HARVEST AND POST-HARVEST HANDLING OF ROSE (Rosa hybrid L.) AS CUT FLOWER AT PAUL VAN DER HULST ROZENKWEKERIJ BV, LIMBURG, THE NETHERLANDS

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ABSTRACT

TRI INDAH WULANDARI PUTRI. Harvest and Post-Harvest Handling of Rose (Rosa hybrid L.) as Cut Flower at Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands. Supervised by SANDRA ARIFIN AZIZ and EKO SULISTYONO.

Rose has a beautiful appearance and distinctive fragrant aroma. Rose is called the queen of flower. Rose can be used as a cut flower, garden flower, rose petals, and as cosmetic ingredient. Rose plants have many functions including food and beverage ingredients, fragrance, traditional equipment, religious ceremonies, and for indoor decoration. This problem which is often experienced in cut flower especially rose is very short of flower vase life. The efforts that can be done to increase flower production both in quality and quantity are to learn how to handle harvest and post-harvest rose properly and correctly. This internship aims to learn about harvest and post-harvest handling of rose in the Netherlands. The data that had been collected was analyzed quantitatively and descriptively. The data was taken of two varieties, namely Jumilia and Karenza. The data that had been collected was analyzed quantitatively and descriptively. The primary and secondary quantitative (numeric) data was analyzed by quantitative analysis using the mean and standard error with Microsoft Office Excel 2013 and t-student test at 5% level with Minitab 16.2. The qualitative data was analyzed by using descriptive analysis. The criteria for roses that ready to be harvested are the center of the flower is already slightly open and the petals are little blooms. The techniques to cut rose that ready to be harvested are by cutting the stem and leaving 1-2 cm from node of the plant that are ready to be harvested, and from the first to the third harvest is done by leaving 3 to 4 nodes to increase productivity. Roses vase life in Paul van der Hulst Rozenkwekerij BV were determined by knowing the best time to harvest roses and how to store roses in the cold storage room. The vase life of roses is affected by the cultivar. Jumilia cultivar has a bigger flower and stem length size than Karenza cultivar. The vase life of Jumilia cultivar is longer than Karenza cultivar.

Keywords: criteria, cultivar, Jumilia, Karenza, production
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as a requirement to earn bachelor degree
at
Department of Agronomy and Horticulture

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PREFACE

Praise and gratitude to Allah Almighty for all the grace so this thesis was successfully completed with the title “Harvest and Post-Harvest Handling of Rose (Rosa hybrid L.) as Cut Flower at Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands”. This thesis is structured as one of the requirements to earn an undergraduate degree. The internship was held in Limburg, The Netherlands during March-May 2019 is about harvest and post-harvest handling. The author acknowledges that the preparation of this thesis involves many parties. Therefore, in this occasion the authors would like to thank:

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INTRODUCTION

Background

Floriculture is one of the important agricultural industry in many countries of the world. The largest market is Europe and followed by North America. The Netherlands is the largest country in cut flower production of 35%, the second largest in Italy of 18% and the third is Germany of 11% (Uffelen and de Groot, 2005). According to Rabobank (2015), global export of cut flowers, cut foliage, living plants, and flower bulbs in 2013 amounted to USD 20.6 billion and almost USD 8.5 billion in 2001. Indonesia is one of the countries that has great potential in floriculture. Based on the results of HPS (Horticultural Production Statistics) data collection and processing in 2014, cut flower production in Indonesia increased by around 8.30% compared to 2013 (Ditjen Horti, 2014). According to BPS (2016), the chrysanthemum is the cut flower which has the largest production, followed by rose, tuberose, and orchid. These data show that the demand for cut flower in Indonesia increased every year. Floriculture in Indonesia has great potential for export. Mostly ornamental plants for exports are chrysanthemum, rose, and orchid. According to BPS (2016), rose was ranked as the second-largest export after chrysanthemum. The volume of rose exports in 2016 increased from 48.01 tons to 56.56 tons. Japan is the importer country of rose from Indonesia.

Rose has a beautiful appearance and distinctive fragrant aroma. Rose is called the queen of flower. Rose can be used as a cut flower, garden flower, rose petals, and as cosmetic ingredient. Rose plants have many functions including food and beverage ingredients, fragrance, traditional equipment, religious ceremonies, and for indoor decoration. The problem which is often experienced in cut flower especially rose is very short of flower vase life. The efforts that can be done to increase flower production both in quality and quantity are to learn how to handle harvest and post-harvest rose properly and correctly. Wahyanto et al. (2012), stated about the issues of rose cultivation, he stated that not all plants have good quality but there are deviations from the quality of rose which can affect the selling value and income of farmers.

One country that has a good harvest and post-harvest handling of floriculture is the Netherlands. According to Huylenbroeck (2009), the Netherlands is the leading role in floriculture with a total production value of 3,900 million Euro in 2006. It was representing 30% of the estimated total production in Europe. The facts indicate that the country can produce floriculture with high quality and high economic value because the growers cultivated the flowers in the glasshouse very intensive with high techniques to get high productions. One company in the Netherlands that concern in the floriculture, especially the cultivation of rose is Paul van der Hulst Rozenkwekerij BV. The company cultivated modern rose which have specialized in the supply of the largest flowered and high quality rose.
Aims

This internship aims to increase the student’s ability in the managerial skill of agricultural companies and cultivate rose in the Netherlands. The specific aims of this internship are to learn about harvest and post-harvest handling of rose in the Netherlands.

LITERATURE REVIEW

Rose

Rose is a woody perennial (Dahal, 2013). The genus of rose is Rosa, subfamily Rosoideae and family Rosaceae. Rose has 150 and 200 species of wild roses in the Northern Hemisphere and more than 20,000 cultivars. Dutch Rose and Local Rose are the most popular varieties because of the fragrance, appearance and the variety of color (Gauchan et al., 2009). According to Yuwono et al. (2008), most species have lengths with range from 5-15 cm, two-opposite (pinnate) leaves that have oval form, pinnate, tapered at the tip of the leaf and thorn on the stem that close to the ground. The color of the flower is usually white and pink or yellow and red in some species. In general, roses have thorn shaped like hooks that function when holding other plants. Some of rose species have thorns that do not develop and not sharp.

The varieties can be differentiated based on color, the shape of the thalamus, shape, and position of the sepal, shape of the petals, shape of the bud, and the shape of the open flower. The shapes of the buds are round, oval, pointed, slim or urn-shaped (de Hoog, 2001). Types of roses based on Dahal (2013) are floribunda, hybrid tea, grandiflora, and miniatures.

Utilization and Growth Environment of Rose

Rose is an ornamental plant that grown in the garden and sometimes indoors. Rose can use for commercial perfumery and commercial cut flower crops (Dahal, 2013). Leghari et al. (2016) also stated that rose can use as room refreshers. The petals of the rose are antiseptic that can use as eyewash ingredient with vitamin A, C, D, E, and B3. The rose water can use as masks to get fair skin which maintains skin pH and controls extra oil also for hair to make hair shiny and healthy. According to Proklamasiningsih (2016), rose is a source of antioxidants and citric acid. Rose florets can be used as a drink or as a skin freshener. Growth environment of rose is very important to get the best quality and quantity. According to Pal and Singh (2013), the ideal temperature for the adequate growth and development for the most varieties of roses is 19-27ºC. The best night temperature for most commercial rose cultivars is 15.5ºC and relative humidity of around 60-70%. Water requirements of rose per day 7-8 liters/m² (Kumari and Choudhary, 2014). Rose can be grown successfully on a
wide range of soils with the good handling of agronomy (Pal and Singh, 2013). The favorable type of soil for rose cultivation are well-drained loam, silty loam, and sandy loam with pH range between 6.0 to 7.5 but also can tolerate pH range up to 8 (Leghari et al., 2016). Rose is a plant that very susceptible to pests and diseases, so controlling pests and diseases must be a top priority to produce quality plants. The level of pest and plant disease will determine the amount of concentration of pesticides used. The main pests that attack rose plants are spider mites and aphids. The main disease that attacks is downy mildew (Sudarsono et al., 2016).

Harvest and Post-Harvest Handling of Rose

Harvesting roses at the right time can extend the flower’s vase life. Roses that are harvested too late or at full bloom index can cause flowers to quickly wither. Conversely, if the harvest is done too early, which is at the index of one bloom, it can cause flower buds to fail to bloom. The cultivar and the distance of marketing objectives also determine the harvest index of the bloom of roses (Amiarsi and Tejasawana, 2011). According to Reid (2009), harvesting is done manually using scissors or a sharp knife. Post-harvest handling of rose is important to get the best quality and quantity of rose. Factors that can be affected the postharvest quality are flower maturity, temperature, food supply, light, water supply, water quality, ethylene, growth tropisms, mechanical damage, and the disease of the flower.

Rose will get a relatively high price if post-harvest handling is good and right. Post-harvest handling that is carried out includes packaging of cut flowers, transportation to packing houses, sorting and grading, binding and packaging, storage, and transportation (Sudarsono et al., 2016). The roses that have been collected are sorted, criteria rose that should be sorted are the flowers that are damaged, withered, and decayed and then separate completely and the chosen flower must be sturdy, fresh, not damaged, not withered, the stem not broken. The thorn on the roses are also removed, the thorns removed are approximately 10 cm from the tip of the stem (Jingga and Ibrahim, 2017). According to Amiarsi and Tejasawana (2011), a decrease in the quality of flowers characterized by withered flower, the color of a petal is faded, and a relatively short period of vase life during storage, this is caused relative high temperatures and bacterial infections.

According to Reid (2009), Ethylene can cause flowers to die quickly, with a small concentration of ethylene gas can make carnations, gypsophila, and some cultivars of roses die quickly. Also, ethylene gas above one hundred parts in one billion parts of water (100 ppb) around sensitive cut flowers can cause damage to flowers. The cold storage room can help to keep the vase life of the cut flowers because the low temperature can reduce the ethylene sensitivity of the product. According to Ella et al. (2003), ethylene causes chlorophyll degradation that can make leaves rapidly increase aging. According to Sudarsono et al. (2016), soaking the flower stalks in preservative solutions can maintain the quality and extend the flower’s vase life because it is can inhibit the ethylene compounds and the senescence process will be hampered.
METHOD

Place and Time

The internship was conducted at Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands. The whole activity of internship was started from 5th March until 28th May 2019.

Practical Method

The practical method in this internship was conducted in whole activities of rose production which is adjusted with time and place from the company. The author worked as a formal worker of the company for three months in the glasshouse. The activities during an internship were the preparation of planting material and media, planting, pest and disease control, learned about fertigation system, harvesting, sorting and grading. The other activity which was conducted was the field orientation. Field orientation aimed to determine the general situation of companies such as company profile, field arrangements, work systems applied, and this activity is carried out to find out all activities carried out during the internship.

Observation and Data Collection

Data were collected in the form of primary and secondary data and documentation. Primary data collection was obtained by making observations directly related to technical aspects and discussions with the owner of the company. Secondary data was obtained indirectly by collecting data that already exists in company records, such as general conditions of the company, which includes the company location, climate and land characteristics, and production. Documentation was obtained from activities carried out to support data and information collection. Primary data was obtained from the results of direct observations were includes:

1. Plant Growth
   a. The amount of branches plants.
   b. Stem-flower length of rose, observation the stem+flower length of rose per week until the flower ready to be harvested. Measurements were made from the node's growing point to the top of the flower in centimeters (cm).
   c. The number of the leaf (compound leaves) in every branch.

Observations were conducted in five weeks with the direct method by taking five plants samples of Jumilia, one of the rose varieties in Paul van der Hulst Rozenkwekerij BV.

1. Harvest (Primary data)

Harvest observations were carried out by taking thirty samples of rose that harvested by the employee. This sample was taken randomly in every harvesting box. This data was taken in five replications of two cultivars,
namely Jumilia and Karenza (Figure 1). The data that presented of this sample were the diameter of flowers, the stem length, and the stem+flower length in centimeters (cm) (Figure 2).

![Figure 1. Rose cultivar. Jumilia cultivar (a), Karenza cultivar (b)](image)

2. Post-harvest
The data which was taken in the post-harvest stages were sorting and grading (by machine and hand calculated), this data was earned by taking four harvesting boxes randomly of each varieties Jumilia and Karenza with 4 replications. In each harvesting box, the author counted and collected rose data based on the size of stem+flower length of rose in first grade and second grade, early harvested roses, discarded rose according to company criteria, and counted total rose.

**Data and Information Analysis**

The data that had been collected was analyzed quantitatively and descriptively. The primary and secondary quantitative (numeric) data was analyzed by quantitative analysis using the mean and standard error with Microsoft Office Excel 2013 and t-student test at 5% level with Minitab 16.2.1. The qualitative data was analyzed by using descriptive analysis.
GENERAL CONDITION

Geographical and Administration Location

Paul van der hulst Rozenkwekerij BV is a family company engaged in floriculture, especially rose as cut flower. Area of the company is located in Reindonkerweg 4, 5966 NC America. America is a town in Netherlands province of Limburg. It is a part of the municipality of Horst aan de Maas, and lies about 16 km northwest of Venlo. Horst aan de Maas is one of the larger municipalities in the province of Limburg and is located between the urban centers Venlo and Venray, both located in North Limburg. Limburg near with Belgium, with the car just 2 hours because south of Limburg is bordered Belgium. Its long eastern boundary is the international border with the German state of North Rhine-Westphalia. The majority of the area consists of agricultural reclamations. The location map of Paul van der Hulst Rozenkwekerij BV is attached in Appendix 1.

Production glasshouse of Paul van der hulst Rozenkwekerij BV is at coordinate 51°26'18.9"N, 6°00'31.1"E. Reported by Weather Spark (2019), the topography within 2 miles of America is essentially flat, with a maximum elevation change of 82 feet and an average elevation above sea level of 100 feet. Within 10 miles is essentially flat (128 feet). Within 50 miles contains only modest variations in elevation (1,926 feet). The area within 2 miles of America is covered of cropland (77%), artificial surfaces (12%), and trees (11%), within 10 miles by cropland (62%) and trees (16%), and within 50 miles by cropland (47%) and artificial surfaces (21%).

Climate Conditions

Over the course of the year 1980 to 2016, according to Weather Sparks (2019), the temperature in America, the Netherlands typically varies from 0°C to 23°C and is rarely below -7°C or above 29°C. The summers are comfortable and partly cloudy and the winters are long, very cold, windy, and mostly cloudy. Warm season from June to September with an average daily high-temperature above 20°C. The hottest day of the year is on August with an average high of 23°C and low of 14°C. The cool season from November to March with an average daily high temperature below 9°C. The coldest day of the year is on February with an average low of 0°C and a high of 6°C. The average of the temperature can be seen in Appendix 2. In 2019, the shortest day is 22nd December with 7 hours, 50 minutes of daylight and the longest day is 21st June with 16 hours, 38 minutes of daylight. The earliest sunrise is at 5:18 AM on 17th June, and the latest sunrise is 3 hours, 23 minutes later at 8:41 AM on 31st December. The earliest sunset is at 4:27 PM on 13th December and the latest sunset is 5 hours, 30 minutes later at 9:57 PM on 25th June. Hours of daylight and twilight can be seen in Appendix 3. Sunrise and sunset with twilight and daylight saving time can be seen in Appendix 4.
History of Paul Van der Hulst Rozenkwekerij BV

In 1975 Sjaak with his wife, Cleta started to cultivate roses in Den Hoorn (South Netherlands). In 1992 they moved to North Limburg with their children. There are Linda, Mark, Koen, and Paul. In North Limburg, they continued their business. Now, they have about 9 hectares glasshouse, spread over three locations that close to each other. In 2019, this company has been located in Limburg for 27 years. The company is managed by a family, three sons of Sjaak and Cleta have responsible for the glasshouse. Paul van der Hulst Rozenkwekerij BV is managed by Paul. This glasshouse bought in June 2008 with an area 15,000 m² and 15,000 m² was added in 2010.

The first cultivar of rose which is cultivated by Paul van der Hulst Rozenkwekerij BV is Tara and then on January 2010, Deep Water cultivar was cultivated. However, in 2012 the company decided to replace Deep Water with Jumilia and Karenza because Deep Water has a problem of quality and the price was unstable. In 2014, this glasshouse got fire accident. Therefore, some of the roses were taken away because of the smoke and 6 months later they replaced with Jumilia and Tara. In 2015, Cadillac cultivar was planted in this glasshouse. In 2018, the company decided not to produce Tara and Cadillac because the growth was not good and the price was unstable. In 2019, Paul van der Hulst Rozenkwekerij B.V still cultivated Jumilia and Karenza.

Area of Concession and Land Use

Paul van der Hulst Rozenkwekerij BV has an area is 34,980 m², with a production area is 30,888 m². The company is also equipped with supporting facilities such as office, toilets, canteen for breaking time, machine room for sorting, grading and packaging, cold storage room, generator room, storage facilities for glasshouse supports, and parking areas. The production area for Jumilia is 27,000 m² and Karenza 3,888 m². The floorplan of the company area is attached in Appendix 5. The type of glasshouse is a modern type of Venlo. The building frame is made of steel and the wall is made of glass. At the roof of the glasshouse has ventilators are designed to be able to control airflow automatically that resembles a window and controlled by a computer. This glasshouse has a screen on the top of that can close automatically when the shine of the sun is too high.

Plant and Production Overview

Paul van der Hulst Rozenkwekerij BV is a company who is engaged in horticulture, especially in floriculture. This company produces rose as a cut flower. The cultivars of rose which is grown in this company are Jumilia and Karenza. Jumilia cultivar from United Selections and Karenza cultivar from De Ruiter. United Selections and De Ruiter are a company who breed a flower. The
The annual production and turnover in Paul van der Hulst Rozenkwekerij BV. Annual production since 2015 (a), annual turnover since 2015 (b)

In 2015 to 2016, the production areas of Jumilia was 18,144 m² and 18,387 m² in 2017, in 2018 was 22,923 m² and now in 2019 is 27,000 m². Since 2015 until 2018, Karenza is cultivated in 3,888 m². The production from 2015 to 2018 was decreased because of the quality of this cultivar, such as damage in the flower and plants. The graphic of production from 2015 to 2018 can be seen in Figure 2a.

Production of Jumilia in 2015 was 163.2 stems m⁻¹, in 2016 was 173.1 stems m⁻¹, in 2017 and 2018 were 180.6 stems m⁻¹ and 180 stems m⁻¹. In 2015, productivity of Karenza was 251.5 stems m⁻¹, in 2016 was 228.8 m⁻¹, in 2017 was 235.1 stems m⁻¹, and in 2018 was 205.3 stems m⁻¹. The turnover in Paul van der Hulst Rozenkwekerij BV increased every year. The annual production and turnover of the company can be seen in Figure 3.
Organizational Structure and Employment

Paul van der Hulst Rozenkwekerij BV has a simple organizational structure. There are only company owners, administration, leader, and workforce. Daily workers such as full-timer and part-timer. The three sons of Sjaak and Cleta which is Mark, Koen, and Paul are responsible for a glasshouse. Paul, the owner of Paul van der Hulst Rozenkwekerij B.V, is the main manager who managing the company from various aspects of managerial and planning corporate strategy. The company owner supervises and controls the daily workforce directly. The leader has a function to help the owner for the technical aspect and to order the worker’s job. The workforce consists of full-time and part-time workers.

Part-Time workers are working less than 32 hours per week. In the weekend and holiday, about 45 students are working in the glasshouse as a part-timer. In Paul van der Hulst Rozenkwekerij BV, 12 workers are working as a full-timer and 19 workers are working as a part-timer. The length of working hours depends on activities in the glasshouse. Normally, work begins at 07.00 until 16.15. On Sunday, work begins at 07.00 until 11.00. Break time is divided into three times with a duration of 20 minutes, 30 minutes, and 20 minutes. First break at 10.00, second break at 12.30, and last break at 15.00. Payroll systems for the student based on age and for part-timer or full-timer based on skill levels for experienced. The worker fee is calculated from the number of hours they are working. The administration are organized by a daughter of Sjaak and Cleta, Linda and their daughters-in-law Kim and Dorothea.

RESULT AND DISCUSSION

Technical Aspect

Preparation of Planting Media and Planting Materials

The planting media that is used in Paul van der Hulst Rozenkwekerij BV are cocopeat or coir pith or coir dust and rockwool that supplied from another company which specifically prepares planting media in accordance with the needs of cultivated plants. The planting media can be seen in Figure 4. According to Bussell and Mckennie (2004), rockwool is made with high temperature with the result media free from pests, diseases and weed seeds. Rockwool slabs and blocks can manage an optimum ratio between air and water for crop production through the season. These products can quickly respond to changes in Electrical Conductivity (EC) or pH requirements delivered by the irrigation to the root zone. Based on Schmilewski (2008), coco pith has extremely high air capacity and low water capacity. Cresswell (2019), also stated that coir dust is hydrophilic (attracts water) which means that moisture spreads readily over these surfaces. Coir dust provides more uniform moisture conditions for roots. The company used media once in the whole production process.
Figure 4. Planting media. Cocopeat (a), rockwool (b)

Rockwool that will be used as a planting media is immersed in a nutrient solution (Figure 5a). According to Bussell and Mckennie (2004), rockwool does not change the availability of nutrients, more than 98% water available and fertilizer absorbed by plants. Roses in Paul van der Hulst Rozenkwekerij B.V are propagated by cuttings (Figure 5b). The planting material is then dipped in 4-indol-3-yl-butyric acid (IBA) as a rooting hormone to increase rooting of ornamental plant cuttings (Figure 5c) and then planted in the rockwool that has been soaked with nutrient solution (Figure 5d). According to Rhizopon (2019), water and nutrient absorption increases when cuttings are well-rooted. Plants grow faster, stronger and resistant to pests and diseases.

Figure 5. Preparation of cuttings. Rockwool that immersed with nutrient solution (a), cuttings process (b), dipped the cuttings to the rooting hormone (c), planting cuttings into rockwool (d)

Cuttings of rose that planted in the rockwool cultivated in the nursery room with a regulated humidity for 4 weeks (Figure 6a), after which planted in cocopeat and cultivated in a glasshouse (Figure 6b).
Chemical analysis of the media at Paul van der Hulst Rozenkwekerij BV divided into 2 parts, in the front and in the back of the glasshouse due to differences in plants age. The roses that planted in the front of the glasshouse are younger than roses that planted in the back of the glasshouse. Parts of the glasshouse can be seen in Figure 7.

Nutrient solution consists of main elements and trace elements. The main elements and trace elements can be seen in Table 1. In table 1 and 2 written K and Ca standards are higher compared to other cations because potassium (K) required for plant growth processes because can increase crop yield and quality. High levels of available K can improve physical quality and disease resistance (Prajapati and Modi, 2012). According to Perrenoud (1990), K significantly can decrease the case of fungal diseases of 70%, insects and mites of 63%, nematodes by 33%, viruses by 41%, and the case of bacteria by 69%. Adequate potassium nutrition can help plants to tolerate pathogen attacks or help plants to recover from pathogen attacks. The other function of Potassium for plant growth based on Leghari et al. (2016) is can increase strength in the stem, drought and disease resistance, and has a direct role in quality constituent. Ca has a role in treating cell walls. Based on Shams et al. (2012), increasing Ca concentration can increase the root length and affect the flowering stem diameter. Chemical analysis of the media in the front of the glasshouse on April 2019 is described in Table 1.
Table 1. Chemical analysis of the media in the front of the glasshouse in Paul van der Hulst Rozenkwekerij BV

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th>Result</th>
<th>Standard</th>
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**Main Elements**

**Cations**

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**Anions**

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**Trace Elements**

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Source: Eurofins Agro, 2019 (The company data)

The laboratory test results in Table 1 show the results of chemical analysis of the media that are in front of the glasshouse. Based on Eurofins Agro chemical analysis on Mo are very low and Na of 1.4 mmol L⁻¹. Table 1 shows the Na concentration less than 3 which is still in the Na tolerance limits of the company standards. Based on Table 2 shows that the chemical analysis of the planting media in the back of glasshouse in April 2019 at Paul van der Hulst Rozenkwekerij BV still in the standard range. Chemical analysis is carried out by the company as a standard for nutrients application in the next time.
Table 2. Chemical analysis of the media in the back of the glasshouse in Paul van der Hulst Rozenkwekerij BV

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Main Elements

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Trace Elements

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Source: Eurofins Agro, 2019 (The company data)

Irrigation and Fertilization

Fertigation system at Paul van der Hulst Rozenkwekerij BV is using a drip irrigation system (Figure 8a). Water supply for this company comes from giants water basin at the backyard of the glasshouse. The water basin function to hold water from the rainfall. Irrigation and fertilization facility consist of generators to supply the water and water recycling system. This company has a water recycling system to recycle water which has been used during the production time. The water recycling system consists of the silo with a dirty drain on the outside of glasshouse. The dirty drain is recycled through an osmotic filter and heated up with temperature 95\(^{\circ}\)C and pH 4 to kill the bacteria. Then the recycled water can be used for fertigation system. At the same site of the water system, the company also installed a fertigation system to fertigate the plant through irrigation flow. The fertigation system consists of a water pump, fertilizer tank, injection nutrition pipe.
Irrigation and fertilization. Drip irrigation system (a), water which has been used during the production time (b), injection nutrition pipe (c), fertilizer tank (d).

The cycles have many turns per day depending on the weather and plant conditions. Normally, the dose of fertilizer compounds per day is 625 mL per plant. The fertilization is done 10 times per day at a dose of 62.5 mL per plant for once giving.

**Pest and Disease Control**

Pest and disease control at Paul van der Hulst Rozenkwekerij BV is divided into mechanical, biological, and chemical control. The company uses chemical control with the machine when the pests and disease in above the economic threshold (Figure 9a). The most pests in the glasshouse at Paul van der Hulst Rozenkwekerij BV are thrips, caterpillars, spider mite, whitefly. The most disease is mildew (Figure 9b). According to Malais and Ravensberg (2003), *Thrips fuscipennis* (rose thrips) occurs naturally in Europe and occasionally causes damage in sweet pepper, aubergine, and roses. *T. fuscipennis* is difficult to control biologically and can thus complicate the control of other thrips. The damage to ornamental crops is of various kinds such as flowers can be seriously damaged, while leaves too are often damaged and misshapen.
Figure 9. Pest and disease control. Machine for chemical control (a), mildew (b), natural enemies in the middle of the plants for biological control (c), trap glue insect (d).

The application of biological control is divided into 2 types, put the sachet of the natural enemies in the middle of the plants (Figure 9c) and pouring the natural enemies on leaves. The biological control also uses garlic that planted in the middle of plants. The mechanical control uses trap glue insect (Figure 9d) and the chemical control follow the rule of crop protection and disinfection from Royal Brickman.

**Bending and Disbudding**

Bending of the rose plant is a special cultural practice under glasshouse structures. The rose bending started in 5-6 weeks after planting in the cocopeat. According to Tjosvold (2001), bended roses have higher quality. The average fresh weight of the cut roses from plants that were trained with bending was 2.8-10.2% heavier for all cultivars except ‘Delores’. There was an 8.8% decrease in fresh weight in ‘Delores’. There was an 8.8% decrease in fresh weight in ‘Delores’. Average stem length increased slightly, 1.3-3.9%, in ‘Hotspot’, ‘Moonlight’, and ‘Obsession’ and decreased slightly, 0.7-0.8%, in ‘Romance’ and ‘Delores’ for roses trained with bending. The criterias of rose plants that selected for bending are weak and have blind shoots. The important things for bending are stems position lay below horizontal and the stem does not break (Figure 10). Based on Choudhary (2019), bending helps in maintaining enough leaf area to build up a strong root system.

Figure 10. The condition of the plants that has been bended
Axillary buds that must be removed. The center and axillary buds (a), the condition of the plant after disbudding axillary buds (b), the center bud that has two side buds (c), the condition of the plant after disbudding two side buds (d).

Disbudding is activities to the removal of buds below the center bud. The disbudding must be done regularly and also as soon as possible in order to avoid large wounds in the upper leaf axil. The standard cultivar of the cut flower is one flower on each stem. The bud that must be disbudding is two side buds and a third side bud lower down the cane (Figure 11a), the top bud will grow larger and give a better bloom after disbudding all 3 side buds (Figure 11b). The other criteria for budding is center bud that has two side buds (Figure 11c). The condition of remaining center bud after removing the two side buds can be seen in Figure 11d.

Plant Growth

The propagation of rose in Paul van der Hulst Rozenkwekerij BV by cuttings that planted in Rockwool and stored in a nursery room for 4 weeks, then the plant cuttings that planted in rockwool are planted in cocopeat and cultivated in glasshouses. The rose was bent 5-6 weeks after planting in cocopeat. The roses were ready to be harvested 5-6 weeks later. Some growth requirements that are needed and arranged in a glasshouse for optimal rose growth are CO2, humidity, day temperature, and night temperature (Table 3).

<table>
<thead>
<tr>
<th>Growth requirement</th>
<th>Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>1200 ppm</td>
</tr>
<tr>
<td>Humidity</td>
<td>80%</td>
</tr>
<tr>
<td>Day temperature</td>
<td>21°C</td>
</tr>
<tr>
<td>Night temperature</td>
<td>18°C</td>
</tr>
</tbody>
</table>

One Jumilia cultivar plant at the beginning of plant growth can produce an average of 3 branches. Based on observations data, 1 branch was bended 5-6 weeks after the rose plant was planted in cocopeat and 2 other branches were
maintained. The branches also must be bented when the condition of the branches was not good during the growing period. The average branch that was bent during the growth period had an average growth height smaller than the plants that had the good condition until harvest. The average growth of stem+flower length from the node’s growing point to the top of the flower in branch number 1 and branch number 2 was 6 cm per week until ready to be harvested (Figure 12). The average data of stem+flower length from the node's growing point to the top of the flower in the first observation can be seen in Table 4.

Table 4. The average data of stem+flower length from the node's growing point to the top of the flower in the first observation.

<table>
<thead>
<tr>
<th>Branch</th>
<th>The conditions</th>
<th>The average of stem+flower length from the node’s growing point (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch number 1</td>
<td>1. Until harvested</td>
<td>67.4</td>
</tr>
<tr>
<td></td>
<td>2. Before bended</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. One week after harvest</td>
<td>3.7</td>
</tr>
<tr>
<td>Branch number 2</td>
<td>1. Until harvested</td>
<td>54.3</td>
</tr>
<tr>
<td></td>
<td>2. Before bended</td>
<td>57.3</td>
</tr>
<tr>
<td></td>
<td>3. One week after harvest</td>
<td>2.6</td>
</tr>
</tbody>
</table>

The average of stem+flower length from the node's growing point ‘harvested’ means the average of stem+flower length from first observation until the rose ready to be harvested. The average of stem+flower length from the node’s growing point ‘before bended’ means the average stem+flower length from the first observation until before the branch was bent. The branches must be bented because weak and have blind shoots during the growing period that makes the plants can not be maintained until harvest. Data ‘one week after harvest’ means an average stem+flower length of a new node that appears in plant branches number 1 or number 2 after harvest.

![Figure 12](image-url)
The average branches that have been harvested have 1 to 2 new shoots that grow after 1 week harvested with an average growth of 30% greater in the first week after harvest than during the initial growth until the first harvest (Figure 12).

![Graph showing compound leaves average of Jumilia cultivar](image)

Figure 13. The compound leaves average of Jumilia cultivar

The histogram in Figure 13 shows that the average number of compound leaves in the first and second branches on the rose that were ready to be harvested was 15 compound leaves. The compound leaves average 'harvested' means the average number of compounds leaves on the rose that were ready to be harvested. The compound leaves average 'before bended' means the average number of compound leaves on the rose before the branch was bent.

### Managerial Aspect

The internship activities carried out were working in accordance with the schedule determined by the company as a daily employee for three months. Daily journal of internship activities can be seen in Appendix 6. The length of the working hours depends on activities in the glasshouse. Normally, work begins at 07.00 until 16.15. Activities carried out include harvesting, sorting, grading, pest and disease control, bending of branches, and disbudding. The division of labor system in the company is governed by a foreman. Every day there is one foreman in the production area to manage and control harvesting activities and one leader in the machine for sorting and grading activities. Every employee has their own schedule. Pest and disease control with the biological system are carried out in accordance with the direction of the owner, depending on the condition of existing pests and disease. Harvesting is carried out every morning starting at 07.00 to 13.00. Meanwhile, there are some employees who also work on machines for sorting and grading activities.
Marketing Management

Paul van der Hulst Rozenkwekerij BV markets their products at the auctions of Royal FloraHolland and at their shop. Royal FloraHolland is an international trading platform for plants and flowers and the largest ornamental plant auction organization in the world. They organize an international marketplace for flowers and plants for growers and buyers, match supply with demand, at highly competitive prices and the lowest possible transaction charges. They were working intensively together with new and existing partners in the horticultural sector. The Royal FloraHolland has six locations in several regions in the Netherlands, namely: Aalsmeer, Naaldwijk, Rijnsburg, Venlo, Bleiswijk and Eelde. The head office is located in Aalsmeer, which has been established for more than 100 years.

The auctions have around 4,031 members, 5,550 suppliers, and 2,465 customers. Royal FloraHolland has a wide variety of ornamental plants, which are around 30,000 different types of flowers and plants sold and have an annual turnover of around 4,648 million euros per year in 2018. Involving countries as suppliers among others, Kenya, Ethiopia, Israel, Belgium and Germany as well as the most important export destination countries are Germany, Britain, France, Italy and Russia (Royal FloraHolland, 2018). The prices of flowers fluctuate, this is influenced by demand in the auction market. The average prices per year starting from 2015 to 2018 can be seen in Table 5.

<table>
<thead>
<tr>
<th>Year</th>
<th>Karenza</th>
<th>Jumilia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0.34</td>
<td>0.54</td>
</tr>
<tr>
<td>2016</td>
<td>0.33</td>
<td>0.53</td>
</tr>
<tr>
<td>2017</td>
<td>0.31</td>
<td>0.51</td>
</tr>
<tr>
<td>2018</td>
<td>0.29</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Source: The company data

Special Aspect

Harvest

Harvesting was carried out in the morning with harvest cart (Figure 14). The techniques to cut roses that are ready to be harvested are by cutting the stem and leaving 1-2 cm from node of the plant that are ready to be harvested, and from the first to the third harvest is done by leaving 3 to 4 nodes to increase productivity. The tools needed for harvesting are leather gloves to protect hands from thorns and scissors for cutting rose.
Karenza and Jumilia cultivars have the same harvested criteria. There is no specific standard for the diameter and stem length of harvested rose. The criteria for roses that ready to be harvested are the center of the flower is already slightly open and the petals are little blooms. The criteria of Jumilia cultivar that ready to be harvested can be seen in Table 6 and for Karenza cultivar can be seen in Table 7.

Table 6. The criteria of Jumilia cultivar that ready to be harvested

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Appearance of Rose</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumilia</td>
<td><img src="image1" alt="Image" /></td>
<td>The rose that does not ready to be harvested because the petals are not blooms.</td>
</tr>
<tr>
<td></td>
<td><img src="image2" alt="Image" /></td>
<td>The rose that does not ready to be harvested because the center of the flower is not open.</td>
</tr>
<tr>
<td></td>
<td><img src="image3" alt="Image" /></td>
<td>The rose that ready to be harvested because the center of the flower is already slightly open.</td>
</tr>
<tr>
<td></td>
<td><img src="image4" alt="Image" /></td>
<td>The rose that ready to be harvested because the petals are little blooms.</td>
</tr>
</tbody>
</table>
Table 7. The criteria of Karenza cultivar that ready to be harvested

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Appearance of Rose</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karenza</td>
<td><img src="image1" alt="Rose Image" /></td>
<td>The rose that does not ready to be harvested because the petals are not blooms.</td>
</tr>
<tr>
<td></td>
<td><img src="image2" alt="Rose Image" /></td>
<td>The rose that does not ready to be harvested because the center of the flower is not open.</td>
</tr>
<tr>
<td></td>
<td><img src="image3" alt="Rose Image" /></td>
<td>The rose that ready to be harvested because the petals are little blooms.</td>
</tr>
</tbody>
</table>

Harvested flowers are collected together in the harvest box and on a net fabric if the harvest box is full. The harvest box and the net fabric are collected in the big cart that is filled with water to keep vase life of flowers (Figure 15). One big cart contains 15 harvest boxes. The big cart that full of harvest box immediately transferred to cold storage room.

Figure 15. Tools to collect the harvest roses. Harvest box (a), net fabric (b), big cart to collect harvest box and net fabric (c)
The average flower diameter of Jumilia cultivar that ready to be harvested based on the data collected in the field was 6.80 cm and Karenza cultivar had an average diameter of 4.29 cm (Figure 16). There was no specific diameter standard for roses that ready to be harvested. The diameter of the flower will increase until the end of the vase life. According to De Ruiter (2019), the diameter of Karenza cultivar can reach 9-10 cm. Both cultivars were harvested everyday but in one day after one cultivar was harvested then move on to the other cultivar. The late-harvested roses had a large diameter and almost every petal has bloomed. The roses's criteria that were earlier harvested was when the center of the flowers was not opened. The foreman always controls how the workers cut flowers to minimize the fault because each worker has a different experience that can make someone made a mistake. Jumilia cultivar has a larger flower diameter and stem is lengthier than the Karenza cultivar (Figure 17).
The histograms in Figure 19 shows that all harvested roses have stem+flower length above the literature average. The literature average is the stem+flower length issued by the breeder of the cultivar. Based on the United Selection (2019), the stem+flower length of Jumilia cultivar is 50-80 cm and based on De Ruiter (2019), the stem+flower length of Karenza cultivar is 64.5-94.5 cm.

Table 8. The test result of flower diameter, stem length of flower, and stem+flower length with t student-test

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Flower diameter (cm)</th>
<th>Stem length of flower (cm)</th>
<th>Stem+flower length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumilia</td>
<td>6.80</td>
<td>81.33</td>
<td>87.13</td>
</tr>
<tr>
<td>Karenza</td>
<td>4.29</td>
<td>68.05</td>
<td>72.79</td>
</tr>
</tbody>
</table>

T-test 0.001** 0.000** 0.000**

Note: ** = very significantly different on α = 5%

The result in Table 8 shows that the average of flower diameter, the average stem length of the flower, and the average stem+flower length of rose between Jumilia cultivar and Karenza cultivar are very significantly different. According to the company’s classification, Jumilia cultivars are grouped based on stem+flower length into 5 groups, 80, 70, 60, 50, and 40 cm and Karenza cultivars are grouped into 70, 60, 55, 50, and 40 cm. Based on data obtained at harvest time in 5 replications of Jumilia cultivars, 76.67% roses had stem+flower length of 80 cm, 20% of roses 70 cm, and 3.33% roses had stem+flower length of 60 cm (Figure 19). Karenza cultivars had 71.33% roses of 70 cm, 20% of roses had stem+flower length of 60 cm, 6% roses had stem+flower length of 55 cm, 1.33% roses had stem+flower length of 50 cm and 40 cm (Figure 20). Data were collected randomly with different ages of plants.

![Figure 19. Total stem length observed in every replication of Jumilia cultivar](image-url)
Post-Harvest

Roses that have been harvested are stored in the cold storage room to await the sorting and grading process. The sorting process aims to select roses according to the company's standard. Rose criteria that passed in the sorting process, namely low number of thrips damage, little mildew spot, not too bent, have a strong stem, the center of the flower is slightly opened, the petals are not broken and slightly bloomed.

**Figure 20.** Total stem length observed in every replication of Karenza cultivar.

- First grade of Karenza (stem is bent) (h)
- Second grade of Karenza (stem is bent) (g)
- Second grade of Jumilia (stem is bent) (d)
- Second grade of Jumilia (semi-circle in the center of flower) (c)
- Second grade of Jumilia (low number of thrips damage) (e)
- First grade criteria of Jumilia (stem is bent) (b)
- First grade criteria of Karenza (stem is bent) (a)

**Figure 21.** Standard criteria for roses in Paul van der Hulst Rozenkwekerij BV.

- First grade of Jumilia (stem is bent) (b)
- Second grade of Jumilia (semi-circle in the center of flower) (c)
- Second grade of Jumilia (low number of thrips damage) (e)
- Second grade of Karenza (stem is bent) (h)
- First grade criteria of Karenza (stem is bent) (a)
The roses that early harvested (in the center of the flower have not open) will be stored for one day and then grading it in the next day. The sorting process is carried out manually by the employee and the grading process is carried out by the machine. The machine will grouping rose in the first grade and second grade, also will grouping based on stem length flower of rose. Second grade criteria of roses have a low number of thrips damage, little mildew spot, the stem is not too bent, in the middle of flower-like a semi-circle but the petal of flower has bloomed, the color of flower brighter than normal. First grade criteria of roses are having a straight stem and perfect flower shape. Standard criterias for roses in Paul van der Hulst Rozenkwekerij BV can be seen in Figure 21.

![Discarded roses criteria in Paul van der Hulst Rozenkwekerij BV.](image)

During the sorting process, several roses must be discarded because the flowers did not accordance with grade 1 or grade 2 criteria. The criterias of discarded roses were same in every cultivar. Discarded roses can be seen in Figure 22.
The average stem total in one harvest box of Jumilia and Karenza cultivars are grouped based on stem+flower length into 5 groups, 80, 70, 60, 55, 50, and 40 cm. Jumilia cultivar is grouped into 80, 70, 60, 55, 50, and 40 cm. The grading process is divided into 2 times, the first grading process is for flowers with stem+flower length ≥50 cm, and the second grading process is for flowers with stem+flower length <50 cm. Sorting and grading are carried out in each harvest box. The average total of Karenza cultivar in one harvest box is higher than Jumilia cultivar (Figure 23). Harvest box of both cultivars has the same size. The difference total in each harvest box between these cultivars is the flower size. Jumilia cultivar is bigger than Karenza cultivar.

The average roses in every replication with different size of stem+flower length can be seen in Figure 24. This data did not come from Figure 19 and Figure 20. Based on these histograms, Karenza cultivar has higher loss percentage than Jumilia cultivar (Figure 24). Loss percentage in sorting and grading process of Karenza cultivar is 15.40% whereas Jumilia cultivar is 7.59%. It is caused by the quality of the flower. Roses of Karenza cultivar is stricken by thrips, it makes the flower must be thrown away in the sorting process. The part of the petals that have low number of thrips damage still can be grouped in second grade. Karenza cultivar has more roses in the second grade with stem+flower length ≥50 cm than Jumilia cultivar but in the first grade with same stem+flower length size Jumilia cultivar has more roses than Karenza cultivar (Figure 24). Roses in second grade with stem+flower length ≥50 cm in Karenza cultivar is 34.10% whereas Jumilia cultivar is 21.60%. In the first grade, Jumilia cultivars have 22.3% roses higher than Karenza cultivars.
Sorting and grading processes were conducted at the same time. The employee was standing beside the machine for sorting roses after it the roses that passed sorting will be hanged in the machine to grading process by machine (Figure 25).

Figure 24. Grouping after sorting and grading. Grouping after sorting and grading of Jumilia (a), grouping after sorting and grading of Karenza (b)

Figure 25. Post-harvest process. Sorting (a), grading machine (b)
The next step after sorting and grading is packaging. The packaging process is done by machine (Figure 2.6a). Roses are packed in one plastic according to the cultivar, grade, and size of each group. The employee checks the roses in plastic to see if there are flowers that have not the same size in one package (Figure 2.6b). After that, the flowers are placed in a basket that has been filled with a solution to keep the flower vase life and for bacteria protection (Figure 2.6c and 2.6d). The flowers that ready to distribute are stored in the cold storage room with a temperature of ± 3°C (Figure 2.6e). The roses will be distributed by large cars that equipped with temperature setting for flower storage during the distribution process. Based on De Ruiter (2019), the vase life of Karenza cultivar is 12-14 days and based on United Selection (2019), the vase life of Jumilia cultivar is more than 15 days.

**CONCLUSION**

Roses vase life in Paul van der Hulst Rozenkwekerij BV were determined by knowing the best time to harvest roses and how to store roses in the cold storage room. The vase life of roses was affected by the cultivar. Jumilia cultivar has a bigger flower and stem length size than Karenza cultivar. The vase life of Jumilia cultivar was longer than Karenza cultivar.
REFERENCES


Perrenoud, S. 1990. Potassium and Plant Health. Int. Potash Institute, Switzerland, CH.


APPENDIX
Hak Cipta Dilindungi Undang-Undang 1. Dilanggar sebagian atau seluruh karya tulis ini tanpa mensuntikan dan menyebutkan sumber:
   a. Pengujian hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah.
   b. Pengutipan tidak merugikan kepentingan yang wajar IPB.
2. Dilanggar mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB.
Appendix 1. The location map of Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands

Appendix 2. The average of the temperature in America, The Netherlands from January to December
3. Hours of daylight and twilight in America, The Netherlands from January to December

4. Sunrise and sunset with twilight and daylight saving time in America, The Netherlands from January to December
Appendix 5. The floorplan of the company area in Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands

Information:
1. Production area
2. Office
3. Toilet
4. Canteen
5. Substrate space
6. Warehouse
7. House
8. Boiler house
9. Parking area
## Appendix

### 6. Daily journal of internship activities in Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands

<table>
<thead>
<tr>
<th>Date</th>
<th>Job Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, 5/3/2019</td>
<td>Discussing about contract and company tour</td>
<td>Van der Hulst Rozenkwekerij BV</td>
</tr>
</tbody>
</table>
| Wednesday, 6/3/2019 | 1. Harvesting roses  
2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Thursday, 7/3/2019 | First meeting with agency                                                   | Office of SUSP, Alkmaar                                                   |
| Friday, 8/3/2019 | 1. Harvesting roses  
2. Put the sachet of the natural enemies in the middle of the plants  
3. Disbudding | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Saturday, 9/3/2019 | 1. Harvesting roses                                                         | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Tuesday, 12/3/2019 | 1. Harvesting roses  
2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Wednesday, 13/3/2019 | 1. Harvesting roses  
2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Thursday, 14/3/2019 | 1. Harvesting roses  
2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Friday, 15/3/2019  | 1. Harvesting roses  
2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Monday, 18/3/2019 | 1. Harvesting roses  
2. Bending                              | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Tuesday, 19/3/2019 | 1. Harvesting roses  
2. Bending                              | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Wednesday, 20/3/2019 | 1. Harvesting roses  
2. Bending                              | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Thursday, 21/3/2019 | 1. Harvesting roses  
2. Bending                              | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
| Friday, 22/3/2019  | 1. Harvesting roses  
2. Bending                              | Glasshouse of Paul van der Hulst Rozenkwekerij BV                          |
## Appendix 6. Daily journal of internship activities in Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands

<table>
<thead>
<tr>
<th>Date</th>
<th>Job Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday, 24/3/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Sorting and grading</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Tuesday, 26/3/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Sorting and grading</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Wednesday, 27/3/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Thursday, 28/3/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Friday, 29/3/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Monday, 1/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Tuesday, 2/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Sorting and grading</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Thursday, 4/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Friday, 5/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Saturday, 6/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Monday, 7/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Tuesday, 8/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Wednesday, 9/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Learning how to handle pest and diseases with machine</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
</tbody>
</table>
### Appendix 6. Daily journal of internship activities in Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands

<table>
<thead>
<tr>
<th>Date</th>
<th>Job Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wednesday, 10/4/2019</td>
<td>Went to Keukeunhof (made bouquet of roses for competition)</td>
<td>South Netherlands</td>
</tr>
</tbody>
</table>
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Friday, 12/4/2019  | 1. Harvesting roses  
2. Made experiment of cuttings rose with different concentration of rooting hormone | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Monday, 15/4/2019  | 1. Harvesting roses  
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Tuesday, 16/4/2019 | 1. Harvesting roses  
2. Sorting and grading                                                 | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Wednesday, 17/4/2019 | 1. Harvesting roses  
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Thursday, 18/4/2019 | 1. Harvesting roses  
2. Discussion with owner                                               | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Friday, 19/4/2019  | 1. Harvesting roses  
2. Learning about fertigation                                                | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Tuesday, 23/4/2019 | 1. Harvesting roses  
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Wednesday, 24/4/2019 | 1. Harvesting roses  
2. Sorting and Grading                                                | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Friday, 26/4/2019  | 1. Harvesting roses  
2. Disbudding                                                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
2. Colouring roses                                                  | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
<table>
<thead>
<tr>
<th>Date</th>
<th>Job Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, 30/4/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Sorting and Grading</td>
<td></td>
</tr>
<tr>
<td>Wednesday, 1/5/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Thursday, 2/5/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Friday, 3/5/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Sunday, 5/5/2019</td>
<td>Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Monday, 6/5/2019</td>
<td>1. Harvesting and bending roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Tuesday, 7/5/2019</td>
<td>1. Harvesting and bending roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Wednesday, 8/5/2019</td>
<td>1. Harvesting and bending roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Thursday, 9/5/2019</td>
<td>1. Harvesting and bending roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Disbudding</td>
<td></td>
</tr>
<tr>
<td>Friday, 10/5/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Discussion with owner</td>
<td></td>
</tr>
<tr>
<td>Monday, 13/5/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td>2. Sorting and grading</td>
<td></td>
</tr>
<tr>
<td>Tuesday, 14/5/2019</td>
<td>Made cuttings of roses</td>
<td>Glasshouse of M&amp;D van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Thursday, 16/5/2019</td>
<td>Made cuttings of roses</td>
<td>Glasshouse of M&amp;D van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td>Friday, 17/5/2019</td>
<td>1. Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday, 19/5/2019</td>
<td>Harvesting roses</td>
<td>Glasshouse of Paul van der Hulst Rozenkwekerij BV</td>
</tr>
</tbody>
</table>
## Appendix 6. Daily journal of internship activities in Paul van der Hulst Rozenkwekerij BV, Limburg, The Netherlands

<table>
<thead>
<tr>
<th>Date</th>
<th>Job Description</th>
<th>Location</th>
</tr>
</thead>
</table>
| Monday, 20/5/2019 | 1. Harvesting roses  
                  2. Disbudding                      | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Tuesday, 21/5/2019 | 1. Harvesting roses and bending  
                          2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Wednesday, 22/5/2019 | 1. Harvesting roses  
                       2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Thursday, 23/5/2019 | Went to breeder of roses                   |                                               |
| Friday, 24/5/2019  | Made cuttings of roses                | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Monday, 27/5/2019  | 1. Harvesting roses  
                       2. Disbudding                          | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
| Tuesday, 28/5/2019 | Harvesting roses                    | Glasshouse of Paul van der Hulst Rozenkwekerij BV |
AUTOBIOGRAPHY

The author was born in Denpasar, June 10th, 1997 from Syamsul Hadi, S.Sos and Suyati as the youngest daughter of three siblings. She was graduated from State Elementary School No. 6 Dalung at 2009, State Junior High School No. 1 North Kuta at 2012, and State Senior High School No. 1 North Kuta at 2015. At 2015, the author enrolled to Agronomy and Horticulture Undergraduate Program of IPB University through National Selection to Enter State Universities. During her study, the author was involved in many student activities such as participant of Environmental Activities on May 2016, member of External and Alumni Department of Student Executive Board Faculty of Agriculture 2017 and 2018, staff of Public Relation in Greenday 2016, staff of Sponsorship in Agriphoria 2016, staff of Event Division in Seri Action Faculty of Agriculture 2017, Chief of Agriphoria 2017, Secretary of National Oil Palm Seminar IKA FAPERTA 2018, staff of Sponsorship in Field Day 2018, she also got an award as The Best Member of External Alumni Department of Student Executive Board Faculty of Agriculture 2017. The author was also active in many student events in Department of Agronomy and Horticulture and Faculty of Agriculture as moderator and Master of Ceremony (MC). She got a Certificate of Competence for Organic Pesticide Operator, Organic Plantation Cultivator, and Organic Fertilizer Operator in The Area of Organic Farming in 2018. In her last semester, she conducted an internship in the Netherlands by Stichting Uitwisseling en Studiereizen voor het Platteland (SUSP) and became a part of her final school project to earn a degree.