



Implementation of Chrysanthemum Post-Harvest Technology in Tomohon City to Extend Storage Time

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Abstract

Chrysanthemum (*Dendranthema grandiflora*) is an ornamental plant that has high economic value, including flowers that are in great demand at domestic or abroad. As cut flowers, chrysanthemums are used for decoration and flower arrangements at weddings, and for opening new offices. The quality of cut flowers depends on the appearance and durability of freshness. Flowers with prime quality have a higher sale value compared to low-quality cut flowers. To maintain the quality of prime cut flowers still need to be implemented several treatments, especially when the flowers are ready to harvest to the consumers. The handling of post-harvest chrysanthemums is an important factor that is inseparable from the stages of cultivation and greatly influences the selling value and added value that will be obtained by farmers and traders. The use of pulsing and holding liquid during display will extend the chrysanthemum vase life. By implementing post-harvest chrysanthemums in accordance with handling procedures (SOP), chrysanthemums will be obtained that can meet quality standards and can provide added value for farmers and flower traders

Keywords: chrysanthemum, flower traders, storage time, cut flower

A. Introduction

Chrysanthemum (*Dendranthema grandiflora*) is an ornamental plant that has high economic value, including flowers that are in great demand at domestic or abroad. This is because

chrysanthemums have several excellence in terms of color, type and size of various flowers (Darmawan, 2007). At present Chrysanthemum's economic value ranks second in the world after roses (Hidayah, A. Iis Nur Asyiah, & Hariani, 2012). Cut flowers are flowers that are used as a series for purposes in human life, such as traditional ceremonies, religious rituals and national holidays. Cut flowers consist of orchid cut flowers and non-orchid cut flowers. Based on the place of growth, ornamental plants are divided into two groups, namely ornamental plants from the highlands such as chrysanthemum, gladiolus, roses, gerbera, carnations, and lowland flowers such as orchids, savory and jasmine (Widyawan dan Prahastuti, 1994).

As cut flowers, chrysanthemums are used for decoration and flower arrangements at weddings, and for opening new offices. Today the demand for chrysanthemums in the city of Tomohon and its surroundings as cut flowers tends to increase not only in household consumers, but at the level of social foundations such as churches, hotels and florists who function as decorators (Lintang and Layuk, 2015). With the increasing demand for chrysanthemum cut flowers, the area of planting and production has also increased, as shown in Table 1.

Table 1. Land and Production of Chrysanthemum for last 5 years in Tomohon City

No	Years	Land (ha)	Production (stalks)
1	2012	3	3,840,000
2	2013	3	2,880,000
3	2014	3,8	4,448,000
4	2015	4,3	5,064,000
5	2016	4,55	5,448,000

Source : Agriculture Agency of Tomohon City (2017)

Some chrysanthemum varieties have been developed in Tomohon City including Kulo, Riri (local variety), White Fiji, Yellow Fiji, Pink Fiji, Yulimar, Arosuka Pelangi, Solinda Pelangi, Kineta, Marimar, Red Hayani, Pasopati, Salzieta, Dwina Kencana, Dwina Pelangi, Sakuntala, Puspita Pelangi, Puspita Nusantara, Yellow Puma, White Puma, White Regent, Yellow Regent and Red Jaguar (Department of Agriculture and Animal Husbandry of Tomohon City, 2017)

The quality of cut flowers depends on the appearance and durability of freshness. Flowers with prime quality have a higher sale value compared to low-quality cut flowers. To maintain the quality of prime cut flowers still need to be implemented several treatments, especially when the flowers are ready to harvest to the consumers. This treatment harvests and post-harvest includes harvesting, storage, transportation, to display in flower shops (Widyawan dan Prahastuti, 1994).

In Tomohon City, post-harvest handling has not been carried out by farmers optimally. Based on the results of research by Sondakh and Rembang (2016), flower endurance at the farm level is not superior because it depends on the age of the harvest. When the crop has reached its time of harvest, the farmer will immediately harvest and try to sell the chrysanthemum flower to the consumer. Usually vase life becomes an important factor when the flowers have been harvested and are in the florist / trader or consumer at the end. Chrysanthemum VUB Many Ornamental Plant research centers (Balithi) have had vase life for approximately 14 days. Chrysanthemum varieties outside of Balithi are still cultivated intensively by farmers. The results of Sondakh and Rembang's research (2016) show that generally florists and consumers want chrysanthemum flowers that are rust resistant and brightly colored, rigid stems and large diameter.

Chrysanthemum post-harvest handling actions are needed to maintain the quality of flowers and encourage farmers to obtain added value from chrysanthemum agribusiness, so that the application of appropriate technological innovations is needed.

B. Factors Influencing the Quality and Endurance of Chrysanthemum Cut Flower

Plants in general will release a hormone called ethylene to help physiological processes that occur in the plant's own tissue. Ethylene can help the process of ripening and cooking fruit. In flowering plants, ethylene gas can accelerate the process of bud bloom, causing the color of the flowers to turn pale or also can cause flower buds to not bloom. In addition, according to Lakitan (1995), ethylene can cause aging and leaf abortion, inhibit fruit lengthening, inhibit leaf enlargement, etc. During the post-harvest process before reaching the consumer's hand, there will be a phase where the flower will experience an extension of time. During the process, the flowers will produce ethylene gas which will speed up the rate of respiration on the flowers that have been cut.

Several factors can reduce the quality of fresh flowers, namely the inability of the system (stems) to absorb water due to the inhibition of bacteria, fungi or other microorganisms; embolism or physiological reaction of the flower itself. The second factor is the low carbohydrate content so it is inadequate to support respiration. The third factor is that plants suffer from too much water loss due to high ambient temperatures. The fourth factor is the presence of ethylene produced by the damaged tissue. The last factor is due to disease or pest attack (Manu, 2007).

Withered flowers are seen by the texture of the flowers that are limp, faded or brown, black or brown spots on the flowers, branches that bend and there is no surface tension of the crown so that the crown tends to limp. Flowers that absorb much liquid can survive longer because they can replace water that lost during the process of his life (Prasetya Sari, 2008).

Factors that greatly affect the shelf life of cut chrysanthemums are the post-harvest stages. According to Ahmad, U., E.Syaefullah, Dan H.K.Purwadaria (2006), post-harvest handling of cut flowers varies depending on the type of flower, producer, production area, and marketing strategy. In general, the steps for handling are: harvesting, sorting, packing, binding, packing, pre-condition, storage, transportation, and marketing.

Table 2. Indonesia National Standard For Fresh chrysanthemum Cut Flowers Standard

No	Test Type	Unit	Quality Class			
			AA	A	B	C
1	Stem Length Minimum					
	-type standard	cm	76	70	61	Asalan
	-type "spray"					
	*aster	cm	76	70	61	Asalan
	*kancing	cm	76	70	61	Asalan
	*santini	cm	60	55	50	Asalan
2	Flower Stem Diameters					
	-type standard, aster and kancing	mm	>5	4.1-5	3-4	Asalan
3	-santini	mm	>4	3.5-4	3-3.5	Asalan
	Half Bloom Flower diameter					
	-type standard	mm	>80	71-80	60-70	Asalan
	-type "spray"					
	*aster	mm	>40	>40	>40	Asalan
4	*kancing	mm	>35	>35	>35	Asalan
	*santini	mm	>30	>30	>30	Asalan
	The number of flower buds ½ blooms per stalk					
5	-type spray	Buds	>6	>6	>6	Asalan
	Flowers Freshness		Fresh	fresh	fresh	Asalan
6	Strange Thing/ Maximum Dirt	%	3	5	10	>10
7	Flower Stem Condition	Strong, straight, not broken	Strong, straight, not broken	Strong, straight, not broken	Strong, straight, not broken	Asalan
8	Cultivar Sameness	Same	Same	Same	Same	Same
9	Leaves on 2/3 of the Flower Stems	Complete and Same	Complete and Same	Complete and Same	Complete and Same	Asalan
10	Post-Harvest Handling	Absolutely Needed	Absolutely Needed	Needed	Needed	Asalan

Source : Badan Standardisasi Nasional (SNI 01-4478-1998).

Flower quality is one of the problems that is often faced by cut flower entrepreneurs and consumers. Flower quality is very dependent on freshness and durability (vase life) of flowers. Age of freshness or length of freshness (vase life) is the main determinant of the quality of cut flowers which is calculated from the time the flower is harvested until it withers or falls.

Improving the quality of flowers, so that the beauty and freshness of chrysanthemum cut flowers can be enjoyed longer is a highly desirable thing. But the obstacle faced by

chrysanthemum cut flowers is the freshness of flowers are short. The quality of chrysanthemum cut flowers must meet the quality standards set by the Badan Standardisasi Nasional (1998) as presented in Table 2.

One sign of a not fresh cut flower is withering, level of florescence and flower stems. Withering is caused by the inhibition of absorption of the liquid so that the flowers will lack water. In addition Yulianingsih, A., Murtiningsih, & Sjaifullah (2002) also stated that the process of wilting was accelerated when the loss of water was more than absorption, thus causing flower stems to lack water and low turgor pressure resulting in plasmolysis. Withered was observed visually during the storage process. Withered characterized by the crown starting to roll outward and said to be wilted if the crown actually falls down because there is no crown rigidity at all (Wiraatmaja, I.W., I.N.G. Astawa, Dan N.N.Deviantri. 2007).

Flower stem is also one of the parameters to determine the quality of flowers. A stem with a large diameter will be able to sustain the entire weight of the flower, so the chance for a bent neck will become small. The diameter of the stems in accordance with the AA grade determined by the National Standardization Agency is 4-5 mm. Stems undergo a change in diameter during storage due to metabolic activity that occurs (Darmawan, 2007) In addition to flower stems and withering, the markers of freshness of flowers are the degree of florescence.

Table 3. Florescence Criteria for Chrysanthemum Cut Flowers.

Score	Florescence	Description
4	Flower after blossom	· Flower crown open maximally 45° to vertical line. · Flower eyes still close together.
3	Flower with perfect blossom	· Flower crown open maximally 90° to vertical line. · Flower eyes start to expand or poke up between the circle of the crown. · Brightly colored (bright orange)
2	Flower after perfect blossom,	· Flower crown open maximally 90° to vertical line. · Flower eyes start to expand or poke up between the circle of the crown. · The color is fading (pale orange).
1	Withered Flower	· The flower's eyes and flower crowns fall out. · The flower crown closes or curls inward. · Flower crown open more than 90° to vertical line. · Drooping flower stalks before full bloom. · There is a change in the color become paler or fading color of the flower crown.

Source : Wiraatmaja (2007)

Every type of flower that has attractive colors and shapes can be cut, but not all flowers that are cut have economic value or can be traded. According to Rismunandar (1995), cut flowers which have the following requirements:

1. Beautiful color, clean and not stained, and the smell is not too pungent
2. Flowers can last long after being cut
3. The flower stem is quite long and strong
4. Flower is not easy to damage in packaging

Flowers are produced from plants that are fertile and easy to flower without knowing the season, therefore the stages of cultivation also play a role in producing good quality flowers.

According to the Dirjen Hortikultura (2012) chrysanthemums as cut flowers with economic value must meet several conditions, namely: (1) beautiful, smooth, clean, no stains, (2) flowers

can last long after being cut; (3) flower stems are quite long and strong, 4) flowers are not easily damaged in packing; (5) green and fresh leaves; and (6) free of plant-disturbing organisms (OPT).

Efforts to improve post-harvest management from cut flowers to arrive at the marketing network are an appropriate way to improve the quality of cut flowers as long as all parties consider the types of cut flowers and the marketing network mileage (Acedo and Kanlayanarat, 2001).

C. Post-Harvest Handling Stage of Chrysanthemum

Flowers with prime quality certainly have a higher sale value than low-quality cut flowers. The purpose of handling post-harvest cut flowers is to maintain the integrity of the flowers, so that the quality of flowers received by consumers remains good and gives added value to the product. In order for the quality of the flowers to remain excellent in the hands of consumers, the flowers need to be given nutrients and preservatives in the flower soaking liquid (Hidayah, A. Iis Nur Asyiah, Sulifah Aprilya Hariani. 2012). Like other live plant parts, chrysanthemum cut flowers require water and nutrients to maintain their freshness. After the flowers are cut from the main plant the natural process will be stopped in the form of transportation of water and nutrients from the roots, and for its survival it relies on existing water and nutrient reserves. By itself the available reserves become a limiting factor for the durability of chrysanthemums to stay fresh. Therefore, it is necessary to substitute water and nutrients from outside that can be used to supplement energy sources for the survival of chrysanthemum flowers for a certain time (Desy and Nyntia, 2012).

Horticulture Research and Development results show that with good post-harvest handling the freshness of chrysanthemum cut flowers can be maintained up to 12 days, conversely if the handling is not good then the freshness of the flowers only lasts 5-6 days (Rukmana & Mulyana, 1997).

The stages of handling post-harvest chrysanthemums include the stages of harvesting, sorting and grading, pickling and packaging and storage.

1. Harvesting

The time of harvest determines the quality of chrysanthemum flowers. Picking too early causes flowers to bloom imperfectly and the color is rather pale. On the other hand, late picking results in flowers can't be endurance in the hands of consumers. Cut flowers of spray type and standard type are harvested at the age of 12 MST for standard types and 14 MST for spray types. The spray type is harvested when a large part of the petal on the old flower has opened but is still upright and not yet in full bloom while the standard type is harvested on the flower having a diameter of 8-10 cm.

According to Isabella (2003), spray-type chrysanthemum is harvested if at least four flowers have bloomed and followed by more than two half-bloomed flowers, while the standard type can be harvested if at least two outer circles of the flower crown have bloomed and are still protected by the wrapper (Isabella, 2003). The right time to harvest is when the flower has $\frac{1}{2}$ bloomed or 3-4 days before the flower is in full bloom. By this time, the flower has reached full size, the color intensity has almost reached its peak, the flower crown is open against the vertical line and the flower's eyes are still pressed or drowned. When the flower is in full bloom, the color of the flower will be brilliant, the flower crown will open close to 90° the vertical line, and the flower's eye will start to expand or peak up between the circle of the crown (Alamanda, 2007).

Flower harvest time for flower farmers, mostly based on practical considerations. For example the harvest in the morning, with the reason the market is close so that the harvest can be directly handled and sold to the market. In Tomohon City, farmers usually harvest flowers when there are buyers who come to the garden and are usually done in the morning or evening. Rismunandar (1995) states that a good harvest time is in the morning before 07.00 WIB or after 15.00 WIB in the afternoon. Harvesting is done when the flower in the middle has opened and the flowers around it have fully developed, while Supari (1999) stated that the best harvest time is in the morning at 06.00-08.00 local time. At that time the water content and other food contents in the plant were still sufficient with visible signs of appearance of fresh flowers.

Flowers harvested in the morning will last longer and have a longer vase life, while flowers harvested in the afternoon should be treated specifically, namely the base of the flower stalk

soaked in water mixed with plant nutrients, for example glucose so that the flower does not quickly wilted.

2. Harvesting Techniques

According to Widiati (1992) harvesting is done by selecting plants with flowers that are ready to be harvested by cutting flowers 15 cm from the ground surface using harvesting scissors and then put them in a bucket filled with water. Harvesting techniques that need to be considered are cutting the chrysanthemum stems with a slope angle of around 45° to provide a broad field of water absorption so that flower endurance is better.

3. Sorting and Grading

Sorting aims to separate flowers based on the criteria for fresh flowers (smooth) and those that are damaged or defective, then cut the base of the flower stems so that the length meets the standard. Usually the bottom three leaves of the flower stem are removed. Grading aims to classify flowers according to grade or quality level, among others. Grading is based on the color of the flower, the size of the inflourescences, and the length of the flower stalk.

4. Binding / Grouping Flowers (Bunching)

Flowers and leaves that have been selected and determined by their grading criteria, bound using a rope or rubber according to the rules of the amount. For standard sizes, cut chrysanthemums are tied by 10 stems per bunch, 10-12 stems per bunch for Daisy chrysanthemums or 5-8 stems per bunch.

5. Preservation

There are 2 preservation technologies, namely pulsing and holding liquid:

- Pulsing is a preservation treatment for a short period after harvesting (after the stages of sorting and grading), with high sugar concentrations. Tisnawati (2005), pulsing is a process of soaking the flower stem immediately after harvesting, which functions as a freshener for 2- 24 hours. The flower preservation method that is commonly used for vase life of cut flowers is a liquid by pulsing. The purpose of pulsing treatment is (a). Extend the freshness period of interest, (b). Prepare the condition of the flower stalk to remain firm during the period of distribution and transportation, (c). Stimulate the florescence that are still buds (Dirjen Hortikultura, 2012).

According to Halevy and Mayak (1981), the usage of pulsing liquid to maintain the quality and freshness of cut flower has been known for long time ago. The liquid consists of three main components namely sugar (sucrose), germicides and acidifying ingredients. The same type of liquid can be used for all types of flowers, but to get optimal results different types of liquid are used according to the type of flower and the level of handling. The sucrose form is the most efficient for plants and is easily transported in plant cells (Wiryanto, 1993). The content of the substrate (sugar) in the flower shows the potential for life of the flower at a certain temperature. A gradual decrease in respiration in flowers is caused by a small reserve of substrate.

- Holding solution. Holding is a preservation treatment by soaking the flowers at a low liquid concentration for a long time (Sunarmani, E. Sukasih, Kun Tanti Dewandari, Sabari, S.D., 2006), which is a treatment that can be carried out by the flower seller, until the flowers are sold or the liquid used by consumers for flower demonstration. In general, the constituent of preservative liquid is a source of energy, pH-reducing substances, biocide, anti-ethylene compounds and growth regulators.

D. Preservation and Storage Technology

Various ways to extend the freshness of cut flowers, among others, by harvesting at the right age, storing at the appropriate temperature, inhibiting ethylene production, providing carbohydrates, and so on (Suradinata, 2012). Generally, the fresh period of chrysanthemums ranges from 5-7 days, depending on the handling process, environmental conditions and durability of the varieties. From the results of several studies have found substances that function as preservatives.

Immersion with ZPT

Increased freshness of cut flowers can be conducted by soaking in ZPT, one of which is cytokines. Several types of cytokines can be used including BA or BAP. The use of cytokines is

widely used to improve the storage life of some ornamental plant commodities such as soaking carnation flower stems, irises, roses, tulips and daffodils in BA to give a good effect in increasing the freshness of flowers.

Provision of growth regulators (PGR) aims to stimulate certain physiological conditions in plants to improve the quality and performance of the expected plants. This application of ZPT will help plant performance and shape to be better, thicker stems, and darker leaf color. ZPT will be absorbed through the leaves of the plant within one hour after application and within 12 hours will be fully absorbed. Younger leaves will absorb ZPT faster than older leaves. Application of ZPT should not be conducted if the conditions are hot and scorching ($> 25^{\circ}\text{C}$) or low temperatures ($<16^{\circ}\text{C}$) (PUSTLITBANGHORTI, 2006).

Growth regulators which are also used to inhibit the growth of plants are retardant. Retardant that often used for chrysanthemum cut flowers are B-Nine with active ingredients Daminozide (Krisantini, 2006). B-Nine is given with a concentration of 2 g / L by keeping it slow and allowed to stand for 6 hours before it is aimed at stimulating or activating the active ingredients in the B-Nine. B-Nine was given a radiation sprayed on the surface of the chrysanthemum as much as 3-4 times. The first B-Nine was given at a plant age of 5 MST with a concentration of 1 g / L. B-Nine was secondly given to a plant with age of 7 MST with a concentration of 1.5 g / L. At the age of 9 MST was given a third B-Nine with a concentration of 2 g / L, while the fourth B-Nine was given at a plant age of 10 MST with a concentration of 2 g / L (Syifaurrehman, 2011)

Immersion with glucose

The provision of glucose is done to provide additional food to the flowers that have been cut because the flowers harvested have undergone a metabolic process or overhaul of carbohydrates, so the flowers that have been cut do not have sufficient food supplies to maintain their vase life (Supari, 1999).

Immersion with chemical compounds

In addition to the nutritional source, in AgNO_3 chemical compounds the holding liquid, it is able to control and prevent the growth of bacteria in the cut flowering solution and also functions as an anti-ethyl so that it can maintain the longest vase life of chrysanthemum cut flowers. Another chemical compound that can be used is the HQS solution. According to Banaee, S., Ebrahim Hadavi and Pejman Moradi (2013) HQS holding liquid functions besides being a germicide, it is also able to absorb water. The HQS inhibitory effect lies in its ability to clog xylem tissue vessels and bacterial colonization so that it can preserve flowers.

Immersion with natural compound nutrition

In order to pay attention to the dangers to human health and environmental risks, for this reason the creation of new substances as alternatives is very important in the floriculture industry. Therefore, an inexpensive and applicative alternative material is needed to replace it, namely by using betel stew as a natural bactericide. The use of betel leaf stew in the chrysanthemum cut flowers soaking liquid acts as an antibacterial capable of maintaining the freshness of flowers / vase life by acting as an antibacterial. The benefits of betel leaf stew need to be known by the public, because when compared with the use of chemicals such as AgNO_3 as a preservative of flowers that have been known to the public, betel leaf stew is far more applicable. Besides being economical, betel leaf is safe to use and environmentally friendly because it does not leave residue after use. Betel leaf stew is able to surpass AgNO_3 which is very expensive, is toxic, causes skin irritation and is harmful to the environment.

The use of ethylene absorbent

To reduce the ethylene content that can accelerate the rate of respiration, there are several substances that can be used to absorb it. One that can be used is KMnO_4 . Several ways to postpone the maturity and senescence of plants and fruits have been carried out in other countries. It aims to maintain the freshness of horticultural products in a certain period of time, so that decay or damage to these products can be avoided. There are several ways commonly used to prevent damage to horticultural products, including the addition of chemicals, waxing (waxing), packaging with polyethylene, and cooling. From some of these methods a combination can also be used to extend the storage of products (Pantastico, 1986).

Ethylene absorbent that can be used are potassium permanganate (KMnO₄), activated carbon and other minerals, which are put into sachets. The most widely used material is potassium permanganate which is absorbed on silica gel. Permanganate will oxidize ethylene to form ethanol and acetate. This ethylene absorbent contains 5% KMnO₄ and is put into a sachet to prevent the release of KMnO₄ because KMnO₄ is toxic (Darmawan, 2007)

Potassium permanganate (KMnO₄) is one type of material that can absorb ethylene content in the air. The ethylene content in the air needs to be removed or reduced to prolong the shelf life of cut flowers. Potassium permanganate oxidizes ethylene and is converted into ethylene glycol and manganese dioxide. Chemicals containing KMnO₄ can be found in chemical stores under the purafil trademark. These material requirements must be strong and have a large surface area. So far, several materials have been investigated that can be used as absorbents or binder permanganate. Some of these materials are vermiculite, pumice, and brick. In this research, which will be used as an absorbent is some type of packaging paper which is commonly used as horticultural packaging. There is a significant influence of chemical treatment on packaging on the physical parameters of changes in flower weight. The results of Darmawan's research (2007) showed that packaging with scrap paper which was treated with KMnO₄ soaking with a concentration of 10% gave the most optimal effect on the weight loss of chrysanthemum when in the storage.

Immersion with Sucrose Liquid

The usage of sucrose in the soaking liquid can extend the storage life, because sucrose is a source of nutrition for cut flowers. But it must be considered levels given. Provision of sucrose into the liquid to exceed the optimal range will cause greater pressure outside the cell fluid so that the fluid inside the cell will come out and plasmolysis occurs. In addition, the provision of high concentrations of sucrose also causes the growth of bacteria and the formation of a mucus layer on the flower stems so that a blockage occurs, as a result the absorption of the soaking solution will be inhibited (Astawa, 2003). Therefore, the provision of sucrose into the immersion liquid should be carried out at optimal concentration, because at that concentration the sucrose acts as a respiration substrate to produce energy that will be used in the life process so that the freshness of the flowers will last longer.

Immersion with Citric Acid

According to Prabawati, S., Murtiningsih, D. A. Setyabudi dan Nurmalinda (2002) citric acid is a good pH-lowering agent, because it does not cause a decrease in pH that is too low, besides that citric acid acts as an antibiotic so that it can inhibit bacterial proliferation. This is supported by the opinion that the provision of citric acid at a concentration that is optimally able to inhibit the growth of microbes on the surface of the flower stalk, so that water absorption by the flower stem is not disturbed. The results showed that the freshness of the longest interest, which was 13.50 days was obtained by giving 2% sucrose by adding asamsitrate 400 ppm or 6.50 days longer than the control. The freshness of flower freshness is strongly influenced by the amount of soaking liquid absorbed. This explains that the more soaking liquid is absorbed, the freshness of chrysanthemum cut flowers will be longer (Wiraatmaja, et al, 2007). Usage of BAP and Coconut water.

Aging chrysanthemum, some processes occur including the change in color of the flower both the flower crown or the flower disc. In addition to the process of changing the color of the flowers to fade, the aging process is characterized by withered flowers caused by the loss of flower cell turgidity which ultimately causes the flowers to fall out (Van Doorn, M.D, Branje, J.T. & Meeus, H.J. 2008). Visualizing flower withering is marked by withering of the crown of flowers increasing the angle of the flower curl and also withering of the discs. Suradinata's research results (2012) giving BAP and coconut water can significantly prolong the process of expansion of discs on White Fiji cultivars but do not significantly affect Yellow Fiji cultivars.

Provision of Vitamin C

Desy and Setiari's research results (2012), giving vitamin C by spraying is more effective than when chrysanthemum is immersed in a marinade liquid added with vitamin C. The provision of vitamin C into the marinade liquid has no longer effect on the freshness of chrysanthemum flowers. Vitamin C contains potassium (K) compounds which can be absorbed in the form of K⁺ which serves to increase plant resistance to drought and play a role in strengthening the body of

the plant. Chrysanthemum (flower crown) which is sprayed with vitamin C is possible potassium compounds absorbed by the cells making up the flower crown and stored in the vacuole so that the chrysanthemum flower crown can be fresh.

A combination of several immersion treatments

Prabawati et al (2002) reported that the best pulsing composition to extend the freshness life (vase life) of chrysanthemum cut flowers of white Reagan variety was 5% sucrose or sugar + 25 ppm AgNO₃ + 200 ppm citric acid (pH of the solution reached 3.5 - 4) . It is expected that by using pulsing solution on chrysanthemum cut flowers can reduce yield losses of 20-40% and vase life of chrysanthemum cut flowers from 7 days to 21 days, guaranteed income stability, building a sustainable flower agribusiness business that can accommodate labor and farmers' certainty in farming cut flower farmer.

The results of research on the use of several soaking solutions had also been carried out in Tomohon City as a flower center in North Sulawesi. The application of soaking liquid consists of AgNO₃, Bayclin and HQS combined with citric acid solution and granulated sugar liquid, as presented in table 3. The usage of bayclin adopts the habits of farmers and flower traders in the city of Tomohon.

Table 3. Amount of chrysanthemum blooms with different immersion liquid

Displ ay Period	Treatment Type of Liquid	Variety		
		Mustika kania	Puspita Pelangi	Puspita Nusantara
5 days	AgNO ₃	1.2000	0.6000	1.0000
	Bayclin	1.6000	0.0000	0.4000
	HQS	0.6000	0.6000	0.6000
10 days	AgNO ₃	5.0000	1.6000	6.4000
	Bayclin	4.6000	2.4000	5.8000
	HQS	5.8000	3.4000	6.8000
15 days	AgNO ₃	5.6000	5.2000	8.2000
	Bayclin	6.0000	5.8000	9.6000
	HQS	8.2000	4.0000	8.4000
20 days	AgNO ₃	7.2000	5.6000	8.2000
	Bayclin	6.8000	6.6000	9.6000
	HQS	8.0000	4.8000	8.4000
24 days	AgNO ₃	6.6000	4.4000	6.8000
	Bayclin	7.0000	3.4000	9.8000
	HQS	8.4000	4.6000	8.4000

Source : Lintang, et al (2016)

Freshness of chrysanthemum flowers after harvest is very dependent on post-harvest handling including preservation activities. The results of the research by Lintang, et al (2016) showed that the use of holding liquid in the display of chrysanthemum flower varieties of Mustika Kania, Puspita Pelangi and Puspita Nusantara significantly affected the diameter, number of florets, number of half-bloomed flowers and number of blooming flowers (Lintang dan Layuk 2014) . Other research results treatment with AgNO₃ holding liquid and HQS can extend the chrysanthemum cut flower life time is 14 days longer than without treatment with the parameter number of flower buds and half-blooming flowers and 5 days longer than without treatment with flower diameter parameters and the number of flowers in full bloom (Lintang and Layuk, 2015)

Freshness of chrysanthemum cut flowers (*Chrysanthemum indicum*) standard varieties are designated with a maximum of 135° open flower crowns against vertical lines, flower eyes begin to expand, bright colors and stems in a solid state. real. The results of the research data showed

that the soaking liquid is one of the elements that determines the freshness of the flowers and the percentage of flower blooms during immersion. The main element is the availability of water and carbohydrates (sugar) in the liquid as an energy reserve for the ongoing metabolic processes of cut flowers.

Chrysanthemum Packaging and Storage

Packaging of cut flowers, in addition to the purpose of preservation, also aims to support the fluent transportation, distribution and also as a means of marketing competition. By using good packaging, flowers will be more durable or resistant during the journey to the marketing location (Nofriati, 2005).

Packaging is a place or container used to package a product, while packaging is one way to protect or preserve food products. In a special sense, packaging is a container or place used to package a commodity and has been equipped with writing or label that explains the contents, uses and others that need or are required. Some of the characteristics of packaging desired during distribution are: (a) . according to the nature of the product to be packaged, (b). has sufficient strength to withstand the risk of damage during transport and storage, (c). has adequate ventilation holes (for certain products that are indeed in need).

In chrysanthemums, if the stems appear to be more than one, the flower bud that grows is cut into small pieces and the largest is left. This bud will form an optimal-sized cut flower and looks beautiful. If the flower bud has begun to bloom and display the color, then it is time to pocket the flowers. The purpose of bagging is to prevent flowers from dust, rain, or insect attacks. Large diameter of the bag varies between 15-25 cm for medium size flowers and 20-30 cm for large flowers. Bags made from oil paper or plastic bags (Soekartawi, 1996).

The stages of packaging and storage work are an inseparable part of the price formation variable. In general, the weakness of a florist lies in the level of packaging and storage work. This is because the job requires special expertise. Usually flowers that have been tied up according to class and size need to be wrapped in paper or plastic only to protect the smoothness of the crown. In the city of Tomohon, the packaging done by traders is still traditional in nature, only using large paper that does not pay attention to the number of flower stems per package and does not pay attention to grade. This is due to consumers not paying too much attention to the grade of interest. Basically there are several types of flower packaging, as follows.

1. HDPE and LDPE Plastic

Plastic is defined as a polymer of high molecular weight organic monomers. Plastic is a practical material, has many uses and inexpensive. The use of plastic in daily life is very rapid development and can almost replace various uses of other wrapping materials.

Based on its density Polyethylene (PE) consists of 3 types namely, Low Density Polyethylene (LDPE), Medium Density Polyethylene (MDPE), High Density Polyethylene (HDPE). The characteristics of the three plastics are as follows: LDPE: has a density of 0.910-0.925 g / cm³, produced through high pressure. Used as a bag, easily hemmed, and cheap. MDPE: has a density of 0.926-0.940 g / cm³, is more rigid than LDPE and has a higher melting temperature than LDPE. HDPE has density of 0.941-0.965g/cm³, most rigid among third of them, resistance to high temperature. LDPE is made from ethylene gas, because it is composed of many branch chains, the molecular structure of LDPE is lacking. It is weak, softer, has a low tensile strength, does not withstand heat and chemicals. (Syarif, 1989). Compared to PE, polypropylene (PP) has better tensile strength and clarity and lower vapor and gas permeability. Other properties of PP are that it does not react with the material, can reduce contact between the material and O₂, does not cause toxins, and is able to protect the material from contaminants (Pantastico, 1989). Usually flowers that have been tied up according to a certain class and size are wrapped in paper or plastic only to protect the smoothness of the crown. Generally, shipping is carried out in a dry manner, the environmental conditions are not regulated by temperature and humidity. Flower packaging is done by wrapped in banana leaves, plastic sacks, cement paper, while bamboo baskets, boxes are sometimes coated with plastic (Soekartawi, 1996).

2. Paper

Paper itself is made from cellulose fibers which are accustomed to come from wood fibers which are added with some additional additives which are added to get certain characteristics and characteristics of paper that will be formed. Paper has different properties according to its

type. So the use of paper in packaging must be considered to suit its purpose. Among the physical properties include tensile strength, resistance to friction, water resistance, stretch strength, crack resistance, water absorption, permeability, and several other physical properties (Hambali, 1990).

The packaging material used for primary packaging was initially scrap paper. Because scrap paper made bad appearance of the flower so it is replaced with 60 grams of plain white paper, but this material is not easily formed into a cone so it takes a long time so that it is inefficient and then the paper for the cone is replaced with 70 gram HVS paper.

Paper packaging is the first flexible packaging before the discovery of plastic and aluminum foil. This material is made from pulp (wood pulp) which is added with some additional ingredients which are intentionally added to obtain certain desired characteristics. At present paper packaging is still widely used and is able to compete with other packaging such as plastic and metal because of its cheap, easy to obtain and its use large. Aside from being a packaging, paper also functions as a communicator and print media. The disadvantage of paper packaging is that it is sensitive to water and is easily influenced by environmental humidity. The properties of the packaging paper are highly dependent on the manufacturing process and additional treatment to the manufacturing process. Paper packaging can be either flexible packaging or rigid packaging. Some types of paper that can be used as flexible packaging are kraft paper, grease proof paper. Glassing and waxed paper or paper made from modified paper.

3. Nylon

One of the packaging that is good enough to be used in packaging agricultural products is nylon packaging. This package has advantages compared to other packages, such as the smooth texture of the material and its shape resembling a net so that the product can still be exposed to light and better air circulation. Besides the packaging with nylon material has elastic properties, so this package can adjust the shape and size of the product (flower crown) and protect the product tightly (tightly) so that damage to the flower crown can be minimized. Packaging made from nylon for flower packaging is still rarely used in Indonesia, this is because raw materials are difficult to obtain because they are still imported .

Storage

Storage is the activity of placing flowers into a temporary storage room or in a long period of time waiting for a consumer delivery schedule. Terms of storage space are: (a). The storage room is cleaned of dust and dirt and sterilized from pests, b). Storage room temperature and humidity are regulated according to standard storage procedures (for cold storage temperatures 8-14 ° C and humidity around 85-90%). C). Flowers are transported to storage (cold storage for long-term storage or for inventory), d). Flowers in storage are arranged according to room capacity and neatly arranged. Interest is grouped according to their quality classes, and e). Every day a control is made to regulate the entry of interest to be marketed (Dirjen Hortikultura, 2012).

Cut flower storage techniques affect the storage life of flowers and the condition of flowers. Storage techniques are carried out with the principle of conditioning the storage environment to match the environmental conditions required by cut flowers to last longer. Flower storage in cool storage averages 50C - 80C. Flowers that have not undergone the packing process are stored in a cold room with a wet system. Whereas cut flowers that have been packaged are stored by dry storage techniques with maximum time. The results of research from (Putranto, 2007), quality changes occur in the process of wet storage and dry storage. The results obtained showed that wet storage is better than dry storage. Nylon packaging with wet storage can maintain flower quality and quality for up to 12 days. Whereas plastic packaging with wet storage is the second best packaging that gives the best results, which can maintain flower quality and quality for up to 8 days by suppressing the increase in crown diameter by 16.38 mm during the storage process.

Overall it can be compared that the 70 gr HVS packaging is the best packaging, then followed by packing stacked newspapers. LDPE and HDPE plastics cannot provide good protection against mechanical damage while flowers without packaging primers give improper flowering results from day 0 with a mechanical damage caused by 100%.

Distribution

Distribution activities must consider the distance, the amount of flowers to be distributed and the type of transportation used. Distribution activities, namely boxes containing flowers, are

transported and arranged neatly in refrigerated box cars in accordance with the capacity of the car, the temperature of the box car is set around 8-14 ° C. For long distance shipments can be carried out by air cargo. After arriving at their destination, the cardboard is put out from the car carefully so that the flowers are not damaged. Flowers are removed then the stem ends must be cut $\pm$ 1cm and dipped briefly in a bucket of warm water with a temperature of around 30-35 ° C for 10 seconds so that the flower pores are open, then the ends of the flower stems are immersed in clean water and ready to be sold to consumers by paying attention to the number of flowers and using a holding liquid.

E. Conclusion

Handling of post-harvest chrysanthemums is an important factor that is inseparable from the stages of cultivation and greatly influences the selling value and added value that will be obtained by farmers and traders. Neglecting one of the factors in the post-harvest stage will reduce the freshness and chrysanthemum display period, so farmers and traders must pay attention to the critical point in each post-harvest cut flower process. The use of pulsing and holding liquid during display will extend the chrysanthemum vase life. By implementing post-harvest chrysanthemums in accordance with handling procedures (SOP), chrysanthemums will be obtained that can meet quality standards. Efforts to maintain the quality of chrysanthemum cut flowers that meet the quality standards can provide added value for farmers and flower traders.

F. References

- Acedo, A.L., & Kanlayanarat. (2001). Handling System For Ornamental Crops. Post Harvest Handling System Of Agricultural Products. Division Of Postharvest Technol. King Mangkut Univ. Of Technol. Thonburi, Bangkok.
- Alamanda, D. T. (2007). Pengkajian kemasan primer pada transportasi bunga potong krisan (*Chrysanthemum indicum*). Skripsi. Departemen Teknik Pertanian Fakultas Teknologi Pertanian Institut Pertanian Bogor. Bogor. 51 hal.
- Ahmad, U., E.Syaefullah, & H.K.Purwadaria. (2006). Evaluasi Mutu Bunga Potong Krisan Yellow Fiji Menggunakan Pengolahan Citra. Jurnal Keteknikan Pertanian Technical Paper. Halaman 243-252.
- Astawa, I.N.G. (2003). Memperpanjang kesegaran bunga mawar dalam vas dengan pemberian sukrosa dan perak nitrat ke dalam larutan perendam. Agrotrop 22 (2): 73 – 76.
- Badan Standardisasi Nasional. (1998). SNI 01-4478-1998. Bunga Krisan Potong.
- Banaee, S., Ebrahim Hadavi & Pejman Moradi. (2013). Effect of Ascorbic Acid, 8-Hydroxyquinoline Sulfate and Sucrose on the Longevity and Anthocyanin Content of Cut Gerbera Flowers. Current Agriculture Research Journal Vol. 1(1), 29-33 (2013).
- Desy, Nintya Setiari. (2012). Pengaruh Pemberian Vitamin C (Asam Askorbat) Terhadap Kesegaran Bunga Krisan (*Chrysanthemum Sp*) Pada Kawasan Sentra Penghasil Di Desa Ngasem, Kecamatan Jetis, Bandungan, Jawa Tengah. Available at: www.Undip.com.
- Darmawan, R. (2007). Pengaruh Pengemasan dengan Perlakuan KMnO₄ terhadap Karakteristik Fisik Bunga Krisan Tipe Fiji Yellow Standar selama Penyimpanan. Skripsi. Departemen Teknik Pertanian Fakultas Teknologi Pertanian Institut Pertanian Bogor. Bogor. 61 hal.
- Department of Agriculture and Animal Husbandry of Tomohon City, (2017).
- Dirjen Hortikultura, (2012). Standar Operasional Prosedur (Sop) Pascapanen Bunga Krisan Potong (*Dendranthema grandiflora* Tzvelev).
- Halevy, A. H. & S. Mayak. (1981). Senescence and postharvest physiology of cut flowers. Part 2. p 39-143. In: J. Janick (ed.). Hort.Rev.Vol 3.AVI. Publishing, Westport, Connecticut dalam Indah Prasetya Sari.
- Hambali, E. Et al. (1990). Pengantar Pengemasan ed. 3. Lab. Pengemasan IPB, Bogor.
- Isabella, N. (2003). Budidaya Bunga Krisan Potong (*Dendranthema grandiflora* Tzvelev) di PT. Alam Indah Bunga Nusantara, Cipanas-Cianjur Jawa Barat. Skripsi. Departemen Agronomi dan Hortikultura Fakultas Pertanian Institut Pertanian Bogor. Bogor. 52 hal.

- Lakitan, Benyamin. (1995). Fisiologi Pertumbuhan dan Perkembangan Tanaman. Raja Grafinda Persada: Jakarta.
- Nofriati. D. (2005). Kajian Sistem Pengemasan Bunga Mawar Potong (*Rosa hybrida*) Selama Penyimpanan Untuk Memperpanjang Masa Pajangan. Tesis. Program Studi Teknologi Pasca Panen, IPB, Bogor.
- Hidayah, A. Iis Nur Asyiah, Sulifah Aprilya Hariani. (2012). Pengaruh Rebusan Daun Sirih (*Piper betle*) pada Larutan Perendam terhadap Kesegaran Bunga Potong Krisan (*Chrysanthemum indicum* L.) dan Pemanfaatannya sebagai Karya Ilmiah Populer. (The effect of Piper betle Leaf Stew in Holding Solution for *Chrysanthemum indicum* L. Cut Flowers Vase Life and Its Utilization as Popular Scientific Work). UNEJ JURNAL XXXXXXXXX 2012, I (1): 1-5.
- Krisantini. (2006). Produksi Krisan Pot. Budidaya Bunga dan Tanaman Hias. PS Hortikultura, Departemen AGH, Fakultas Pertanian Institut Pertanian. Bogor.
- Lintang & Payung Layuk (2014). Kajian Penggunaan Larutan Holding Dalam Mempertahankan Masa Pajang Bunga Potong Krisan Varietas Remix. Prosiding Seminar Nasional Inovasi Pertanian Mendukung Bio-Industri. 9 Oktober 2014 di Manado. BBP2TP, Badan Litbang Pertanian. ISBN 978-602-1280-70-6.
- Lintang & Payung Layuk. (2015). Keragaan Masa Pajang Beberapa Varietas Krisan Tipe Spray di Kota Tomohon. Buletin Agrosaintek Sulawesi Utara Volume 1. Nomor 2. Desember 2015. ISSN 2528-519X.
- Manu, G. S. S. (2007). Pengaruh Perlakuan Pra Penyimpanan, Suhu dan Komposisi Larutan Pulsing terhadap Kesegaran Bunga Potong Gerbera (*Gerbera jamesonii*) Selama Penyimpanan. Departemen Teknik Pertanian, Fakultas Teknologi Pertanian, Institut Pertanian Bogor. Unpublished essay.
- Prasetya Sari, I. (2008). Aplikasi Pewarnaan Biru Pada Bunga Potong Krisan (*Dendrathera Grandiflora Tzvelev*), Gerbera (*Gerbera Jamesonii* Bolus) Dan Mawar (*Rosa Hybrida* L.). Unpublished essay. Institut Pertanian Bogor.
- Pantastico, E.R. (1989). Fisiologi Pascapanen. Penanganan dan Pemanfaatan Buah-Buahan dan Sayur-Sayuran Tropika dan Subtropika. Terjemahan Kamariyani. Gadjahmada University Press, Yogyakarta.
- Pantastico, E.B. (ed). (1986). Fisiologi Pasca Panen. Gajah Mada University Press, Yogyakarta.
- Prabawati, S., Murtiningsih, D. A. Setyabudi & Nurmalinga. (2002). Pengaruh pulsing terhadap mutu segar bunga krisan. J.Hort. 12(2):124-130.
- Puslitbang Horti (2006) Available at : <http://hortikultura.litbang.pertanian.go.id/>.
- Putranto, I. (2007). Pengaruh Bahan Kemasan Dan Metoda Penyimpanan Terhadap Perubahan Karakteristik Mutu Fisik Bunga Krisan (*Chrysanthemum* Sp) Potong Varietas Fiji Yellow Selama Penyimpanan.
- Rismunandar. (1995). Budidaya Bunga Potong. Penebar Swadaya. Jakarta. 163 hal.
- Rukmana, R & A, Mulyana. (1997). Krisan. Kanisius. Yogyakarta.
- Soekartawi. (1996). Manajemen Agribisnis Bunga Potong. UI Press. Jakarta. 97 p.
- Syifaurrehman, A. (2011). Pengelolaan Panen Dan Pasca Panen Bunga Krisan Potong Di Pt. Alam Indah Bunga Nusantara, Cipanas – Cianjur Jawa Barat. Departemen Agronomi dan Hortikultura Fakultas Pertanian. Institut Pertanian Bogor.
- Suradinata, Y. (2012). Penggunaan Benzyl Amino Purine (Bap) Untuk Meningkatkan Kesegaran Bunga Krisan. Application of benzyl amino purine (BAP) to improve the freshness of chrysanthemum flower. J. Agrivigor 11(2): 223-229, Mei – Agustus 2012; ISSN 1412-2286.
- Supari. (1999). Tuntutan Membangun Agribisnis. Edisi pertama. PT. Alex Media Komputindo. Jakarta. 413 hal.

- Sunarmani, E. Sukasih, Kun Tanti Dewandari, Sabari, S.D., (2006). Pengelolaan Pasca Panen. Bunga Krisan. Puslitbanghorti, Jakarta.
- Sondakh Joula Oliev Maya dan Rembang J. H. W. (2016). Analisis Produksi Varietas Unggul Baru (VUB) Bunga Krisan (*Chrysanthemum* Sp) Hasil Balai Penelitian Tanaman Hias di Provinsi Sulawesi Utara dalam Buku Teknologi Pertanian Spesifik Lokasi. IAARD Press, 2016.
- Tisnawati, (2005). Teknik Memperpanjang Masa Simpan Bunga Potong *Alpinia*. Buletin Teknik Pertanian. Volume 10. Nomor 1.
- Van Doorn, M.D, Branje, J.T. & Meeus, H.J. (2008). Conflict resolution in parent-adolescent relationships and adolescent delinquency. *The Journal of Early Adolescence*, 25-47.
- Wiraatmaja, I.W., I.N.G. Astawa., & N.N.Deviantri. (2007). Memperpanjang Kesegaran Bunga Krisan (*Dendranthema Grandiflora* Tzvelev.) Dengan Larutan Perendam Sukrosa Dan Asam Sitrat. *Agritop* 26 (3) :129 – 135. Fakultas Pertanian Udayana Denpasar, Bali.
- Widiati, S. (1992). Pengusahaan tanaman bunga potong krisan (*Chrysanthemum morifolium*) di Pusat Koperasi Bunga Indonesia (Puskopbinddo), Cipanas, Jawa barat. Laporan Praktek Lapang. Departemen Budidaya Pertanian Fakultas Pertanian Institut Pertanian Bogor. Bogor. 55 hal.
- Widyawan, R. & Prahastuti, S. (1994). Bunga Potong Tinjauan Literatur. PusatDokumentasi dan Informasi Ilmiah. LIPI, Jakarta.
- Wiryanto, K. (1993). Penangan Pasca Panen Bunga Aggrek. *Buletin Anggrek* 6, (2):20.
- Yulianingsih, A., Murtiningsih, Dan Sjaifullah. (2002). Penggunaan Larutan Perendam Pulsing Untuk Mempertahankan Kesegaran Bunga Mawar Potong Idole Dalam Suhu Ruangan. *J.Hort.* 12(3): 178-183.