: Degree of Bachelor of Agriculture Science with Honor

SAYA: PANG YI LING  
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SESI PENGAJIAN: 2016 / 2017

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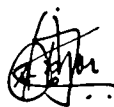
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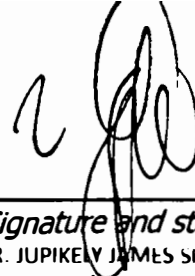


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## ACKNOWLEDGEMENT

I would like to express my deepest gratitude to God for all the blessings and strengths in completing my final year project. The experiences that I have gained through this study were very meaningful to me, in which I was exposed to the postharvest practices of cut flowers.

In particular, I would like to express my sincere thanks to my supervising lecturer, Dr. Jupikely James Silip for providing his valuable time, advices, valuable knowledge and continuous encouragement towards the completion of my final year project. I also would like to appreciate to all the lecturers who provided me with the abundance of knowledge, guidance and support in this study. I would also like to thank all the examiners who have invigilated and pointed out some encouraging comments on the report and presentation.

Besides, I also want to thank the staffs and lab assistants particularly to Miss Nurul Shakina Binti Marli who offered to provide all the materials and tools required in the experiment.

Me appreciation also goes to my family which are so tolerant and supported me all these years. I would like to thank my father, Philip Pang Pak Shee and my mother Chong Lee Moi who unconditionally giving me courage, moral and financial supports.

Last but not least, special thanks given to my best friends (Chee Hoyau, Cheong Kah Kei, Lim Siew Lian, Huang Yen Zen and Ser Li Yun) and seniors who helped directly or indirectly and encouraged me while completing my final year project.



## ABSTRACT

Gerbera ( *Gerbera hybrida*) is one of top ten popular cut flowers in the world which occupies the forth place according to the global trends in floriculture. A study was conducted to determine the effect of selected vase solutions on postharvest qualities of gerbera cut flower ( *Gerbera hybrida*). The experiment was conducted at Postharvest Laboratory in Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, Sandakan campus, during August to September 2016 following Completely Randomized Design with five replicates. 11 treatments were exerted in experiment. i.e., 2% sucrose (T1); 0.5% vinegar (T2); 0.5% lemon juice (T3); 1 % calcium (T4); tap water (T5); distilled water (T6); 2% sucrose+0.5% vinegar (T7); 2% sucrose+0.5% lemon juice (T8); 2% sucrose+1% calcium (T9); 2% sucrose+0.5% vinegar+1% calcium (T10) and 2% sucrose+0.5% lemon juice+ 1 % Calcium (T11). 2% sucrose+0.5% vinegar (T7) significantly increased the flower head diameter and solution uptake. Lowest stem bending was obtained in (T7). Vase life was significantly higher when exposed to 2% sucrose+0.5% vinegar+ 1 % calcium (T10) than other treatments with maximum of 16.60 days vase life. 2% sucrose+0.5% lemon juice+ 1 % calcium (T11) shown the maximum days taken for petal fall and relative fresh weight of cut flowers. It has been concluded that 2% sucrose+0.5% vinegar (T7) has the potential to be used as a commercial cut flower vase solution to delay flower senescence, enhance postharvest quality and prolong the vase life of gerbera cut flowers. The findings provide scientific information for improving postharvest characteristics of gerbera cut flowers for the satisfaction of flower users and sustainable gerbera cut flower production.

# **KEBERKESANAN LARUTAN PASUAN TERPILIH TERHADAP KUALITI LEPAS TUAI BUNGA KERATAN GERBERA (*Gerbera hybrida*)**

## **ABSTRAK**

*Gerbera (Gerbera hybrida)* merupakan salah satu bunga keratan paling terkenal dan mendapat tempat keempat dalam trend florikultur di seluruh dunia. Kajian telah dijalankan untuk mengkaji kesan larutan pasuan terpilih terhadap kualiti lepas tuai bunga keratan gerbera (*Gerbera hybrida*). Kajian ini telah dijalankan di makmal lepas tuai, Fakulti Pertanian Lestari, Universiti Malaysia Sabah, Kampus Sandakan, dari bulan Ogos hingga September 2016. Kajian dilakukan menggunakan Rekabentuk Rawak Lengkap (CRD) dengan lima replikasi. 11 larutan pasuan yang telah digunakan dalam eksperimen ini adalah 2% sukrosa (T1); 0.5% cuka (T2); 0.5% jus limau (T3); 1%  $\text{CaCl}_2$  (T4); air paip (T5); air suling (T6); 2% sukrosa +0.5% cuka (T7); 2% sukrosa +0.5% jus limau (T8); 2% sukrosa +1%  $\text{CaCl}_2$  (T9); 2% sukrosa +0.5% cuka +1%  $\text{CaCl}_2$  (T10) dan 2% sukrosa +0.5% jus limau+1%  $\text{CaCl}_2$  (T11). Hasil kajian menunjukkan 2% sukrosa +0.5% cuka (T7) memperbesarkan kelebaran kepala bunga dan meningkatkan jumlah penyerapan larutan pasuan secara signifikan. Minimum kelayuan pada bunga keratan gerbera didapati dalam larutan pasuan 2% sukrosa +0.5% cuka (T7). Larutan pasuan 2% sukrosa +0.5% cuka +1%  $\text{CaCl}_2$  (T10) secara signifikan member kesan kepada jangka hayat bunga keratan gerbera dan mencapai jangka hayat maksimum sebanyak 16.60 hari. Bunga keratan dalam larutan pasuan 2% sukrosa +0.5% jus limau+1%  $\text{CaCl}_2$  (T11) mencatat berat basah relatif paling tinggi dan memanjangkan jangka masa keguguran bunga. Secara konklusinya, larutan pasuan 2% sukrosa +0.5% cuka (T7) merupakan rawatan terbaik dan berpotensi untuk dijadikan sebagai larutan pasuan komersial bagi melewati kelayuan, meningkatkan kualiti lepas tuai dan memanjangkan jangka hayat bunga keratan gerbera. Kajian ini menyediakan informasi secara saintifik bagi meningkatkan kualiti lepas tuai bunga keratan gerbera bagi kepuasan pengguna dan pengeluaran yang mampan.

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## LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

°C	Degree celcius
%	Percentage
AgNO <sub>3</sub>	Silver nitrate
ANOVA	Analysis of variance
ATP	Adenosine triphosphate
CaCl <sub>2</sub>	Calcium chloride
cm	Centimeter
CRD	Completely Randomized Design
DOA	Department of Agricultural Malaysia
EC	Electrical Conductivity
EU	European Union
FAMA	Federal Agricultural Marketing Authority
g	Gram
ha	Hectare
HQS	Hydroxyquinoline sulphate
MAO	Ministry of Agricultural and Agro-based Industry
ml	Mili litre
mM	Milimolar
oz	Ounce
p	P-value or probability
ppm	Parts per million
RM	Ringgit Malaysia
SA	Salicylic acid
SAS	Statistical Analysis System
Sdn. Bhd.	Sendirian Berhad (Malay equivalent to incorporated)



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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Cut flower is simply any flower that is cut from the plant and it is very fragile because they are detached from the soil and roots. The cultivation of cut flowers is in the branch of horticulture known as floriculture. Today, cut flowers are still playing an important role in both developed and developing country as decoration in many special occasions and parts of many rituals. Cut flowers demand increased significantly over the last two decades. Demand patterns are seasonal, depending highly on trends, customer tastes and special occasions. Cut flowers are regularly purchased as gift during festivals and display items in churches, homes, businesses and other hospitality outlets. Up to date, the cut flower industry is very competitive as there are more newer and exotic varieties being discovered. Cut flowers are valuable products of horticulture, hence it is very important to maintain their quality and prolonging their vase life so that their marketability is higher (Sardoei and Shahdadneghad, 2014).

Gerbera is known as the flower for all season and it symbolizes beauty. Gerbera has soft appearance and sweet fragrance. Gerbera can be grown in garden as potted ornamental plants, indoor decorative item as fresh or dried cut flowers. *Gerbera hybrida* is one of the important cut flower which can be produced in Malaysia and mostly found in temperate and higher topography areas such as Cameron Highlands and Kundasang. *G. hybrida* is very popular and in great demand in Malaysia owing to its attractive appearance, available with wide range of colours and shades (Silva *et al.*, 2013). *G. hybrida* has moderate vase life (Khenizy *et al.*, 2013), hence maintaining good quality of gerbera cut flower is needed to fetch good market price and meet the considerable demand and standards for domestic and export markets. Price surveying



had been done on florist shops in Sandakan area, the retail price is RM2.50 per stalk and RM55.00 for half dozen of gerbera cut flowers.

Cut flowers should be placed in vase solution or preservatives immediately after harvesting to prevent wilting as they have been removed from the water source which is the root system. This can prevent the air from moving into water conducting tissues and plugging the cells. (Meyer, n.d.). Vase solutions function as energy provider, reducing microbial accumulation and proliferation, enhancing solution uptake and inhibiting ethylene synthesis. Admixing and combining various elements or chemicals to the vase solution can effectively prolong the vase life of cut flowers (Gebremedhin *et al.*, 2013). There are two major types of floral preservative which are chemical and natural preservatives. Common chemical preservatives include Silver nitrate ( $\text{AgNO}_3$ ), Calcium chloride ( $\text{CaCl}_2$ ), 8-hydroxyquinoline sulphate (8-HQS), Salicylic acid (SA), chlorine, etc. Natural preservatives such as lemon juice are readily available, inexpensive and less hazardous to the environment. Cut flowers treated with tap water normally have shorter vase life, application of vase solution could help to extend the vase life for satisfaction of consumer, and market demand for cut flower with natural beauty and appearances for a longer period of time is higher (Tsegaw *et al.*, 2011).

Two major factors contributing to low postharvest qualities are ethylene synthesis and microbial activities, which promotes wilting of cut flowers. Water relation is also an important factor that affects the postharvest quality of vase life (Mehraj *et al.*, 2016). According to Silva *et al.* (2013), gerbera cut flowers are susceptible to low vase life and bent neck symptom. Major researches have been done to improve the postharvest qualities of gerbera cut flowers which include parameters such as vase life, stem bending percentage, weight loss percentage, amount of solution uptake, etc.

## 1.2 Justification of Study

This research was conducted to determine the effectiveness of various vase solutions on the postharvest qualities of *G. hybrida*. The selected vase solutions in this study are readily available, inexpensive and less hazardous to the environment compared to some commercial floral preservatives such as  $\text{AgNO}_3$  and 8-HQS. Postharvest losses about 20% of total fresh produce occurred while passing through the market chain

from harvest (farm), packaging, transportation, and reaching the consumer (Panhwar, 2006). An effective vase solution can maintain the postharvest quality and reduce postharvest losses of fresh cut flowers. Most of the producers and florists in Sabah do not emphasize on extending the vase life using vase solution, commonly the cut flowers are only treated with tap water and stored in cold room only. In fact, the growers and sellers are very poor in terms of postharvest handling knowledge and maintain the quality of *G. hybrida*. Another possible reason was that the commercial preservatives are expensive and suppliers and sellers choose not to treat the harvested floral with preservatives.

*G. hybrida* was chosen for my study due to its popularity in Malaysia. In fact, it is also recognized as one of the ten most popular commercial cut flowers in the world and fourth according to the floriculture global trends (Choudhary and Prasad, 2000). Various researches have been advocated for extending the vase life of different varieties of gerbera cut flowers especially *G. jamesonii*. However, such information on *G. hybrida* treated under natural and less hazardous vase solution is scanty. Thus, present investigation was undertaken to provide deeper knowledge on physiology of *G. gerbera* and effective vase solution to be used for consumers. The method of preparation of the vase solutions selected in this study is relatively easy.

Khenizy *et al.* (2013) mentioned that *G. hybrida* has a relatively short vase life, therefore there is an urgent need to evolve an appropriate solution to delay the senescence. Alternative techniques for prolonging the vase life of cut flowers are commercial interest to solve the physiological and pathological problems during postharvest management (Gebremedhin *et al.*, 2013). Postharvest management and value addition can fetches higher market price of cut flowers up to 9-10 times (Srivastava *et al.*, 2015). Moreover, maintaining good postharvest quality especially the vase life of *G. hybrida* cut flowers and bright colour inflorescence are attractive and considered important for getting consumer preferences. (Asfanani *et al.*, 2008), many remaining flowers with low postharvest quality condition posses dissatisfaction of the consumer. Marketability of low quality cut flowers is relatively low and normally sold at a lower market price. Sellers and producers are concerned with the postharvest loss of cut flowers, because missing a profit is economic loss for the farmers and sellers. Thus, appropriate postharvest handling and application of effective vase solution could help



to improve or maintain the postharvest qualities and characteristics for consumer satisfaction and exploitation of the business.

### **1.3 Objective**

To study on the effect of selected vase solutions on postharvest qualities of gerbera cut flower (*Gerbera hybrida*).

### **1.4 Hypothesis**

$H_0$ : There was no significant difference between the selected vase solutions on postharvest qualities of gerbera cut flower (*Gerbera hybrida*).

$H_A$ : There was significant difference between the selected vase solutions on postharvest qualities of gerbera cut flower (*Gerbera hybrida*).

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Cut Flowers

Cut flowers are flower cut to a specified length with stem leaving the flower head, buds and leaves together (Bhattacharjee and De, 2005). The cut flowers used at international level includes roses, chrysanthemum, carnation and lily. Cut flowers are commonly used while they are fresh. Recently, dried and dehydrated flowers are right on trend in flower arrangements, as they can be stored for a longer period, reusable and provide vintage effects.

Consumptions of the cut flowers associated with income development, the better the economic development, the higher the consumption per capita of flowers (Bhattacharjee and De, 2005). The decision of purchasing cut flowers by consumers depends highly on uses of cut flowers. For example, 74% of flowers are being sold for use as gifts in United States and 55% flowers are being used for personal use in Netherlands (Southern African Development Community, n.d.). Higher demand and consumptions were observed during festive seasons and special occasions such as Mother's Day, Valentine's Day, Christmas, Deepavali, etc. Different marketing strategies and competition with confectionery, accessories and more pose challenges to the cut flower industry and market.

#### 2.2 History of Gerbera Flower

Gerbera flower was discovered unintentionally by a gold miner, named Robert Jameson near Barberton, South Africa in year 1880. The plants were donated to the Durban Botanical Gardens. Harry Bolus indentified the gerbera flower and the botanical name, *Gerbera jamesonii* was suggested. Later, various extensive breeding programs had



been done on gerbera flowers at the University of California at Davis during the 1970s. (Alabama Cooperative Extension System, n.d.) The breeding and cultivar development also have been done by other countries such as Japan, France, Netherlands, Germany, etc. The extensive breeding programs resulted with development of gerberas that is suitable for the garden (Harding *et al.*, 1981). Cut and pot gerbera are produced in commercial scale in Europe since 20<sup>th</sup> century and 1920s in North America. (Kloss *et al.*, 2004).

### 2.3 Botanical Descriptions of *Gerbera hybrida*

*Gerbera hybrida* commonly known as gerbera daisies is a member of the daisy family or Asteraceae (Compositae), which is the largest family of flowering plants. It has proximately 30 species in the wild and is native of South Africa and Asiatic regions (Sardoei and Shahdadneghad, 2014). *Gerbera* is perennial with 50-70 cm in height (Khenizy *et al.*, 2013). It is perennial and characterized by its vivid coloured flower head that is available in various colours such as pink, yellow, red and orange. *G. hybrida* flowers can be propagated sexually or asexually. Asexual propagation of *G. hybrida* can be done by division of the healthy mother plant (Royal Horticultural Society, n.d.). *Gerbera hybrida* cultivation is suitable to be done under wide range of climatic conditions but the most ideal is growing in temperate climate.

*Gerbera hybrida* is the diploids resulting from crosses of *G. jamesonii* and *G. viridifolia* (Kloss *et al.*, 2004). Ray, trans and disc are the three distinct flowers that form the inflorescence of *G. hybrida* (Sardoei and Shahdadneghad, 2014). The size of the disk florets approximately 1.6 cm are small. According to Drennan *et al.* (1986), the florets produce stamens and consist of two corolla internal lips similar to the size of outer corolla lip. Ray florets are larger in size with approximately 6.1 cm in length and they produce pistils. Ray florets have a large outer corolla lip (ligule) and two rudimentary corolla internal lips.

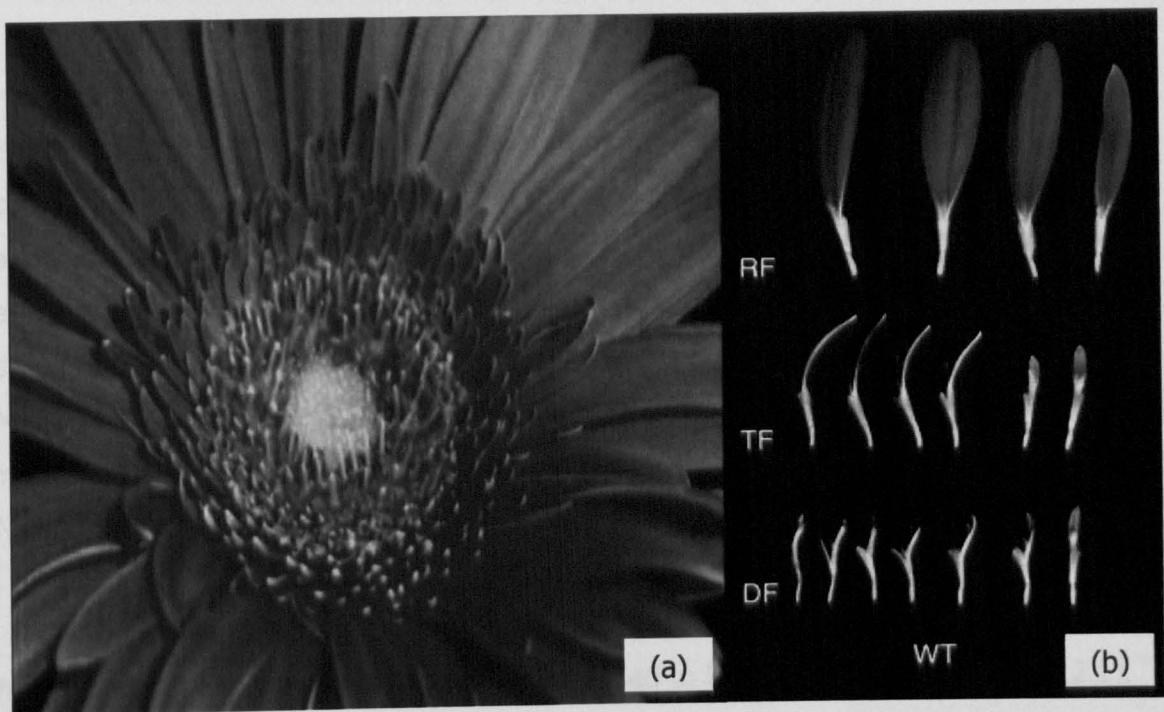


Figure 2.1 (a) Flower head of *Gerbera hybrida* (Broholm *et al.*, 2014) and (b) All the three types of flowers that form capitulum of wild type *Gerbera hybrida*: Ray Flower (RF), Trans Flowers (TF) and Disc Flower (DF) (Ruokolainen *et al.*, 2011)

## 2.4 Cut Flower Production in Malaysia

Commercial floriculture is a recent approach in Malaysia. Rising demand of cut flowers created development of floriculture in Malaysia moving towards an intensive horticulture. High economic returns for exporting flowers increased awareness for production of flowers among the growers. Gerbera cut flowers progressively cultivated for both export and domestic markets.

Floriculture is one potential industry in Malaysia as emphasized in National Agriculture Policy. In the Third National Agricultural Policy, planting area is targeted to increase up to 7,800 ha, based on projected global cut flower market growth of 6-9% (Chiew, 2001). However, the actual planting area of cut flower in 2006 was 1,787 ha, Peninsular Malaysia covered 95% of planting area for cut flowers according to MOA (2006) as shown in Figure 2.2. This shows that we are still far behind from our target, the actual planted area under floriculture was below the targeted planting area.



There are many available statistics showing that the domestic demand in Malaysia for fresh cut flowers is increasing although Malaysia's per capita consumption is very low compared to other countries. FAMA (2005) reports that the per capita consumption arranged 4.91 stalks over the period October 2003 – September 2004, and is higher in urban locals than in rural areas. Among the races in Malaysia, Indians are the highest of all racial groups at 24.50 stalks, followed by the Chinese at 9.60 stalks and Malays at 0.43 stalks in terms of per capita. The demand of cut flower in Malaysia is high especially during the festivals and ceremonies such as Chinese New Year and Deepavali. Chrysanthemum and jasmine demand is very high during Chinese New Year for the ritual ceremonies.

According to DOA (2013), the contribution of floriculture commodity to Malaysia for exports in 2010 was RM 345,754 and increased to RM 354,004 in 2011 (Table 2.1). Exportation of cut flowers in Malaysia to other countries is increasing as shown in the Figure 2.3. The export of cut flower- fresh and cut flower- other than fresh have increased over the period of 2000 - 2005. 50.8% and 34.1% respectively for orchid and temperate cut flowers out of the total production have been exported in year 2004 (MOA, 2005).

Table 2.1 Agricultural sector trading, 2010-2011

Commodity	2010			2011		
	Export (RM '000)	Import (RM '000)	Balance (RM '000)	Export (RM '000)	Import (RM '000)	Balance (RM '000)
Total	106,864,	64,597,	42,266,	133,636,	77,568,	56,067,
Agricultural Sector	234	445	788	292	862	430
Total Food Materials	18,108,690	30,193,302	-12,084,611	20,500,003	34,449,265	-13,949,262
Rice	1,241	1,609,304	-1,608,063	1,293	1,854,067	-1,852,774
Fruits	570,295	1,609,304	-1,608,063	1,293	1,854,067	-1,852,774
Vegetables	682,222	2,777,794	-2,095,572	750,788	2,734,600	-1,983,812
Coconut	19,274	24,681	-5,407	49,263	52,544	-3,281
Floriculture	345,754	17,054	328,700	354,004	20,106	333,898

Source: DOA, 2013

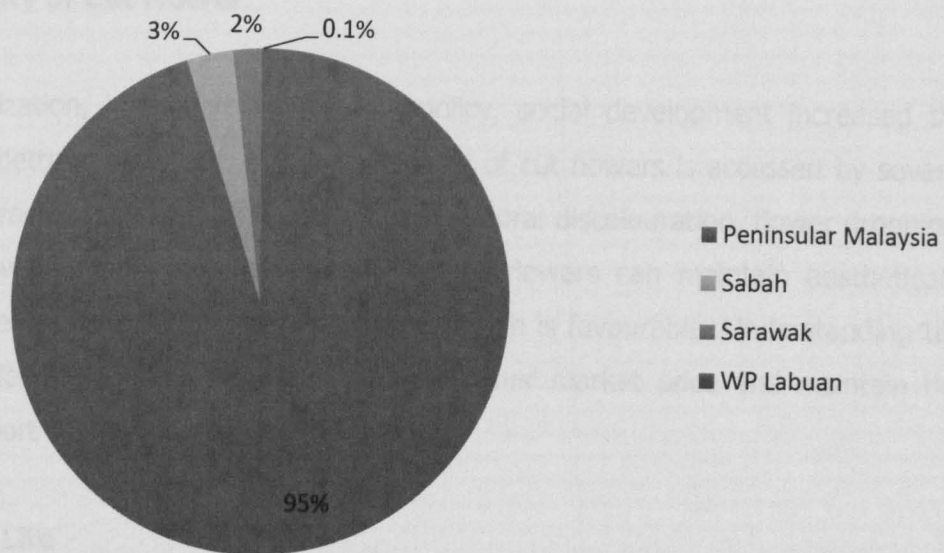


Figure 2.2 Area of flower farms (Hectares)  
Source: MOA, 2006

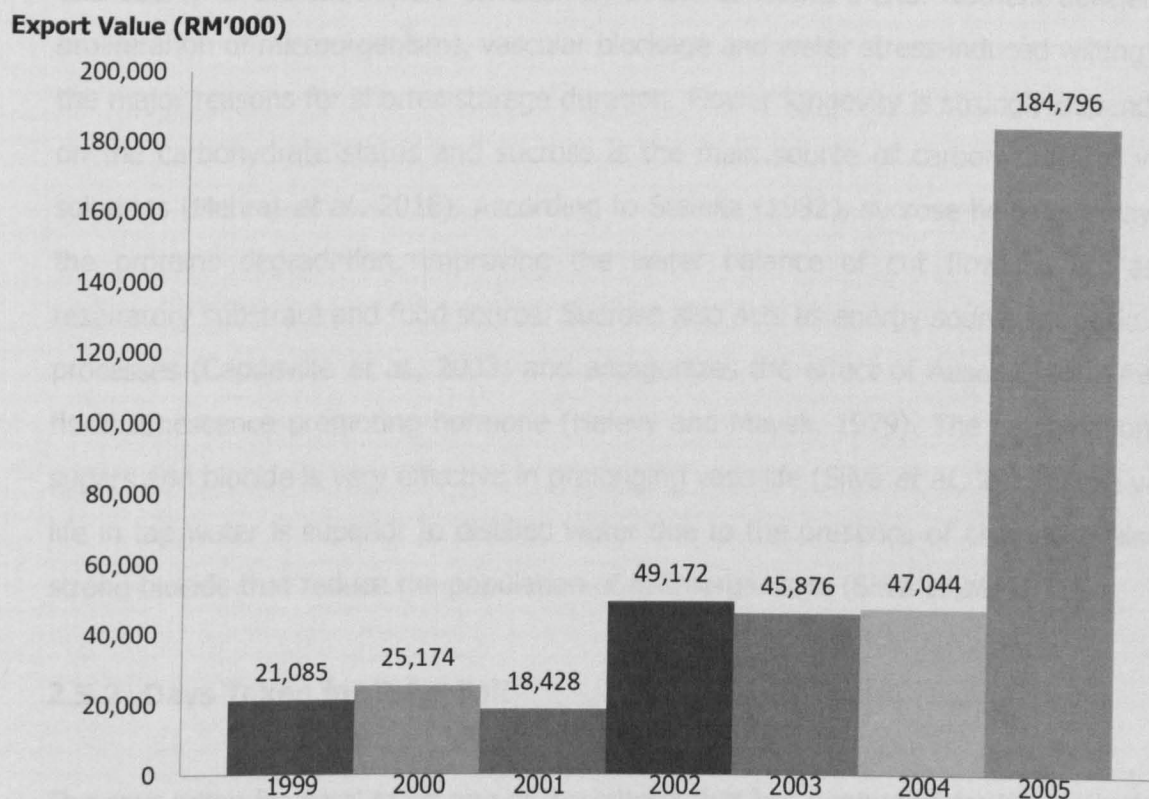


Figure 2.3 Value exports of flowers and foliage plants (RM'000), 1999 - 2005  
Source: MOA, 2005



## 2.5 Quality of Cut Flower

Rapid urbanization, innovative technology, policy, social development increased the demand for better quality of cut flowers. Quality of cut flowers is accessed by several common characteristics such as flower longevity, floral discolouration, flower dropping, bent neck, weight loss, etc. Best quality of cut flowers can maintain aesthetically pleasing appearance for a long period of time, which is favourable. Understanding the factors that lead to deterioration can fetch a higher market price and maintain the quality in export cut flowers (Reid, 2009).

### 2.5.1 Vase Life

Vase life also known as longevity, shelf life, display life, storage duration, etc is a common term used in postharvest technology. Vase life expresses the potential lasting and quality of the cut flowers conclusively at the consumer's end. Nutrient deficiency, proliferation of microorganisms, vascular blockage and water stress-induced wilting are the major reasons for shorter storage duration. Flower longevity is strongly dependent on the carbohydrate status and sucrose is the main source of carbohydrate in vase solutions (Mehraj *et al.*, 2016). According to Steinitz (1982), sucrose helps in delaying the proteins degradation, improving the water balance of cut flowers, act as a respiratory substrate and food source. Sucrose also acts as energy source for basic cell processes (Capdeville *et al.*, 2003) and antagonizes the effect of Absciscic acid (ABA), floral senescence promoting hormone (Halevy and Mayak, 1979). The combination of sugars and biocide is very effective in prolonging vase life (Silva *et al.*, 2013). The vase life in tap water is superior to distilled water due to the presence of chlorine is also a strong biocide that reduce the population of microorganisms (Silva *et al.*, 2013).

### 2.5.2 Days Taken for Petal Fall

The days taken for petal fall is one of the criteria that has been used for the evaluation of the postharvest cut flower quality. Petals fall indicates the starting of floral wilting and senescence. Many studies had shown that the combination of sugar and biocide ( $\text{AgNO}_3$ ) floral preservatives maximized the days taken for petal fall (Sujatha *et al.*, 2003). The chlorine in Calcium chloride also acts as strong biocides that prevent the proliferation of bacteria, thus maintaining the postharvest quality of cut flowers.

### 2.5.3 Flower Head Diameter

Larger flower head is more favourable and the key of good cut flower quality is to maintain the flower head size for a longer period of time. The flower head diameter reduced at the end of the cut flower vase life due to the petal fall or shrinking of petals due to water loss. Sucrose is an important carbohydrate source that produces turgor pressure for flower opening (Sarkka, 2005). Study shows that combining 250 ppm 8-HQS and 1.5% sucrose can effectively maximizing the flower head diameter (Bhat *et al.*, 1999). The high antibacterial efficiency can hinder the accumulation of bacteria at the cut section of stem that leads to plugging and ethylene synthesis that links to xylem vessels blockage, wilting and reduction in flower head diameter (Jafarpour *et al.*, 2015).

### 2.5.4 Relative Fresh Weight

Relative fresh weight is the appropriate measure of the plant water status in percentage. Generally, the relative fresh weight shows decreasing trend from the beginning until the end of vase life. In the early storage period, the relative fresh weight of cut flowers was higher due to higher solution uptake but the fresh weight decreased at prolonged storage period and this might be due to high water loss. (Seyf *et al.*, 2013; Bayleyegn *et al.*, 2012). Mixture of sucrose and antimicrobial compound maintains and produce higher relative fresh weight of cut flowers (Mehraj *et al.*, 2013).

### 2.5.5 Solution Uptake

The amount of solution uptake relies on the effectiveness and on the type of vase solutions. The solution uptake decreases with the vase life, the amount of the solution is the highest on first day. This is due to air embolism, proliferation of microbes and plant reaction to wounding (Gebremedhin *et al.*, 2013). Bacterial plugging and blockage at the end of the stem can be prevented by the germicidal activities of 8-HQS, Salicylic acid (SA) and AgNO<sub>3</sub>.



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