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Table of Content

Volume 5, No. 1, June 2020

The Vigor and Viability Seed Testing of Three Tobacco Varieties on Various Seed Germination Media <i>Taufiq Hidayat RS, Aprilia Ridhawati</i>	1-9
Technology Innovation Support in Development of Local Superior Shallot in North Sulawesi <i>Olvie Grietjie Tandi, Faisal</i>	10-21
The Growth and Production Improvement of Soybean Plant (<i>Glycine max</i> L.) by Applying The Local Microorganisms of Fruit Waste in Palopo <i>Rahman Hairuddin</i>	22-26
Implementation of Chrysanthemum Post-Harvest Technology in Tomohon City to Extend Storage Time <i>Meivie Lintang , Olvie Tandi, Payung Layuk</i>	27-40
Growth and Production of Pakchoy Under Various Type of Organic Fertilizer <i>Rahmawati</i>	41-46
Population of Natural Enemies in Three Varieties of Rice Plants in Turikale Subdistrict, Maros District <i>Nining Triani Thamrin, Aksal Mursalat</i>	47-51
Using Oil Palm Segregation Genetics to Decipher Illegitimate Seed Distribution Channels to Smallholder Farmers in Cameroon <i>Walter Ajambang Nchu, Paul Koona</i>	52-62



The Vigor and Viability Seed Testing of Three Tobacco Varieties on Various Seed Germination Media

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Abstract

Seed viability is one of the most important physiological quality benchmarks of seeds. The use of appropriate germination media can affect the results of seed viability testing. This study aims to determine the optimal germination media in tobacco seed viability testing. This research was conducted at the Seed Laboratory of the Indonesian Sweetener and Fiber Crops Research Institute, Malang in January - March 2019. The research method used a two-factorial randomized block design (RAK). The first factor is tobacco seed varieties consisting of Kasturi in 2007, Bojonegoro in 2012 and Kemloko in 2014. The second factor is the seed germination media consisting of straw paper, cotton, towel tissue, paperboard and newspaper. The results showed that the Kemloko variety of tobacco seeds germinated in the towel tissue had the best seed vigor and viability percentage. Seed germination media with paperboard, towel tissue and straw paper can be used to test the viability of tobacco seeds because they have a percentage of simultaneous growth, percentage of the growth speed, percentage of germination, percentage of the growth potential maximum and normal seedling dry weight which are equally well

Keywords: germination, kemloko, paperboard, towel tissue, straw paper

A. Introduction

One of the leading commodities of smallholder plantations in East Java Province is tobacco (*Nicotiana tabacum* L). This commodity is quite a big contribution to the national economy and can indirectly have an impact on the social and cultural aspects of society. In the international world, Indonesia is the sixth largest tobacco leaf producing country after China, Brazil, India, the United States, and Malawi. In 2017, the tobacco plantation area in Indonesia reached 201,909 Ha and production reached 180,929 tons. Tobacco development is carried out in 14 provinces and

East Java is the highest tobacco producing province, which is around 79,442 tons in 2017, and production is estimated to increase to 85,053 tons in 2019 (Direktorat Jenderal Perkebunan, 2018).

Utilization of tobacco plants is not only a raw material for cigarettes but can also be used as antioxidants and larvicides (Handayani, S.W., Prastowo, D., Boesri, H., Oktsariyanti, A., Joharina, A.S., 2018), bioinsecticides (Paramartha and Lazurdi, 2013); (Siswoyo, E., Masturah, R., Fahmi, N., 2018), even to soundproofing materials (Fransiska, Windy A., Sari, O.K., Hardiansyah, Nugroho, D., 2015). One of the problems in developing tobacco plants is the provision of quality seeds (Rachman, 2007). In the rainy season, farmers usually store their tobacco seeds from their own plants at room temperature and humidity conditions that are not suitable for seed storage. According to (Sutopo, 2004) that the optimum temperature in long-term seed storage ranges from -18°C - 0°C. Changes in temperature conditions during storage can cause a decrease in seed quality. Tobacco seeds must meet the quality requirements of scattered seeds with a percentage of germination power $\geq 85\%$ and percentage of moisture content 6-8% (BSNI, 2006). According to Hasanah (2002) that the use of seeds with high seed viability can reduce production costs for replanting and increase crop productivity.

Seed viability testing is carried out to determine the physiological quality of seeds using appropriate germination media. Testing viability of seeds such as germination requires optimum conditions on germination media, temperature and humidity. Terms of use of germination media must have good physical properties, have the ability to absorb water and oxygen, and are free from disease-causing microorganisms. The germination media substrates in seed quality testing vary, depending on the testing method, size and type of plant seed (Susanti, 2010). Some germination media commonly used are paper substrate, sand, compost and organic media. Based on recommendation of International Seed Testing Association, 2014), the paper substrate for seed germination media used is filter paper, filter paper, and tissue paper (towel). The use of paper media is quite difficult to apply in testing the seed germination because of the limited availability of paper material and the price is relatively expensive (Purbojati and Suwarno, 2006); (Rahayu and Suharsi, 2015).

Each seed has a different shape and size and character so that the germination test uses different germination media. The use of appropriate germination media will correlate with the results of the test. The results of the Setiarini (2010) study showed that the pre-germination treatment for watermelon without seeds cultivar *New Lucky* is to moisten the seeds with water on paper straws for 2 days, then plant them on sand media or mix soil, sand and compost (3: 2: 1). Sand media can be used in testing the germination of corn seeds (Mapasiatta, 2014). In the Panggal Buaya (*Zanthoxylum rhetsa* (Roxb.)) Germination test using sand media, zeolite, soil mixture, compost, sand, cockpiti and husk charcoal (Susanti, 2010).

Media germination using paper substrates for testing the seed germination has been done various studies including the use of paper straw in testing jute seeds (*Corchorus olitorius* L.) (Hidayat and Marjani, 2017); straw paper used in tobacco seed testing (Sumartini, S., Mulyani, S., Rochman, F., 2014) (Suroh, M., Rahayu, T., Hayati, A., 2017), Stencil paper can be used as a substitute for straw paper substrate (Suwarno and Hapsari, 2008); Newspaper substrate for testing the viability of *Eucalyptus pellita* seeds (Yuniarti, N., Megawati, Leksono, B., 2017); Paper CDs in testing winged bean seeds (Rahayu and Suharsi, 2015). According to Agustin and Lestari (2016) that germination media using flannelette, newsprint, samson paper, towel tissue, cotton, stencil paper, rock wool and filter paper are suitable for use in the viability test of lettuce and onion seeds. Research on appropriate germination media, especially paper substrates, is needed to obtain optimal test results on tobacco seeds. This study aims to determine the optimal germination media in testing the viability of tobacco seeds.

B. Literature Riview

1. Tobacco Development

The Tobacco Plant (*Nicotiana tabacum* Linn.) Is a plant native to the American continent and entered Indonesia about 400 years ago, so it has long adapted to the diverse growing. Adaptation which has become a culture has resulted in the emergence of popular types of tobacco known as the development area, such as Madura, Temanggung, Kendal, Selopuro, and others. Tobacco plants

cultivated in Indonesia are included in the *Nicotiana Tabacum* species and can be broadly grouped into two major groups namely introduced tobacco such as Virginia, Burley, Oriental and Cigar tobacco as well as local tobacco such as Madura, Temanggung, Weleri and others (Basuki and Yulaikah, 2006).

The development of tobacco in Indonesia itself began since the colonial era. In the colonial era, tobacco harvests were only used to be smoked by themselves in the form of rolled cigarettes themselves. After that, the cultivation continued to increase since tobacco was used as a raw material for the cigarette industry, so it became a commercial commodity. Some cigarette industries continue to grow after Indonesia's independence, so the area of tobacco cultivation is expanding, especially in East and Central Java (Djajadi, 2018).

Based on data from Direktorat Jenderal Perkebunan (2018) that the tobacco plantation area in Indonesia in 2017 reached 201,909 ha and it is estimated that in 2019 it will increase by 204,562 ha. While the total production of tobacco dried leaves in 2017 is 180,929 tons and is expected to increase in 2019 to 183,146 tons. East Java Province is the highest tobacco producing area, which is around 79,442 tons in 2017, and it is estimated that production will increase to 85,053 tons in 2019.

2. Tobacco seed

Tobacco seeds are obtained from tobacco fruit harvested. Tobacco fruit is oval with a length between 1.5 - 2 cm. When early plant, the fruit turns green and when it ripe become brown Inside the fruit contains many seeds that are very light weight. The fruit will be on the base of the flower and have 4 large spaces. Each room contains about 2.000-3.000 seeds of anatropical seeds. Color of tobacco seeds are dark brown. Weight of 1,000 seeds between 0,7-0,9 grams. This ovary will be connected by a pistil stalk with one head pistil on it. In general, each plant produces seeds of 7-10 grams from 75-100 fruit (Hamida and Rochman, 2018).

The level of maturity of each individual tobacco fruit is different and not uniform after the fruit enters fertilization for 3 weeks. Seeds from newly tobacco fruit harvested cannot germinate when planted because the tobacco seeds have a dormancy of around 2-3 weeks to germinate. This phase is referred to as partial dormancy (after ripening). Tobacco that is ready to be harvested must be in physiological mature condition so that the seeds can germinate with a percentage of about 95%. For the storage stage, tobacco seeds can be stored at 7-10 ° C, humidity 40-50%, and moisture content 7-8% (Ilyas, 2010).

3. Media of Seed germination

Germination media is one important factor that influences seed germination. The use of suitable germination media will make it easy for sprouts to grow and develop on the surface of the germination substrate. There are four types of germination media, namely germination media using paper, sand or organic material, soil, and a combination of paper and sand (Sudrajat, D.J., Nurhasybi, Bramasto, Y., Djoko Irianto, Zanzibar, M., Setio, P., 2015). According to ISTA (2014), paper substrates commonly used are filters, blowers and towels which are foreign products that must be imported and relatively expensive (Purbojati and Suwarno, 2006). Overall, the physical properties of the paper substrate it is the best, because it has a high absorption capacity, is uniform, is able to maintain water and the absorption rate of capillary water is high even though it fluctuates. Stencil and opaque paper / CD is a substrate paper that shows the ability to absorb water, maintain water and good water absorption speed, and has the potential to be used as an alternative substrate to replace straw paper (Suwarno and Hapsari, 2008).

The results of research related to germination media include to use of straw paper media for testing jute seeds (Hidayat and Marjani, 2017), kecipir seeds (Purba and Suharsi, 2017), tobacco seeds (Purba and Suharsi, 2017); (Sumartini et al., 2014). The result of research Suwarno and Hapsari (2008) used stencil paper as a substitute for straw paper. The Newspaper for testing the viability of *Eucalyptus pellita* seeds (Yuniarti et al., 2017) and CD paper in kecipir seed testing (Rahayu and Suharsi, 2015).

C. Methodology

1. Research Design

This research was conducted at the Seed Laboratory of Indonesian Sweetener and Fiber Crops Research Institute, Malang, East Java in January - March 2019. The ingredients used were variety

of tobacco seeds of Kasturi 2 in 2007, Bojonegoro 1 in 2012 and Kemloko 3 in 2014, straw paper, cotton, tissue towels, paperboard and newspaper.

This research uses factorial two-factor randomized block design. The first factor is tobacco seed varieties consisting of Kasturi 2 in 2007, Bojonegoro 1 in 2012 and Kemloko 3 in 2014. The second factor is the seed germination media consisting of straw paper, cotton, tissue towels, paper board and newspaper. The study consisted of 4 replications and 12 treatment combinations so that there were 60 experimental units. Each treatment was tested as many as 400 seeds according to the germination media using the UDK method (Test on paper) (ISTA, 2014) on a 9 cm diameter petri dish. Germination is carried out in a germinator type IPB type 72 with a temperature of 25-30°C.

2. Observation parameters

The observed variables were the percentage of simultaneous growth (%), percentage of the growing speed (% KN/etmal), percentage of germination (%), percentage of the maximum growth potential (%), seedling vigor index (%) and normal seedling dry weight (g). The first observation was made on the 7th day and the second on the 14th day after planting (Balai Penelitian Tanaman Pemanis dan Serat, 2016).

3. Data analysis

Experimental data were analyzed using analysis of variance (F test) with SAS 9.1 software. Significantly different F test results were further tested using the Duncan Multiple Range Test (DMRT) at 5% level.

D. Findings and Discussion

1. Percentage of simultaneous growth and growing speed

The ability of seeds to grow plants with good physiological vigor can be identified, one of which is from the parameters of simultaneity and speed of seed growth. Physiological vigor is indicated by the growth of radicles or roots and plumules or coleoptiles (Sutopo, 2004). The speed of sprout growth is observed based on germination every day, so that the percentage of seeds that produce sprouts can be obtained with the appearance of radicular and hypocotyl structures on the day of observation. Tobacco seed testing on various germination media showed a very significant effect on the percentage of growing simultaneity and speed of growth. Table 1 shows the percentage of simultaneity and the highest growth rate in the kemloko 3 variety of tobacco seeds which were added to paperboard (97,5% and 23,0%), tissue paper (97,5% and 22,8%) and straw paper (96,3% and 21,8%) which are significantly different from other treatments.

The germination media using paperboard, tissues and newspaper in the simultaneous testing and speed of growing tobacco seeds showed the highest results. This is caused by the high ability of the media to absorb and store water. One of the germination media that has the ability to absorb water is paper straw which reaches 46.5 g per media unit (Suwarno and Hapsari, 2008); (Suwarno and Santana, 2009). Even paper straw has a 100% similarity level in the test of growing simultaneity when compared with sand media. Cardboard paper can also be used as a good germination media because it can absorb water with a thickness of paper that has a high cellulose content (Sari, 2016).

Table 1. Percentage of simultaneous growth and growing speed of tobacco seeds in seed germination various media

Variety	Treatment	Simultaneous growth(%)	Growing speed
	Seed germination media		
Kasturi 2	Straw paper	55,5 d	10,3 d
	Cotton	34,0 e	8,0 d
	Tissue towel	49,5 d	10,0 d
	Paper board	56,5 d	10,3 d
	Newspaper	51,5 d	9,8 d
Bojonegoro 1	Straw paper	20,5 f	4,3 e
	Cotton	23,3 f	4,8 e
	Tissue towel	26,3 f	4,5 e

	<i>Paper board</i>	23,8 ^f	5,0 ^e
	<i>Newspaper</i>	7,8 ^g	3,3 ^e
Kemloko 3	<i>Straw paper</i>	96,3 ^a	21,8 ^{ab}
	<i>Cotton</i>	76,0 ^b	16,5 ^c
	<i>Tissue towel</i>	97,5 ^a	22,8 ^a
	<i>Paper board</i>	97,5 ^a	23,0 ^a
	<i>Newspaper</i>	66,3 ^c	19,8 ^b
	Coefficient of variation (%)		8,69

Note: The numbers followed by the same letters in the same columns are not significantly different in the DMRT test $\alpha 0,05$

2. Percentage of germination and maximal growth potential

Seed germination and maximum growth potential are benchmarks of total seed viability as indicated by the ability of seeds to grow and live into normal and productive plants in optimum field conditions (Sadjad, S., Murniati, E., Ilyas, S., 1999). Testing the germination and maximum growth potential showed a very real effect on three varieties of tobacco seeds using various germination media. Percentage of germination and maximum growth potential was shown in the Kemloko 3 variety of tobacco seeds tested on paperboard (98.0% and 98.0%), tissue paper (97.5% and 97.5%) and straw paper (96,3% and 97.3%) (Table 2). These results show the highest results and are significantly different from other treatments.

The Kemloko 3 tobacco variety seed showed a better percentage of germination and maximum growth potential compared to the other two varieties. This is due to the fact that the tobacco seeds of the Kemloko 3 variety have a shorter storage period compared to other varieties. The storage time affects the germination of tobacco seeds, the longer the seeds are stored the germination will continue to decrease. This is consistent with the study of Suroh et al., (2017) that tobacco seeds stored for 0 days have a percentage of germination of 96%, seeds stored for 10 years 85.35% and seeds stored for 25 years have a germination capacity of 6%. Seeds will germinate if storage has passed a period of time but can also with the help of light and gibberellins (GA) during imbibisi. Abscisic acid (ABA) can inhibit endosperm rupture but not with testa (Leubner-Metzger et al., 1995).

Table 2. Percentage of germination and maximal growth potential of tobacco seeds in seed germination various media

Variety	Treatment Seed germination media	Germination(%)	maximal growth potential
Kasturi 2	<i>Straw paper</i>	69,8 ^c	84,5 ^b
	<i>Cotton</i>	52,8 ^d	75,5 ^d
	<i>Tissue towel</i>	68,5 ^c	82,3 ^{bc}
	<i>Paper board</i>	70,3 ^c	86,0 ^b
	<i>Newspaper</i>	67,5 ^c	76,8 ^{cd}
Bojonegoro 1	<i>Straw paper</i>	23,8 ^e	24,0 ^e
	<i>Cotton</i>	24,3 ^e	24,8 ^e
	<i>Tissue towel</i>	27,5 ^e	27,8 ^e
	<i>Paper board</i>	24,5 ^e	24,5 ^e
	<i>Newspaper</i>	25,0 ^e	25,0 ^e
Kemloko 3	<i>Straw paper</i>	96,3 ^a	97,3 ^a
	<i>Cotton</i>	76,0 ^{bc}	82,3 ^{bc}
	<i>Tissue towel</i>	97,5 ^a	97,5 ^a
	<i>Paper board</i>	98,0 ^a	98,0 ^a
	<i>Newspaper</i>	82,8 ^b	82,8 ^{bc}
Coefficient of variation (%)		8,94	5,92

Note: The numbers followed by the same letters in the same columns are not significantly different in the DMRT test $\alpha 0,05$

The use of paper substrates / media used for germination test with paperboard, tissues and straws is quite in accordance with the character of tobacco seeds. The use of these media makes it easy for seed sprouts to grow upright and sturdy and does not inhibit root growth. The results of Agustin and Lestari (2016) research show that tissue towels are quite effective for testing lettuce and onion seeds. The percentage of germination of rice seeds germinated with straw paper

was significantly higher than CD paper (Nugraha, U.S., Rasam, Wahyuni, S., 2003). In addition to the use of media, the germination method with the UDK method is suitable for testing the viability of tobacco seeds. According to Widadjati, E., Muniarti, E., Palupi, E.R., Kartika, T., Suhartanto, M.R., Qadir, A., (2014) that germination testing for small seeds can use the paper test method (UDK). The UDK method is a germination test method that uses a petri dish coated with three sheets of paper media and the seeds are placed on paper. Test methods with substrate as a media, faster and easier to assess the important structures of sprouts and can be easily standardized. Test methods can be carried out to obtain germination and growing strength, this depends on the environmental conditions of seed testing

3. Percentage of seedling vigor index and normal seedling dry weight

An increase in seedling vigor index can be associated with an increase in active oxygen metabolism in sprouts. According to Tilaki, G.A.D., Behtari, B., Alizadeh, M.A., Jafari, A.A., (2010) that the sprouts vigor index test can be calculated using the formula (hipokotil length + root length) x germination. The seedling vigor index is also related to the normal seedling dry weight which reflects the weight of biomass material that has accumulated during 14 Day After Planting (DAP). The biomass material is obtained from the process of plant photosynthesis which produces a substrate in the form of carbohydrates for plant growth (Sitompul, 2016). Testing of three tobacco varieties seed using various germination media showed a very significant effect on the percentage vigor index and normal seedling dry weight. Table 3 shows that the Kemloko 3 tobacco variety seeds planted on straw paper and paper tissue media had a high percentage of seedling vigor index (153,3% and 149,8%) and differed significantly from the other treatments. While the seeds of Kemloko 3 variety planted on paperboard germination media showed the best normal seedling dry weight which was 0,0068 g but not significantly different from the media of rice straw (0,0063 g) and tissue paper (0,0061 g).

Table 3. Percentage of seedling vigor index and normal seedling dry weight of tobacco seeds in seed germination various media

Variety	Treatment	Seedling vigor index(%).....	Normal seedling dry weight(g).....
	Seed germination media		
Kasturi 2	Straw paper	90,3 c	0,0053 bcd
	Cotton	41,5 e	0,0037 ef
	Tissue towel	80,0 cd	0,0045 cde
	Paper board	71,5 d	0,0047 cde
	Newspaper	82,8 cd	0,0049 cd
Bojonegoro 1	Straw paper	25,0 f	0,0025 gh
	Cotton	19,5 f	0,0017 h
	Tissue towel	29,3 ef	0,0024 gh
	Paper board	23,3 f	0,0029 fg
	Newspaper	22,8 f	0,0024 gh
Kemloko 3	Straw paper	153,3 a	0,0063 ab
	Cotton	77,3 cd	0,0042 de
	Tissue towel	149,8 a	0,0061 ab
	Paper board	120,8 b	0,0068 a
	Newspaper	91,8 c	0,0056 bc
Coefficient of variation (%)			16,99

Note: The numbers followed by the same letters in the same columns are not significantly different in the DMRT test $\alpha 0,05$

The percentage of seedling vigor index on tobacco seeds using paper germination media is done by measuring the length of normal sprouts. This parameter shows a good germination stage that is in the presence of strong, upright radicles and have primary and / or secondary roots. While hypocotyl from normal sprouts has the characteristics of upright, sturdy, no injuries, and color white. The cotyledons from normal sprouts are light green, dark green or yellow, fresh looking, no injuries, no contamination from fungi or bacteria, and some cotyledons have bloomed completely. An increase in vigor index was also found in corn and cowpea seeds (Eskandari and Kazemi, 2011), an increase in vigor index was caused by an increase in germination and length of

the sprouts or the length of the sprouts compared to the control (Hanegave, A.S., Hunje, R., Nadaf, H.L., Biradarpatil, N.K., Uppar, D.S., 2011).

The use of germination media suitable and adapted to small types of tobacco seeds can affect seed germination. In addition, germination media must have high porosity, good drainage and aeration (Hardiwinoto, S., Nurjanto, H.H., Nugroho, A.W., Widiyatno, 2011.). The substrate specifications for seed testing are: (1) paper must be porous, allow roots to grow (2) free from molds, bacteria, and toxic substances that can affect germination, (3) remain tenacious / strong for the duration of the test, (4) able to hold enough water during the test, and (5) pH 6.0-7.5. The low ability of newsprint and cotton in testing the viability of tobacco seeds is caused by not being effective enough for seed growth until observations at the last count that is on the 14th day after planting. This is suspected because the cotton media is not dense enough and there is ink attached to the newspaper and can inhibit the growth of seeds. Newspapers have inherent ink and Pb content which has the potential to cause fungus during germination (Agustin and Lestari, 2016); (Azhar, 2014).

E. Conclusion

The Kemloko 3 variety tobacco seeds germinated on paper board, tissue and straw paper have the best percentage of seed vigor and viability. Seed germination media with paper board, tissues and straw paper can be used to test the viability of tobacco seeds because they have a growing percentage of Simultaneous growth (97,5%; 97,5%; 96,3%), growth speed (23,0%; 22, 8%; 21,8%), germination (98,0%; 97,5%; 96,3%), maximum growth potential (98,0%; 97,5%; 97,3%) and normal seedling dry weight (0,0068 g; 0,0063 g; 0,0061 g) are equally good.

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Technology Innovation Support in Development of Local Superior Shallot in North Sulawesi

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Abstract

The need for Shallot at the community level continues to increase every year in line with the increase in population. Shallots are used as cooking spices and used in the herbal medicine industry. Minahasa Regency is one of the centers of shallot development in North Sulawesi, where production at the farm level is still below the average of 7-8 t/ha. For this reason, a breakthrough in cultivation technology innovation is needed to increase yields. This writing aims to provide information on technological innovation support in the effort to develop local superior shallots in North Sulawesi and to see the results of farming from the application of the technology. The data obtained from the results of interviews and research results both conducted by the North Sulawesi AIAT Assessment Team and other research results. The support of technological innovation in efforts to develop shallots is the application of onion PTT Innovations: land management, preparation of plant spacing, use of certified seeds, planting and fertilizing, watering and controlling weeds, controlling plant pests, harvesting and post-harvesting. The conclusions obtained by the application of PTT shallots, which were examined by BPTP North Sulawesi using local varieties Lansuna. The B / C ratio is 4.23 by giving an income of Rp. 273,058,000 compared to the way of farmers where B / C ratio = 2.23 with income of Rp. 138,233,000 / hectare

Keyword : shallot, local, technology innovation

A. Introduction

Shallot is a main ingredient of Indonesian cuisine seasoning. In addition to the basic seasoning of cuisine, shallots can be used as a herbal medicine because the nutrient content is quite complete. In 100 grams of shallots contains carbohydrate (9,34 g), sugar (4,24 g), fiber (1,7 g), saturated fat (0.042 g), protein (1.1 g), water (89.11 g), thiamine (0.046 mg), riboflavin (0.027 mg), niacin (0.116 mg), vitamin B6 (0.12 mg), folate (19 mg), vitamin C (7.4 mg), vitamin E (0.02

mg), vitamin K (0.4 mg), calcium (23 mg), iron (0.21 mg), magnesium (0.129 mg), phosphorus (29 mg), potassium (146 mg), sodium (4 mg), and zinc (0.17 mg) (Waluyo and Sinaga, 2015).

The production of shallots to date is still centered in several districts in Java namely Kuningan, Cirebon, Brebes, Tegal, Pemalang, Bantul, Nganjuk, and Probolinggo. Based on data from Directorate General of Horticultural, Ministry of Agriculture, the demand of shallots nationally tends to increase from year to year, as well as shallot production. In 2007 For example, the demand for shallots amounted to 909,853 tons with a production of 807,000 tons, the year 2008 demand increased to 934,301 tons with a production of 855,000 tons. In the year 2009, the need for shallots in Indonesia reached 936,103 tons with a production of 965,164 tons and increased in 2010 to 976,284 tons with a production of 1,048,228 tons. Production decline occurred in the year 2011 with production of 893,124 tons. Increased production of shallots is predicted to occur in 2012 to 960,179 tons (Departemen Pertanian, 2013). Increased production of shallots directed to meet domestic needs and increase competitiveness can be pursued through the expansion of new areas and increased productivity.

According to Badan Pusat Statistik (2016) specifically for North Sulawesi the harvest area of shallots is 310 ha, production of 1,715.5 tons with productivity 5.5 tons/ha. The pattern of shallots consumption on North Sulawesi people is 4.56 kg/KAP/year (Dinas Pangan Sulut. 2016). Data of the population of North Sulawesi up to the year 2015 amounted to 2,412,118 people, then the need for consumption of shallot in North Sulawesi is 10,999 tons/year means North Sulawesi still requires shallots consumption of 9,238.8 tons/year, which must be in From outside areas like Enrekang and Brebes.

Demand for shallots seeds throughout the year in North Sulawesi continues to increase, if it refers to the extensive harvest data of 2015 is 310 ha, specifically for the shallots varieties Lansuna requires seed of 1200 kg/ha, so the total needs of Special varieties seeds of Lansuna in North Sulawesi amounting to \pm 372 tons per year. For varieties of Bima, Maja Cipanas or varieties of Sembrani (Balai Pengkajian Teknologi Pertanian, 2016b), with the need for seed of 800-1000 kg/ha, then the seed needs of the 3 varieties are 310 tons.

The main barrier factor in shallots farming is the availability of high quality seeds that are still very limited, the height intensity of pests and diseases in certain seasons. The seeds of a superior variety of certified shallots are required as the main requirement to initiate the commodity production process in order to achieve high quality and prime results. Certified shallot seeds are still a rare item and can meet the needs of farmers.

In supporting the productivity of shallots, maximum required seed tuber high quality. According to Sutoso, S.W. Hetetik dan I Purnomo (2007). Tuber seeds are good to be planted contain no disease, no defects, and not too long stored in the shed. The need for seed is between 1.3-2.6 ton/ha with the diameter of the seed bulbs of 1.5-1.8 cm (Sunarmani and Hidayat, 2005) with a land efficiency of 65%. Good seed tuber is a tuber that does not break the dormancy time, healthy and optimal size. Large tuber can provide enough food reserves to support growth and development in the field.

Shallots are generally reproduced with tuber as a seed. A good seed tuber must come from a healthy crop, it is quite old or aged 70-80 days after planting. The superior varieties used are adaptive in the rainy season in dry land or *tegalan*. The seeds used are tuber that have been stored 2.5-4.0 months with a growing point of at least 80% fresh, stocky, non-flawed, and free from pest diseases. Further, a selection of tuber that will be made to seed for same plant growth. The size of the seed tuber is classed into three classes, namely (a) large ($\emptyset = > 1.8$ cm or > 10 g), (b) moderate ($\emptyset = 1.5$ -1.8 cm or 5-10 g), and (c) Small ($\emptyset = < 1.5$ cm or < 5 g). Good seed tubers are medium-sized, because they are more efficient than large-sized seeds, and early growth is good. Seeds need about 1,200 kg/ha (Rismunandar 1986; Stallen and Hilman 1991).

In 2015, the need for shallot was projected to reach 1,195,235 tons. If the productivity of the shallot is projected to reach 10.22 tons/ha, it takes about 116,950 ha of Harvest area. Referring to the harvest area in the year 2012, which is 99,519 ha, then the fulfillment of the need for shallots year 2015 requires the expansion of the harvest area about 17,432 ha or about 6 000 ha per year. The production target of 1,195,235 tons in 2015 included for shallots seeds about 102,900 tons. The projection of shallots needs up to year 2025 is listed in table 1.

The results of the explanation, and the synchronization of the horticultural development implementation 2008, revealed some fundamental problems confronted in the development of shallot production, namely; 1) The capability of cultivation technology and seed multiplication by

breeders still limited, 2) local varieties of existing seeds are not able to adapt throughout the season so forced to use the seeds of imported shallot, 3) often occurs price fluctuations of shallots especially in Brebes district, so it does not provide guarantees of business continuity, 4) imported shallots entered at the time of harvesting even in the supply to the production centers so that the selling price of farmers fall, 5) Production costs continue to increase due to the use of excessive chemicals (not according to the rules), the price of chemical inputs continues to increase while farmers have a dependency on such substances, and 6) the limitation of seed sources so that it inhibits in the multiplication of seeds.

Table 1. Project Data Of Shallots Need In 2015-2025

Years	Needs (Ton)				
	Consumption	Seeds	Industry	Export	Total
2015	952,335	102,900	40,000	100,000	1,195,235
2020	1,067,527	107,000	50,000	110,000	1,335,427
2025	1,194,837	116,900	80,000	150,000	1,541,737

Source: Directorate General of Horticultural Production, Republic Indonesia Ministry of Agriculture

B. Technology Innovation Support in Development of Local Shallot Superior in North Sulawesi

1. Potential

Minahasa, one of the districts in North Sulawesi, where the West Tompaso district is the most widely cultivated area of shallots. This area is located at an altitude of \pm 800-900 meters from sea level with a condition of topography flat to the ramps and has an average ground slope above 5-10 degree, which includes 20 km with an average slope of 10 degree. The dominating soil type is Reyosol with a pH of 5-7.

According to the Dinas Pertanian Kab. Minahasa (2017), the area of horticultural cropping crop is approximately 5000 ha, the area that can be optimized for cultivation of shallots is approximately 2000 ha spread in sub-district in several sub-districts. Data of potential land area for the development of shallot in Minahasa district is as follows:

Table 2. Data of Potential Land Area For the Development of Shallot in Minahasa District

No.	Sub District	Potential Area (ha)	Description
1.	Tompaso	150	
2.	Tompaso Barat	350	
3.	Langowan Utara	40	
4.	Langowan Barat	800	
5.	Langowan Selatan	50	
6.	Langowan Timur	25	
7.	Kawangkoan	100	
8.	Kawangkoan Barat	50	
9.	Kawangkoan Utara	20	
10.	Sonder	25	
11.	Kakas	25	
12.	Kakas Barat	40	
13.	Romboken	10	
14.	Tondano Selatan	20	
15.	Tondano Utara	10	
16.	Tombulu	10	
17.	Tombariri	30	
18.	Kombi	50	
19.	Lembean Timur	50	

Source: Agriculture Agency of Minahasa District 2017

The production of shallots that still leafy in 2012 in North Sulawesi for 5,301 tons with a crop area of 680 hectares and a productivity average of 7.80 tons/ha (BPS, 2013). The data of average local shallots productivity Lansuna at the farmer level in the Minahasa district just reached 7-8 t/ha. That productivity is still relatively low because the shallots plants are well-preserved productivity can reach 20 tons/ha. Demand needs for the shallots seeds continues to increase. The activities of mentoring especially the development of shallots in North Sulawesi in the year 2015 (state budget of North Sulawesi province) is 30 ha need seeds for 30 t/ha and for the year 2016 increase to 120 ha and need seed \pm 120 T/ha or 12,000 kg/ha.

Lansuna varieties is one of the local superior shallot that has got protection of plant varieties (PPV) by the central government based on SK Agriculture Minister No. 044/Kpts/SR. 120/D. 2.7/5/2016. This variety has long been used by local farmers planted continuously and traditionally selected by farmers in Tompasso sub district and known as Bawang Magelang. Because this shallots in its growth is able to adapt to both summer and rain, the Minahasa government made a request for the protection of a variety in 2016. From the results of temporary research by BPTP North Sulawesi varieties Lansuna has a high average plant 34.9 cm; The number of leaves 23.7 per plant and the number of saplings 6.7 per plant with the potential yield 13.5 t/ha bulbs. Bright tubers color. Pests and diseases (OPT) often attacked in local shallots are shallots caterpillars (*Spodoptera Mauritia*, *S. Litura* and *S. Exiqua*) while the common disease encountered in this local shallots crop is fusarium wither caused by *Boletus fusarium oxysporum* (BPTP, 2016a).

Tabel 3. Description of Local Shallots Lansuna Varieties

No	Description	Description
1	Origin	Introduction from Filipina
2	Lineage	Positive selection
3	Varieties Type	Klon
4	Plant Height	26 – 44 cm
5	Leaf Shape	Silindris, middle hollow
6	Leaf Size	21 – 39 cm
7	Leaf Color	Bright green (RHS 140 C)
8	Leaf amount per tuber	4 – 11 blades
9	Leaf amount per clumps	23 – 61 blades
10	Harvest age (80% batang melemas)	56 – 60 days
11	Tuber shape	Round
12	Tuber size	Height 2,4 – 3,6 cm Diameter 2,0 – 3,6 cm
13	Tuber color	Dark red (RHS N 57 B)
14	Weight per tuber	3,25 – 15,14 gram
15	Tuber amount per clumps	3 - 12
16	Tuber weight per clumps	35,71 – 93,52
17	Tillers amount	3 – 12 tillers
18	Storage capacity of tuber in temperature 27-30oC	3-4 months
19	Shrink tuber weight (wet-dry save)	18,7 – 20,0 %
20	Tuber results per hectare	7,94 – 14,12 tons
21	Population per hectare	222.223 plants
22	Seeds need per hectare	1.111,12 kg
23	Main characteristic	Round tuber shape, large tuber size, with largest diameter in the centre, tuber color is red (RHS N 57 B)

Based on SK Agriculture Minister No.044/Kpts/SR.120/D.2.7/5/2016

Source : BSPB Minahasa District (2016)

The age of plants in the field is only about 65-70 days, then within a year of chance to harvest 2-3 times, so that in one year to 1 ha will be produced approximately 30 tons of fresh shallots. Planting season (PS I) is valid during the rainy season in February, where farmers generally utilize the existing lands in the area surrounding the mountains while for the dry season (PS II) in July

generally the shallot in planting on rice field lands. Local shallots from Minahasa District have description as below table 3.

2. Seed System

In general, shallot farmers in Minahasa District farming is still conduct farming business of shallots with a traditional way. The use of local varieties has been a long time ago and farmers selected their own tuber crops to be used as a source of seed. A few varieties of perna are planted by farmers such as Super Filipine and Bima and are unable to adapt to the environment. Fertilization of plants has not been recommended as well as the use of inorganic fertilization tends to be excessive, and less utilizing organic fertilizer. To achieve high productivity needed an assembly of appropriate technology that can increase farmers' income and the availability of superior seeds continuously. The technology that must be applied is the cultivation technology of the GAP (Good Agriculture Practice) shallots, ranging from seed preparation, soil processing, spacing, fertilization, harvesting and handling in the field post harvest.

Adiningrat (2008) states that, in developing a growing industry there are 6 main steps that should be carefully conducted and passed in full to differentiate it from the seed trading efforts, namely: the development of production systems, marketing system development, distribution system development, quality control, and market control.

The national private sector of seeding is a business institution that organizes a series of processes all activities in producing new seed/superior varieties, producing and high quality with high competitiveness, multiply, circulate, and trade it, whether in one intact business institutional or one of the other business units such as seed-making, and incubators that utilize national biological resources wisely and sustainable (Baihaki, 2008).

Seeds of superior varieties shallots, both seed source as well as seed spread today is still a necessity of goods that are still difficult to be obtained by farmers. To be able to plant shallots, farmers are forced to buy seeds in the market with common varieties and quality. The shallot seeds that are on the market are often made from the reduced shallot consumption. Farmers are still struggling to acquire high quality shallot seeds that are certified. The use of seed certified by farmers is still very low, which is about 5% and limited in the area of main production center Pantura (Baihaki, 2002). The cause among others is the availability of source seed (FS or SS) is virtually none, the route of the BS trip to the SS is not smooth, and the lack of passion of farmers become the seed/producer of shallots as the process is too complicated (Badan Tenaga Atom Nasional, 2008).

Seed is one of the main key in the success of a farming. The requirements of good shallot seeds include:

- Storage life of seed is enough namely about 2.5-3 months. It aims to make the growth good and evenly, although for the younger storage life of the seed still grows but in subsequent growth will be lower result than the seed that has been ready to plant (have enough of the shelf life).
- Harvest age when prospective seed tubers are planted in the right field.
- Medium seed size, about 5-6 grams. The use of a seed that is too large will increase the cost as more needs.
- The seed needs of each hectare range from 800 – 1200 kg, depending on the size of the tuber.
- Tubers of brightly colored seeds, with shiny skin, tuber seeds of pious, healthy, dense, non-bone loss and not malleable. If there is a seed tuber that does not have such properties should not be used.
- Tuber seeds are not attacked by pests and diseases.
- Before planting, the tuber is cleaned first from the dry skin and if the performance has not been seen at the end of the tuber, then preferably the tip of the tuber cut 1/3 to accelerate the emergence of shoots

The requirements for agroecological suitability for the shallots are mainly determined by moisture, texture, structure and soil fertility. In general the plant of shallots requires dry month 4-5 months, precipitation 1000-1500 mm/year, drainage and good fertility, sandy clay texture and soil structure.

Table 4. Productivity Potency of Some Shallots Varieties

No.	Varieties	Tillers Amount (tubers /clump)	Development Area	Productivity Potency (ton/ha umbi kering)
1.	Bima Brebes	7-12	Brebes	9,9
2.	Bauji	9-16	Nganjuk	14
3.	Super Philip	9-18	Jawa	17,6
4.	Tiron	9-21	Bantul	13
5.	Kuning	7-12	Probolinggo, Brebes	21,4
6.	MajaCipanas	6-12	Jawa Barat	10,9
7.	Keramat 1	6-9	Probolinggo, Brebes	22,7
8.	Biru Lancor	6-13	Probolinggo, Bantul	12,47-14,08

Source: Directorate of Germination, Directorate General of Indonesian Horticultural Production Development Ministry of Agriculture's, 2004

3. The Application of Shallot PTT Technology Innovation

The application in the shallots technology PTT innovation is basically not much different from the application of conventional cultivation of farmers, only some components of technology that must be adjusted such as seed treatment, planting distance, fertilization, pest control and the management of proceeds for the preparation of tubers for commercial and tubers for the seed.

Table 5. Shallots Existing Technology in Minahasa district

Technology Components	Traditional Farming Business
Varieties	- Lansuna varieties (local superior) - Seed needs : 800 kg-1400 kg/ha - Without tuber cut
Planting Distance	Planting distance in the field 30 cm x 15 cm; 40 cm x 15
Fertilizer	Rarely use manure, if there are 1-3 ton/ha, SP-36: 500 kg/ha, 300 kg/ha; Phonskah 300 kg/ha; fertilizer 3 x (basic: manure, SP-36, ½ Phonska, 14 hst urea dan 30 hst ½ phonska)
OPT Control	OPT worm shallots, Fusarium wither and rotten tuber by bacteria especially on the tuber that has been harvested. Sprayed by mixing some pesticide products, fertilizer leaves etc.). Spraying Schedule 3 a week.
Productivity	7-8 t/ha

Primary data from interview results of farmer

Production efforts in accordance with good and proper cultivation norms need to be conducted to produce quality shallots with optimal productivity. Therefore, the implementation of the standard operational procedure (SOP) of the shallots cultivation as published by the Ministry of Agriculture must be consistent and well documented by every business performer. Good SOP can generate productivity by 15-20 tons/ha (depending on the shallot varieties). In order to execute the SOP, the appropriate production process will be required as below.

Soil Processing

The processing of soil is conducted when there are not rain for 2-4 weeks before planting. The aim is to inflate the soil, improve the drainage and aeration of the soil, flatten the ground, and eradicate the remnants of weeds. Soil processing begins with the create of trenches as the distance between the bedwith the width of 40-50 cm, then the soil is chopped up as deep as 40 cm. Cultivation is done on a bedthat has been prepared with the desired size and the direction of the bed is correct. The size of the bedis 100-200 cm with a height of 30-50 cm, and the length according to the needs of land processing begins with creating bedengan. The direction of the bedis East-west with a width of 1-2 m with a long adjustable land condition. A week later, it was melted down. It is then left for 1-2 weeks so that soil pests and diseases can be minimized, as well as the seeds of weed in the soil also experiencing death. After 2 weeks, there was the cleaning of the grass on the ground and the making of trenches between the bedengan. Water is then channeled to the land until the ground level, so that the soil gets enough water content. A week

later it was conducted by manure. After a week of silence, the soil is ready to be planted with shallots.

Table 6. Components of Technology Innovation PTT Shallots

Technology Components	Technology Innovations
Varieties	- Sembrani, Maja Cipanas, Trisulla dan Bima I dan II - Lansuna (superior local seeds) -Seed treatment, where the tip cutting treatment is 1/3 seed and given Mancozeb (100 kg Seed: 100 g mancozeb), put in the sack, tied and stored 1x 24 hours after that the seeds are ready planted
Planting Distance	15 cm x 20 cm and 20 cm x 20 cm and height bed 25 cm
Fertilizer	Manure 5 t/ha, basic fertilizer Ponska 533 kg/ha; SP-36 111 kg/ha and KCl 66 kg/ha administered 7 days before planting together with manure. Follow-up Urea 92 kg/ha and ZA 202 kg/ha administered when the plant is 15 HST and 30 HST
OPT Control	-Carried out in a preventative range of plants aged 7 HST with an interval of 3-4 days. -Systemic fungicide: 21 HST next use contact fungicide if there is wither plant. -Mounting trap OPT: Feromon exi 40 point/ha where control decision based on the catch of the Exigua moth as many as 30 tails/traps or crop damage has reached 50%.
Productivity	10-15 ton/ha

Primary Data Technology Components of PTT Shallots from Balitsa

Planting Distance Setup

Planting distance arrangement basically aims to give plants the possibility to grow well without experiencing competition in water intake, nutrients and sunlight, as well as facilitate the maintenance of crops. Less precise planting distance can stimulate weed growth, thereby lowering the yield. Results showed that the results of the highest shallots were obtained on the use of large seed tuber (> 10 g) with a planting distance of 20 cm x 15 cm, but statistically not distinct with the use of medium seed tuber (5-10 g) and the same spacing.

Seed Preparation

The use of seed quality is an absolute condition in the cultivation of shallots. The varieties of shallots that can be used are Bima, Brebes, Ampenan, Medan, Keling, Maja Cipanas, SUMENEP, Yellow, Timor, Lampung, Bull and other local varieties. The difference in productivity of any variety/cultivar not only depends on its nature, but is also heavily influenced by local situations and conditions. Climate, fertilization, irrigation, and soil is a determining factor in the productivity and quality of shallot. Plants are usually harvested quite old between 60-80 days, have been selected in the field and in the storage place. The tuber to be used for the seed should come from a plant that is already old enough age, which is about 70-80 days after planting. Tuber for seed should be medium size (5-10 g). The appearance of the seed tuber should be fresh and healthy, pious (solid, not wrinkled), and the color is bright (not dull). Seed tuber is ready to be planted when it has been stored for 2-4 months since the harvest and its shoots have reached the end of the tuber. A sufficient factor determining the quality of shallot seeds is the size of tuber. Based on the size of the tuber, seed tubers are classified into three classes, namely: large seed tuber (diameter 1.8 cm or > 10 g); Medium seed tuber (diameter 1.5-1.8 cm or 5-10 g) and small seed tuber (diameter < 1.5 cm or < 5 g).

Planting and Fertilization

Planting is conducted at the end of rainy season. With the Penugal tool, the planting holes are made as deep as an average as high of tubers. The way of cultivation is: tuber skin pads are peeled first and separated by the cloves. As a note, for the tubers of shallots that had been stored more than 40 days, at the time of planting does not need to be cutting the tip of the tuber. This is due to the tuber is quite a time of Dorman, the growth rate is quite good and the mortality rate of the tuber is also low. As for tubers stored less than 40 days, it is necessary to cut the tip of the tuber to accelerate the exit of shoots by cutting the seed end to 1/3 parts. The seed planted stands on a

beduntil the surface of the slice is covered by a thin layer of soil. Basic fertilizer used is an organic fertilizer that is ripe like chicken manure at a dose of 5-6 tons/ha, or compost at a dose of 4-5 tons/ha especially on dry land. Fertilizer is done in conjunction with soil processing. Fertilizer is an artificial fertilizer with a dose of Urea fertilizer 200 kg/ha, ZA 300 kg/ha, SP-36 250 kg/ha, KCl 200 kg/ha, and TSP 250 kg/ha. Fertilization is done 3 times in 1 planting season. Fertilization was first done a week after planting, namely Urea 100 kg/ha, ZA 150 kg/ha, SP-36 150 kg/ha, TSP 100 kg/ha, and KCl 100 kg/ha. The second fertilization is done 3 weeks after planting of Urea 50 kg/ha, ZA 75 kg/ha, SP-36 50 kg/ha, TSP 75 kg/ha, and KCl 50 kg/ha. The last fertilization is done when the shallot is 6 weeks after planting, namely Urea 50 kg/ha, ZA 75 kg/ha, SP-36 50 kg/ha, TSP 75 kg/ha, and KCl 50 kg/ha.

Watering and Weed Control

Although it does not require a lot of rain, but the shallot plants require adequate water during its growth through watering. Cropping in the field of former rice fields in the blistering dry season requires adequate watering, usually 1 times a day in the morning or evening, since planting until the harvest. The watering done in the rainy season is generally aimed at rinsing the leaves of plants, namely to lower the spark of soil stuck on the leaves of shallots. Watering can use a gembor or sprinkler, or by melting the water around the bedso-called LEB system.

Watering is conducted by first pumping the groundwater using a diesel pump machine. By using the pump machine, the water will be out and then channeled into the shallots cultivation area. Water that flooded/filled the trench was then used to irrigate shallots. The way of watering the shallots is to use a small bucket or gembor. With the Gembor/small bucket, the farmer will walk along the trench while watering the shallots that the water comes from the groundwater resulting from the diesel pump. The growth of weeds in the planting of young shallots until the age of 2 weeks is very fast. Therefore, weeding is imperative and is done intensively for limited area. Weeding can be conducted in conjunction with watering.

Plant Destruction Organism (pest) control

Pests that commonly invade the plant of shallots are soil caterpillars, leaves caterpillars, grayak caterpillars, lice leaves, and nematodes roots. Pest control is conducted by sanitation and disposal of weed, collecting and destroying larvae, land processing to dismantle the caterpillars, the use of insecticides, as well as crop rotation. The main pest in the shallots that need to be wary of is the shallots-leaf caterpillars (*Spodoptera exigua*). *S. Exigua* control can be done as follows:

1). Use of trap lights.

The trap lamp is mounted on a wooden pole with a height of 10-15 cm above the water tub. The mouth of bath water should not be more than 40 cm above the tip of the leaves of shallots. The type of lamp used is neon, with the distance between one light trap (point) with the other point is 20 m x 20 m or 25 dots/ha.

2). Use of SE-NPV.

Se-NPV can be obtained from Balitsa Lembang or IPB to be further reproduced through the worm *S. Exigua* infected. The infected caterpillars are taken, crushed and then filtered and sprayed into the shallot plant. With this SE-NPV can turn off the Caterpillar 4 days after application.

3). Chemical control.

This is the most recent recommendation, if the two ways above are not effective or cannot be done and the pest population has reached the threshold of control, namely damage to leaves > 5% per clump. Diseases that often attack shallots are purple patches, dew flour, rotten stem neck, antrnosa, rotten tuber, *Fusarium* wither, and rotten wet. Disease control can be done by curative and preventive. Curatively is:

(a). Sanitation, that is, immediately unplug the plants that have been severely attacked or died and pluck the leaves are dried, collected and then removed from the garden and burned. This is an attempt to reduce the source of infection.

(b). Watering, that is watering the plants if it rains with the use of gembor so that the grains of soil attached to the leaves due to a splash of rain water is not long to stick, because it can be a source of infection (containing pathogenic incoum).

(3). Chemical control by using a chemical fungicide, should be done when the intensity of the attack has reached the threshold of control, namely the average attack intensity above 10%.

It is preventative:

- (1). Sanitation, special against the plant and the rest of the infected plant.
- (2). Planting of disease-free tubers.
- (3). Tuber treatment with fungicide effective.
- (4). Rotate the crop with the plant instead of shallots, nuts, pumpkins, or eggplants.
- (5). Set the planting time, namely in the dry season.
- (6). Improvement of land drainage system.
- (7). Plant a resilient cultivar, for example Sumenep cultivars .
- (8). Use of antagonist agents, such as fungi, or bacteria.

Harvest

The harvest of shallots is done when the tuber is quite age about 60 – 70 HST. The shallot plants began to be harvested after visible signs of 60% soft stem neck, plant collapsed, and leaves began to yellow. The way is remove the whole plant carefully so that no tuber is left or blisters. Harvesting should be carried out on dry soil conditions and sunny weather to prevent tubers of rotten disease attacks in storage warehouses.

Storage is conducted in the para-para with dried. The old seed storage is 3-6 months which can be used on the next PS. Each week is controlled and fumigation. The warehouse has enough ventilation, the floor should cement to be waterproof, warehouse roof with direct sunlight. Shallots storage activities are absolutely done during the period of seed dormancy, before the seeds ready to plant. During storage is done maintenance by means of sorting after \pm 25 days to dispose of the foul. The seed storage process in the warehouse also determines the quality level of the resulting seed and imperfect storage will bring losses due to high weight shrinkage. According to Darkam & Sinaga (1994), decrease in quality of shallots during storage due to mechanical damage, physiological and microorganisms characterized by decreased moisture content, growth of shoots, softening tubers, growth and rot. Therefore, the need for post-harvest (storage) technology is an integral part of the effort to obtain a quality seed. The results showed that the seeds of shallots that were stored in the dry season in the drought had a depreciation of 22%, while the unsmoked depreciation occurred about 17%.

Shallots Farmer Business Analysis

Shallot farming in the dry plains of the medium-land in Minahasa District uses Lansuna varieties (local superior), following the farmer's pattern economically worthy to be cultivated with B/C ratio = 2.23 with revenues of RP. 138, 233, 000/108/hectare (table 7). While using technology innovation PTT shallot results study by BPTP planted in April 2016, using Lansuna varieties, B/C ratio = 4.23 with revenues of Rp. 273,058, 000/hectare (table 8). This means that the received profit can be used to perform farming activities in the next planting season. Fore is expected with technological innovations and the establishment of the Farmer Group and the existence of a promising distribution line market, shallots farming business in Minahasa District can thrive.

Table 7. Analysis of Lansuna Shallots Farming Business Farmer Technology in Minahasa District

NO	DESCRIPTION	UNITS	Volume	PRICE UNITS	
				(RP)	PROCE (Rp)
A.	Materials				
1	Seeds	kg	800	35,000	28000000
2	Pukan	kg	3000	600	1800000
3	SP-36	kg	500	2,100	1050000
4	Phonska	kg	300	2340	702000
5	Urea	kg	300	1,800	540000
	Fungisida				
6	Dithane	kg	3	100000	300000
7	Score	bottle	12	150,000	1800000
8	Tarmex	bottle	5	75,000	375000
9	Sack	sheet	150	3000	450000
B.	Labor				
	Land Processing				
1	and bed	man-hour	30	125000	3750000
	Planting and				
2	basic fertilizer	man-hour	45	125000	5625000
3	Weeding I	man-hour	30	125000	3750000
	Continuation				
4	Fertilizer	man-hour	3	125000	375000
5	Weeding II	man-hour	30	125000	3750000
6	Spraying H & P	man-hour	16	125000	2000000
7	Embellishment	man-hour	30	125000	3750000
8	Harvest	man-hour	30	125000	3750000
	Total Cost				61767000
	Production				
	a. Total	kg	8000	25,000	200000000
	B. Cost		25,000		
	Revenue		200,000,000		
	Revenue				138,233,000
	B/C				2,23

Table 8. A Analysis of Lansuna Variety Shallots Farming Business Using Shallots PTT Innovations

NO	DESCRIPTION	UNITS	Volume	PRICE UNITS	
				(RP)	PRICE (Rp)
A.	Materials				
1	Seeds	kg	800	35,000	28000000
2	Pukan	kg	5000	600	3000000
3	SP-36	kg	150	2,100	315000
4	Phonska	kg	550	2340	1287000
5	Urea	kg	300	1,800	540000
6	KCL	kg	100	5,500	550000
7	Pestisida	Package	1	2,000,000	2000000
8	PPC	Package	1	550,000	550000
9	Sack	Sheet	150	3000	450000
10	Pestisida nabati	Package	1	1,000,000	1000000

Tabel 9. A Analysis of Lansuna Variety Shallots Farming Business Using Shallots PTT Innovations

NO	DESCRIPTION	UNITS	Volume	PRICE UNITS	
				(RP)	PRICE (Rp)
A.	Materials				
1	Seeds	kg	800	35,000	28000000
2	Pukan	kg	5000	600	3000000
3	SP-36	kg	150	2,100	315000
4	Phonska	kg	550	2340	1287000
5	Urea	kg	300	1,800	540000
6	KCL	kg	100	5,500	550000
7	Pestisida	Package	1	2,000,000	2000000
8	PPC	Package	1	550,000	550000
9	Sack	Sheet	150	3000	450000
10	Pestisida nabati	Package	1	1,000,000	1000000
B.	Labor				0
	Land Processing				
1	and bedengan	man-hour	30	125000	3750000
	Planting and				
2	basic fertilizer	man-hour	45	125000	5625000
3	Weeding I	man-hour	30	125000	3750000
	Continuation				
4	Fertilizer	man-hour	3	125000	375000
5	Weeding II	man-hour	30	125000	3750000
6	Spraying H & P	man-hour	16	125000	2000000
7	Embellishment	man-hour	30	125000	3750000
8	Harvest	man-hour	30	125000	3750000
	Total Cost				64442000
	Production				
	a. Total	kg	13500	25,000	337500000
	B. Price		25,000		
	Revenue		337,500,		
			000		
	Revenue				273,058,000
	B/C				4,23

C. CONCLUSION

Lansuna is one of the local superior varieties with the average potential yield at the farmer level at 7-8 t/ha. These varieties are adaptable to both the rainy season and the dry season. The prospect of developing shallots in the Minahasa district is very potential, and provides benefits on raising farmers' income. The result of the analysis of the farming efforts of the way farmers used Lansuna B/C ratio = 2.23 with revenues of Rp. 138,233,000/hectare. According to the results of study BPTP of North Sulawesi B/C Ratio was 4.23 with revenues of Rp. 273,058,000

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The Growth and Production Improvement of Soybean Plant (*Glycine max* L.) by Applying The Local Microorganisms of Fruit Waste in Palopo

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Abstract

This study was aimed to find out the effective local microorganism of fruit wastes concentration on the growth and production of the soybean plants. This study was conducted in the trial land of Campus 2, Faculty of Agriculture, Cokroaminoto University, Palopo from September to December 2019. The method used in this study was the randomized block design with 5 treatments and 4 replications, therefore there were 20 experimental units. Each experimental unit comprised 2 plant units, therefore there were 40 plant samples on the given concentration of P0: Control, P1: 50 mL/L fruit waste local microorganism concentration, P2: 100 mL/L fruit waste local microorganism concentration, P3: 150 mL/L fruit waste local microorganism concentration, and P4: 200 mL/L fruit waste local microorganism concentration. The results showed that the local microorganism application on the soybean plants had no significant effects on the plant height, total of leaves, flowering period, and a total of pods. The local fruit waste microorganism with 100 mL concentration was capable of improving the plant height, total of leaves, flowering period, and a total of pods with the respective average of 31.9 cm, 51.6 leaves, 21,8 days, and 35 soybean pods

Keywords: local microorganisms, fruit waste, soybean

A. Introduction

Soybean is one of the food plant types which has the important means after rice plant and corn. Soybean is also the main plant protein and oil source, therefore consuming the soybean has been assured will increase each year along with the increased total of population or public awareness on the nutrients required from the soybean plant. Based on the dry weight basis, soybean contains approximately 40% proteins, 20% oils, 35% dissolved carbohydrates (sucrose, stachyose, and raffinose, etc.), undissolved carbohydrates (food fibers), and 5% ashes (Liu, 2004).

Although does not contain vitamin B12 and C, soybean is the best vitamin B source compared to the other beans.

The productions and productivities of soybean in South Sulawesi Province from 2014 – 2018 were 54.723 ton/ha, 67.192 ton/ha, 62.054 ton/ha, 16.101 ton/ha, and 35.824 ton/ha. Based on the production data, the data was fluctuative due to lack of soil nutrient fulfillment acquisition in the soybean cultivation system.

The soil nutrient acquisition to support the soybean cultivation system is necessary to achieve more optimal results in terms of improved soybean plant growth and production. One of the supporting nutrients that can often be used is the local microorganisms.

Local microorganisms is a group of microorganisms that can be cultivated by providing a food as an energy source serves as a starter in the compost production (Ole, 2013). Local microorganisms contains macronutrients, micronutrients, and potential microorganisms as organic matter degrading agent, growth promoter, as well as pest and disease controller, which can be used as decomposer, organic fertilizer, and organic pesticide. Factors determining the local microorganisms quality are the fermentation media, materials or substrates concentration, shape and behavior of the active microorganisms in the fermentation process, pH, temperature, fermentation period, and C/N ratio of local microorganisms solution (Seni, 2013). One of local microorganisms production materials are fruits as microorganism sources. Local microorganisms obtained from fruits has macronutrient and micronutrient contents of 0,1833% N, 54,989 mg/L P, 3,125 mg/L K, 3,7 mg/L Ca, 64,5 mg/L Mg, 1,605 mg/L Fe, 0,274 mg/L Mn, 1,115 mg/L Zn, and 38,78 mg/L NH₄ (Wiswasta *et al.*, 2016).

Pratiwi (2018) applied the local microorganisms of banana suckers on the rice plant which resulted shorter flowering period of 66,33 days after planting and harvesting period of 102,33 days after planting. Tambunan (2018) stated that local microorganisms of tomato and coconut water wastes application influenced the growth and productivity improvement of chilli plants. Salamah (2016) reported that the local microorganisms of Indian bael fruit affected the growth and productivity improvement of Tosakan choy sum plant.

This study was aimed to discover the response of local microorganisms in fruit wastes to the growth and production of soybean plant and capable concentration to improve growth and production of soybean.

B. Methodology

1. Study Location and Period

This study was performed in the trial land of Campus 2, Faculty of Agriculture, Cokroaminoto University, Palopo, Lamaranginang street, Batupasi Village, Wara Utara Subdistrict, Palopo on September – December, 2019.

2. Materials and Equipments

Materials used in this study were the soybean plant seedlings, fruit waste, coconut water, rice water, molase, and water. Equipments used in this study were hoe, shovel, scales, measuring cylinder, tape measure, bucket, hose, and writing utensils.

3. Experiment Methods

This study used a randomized block design containing 5 treatments and 4 replications, therefore there were 20 experimental units. The treatments used in this study were P0: Control, P1: local microorganisms with concentration of 50 mL/L, P2: local microorganisms with concentration of 100 mL/L, P3: local microorganisms with concentration of 150 mL/L, and P4: local microorganisms with concentration of 200 mL/L.

The first step was preparing the equipments and materials of local microorganism production by mixing all materials in the bucket and stirring until all materials were merged and ready for the fermentation process within 2 weeks. The second step was preparing the planting media by forming 20 bed units with the size of 85 cm x 60 cm and planting distance of 30 cm x 30 cm. Before planting, planting holes were made using a sharpened stick with 2 planting holes on each bed with the distance between planting holes was 30 cm. Seedlings were planted on the planting hole with 2 seedlings for each planting hole. The third step was applying the local microorganism on the plants started at 2 days after planting until the generative phase based on the determined

concentration. The last step was observing the plant height (cm), total of leaves (leaves), flowering period (days), and total of pods during the harvest (pods).

C. Result and Discussion

The statistical analysis showed that the fruit waste local microorganism application had no significant effect against the growth and production of soybean plants as presented on the following Figure 1, 2, 3, and 4.

1. Plant Height (cm)

Figure 1 shows the local microorganism of fruit wastes with 100 ml concentration was capable of producing the best plant height with the average of 31,9 cm. The fruit waste local microorganism contains macronutrients that promote the plant growth (Handayani, S. H., A. Susilowati, dan A.Yunus, 2015) reported that local microorganisms of papaya fruit has the highest N element (0,45%), while K, Mg, and Fe content on local microorganisms of cow urine which had the highest value were K (417,76 ppm), Mg (2.460,88 ppm), and Fe (6,66 ppm). Jamilah dan Novita E. (2016) added that the balanced macronutrients and micronutrients can help improve the plant metabolism, thus achieving an optimum growth.

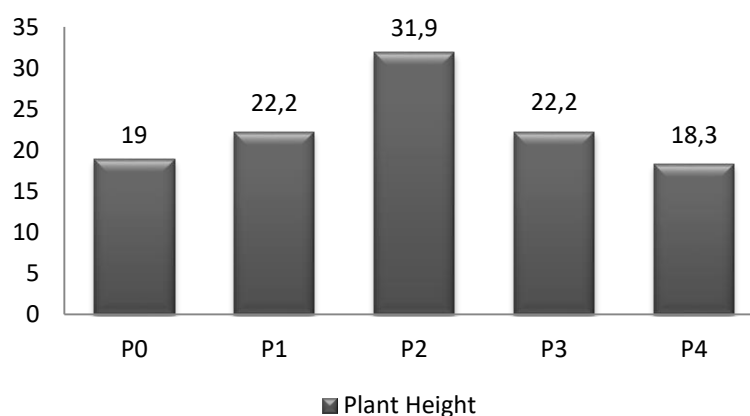


Figure 1. The average of soybean plant height on several concentrations of local microorganisms

2. Total of Leaves (leaves)

Figure 2 showed the best total average of leaves on the local microorganism concentration of 100 ml with 51,6 leaves. The fruit waste local microorganism contains N, P, and K nutrient required for plants as leaf is one of plant organs with the ability of receiving light to perform a photosynthesis; the faster photosynthesis process, the more leaves formed. According to Poerwowidodo (Parman, 2007), nitrogen nutrient acts as a chlorophyll former, therefore inducing the photosynthesis activity. This photosynthesis will produce a photosynthate which supports the leaf meristematic tissue developments.

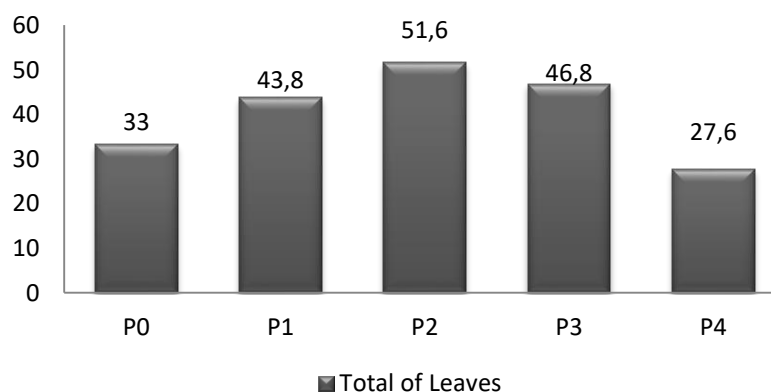


Figure 2. The total average of soybean plant leaves on some concentrations of local microorganisms

3. Flowering Period (days)

The best flowering period presented on the following Figure 3 showed that P2 as 100 ml fruit waste local microorganism concentration had the fastest flowering period with 21,8 days. The application of fruit waste local microorganism could induce faster flower occurrence on the soybean plants was suspectively due to the mixture of local microorganism production contained coconut and rice water required for plants to enhance the flowering process, as stated by Syaifuddin (2013), that coconut water contains cytokinin as the growth substance source and coconut contains proteins, less lipids, minerals, carbohydrates, and various vitamins. The utilization of rice water on each local microorganisms production gave double contents on the five mixtures of local microorganisms production application because of containing phosphorus, as one of the functions could enhance flower and fruit formation.

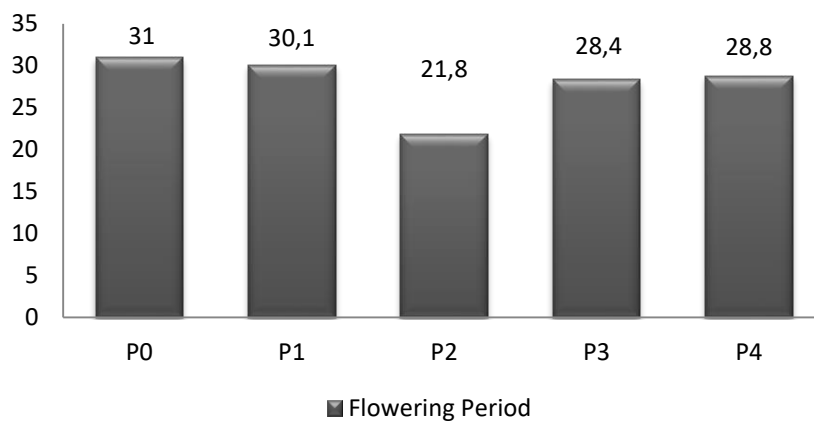


Figure 3. The average of flowering period on some concentrations of local microorganisms

4. Total of Pods (pods)

Figure 4 showed that the application of 100 ml fruit waste local microorganism concentration produced the best total of pods with 35 pods. The application of local microorganism could improve the total of pods on the soybean plants. It can be due to the local microorganism contains P nutrient required for plants during the generative phase. Fitri (2010) stated that the soyben plant pod formation requires nutrients, especially phosphorus, as plants which receives phosphorus will grow higher along with more pods formed. Jumin (1992) added that phosphorus in plants play roles in the cell division, albumin formation, fruit formation and maturation, root development, disease resistance.

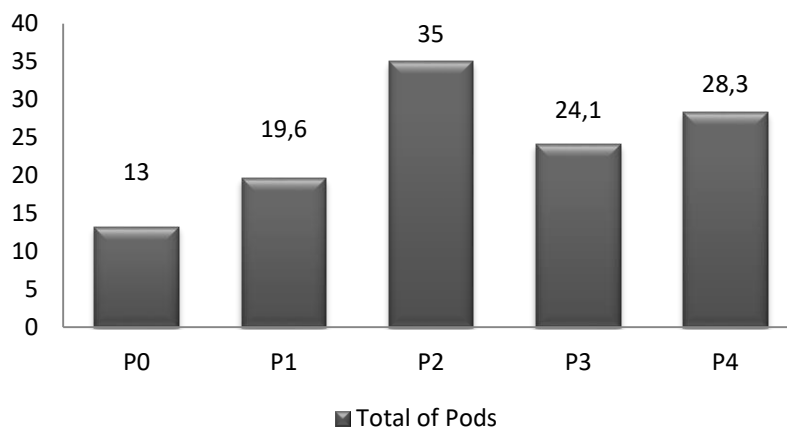


Figure 4. The total average of soybean plant pods on several concentrations of local microorganisms

D. Conclusion

The application of local microorganism on the soybean plants had no significant effect on the plant height, total of leaves, flowering period, and total of pods parameters. The fruit waste local microorganism with the concentration of 100 ml could improve the plant height, total of leaves, flowering period, and total of pods with the respective average of 31,9 cm, 51,6 leaves, 21,8 days, and 35 soybean pods. The fruit waste local microorganism contains the nutrients of N, P, K, and cytokinin hormones in large quantities, therefore capable of improving the growth and production of soybean plants.

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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	cm	76	70	61	Asalan
	-type standard					
	-type "spray"					
	*aster					
	*kancing					
*santini	60	55	50	Asalan		
2	Flower Stem Diameters	mm	>5	4.1-5	3-4	Asalan
	-type standard, aster and kancing	mm	>4	3.5-4	3-3.5	Asalan
3	Half Bloom Flower diameter	mm	>80	71-80	60-70	Asalan
	-type standard					
	-type "spray"					
	*aster					
	*kancing					
*santini	>30	>30	>30	Asalan		
4	The number of flower buds ½ blooms per stalk	Buds	>6	>6	>6	Asalan
-type spray						
5	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 (Wiratmaja, 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	<ul style="list-style-type: none"> · Flower crown open maximally 45° to vertical line. · Flower eyes still close together.
3	Flower with perfect blossom	<ul style="list-style-type: none"> · 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,	<ul style="list-style-type: none"> · 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	<ul style="list-style-type: none"> · 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 : Wiratmaja (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 Aprilia 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 inflourescence, 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 0C) or low temperatures (<16 0C) (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 AgNO₃ 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 AgNO₃ 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 AgNO₃ 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 KMnO₄. 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.

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Growth and Production of Pakchoy Under Various Type of Organic Fertilizer

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Abstract

This study was conducted in Wiringpalenna village, Tempe sub-district of Wajo district, with the aim to determine the effect of the type of organic matter on the growth and production of pakchoy plants. The study was arranged based on a Randomized Block Design with five treatments namely: without organic matter, chicken manure, Blotong (Filter press mud), bokashi common water hyacinth, bokashi rice straw. The results showed that from variables tested; plant height, the number of leaves, the width of leaves, fresh weight of plants, fresh weight of plants per plot, and fresh weight per hectare, treatment with bokashi common water hyacinth obtained the best result

Keywords: pakchoy, manure, bokasi

A. Introduction

Development of the horticulture subsector in Indonesia today is directed at the agribusiness system. The role of horticultural commodities is quite large for improving nutrition of the communities, increasing farmers' income, expanding employment opportunities, developing agribusiness and agro-industry, increasing exports, and reducing imports.

During the past five years, in the 2000s, there has been an increase in the absorption of vegetable commodities in the local market. This increase occurred due to public awareness about the nutritional value of vegetables, along with an increase in people's purchasing power that is getting better, especially in organic vegetables. Therefore, efforts are needed to improve the quality and quantity of production and income of vegetable farmers.

One vegetable with a close relative of mustard greens is pak choy. This plant belongs to the same genus as mustard greens in the plant classification, but different in varieties. For the appearance, it is very similar to mustard greens but shorter and compact. Based on this similarity

and the fact that it has almost the same taste as mustard greens, then its presence is easily accepted at the dinner table. In addition, these plants are able to grow in the lowlands and highlands but produce better in the highlands, and can be harvested in a short time, thus, this plant has the potential to be developed.

In order to develop pak choy plants, one way that needs to be conducted is to improve its cultivation techniques. Related to the cultivation of plants which lately is often discussed about sustainable agricultural production systems that are indicated by the existence of sustainability, environmentally friendly and ensure ecological sustainability, so that sustainable agricultural production systems are synonymous with the term organic agriculture development.

The potential and opportunities for developing organic agriculture are quite open and bright in the future. Therefore the results of the study on organic agriculture need to be applied and disseminated quickly and widely.

Considering the above explanation, pak choy cultivation should be developed by applying agricultural technology including the use of organic materials. Sources of organic matter that can be used to increase the production of agricultural crops may come from manure, rice straw, and common water hyacinth leaves, and blotong (waste from a sugar factory). Waste from organic matter usually contains many elements, some of them are essential for crop maintenance.

Common water hyacinth is one of the aquatic plants that live floating on the water due to its hollow stem, this plant contains organic matter which is needed for plant growth and development. This is proven by the results of laboratory analysis stating that common water hyacinth contains 1,681 % nitrogen, 0,275 % phosphorus, 14,268 % calcium, 37,654 % carbon with a C/N ratio of 22,399 (Fryer & Matsunaka, 1988).

Blotong (Filter press mud) as a by-product of the process of making sugar from sugar cane, always produced in large quantities, less than 2,7% of the weight of sugarcane that is ground each year. Blotong is a mixture of various materials consisting of sugarcane fiber, sucrose, and thickened colloids such as wax, sand, and soil.

Blotong has physical properties which are formless material, dark brown to black, soft, light and can be as a sponge; has a high ability to absorb water; fresh blotong contains up to 70 % water, while dry blotong that placed in storage for 6 to 12 months contain 15 % water; can be used as mulch, with its chemical properties for releasing nutrients slowly; has a high cation exchange capacity. Nutrient composition of blotong is : 2.19 % N, 2.77 % P₂O₅, 0.44 % K₂O, and microelements such as Fe, Mn, Mg and B (Muhali, 1981).

Rice straw is an agricultural waste that has enough nutrient content, is easy to decay, and has a high-water absorption capacity up to three times its own weight (Setyamidjaya, 1986). Based on research of FAO/UNDP Regional Project RAS / 75/2004 nutrient compositions in rice straw are 0.58 % N, 0.10 % P₂O₅, 38 % KCl and 105 % C/N (Wididana & Higa, 1993).

Chicken manure is classified as hot fertilizer with rapid decomposition by microorganisms. The mineral composition and water content of chicken manure are 1.5 % N, 9, 45 % P₂O₅, 0.4 % K₂O, 3.0 % Ca, and 0.6 % Mg (Ayub, 2004).

In agriculture, the use of organic waste to increase soil fertility and agricultural production has been done for a long time. Thus the use of organic waste as a source of plant nutrients can solve the problem of environmental pollution while providing benefits to the soil. The function of organic matter in the soil is as a nutrient source, stimulates the activity of soil microorganisms and improves the physical, chemical and biological properties of the soil.

Based on the explanation above, a study was carried out the entitled effect of organic matter on the growth and production of pak choy plants.

B. Methodology

This research was arranged according to a Randomized Block Design (RBD) consisting of five treatments namely: Without Organic Materials (p₀), Chicken Manure (p₁), *Blotong* (p₂), Bokashi common water hyacinth (p₃), Bokashi rice straw (p₄). Each treatment was repeated three times as a group, then there were 15 experimental plots.

Pak Choy seeds are spread evenly in nursery plots that have previously been mixed with manure and then covered with fine soil. Furthermore, germinated seeds were covered with coconut leaves. Seedling maintenance was done by watering the seedling in the morning and evening by taking care of the moisture of the seedling media. At four weeks after planting the seedlings of pak choy are ready to be transferred to the experimental plot.

Land preparation was done two weeks before planting. Land sanitation was carried out by removing weeds and remaining plant roots. The ground was loosened using a hoe or plows, then a plot was made with a size of 1,2 m x 1,5 m = 1,8 m² with a space between plots of 0,5 m. Around the experimental field, a canal was constructed with a width of 0,5 m and a depth of 25 -30 cm. Then fertilizer was applied based on the treatment.

When the seedlings are at one month after planting (leaves 4-5 strands), the seedlings could be transferred to the experimental plot. Planting was done in the afternoon. Before planting, the plot should be watered evenly. The spacing used was 20 cm x 20 cm so that each experiment plot contained 45 plants.

At the beginning of the growth of the pak choy plant, watering was performed routinely twice a day in the morning and evening. The application of organic fertilizer was conducted when making experimental plots with a dose of 2 tons/ha (0,36 kg/plot). Subsequent fertilization using urea fertilizer as a base fertilizer with a dose of 50 kg/ha (9 g/plot) which was done 1 week after transplanting. The first weeding was done when the plants are 1 week after planting and the next weeding was considered based on the field conditions.

Harvesting was done when the plants are 44 days after planting when the lowest leaf has begun to turn yellow. This plant is harvested by cutting the stem of the plant just above the soil surface without the roots.

Variables were observed in each 5 plant samples which randomly selected in each plot, the variables including the plant height, number of leaves, width of leaves, fresh weight per plot and fresh weight per ha

C. Discussion

Mm Bokashi common water hyacinth provided better results on plant height, the number of leaves, the width of leaves, and fresh weight per plant, fresh weight per plot, and fresh weight per hectare. This result obtained by Bokashi common water hyacinth was better compared to other types of fertilizer treatments (Figures 1,2,3,4,5 and 6).

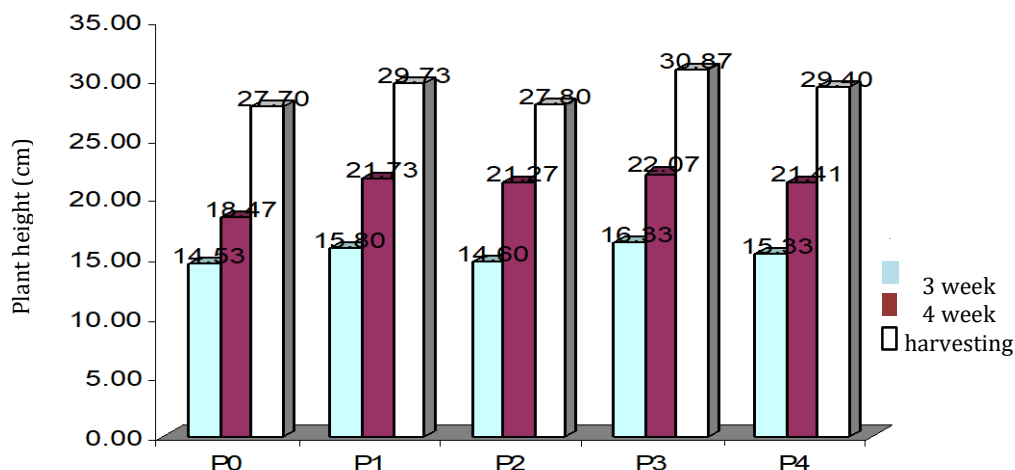


Figure 1. Diagram of Average Plant Height of pak choy

Well grown of the plant in the initial phase causes subsequent well generative growth. As it is known that bokashi common water hyacinth; besides its high nutrient content also been fermented, made this material decomposes quickly and easily available to plants.

While bokashi rice straw, although it has also been fermented, because the nutrient content is rather low, thus, the effect is insufficient to meet the needs of plant nutrients. The application of chicken manure is also showed different results, however, it tends to be better than bokashi straw, blotong, and without organic matter. This might be because manure contains nutrients that are needed for growth and development of the plant, but the effect is slower than bokashi common water hyacinth because chicken manure is not provided in the form of bokashi even though chicken manure is classified as hot fertilizer. Similarly, blotong because it is not in the form of bokashi or did not get fermentation process, therefore, it is slow to available in plants even though the nutrient contents are higher especially nitrogen.

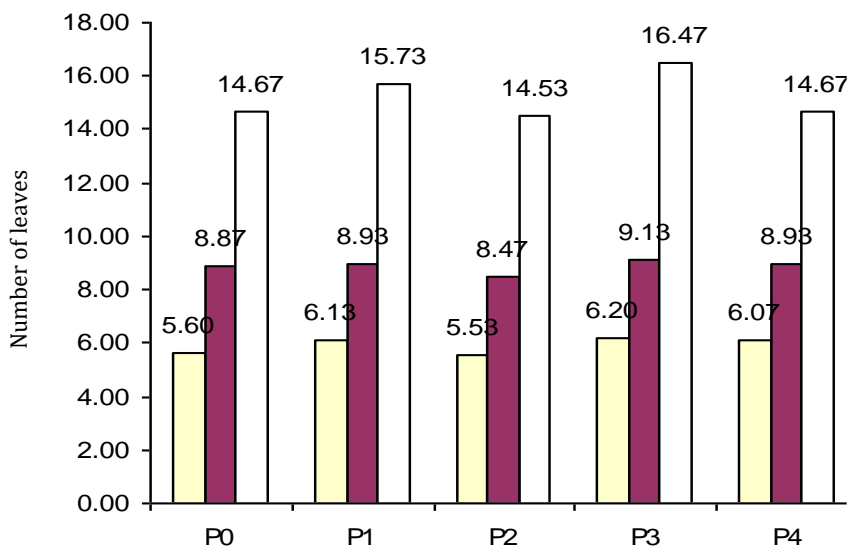


Figure 2. Diagram of Average number of leaves of pak choy

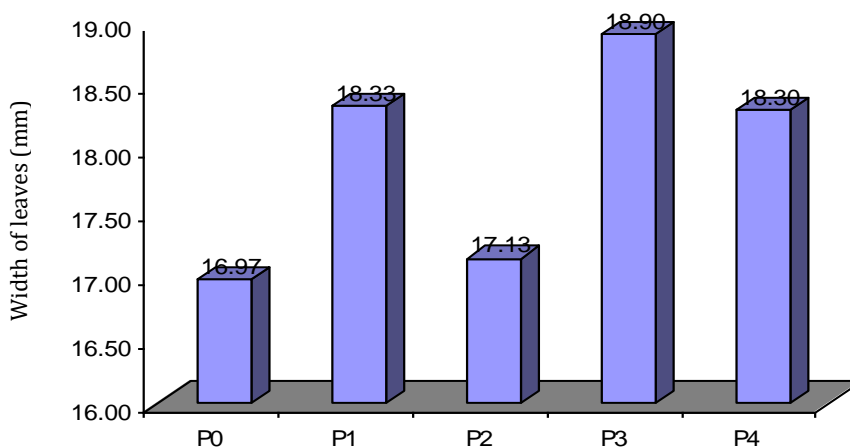


Figure 3. Diagram of Average width of leaves of pak choy

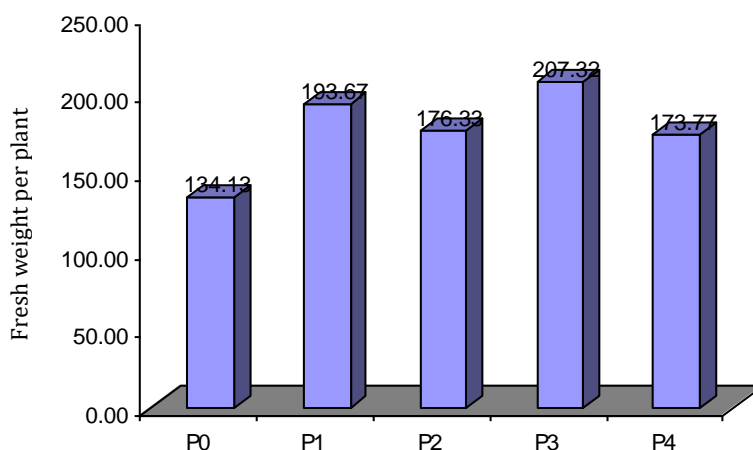


Figure 4. Diagram of Average fresh weight of pak choy

The best growth and production of pak choy were obtained by the treatment of bokashi common water hyacinth, this might be because the nutrient of bokashi common water hyacinth is easily to decompose, so it can more quickly be absorbed by plant roots to support its growth.

The application of organic matter into the soil will increase the availability of nutrients needed by plants. Thus plants can grow and produce well. According to Hakim, Nyakpa, Lubis, Nugroho, Rusdi, Diha, Hong, & Bayley (1986), the addition of organic material into the soil can increase the absorption and cation exchange capacity of the absorption complex.

The application of organic matter into the soil will increase the availability of groundwater. This is in line with the opinion of Setyamidjaja (1986) that the application of organic matter into

the soil will improve soil structure, soil infiltration capacity, water binding capacity, soil aeration, and soil resistance to erosion.

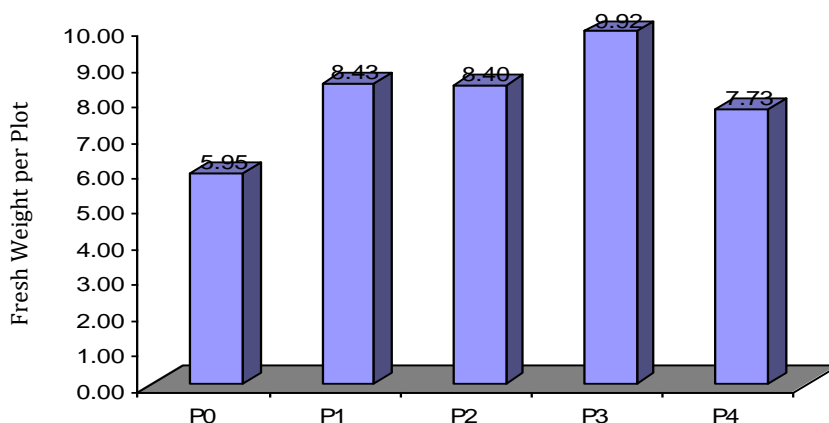


Figure 5. Diagram of Average fresh weight of pak choy per plot

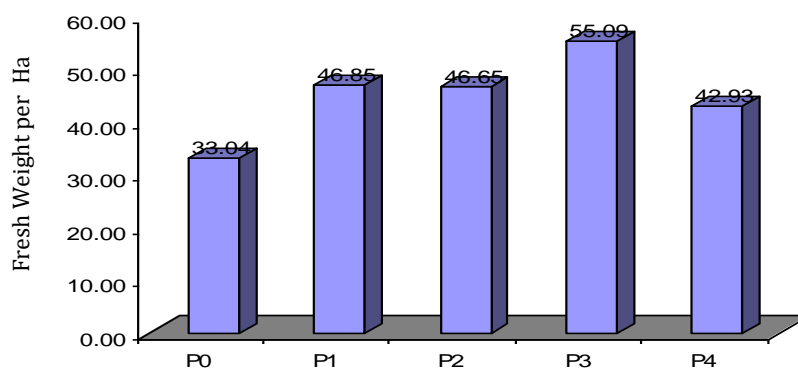


Figure 6. Diagram of Average fresh weight of pak choy per hectare

Whereas N, P, and K contained in the organic matter according to Sarief (1993), nitrogen has a role to stimulate vegetative growth by increasing plant height and is a constituent of protein, protoplasm and the formation of plant parts such as stems and leaves which are photosynthetic activities that produce photosynthates for vegetative growth. In addition, Setyamidjaja (1986) suggested that the leaves are an active part of the plant. In the leaves, photosynthesis as a very important plant life activity is carried out, where plant nutrients play a role. Meanwhile, according to Hardjowigeno (2002), functions of P is for cell division, the formation of albumin, the formation of flowers, fruit, and seeds and accelerate maturation; while K functions to activate enzymes, and enhance resistance to drought, disease, and root development.

D. Conclusion

Based on the results of the study, it can be concluded that plant height, number of leaves, the width of leaves, fresh weight of plants and fresh weight of plants per plot, and fresh weight of plants per hectare are best produced in the treatment with application of bokashi common water hyacinth. For the upcoming experiments, it is recommended that all organic matters used in the form of bokashi.

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Population of Natural Enemies in Three Varieties of Rice Plants in Turikale Subdistrict, Maros District

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Abstract

Rice (*Oryza sativa* L.) is an annual crop that plays an important role in meeting the food sources of the Indonesian population. In addition, rice plants have a diversity of insects as their natural enemy. This study aims to determine the population of natural enemies of 3 rice varieties, namely Inpari 30, Ciliwung, and Mekongga varieties. The research location is the rice fields in Turikale Subdistrict, Maros District. The method used for the study was the survey location of rice fields with each paddy field size of about 20 x 15 m. The results showed that there were 3 types of predators namely *Lycosa*, *Coccinella*, and *Orthetrum* which were found in each variety with varied total numbers at every 2-week observation interval. The highest population of *Lycosa* was found in the Inpari 30 (6 wap) variety, the highest *Coccinella* population also was found in the Inpari 30 (10 wap) variety, while the highest *Orthetrum* population was found in the Mekongga variety (6 wap). The highest proportion of each variety was *Lycosidae* 50% in the Inpari 30 variety, *Lycosidae* 51.35% in the Ciliwung variety, and *Lycosidae* 44.44% in the Mekongga variety

Keywords: rice, varieties, lycosa, coccinella, orthetrum

A. Introduction

Rice (*Oryza sativa* L.) is a food crop that is the main food source for the Indonesian population. Over time the need for rice is increasing every year while the need for an effort to increase rice production is urgently required. However, until now the efforts to increase rice production still faces some obstacles including the existence of a pest attack that attacks rice plants which causes a decrease in rice crop production. Usyati, et al (2008) stated that the average loss of agricultural production due to OPT attacks was \pm 30% of the potential yield, and yield losses due to pests around 20-25%.

One of the solutions in controlling pests in IPC is to utilize natural enemies. In the concept of integrated pest control (IPC), it is emphasized that pest control should be carried out biologically

by utilizing natural enemies that already exist in plantations. Natural enemies on a good balance of nature always manage to control the pest population which can be managed to remain under the economic level. Therefore, providing natural enemies an opportunity to work means reducing the use of pesticides.

The natural enemies that inhabit rice plantations are very diverse and can be used to suppress pest populations if managed properly (Acep, 2015). The utilization of natural enemies does not cause pollution, in terms of ecology remain sustainable and in the long run, are relatively inexpensive. Control by biologically utilizing natural enemies is the work of biotic factors such as parasitoids, predators, and pathogens to prey or host, so as to produce a general balance that is lower than the conditions indicated if the factor is absent or does not work (Bach, 1979; Stern, 1959). Therefore, it is necessary to conduct research to determine the population of natural enemies from the three varieties of rice plants namely Inpari 30, Ciliwung, and Mekongga variety.

This study was aimed to explore and discover the natural enemy existence of these three rice varieties, namely Inpari 30, Ciliwung, and Mekongga variety.

B. Methodology

This study was conducted at rice fields in Turikale Subdistrict, Maros District. Materials and tools used in this study included killing bottles, gauges, collection bottles, insect nets, labels, plastic bags, bamboo stakes, scissors and writing stationery.

This study used a survey location method to determine the sampling location. Each rice field plot was determined with a size of 20 x 15 m and divided into 3 sub-plot observations which were spread with each 10 plants of each cluster.

Observation Method

1. Direct observation

Direct observation was performed on 10 clusters per sub-plot observations which were randomly systematically determined. Each cluster was observed from the stem base to the leaves. The observation was performed every 2 weeks until before harvesting, then the natural enemies found were put into a killing bottle then observed and calculated the number of individuals. Furthermore, the natural enemies obtained were counted and identified up to the family level referred to the insect determination (Borror & DeLong, 1971).

2. Netting

Netting was performed to catch the natural enemies that were actively flying around the plant canopy. The netting was performed using net with 10 insect swings and 20 replications in a designated rice sub plot plantation. The selection was performed on the observation field with systematic distribution. The arthropods obtained were put in a plastic bag and collected into a collection bottle containing 70% alcohol followed with identification, as well as recording the total number and type.

C. Result and Discussion

1. Population of Natural Enemies

The natural enemies found in rice plantations during the study were Lycosidae, Coccinelidae and Orthetrum. The observation indicated that the population of the three varieties was fluctuative following the figure.

As shown in Figure 1, an increased number of insects was shown simultaneously among the three varieties at 6 wap, then decreased individual population was shown at 8 and 10 wap. This result was similar to Bambaradeniya & Edirisinghe (2008), who stated that the arthropod community on terrestrial land in plantations either in rice, weeds, and soil surface consists of insects and spiders which is strongly influenced by the rice cultivation.

Figure 2 above shows the population of Coccinelidae that increased simultaneously for all three varieties at 6 wap and increased again at 10 wap for both varieties, namely Inpari 30 and Ciliwung variety, but the same did not occur in Mekongga variety as the number of Coccinelidae did not increase at 10 wap.

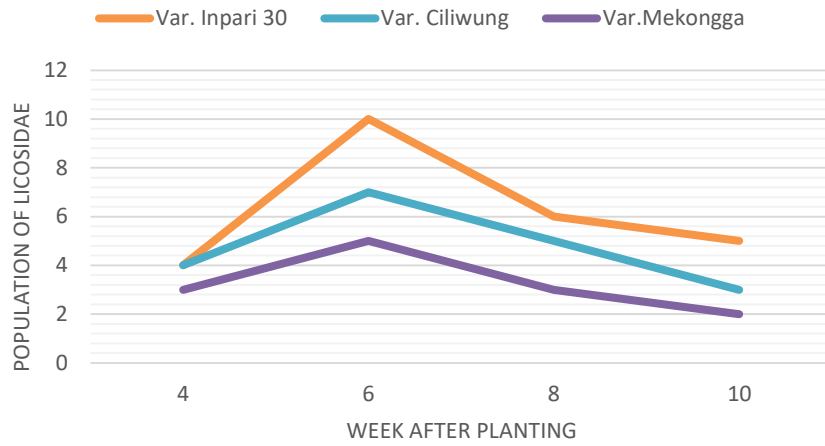


Figure 1. Lycosidae Population in Three Rice Plant Varieties

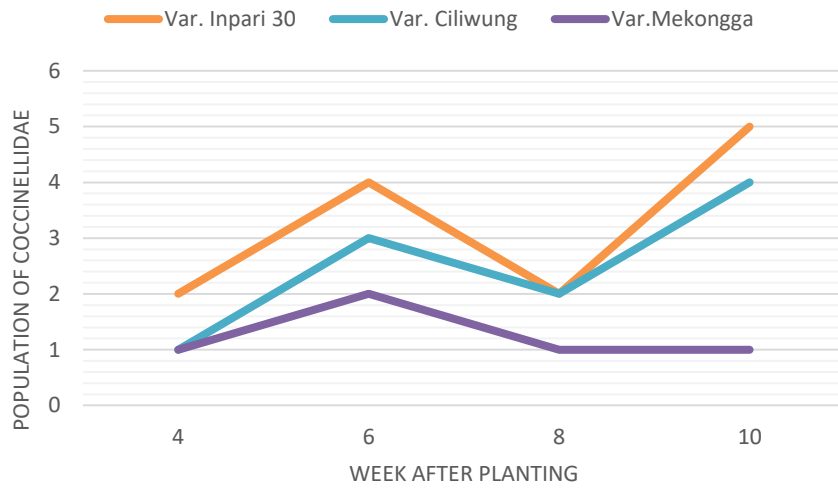


Figure 2. Coccinellidae Population in Three Rice Plant Varieties

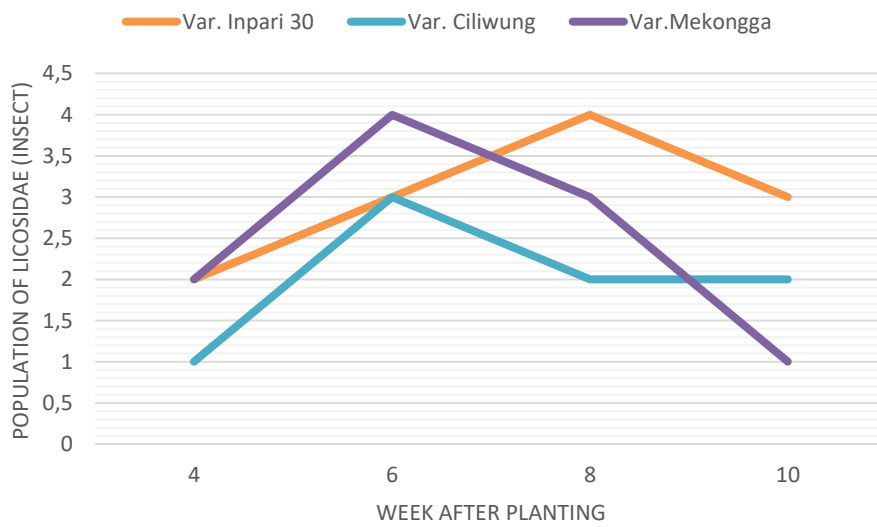


Figure 3. Orthetrum Population in 3 Rice Varieties

Orthetrum population increased at 6 wap in Ciliwung and Mekongga variety and the following week showed the decrease in the total number of insects, but the number of populations in the Inpari 30 variety increased at 8 wap and also decreased at 10 wap.

2. The Amount and Proportion of Natural Enemies in 3 Rice Varieties

The natural enemies in the three varieties showed different amounts and proportions as seen on the following table:

Table 1. The Amount and Proportion of Natural Enemies in Inpari 30 Variety

Order	Family	Amount (insect)	Proportion (%)
Araneida	Lycosidae	25	50
Coleoptera	Coccinellidae	13	26
Odonata	Orthetrum	12	24
Total		50	100

Source : Primary data after processing (2019)

The most natural enemies obtained in the Inpari 30 variety was from the Lycosidae family with 25 insects made up 50% proportion of the total natural enemies, followed by Coleoptera family with 13 insects proportioned as 26% and the lowest population was from the Orthetrum family with 12 insects proportioned as 24%.

Table 2. The Amount and Proportion of Natural Enemies in Ciliwung Variety

Order	Family	Amount (insect)	Proportion (%)
Araneida	Lycosidae	19	51.35
Coleoptera	Coccinellidae	10	27.03
Odonata	Orthetrum	8	21.62
Total		37	100

Source : Primary data after processing (2019)

The highest natural enemy population in the Ciliwung variety was obtained from the Lycosidae family with 12 insects proportioned as 44.44% of the total natural enemies found in the Ciliwung rice plant variety, followed by Coccinellidae family with 10 insects proportioned as 27.03% and the lowest population was obtained from Orthetrum family with 8 insects proportioned as 21.62%.

Table 3. The Amount and Proportion of Natural Enemies in Mekongga Variety

Order	Family	Amount (insect)	Proportion (%)
Araneida	Lycosidae	12	44.44
Coleoptera	Coccinellidae	5	18.52
Odonata	Orthetrum	10	37.04
Total		27	100

Source: Primary data after processing (2019)

Based on the observation result, the highest natural enemy population in Mekongga variety was from the Lycosidae family with 12 insects proportioned as 44.44%, then followed by the Orthetrum family with 10 insects proportioned as 37.04% and the lowest population was from the Coccinellidae family with 5 insects made up a proportion of 18.52 %.

D. Conclusion

Based on the results, the population of natural enemies found, namely Lycosidae, Coccinellidae, and Orthetrum family in three varieties of rice plants was relatively high. Increased potential and role can be expected once the predator population can be maintained and increased to reduce increased pest populations.

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Using Oil Palm Segregation Genetics to Decipher Illegitimate Seed Distribution Channels to Smallholder Farmers in Cameroon

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Abstract

Planting material or seed is the most determinant factor for oil palm productivity along side agro climatological and management considerations. A study was conducted to determine the different varieties of oil palm planted in smallholders' plantations, the distribution channels for oil palm seeds and all the actors involved in the seed trade sector in Cameroon. This is a bid to secure the supply of only improved planting materials to smallholder farmers. 230 oil palm smallholder plantations were surveyed and individual palms were subjected to varietal determination. The Chi-Square Test (χ^2) for Fixed Ratio Hypothesis ($\alpha= 0.05$) was used to determine whether the observed ratio deviates significantly from the Mendellian hypothesized genetic segregation ratio. Up to 65% of smallholder farms were found to be planted with poor planting material distributed in the different Mendellian ratios; 100% Dura, 50% Tenera and 50% Dura (1:1), 25% Dura, 50% Tenera and 25% Pisifera (1:2:1). The source of this poor quality planting material for these farms was deduced to come from private nursery entrepreneurs and workers of industrial plantations such as the Cameroon Development Corporation (CDC), Cameroon Palm Oil Company (SOCAPALM), Common Initiative Groups (CIG's) and Non-Governmental Organisations (NGO's). Farmers supplied by government services especially the Ministry of Agriculture and Rural Development and some of its specialized development projects all received good quality material. Thus, this is the only means now available which can assure the distribution of seeds good quality seeds

Key Words: genetic segregation ratio, illegitimate seeds, climate change, seed distribution

A. Introduction

Agriculture is the backbone of Cameroonian economy. More than 75% of the population is dependent on agriculture and related sectors. Agriculture in Cameroon is mainly rudimentary with the use of slash and burns techniques especially in subsistence farming which makes up 85% of Cameroonian agriculture.

Agriculture, especially the cultivation of oil palm has been seen as one of the most important causes of climate change (Hasanah, Komarudin, Dray & Ghazoul, 2019). Agriculture does not only convert large expanses of forests into monoculture plantations, but also as a great emitter of Green House Gases (GHG) emission into the atmosphere (deAlmeida, Vieira, Silvio, & Ferraz, 2020). Cameroon is ranked 62nd among emitters of Green House Gases in the world. The country is ranked at the 148th level on the globe in terms of GDP per capita. Therefore, it is a relatively high producer of GHG for a less industrialized nation. This high GHG level is from agriculture and related sectors.

Constraints in oil palm production in Cameroon include the use of poor seed material, rudimentary planting techniques, and Fresh Fruit Theft (Ajambang & Ijang, 2016), pollination success Li, Tschardtke, Saintes, Buchori & Grass (2019). This has caused productivity (1.2 tons CPO/ha/yr) to remain low, (MINADER, 2011; Hoyle & Levang, 2012) when compared to 4.5 tons CPO/ha/yr for South East Asian countries. This has a great impact on climate change because more forests shall be converted to increase production by surface area expansion.

Cultivation of the oil palm (*Elaeis guineensis* Jacq.) has expanded tremendously in recent years. The Oil Palm is a major source of vegetable oils in Cameroon where annual production stands at over 150 000 MT (Bakoume & Mahbob, 2005). Its major uses include human consumption, soap and candle industry and kernel cake for animal production.

The drop in prices of cocoa and coffee that were the major export crops, associated to the increase in consumption of palm oil due to population growth has led farmers to embark on oil palm cultivation. Moreover, increased plantings are to be expected with the use of palm oil in the bio diesel industry.

Oil palm is commonly divided into three types based on their shell thickness (*sh*). The *sh* gene had been discovered by Beinaert & Vanderweyen, (1941). The *Dura* has a shell thickness between 2 to 8 mm; the *Tenera* 0.2 to 2 mm and the *Pisifera* has no shell. The fleshy mesocarp of *Dura* yields between 15 to 17%, oil that of *Tenera* yields between 21 to 23% oil and *Pisifera* more than 23% oil. The *Pisifera* mostly aborts its fruits and thereby produces virtually empty bunches, thus it is not cultivated on large scale for commercial purpose. The commercially planted and high yielding variety *Tenera* is a hybrid obtained from *Dura* mother parent and *Pisifera* male parent (Fig. 1). Among the three types of oil palm *Dura*, *Pisifera* and *Tenera* commonly found on smallholders' plantations in Cameroon, the hybrid *Tenera* had been adopted as the unique planting material. Oil palm selection and breeding has made it possible to have an oil yield of up to 4.5 t/ha/yr in a plantation cultivated with improved *Tenera* seeds. There are two oil palm seed production centres in Cameroon that include the Specialised Centre for Oil Palm Research (CEREPAH) of the Institute of Agricultural Research for Development (IRAD) at La Dibamba and the PAMOL Plantations at Lobe. Seed production at CEREPAH dates back as from 1985 and consists of reproducing the best crosses identified in the *Dura* x *Pisifera* and *Dura* x *Tenera* progeny tests. Oil palm has undergone two successful breeding cycles. The first cycle resulted in a genetic progress of 18% in oil yield while the second represented 36% of the best progenies of the "Expérience Internationale" (First Inter - origin crosses). Today 100% of all oil palm seeds supplied by CEREPAH are of the second breeding cycle. CEREPAH has projected the production and distribution of over 15 million seeds of which 50% will be vascular wilt tolerant in the next five years (MINRESI, 2008).

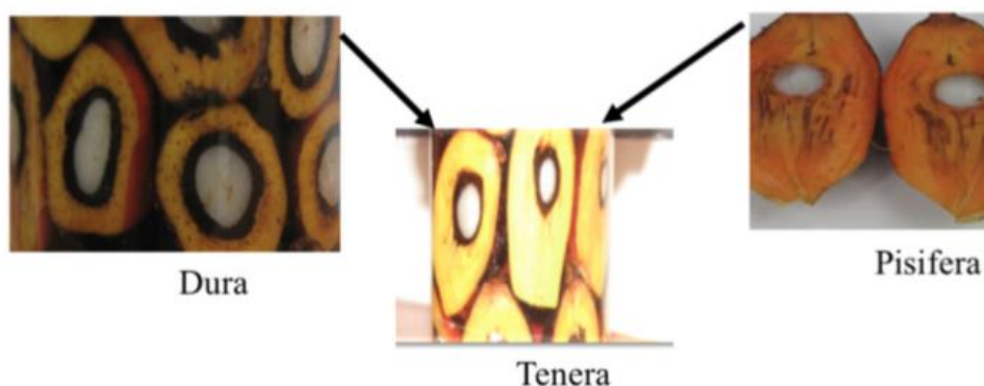


Fig. 1. The different types of oil palm planted by farmers

Recent studies on oil palm smallholdings in the Western Highlands of Cameroon reveal that the supply of improved planting material is a major hindrance to oil palm development (Ngoko, Bakoume Djoukeng, Tchamo, Imele & Adon. (2004); Bakoumé & Mahbob, 2005). This is the case with farms far away from agro industrial plantation (Cheyns & Rafflegeau, 2005). Whereas the development of oil palm small holder plantations started around the agro industrial plantations who supplied high quality planting material and modern cropping techniques to the surrounding farmers (Rafflegeau & Ndigui, 2001). The principal distributors of planting material to the small holder farmers in areas far away from agro industries include elites, private individuals, CIG's, NGO's and Government services (Bahoya, 1999). Differences in variety for oil palm cannot be made at the seedling stage until when the crop starts production four years after planting. Most farmers are ignorant of what variety they are planting although all of them may be aiming to plant the improved variety Tenera. Losses in time and money are enormous after discovering four years later that the farmer had been deceived by unscrupulous seed merchants. According to Kandi, Das & Sable (2013), the simplest and most efficient seed distribution system is to establish a central marketing cell that will supply all other channels.

The Cameroonian seed law signed by Prime Ministerial decree No. 2005/3091/PM of 29th August 2005 fixes the modality of production, quality control and commercialisation of seeds. Seed producers and distributors have to conform to the provisions of this law with respect to quality. Therefore, all farmers are advised to plant certified quality seeds. Most of the time farmers are duped by some unscrupulous seed agents who supply them with poor unproductive seeds. This is possible with most perennials especially oil palm where seed quality cannot be distinguished at the seed or nursery state. Also, these seed suppliers pretend that the seeds are from the right source whereas; they are just out to make some money.

The objective of this study was to find the quality of seed planted and detect the different possible distribution channels of illegitimate seeds that are supplied to farmers.

B. Materials and methods

1. Zone of study

The study was carried out in a series of smallholder plantations in Cameroon. The zone is located in the bimodal rainfall forest with two rainy seasons and two dry seasons. The mean annual rainfall is 1300-2000 mm and the annual temperature mean is 24 °C. Palm oil cultivation was newly introduced in the zone (during the last ten years).

2. Analysing the type of planting material by varietal determination in the field

In the zone, a total of 230 oil palm smallholder plantations were visited. All the farms visited were already in production and could make up at least a hectare. This was to ensure that the process for varietal determination for oil palm could well be carried out. Some physical characteristics which are conventionally used to distinguish between the different oil palm varieties were used. This included the size of the trees, the quantity of fruit mesocarp and shell thickness.

Table 1. Number of smallholder farmers per subdivision surveyed.

Sub divisions	Number
1	90
2	70
3	40
4	30
Total	230

1 = Ambam, 2 = Kye Ossi, 3 = Meyo Centre, 4 = Ma'an

Size of trees: All trees planted at the same time with uniform density and given the same upkeep are supposed to be the same in both trunk height and stem width except they are of different varieties. The Dura has a slow growth rate of 20 to 30 cm/yr; the Tenera has a growth rate of 25 to 75 cm/yr while the Pisifera has a growth rate of 50 to 100 cm/yr. Hence it is possible to distinguish the three varieties from neighbouring trees planted in the same year.

Quantity of fruit mesocarp: This varies greatly among descendants of the same variety and also the breeding cycle.

3. Oil Palm Varietal Determination and The Punnett Square

The genetically determining and most sure character used in variety determination in oil palm is the shell thickness. For the Dura, it is between 2 to 8 mm, 0.2 to 2 mm for Tenera and a fibre ring surrounding the ring and Pisifera has no shell (Beinaert & Vanderweyen, 1941; Hartley, 1988). Fortunately, this character follows the patterns of Mendelian inheritance for gene segregation and independent assortment making it easier to identify the genotype from the phenotype. These genes are;

- i. (sh+/sh+) for thick shell *Dura* type (DD)
- ii. (sh-/sh-) for shellless *Pisifera* type (PP)
- iii. (sh+/sh-) for thin shell *Tenera* type (T or DP)

Sampling was done on 50% of all the trees found on each plot, which is considered as our experimental unit. A plot in this sense means a piece of land cultivated with material from the same origin and in the same year of planting. Only trees carrying mature fruit bunches were sampled. Five fruits were collected from each tree and with the use of a very sharp cutlass, the fruits cut through the middle to estimate the thickness of the shell. A Punnett Square is a graphical representation that shows all the possible genotype combinations of offsprings arising from a particular cross or breeding event. It shows the different segregated genotypes that two parents can produce when crossed. Assuming that all traits exhibit independent assortment. A Punnett square grid containing 80 boxes (fig. 2) was used to indicate whether the tree sampled from its shell thickness is a Dura, Pisifera or Tenera. Each variety is expressed as a percentage of the 80 trees sampled. The Chi-Square Test for a Fixed Ratio Hypothesis ($p = 0.05$) was used to determine whether the observed ratio deviate significantly from the Mendelian hypothesized genetic segregation ratio.

D	D	P	T	D	D	D	P	P	D
T	T	T	P	T	P	P	T	T	T
T	D	T	D	P	D	D	D	T	T
T	T	P	P	T	P	T	P	P	T
T	D	P	D	D	T	T	D	T	P
T	T	T	P	T	P	T	P	P	T
D	T	D	P	T	T	T	T	D	T
T	D	T	T	T	D	T	T	T	P

The Formula for Chi Square Is

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where:

c = degrees of freedom

O = observed value(s)

E = expected value(s)

Fig. 2. Punnett Square used in sampling oil palm

D = Dura, P = Pisifera, T = Tenera

3. Principles of Segregation Analysis

Segregation analysis is a statistical approach based on the genetics of Gregor Mendel that makes assumptions to determine if the pattern of phenotypes observed is consistent with the genetic inheritance of a major gene for that trait. This statistical model is applied to explain the best fit pattern of inheritance and distribution of a trait. Tizaoui & Kchoul, (2012) used segregation genetics associated with the chi-square test to study transgene inheritance in tobacco. Weigel & Glazebrook, (2008) identified new mutants in *Arabidopsis* using segregation analysis.

4. Identifying oil palm seed acquisition channels and the actors involved

Focus Group Discussions (FGD) and Key Informant Interviews (KII) were done in all the sub divisions. In the case of KIIs, only agricultural officers and local administrative and traditional authorities were concerned. The FGD included the KII tam and other main actors in the seed distribution chain. Information obtained from the FGD and the KIIs were used to develop a semi-

structured questionnaire used in collecting data in households. This was used to interview, on purposive sampling, the farmers on the date of planting, the sizes of their farm, the supposed variety planted, the motivation behind the cultivation of oil palm, knowledge of the different oil palm varieties, their supplier for planting material, the difficulties they face in obtaining planting material and how these difficulties can be overcome. All the above data was reported into an excel spread sheet. The information was taken to the farms to determine who supplied what variety. The Chi-Square Test for Independence in a Contingency Table ($p = 0.05$ and 0.01) was used to determine whether a number of socio economic factors influence the choice of variety planted.

C. Findings and Discussions

1. Varieties of oil palm planted in smallholders' plantations

From the analysis of the type of planting material on smallholder plantations, we found out that three varieties of oil palm were present in most of the farms. 80 farms (35%) out of the 230 sampled were planted with improved planting material or 100% Tenera. 150 (65%) out of the 230 farms were planted with bad quality planting material (fig. 3) represented in three particular cases as follows;

1. Plots planted with 100% Dura,
2. Plots with 50% Tenera and 50% Dura and
3. Plots containing 50% Tenera, 25% Dura and 25% Pisifera.
4. Plots with 100% of Tenera

Analysis from socio economic data showed that all the farmers (100%) intended to plant the improved variety of the oil palm (Table. 2).

Table. 2. Variety of oil palm supposedly planted by farmers from interviews

S. division	variety	Frequency	Per cent
1	Improve	90	100.0
2	Improve	70	100.0
3	Improve	40	100.0
4	Improve	30	100.0

N.B. 1 = Ambam, 2 = Kye Ossi, 3 = Meyo Centre, 4 = Ma'an.

But after the field varietal determination, there were large discrepancies from their intentions of planting Tenera and what they actually planted (Table. 3).

Table. 3. Variety actually planted by farmers after verification (at least 4 years later)

Sub Division	Variety planted	No. of farms	%	Total no. of farms
AMBAM	Improved	50	55,6	90
	Poor	40	44,4	
KYE OSI	Improved	20	28,6	70
	Poor	50	71,4	
MEYO CENTRE	Improved	10	25,0	40
	Poor	30	75,0	
MA'AN	Improved	0	0,0	30
	Poor	30	100,0	
TOTAL	Improved	80	35,0	230
	Poor	150	65,0	

2. Channels of oil palm planting materials acquisition and actors involved

According to the results obtained from farmers' interviews, planting material is obtained the following four channels;

1. Staff of the Ministry of Agriculture and Rural Development (MINADER)
2. NGOs
3. Private nursery operators and
4. Workers of the Institute of Agricultural Research for Development (IRAD)

Figure 3 shows the different suppliers of oil palm planting material to farmers and the associated quality that they supply. This result is a combination of both the interviews and the actual field variety determination.

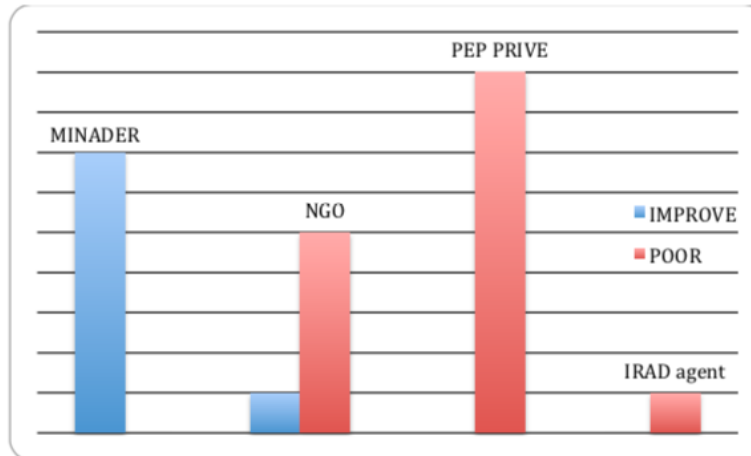


Fig. 3. Representation of the different suppliers and the quality of planting material supplied.

The staff of MINADER supplied planting materials to 70 farmers and 100% of that material was improved seed. The NGOs supplied planting materials to 60 farmers, of which 10 were improved and 50 poor quality. Private nursery owners sold planting materials to 90 farmers and 100% of that material was poor. IRAD agent supplied oil palm plants to 10 farmers, all of which was of bad quality

3. Knowledge of the existence of different varieties of oil palm

All farmers intended to plant only high quality seeds in their farms. It was found out that neither ignorance nor awareness of the differences in oil palm variety influenced the choice of material planted ($p = 0.05$). This signifies that the preferences of the farmers to plant the high yielding variety were not met. Also, the reasons for planting oil palm from our survey, which included income search, mode or because it is the trending business of the time, source of youth employment, for subsistence or for securing land did not influence the choice of variety planted. Hence, the hypothesis that people plant just any thing to occupy their land for security purposes was rejected.

4. Composition of the different farms

The farms planted with poor quality material had the following representation after field variety analyses.

- Farms planted with 100% Dura,
- Farms with 50% Tenera and 50% Dura and
- Farms containing 25% Dura 50% Tenera and 25% Pisifera.

These ratios were obtained after analysis of the counts per genotypic class using the Chi square prediction for classical genetic ratios. The few farms that did not respect any particular known ratio were discarded since no valid inference could be drawn from them.

➤ Case of Farms with 50% Tenera and 50% Dura

The corresponding χ^2 tabular value at $n - 1$ degrees of freedom is 3.841 at $\alpha = 0.05$ which is far greater than the observed value of 0.45. We then conclude that the results uphold the hypothesis of the standard ratio of 1:1.

Table 4: Representation of data for case of farms with 50% Dura and 50% Tenera

Genotypic Class	Observed	Expected	$(O - E)^2$	$(O - E)^2/E$
Sh+/Sh+	106	100	36	0.36
Sh+/Sh-	97	100	9	0.09
				$\chi^2 = 0.45$

➤ **Case of Farms containing 25% Dura 50% Tenera and 25% Pisifera**

Table 5: Representation of data for case of farms with 25% Dura, 50% Tenera and 25% Pisifera (1:2:1).

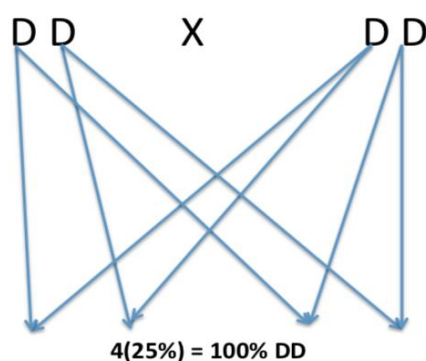
Genotypic Class	Observed	Expected	$(O - E)^2$	$(O - E)^2/E$
Sh+/Sh+	45	50	25	0.5
Sh-/Sh-	52	50	4	0.08
Sh+/Sh-	103	100	9	0.09
				$\chi^2 = 0.67$

The corresponding χ^2 tabular value at $n - 1$ degrees of freedom is 5.991 at $\alpha = 0.05$ which is far greater than the observed value of 0.67. We then conclude that the results uphold the hypothesis of the standard ratio of 1:2:1. The results obtained showed that 65% of smallholder farmers cultivate bad quality material composed of a mixture of all the three varieties. This result may be slightly different to that obtained in areas closed to agro industries by Rafflegeau & Ndigui (2001). Smallholder farms planted around agro industrial plantations benefit from the know-how of these industries.

From the three cases observed (farms planted with 100% Dura, farms with 50% Tenera and 50% Dura and farms containing 50% Tenera, 25% Dura and 25% Pisifera), the origin of the planting material and even the possible suppliers of planting material could well be sought implicitly by using the Mendellian inheritance principles based on the segregation of the oil palm shell thickness alleles Sh+ (D) /Sh- (P).

1. *Case of farms planted with 100% Dura*

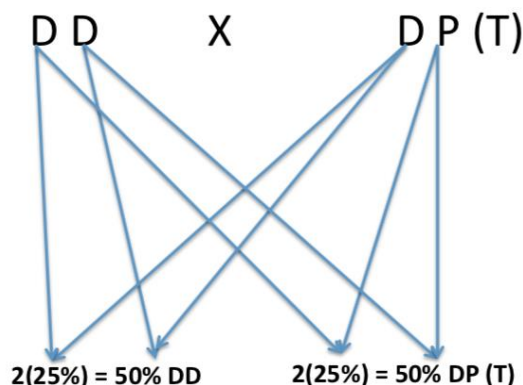
Farms having 100% Dura were planted with seeds obtained from natural groves under nearby Dura trees otherwise; they were collected from the seed farms of female genitors which contain only Dura trees. This is because 100% Dura can only be obtained from a self cross of Dura X Dura.



The possible suppliers of this type of planting materials to farmers are the pollinating agents of seed production units of the research centres (IRAD agent), who collect free pollinated fruits that fall under female genitors in the seed gardens used for the production of improved seeds thinking that these seeds will perform the same as those obtained in the artificial cross pollination of this female genitor with a compatible male pollen to produce the hybrid Tenera.

2. Case of farms with 50% Tenera and 50% Dura

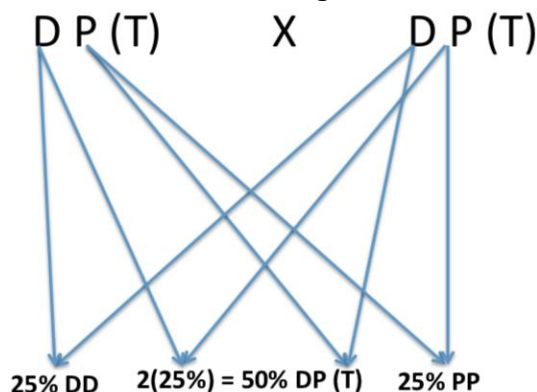
Farms having 50% Tenera and 50% Dura were planted with seeds obtained either from old smallholder plantations cultivated with a mixture of the different varieties. They might also have originated from research centres either from the experimental plots used for progeny tests or from parent plots used for seed production. In any of the above mentioned cases, Dura trees are planted nearby Tenera trees and this will normally lead to cross pollination (D X T) between them to produce 50% Dura and 50% Tenera.



The possible suppliers of these farms are either relatives of the farmers who have collected seeds from farms planted with bad quality material. Workers of research centres producing oil palm seeds may also disseminate such quality of planting material. These type of seeds can also be supplied by IRAD agents who collect seeds from progeny trial plots and raise nurseries.

3. Case of farms with 50% Tenera, 25% Dura and 25% Pisifera

These are seeds obtained from self-pollination of Tenera variety (T X T). Loose fruits that fall and later germinate under trees planted with 100% Tenera as is in the case of Industrial plantations must have served as seeds for cultivating such farms.



The possible suppliers of seeds for such farms are workers of agro industrial plantations such as the CDC, SOCAPALM, and SAFACAM. These workers are very ignorant of the hybrid nature of the Tenera variety of oil palm, which will always segregate in its F1 generation to produce its constituent parents, the Dura and Pisifera along side Tenera.

4. Case of farms with 100% Tenera

These seeds are acquired from the seed production centres of PAMOL Lobe and CEREPALH La Dibamba bought either directly or through honest intermediaries in the seed sector. All farmers supplied by the authorities of MINADER or some of their specialised programmes received improved planting material. Since all MINADER staff are aware of the differences between oil palm varieties, the complexity involved in the production of the Tenera hybrid and the losses that ensue as a result of planting material of doubtful origin. The stability and the usual close relationship that exist between them and their farmers might also have played greatly in this faithfulness. Most of the farmers (61%) are ignorant of the fact that only the seeds produced from research centre through artificial pollination can give the highly appreciated Tenera variety.

D. Conclusions

This study shows that the majority of smallholder farmers (65%) in the South Province of Cameroon cultivate bad quality material composed of a mixture of all the three varieties either obtained from natural groves or from precedent crops. No single farmer planted bad quality material intentionally; hence, their various suppliers only deceived them. Planting improved quality material will increase productivity, income and limit the unnecessary conversion of forests for new plantations. The major suppliers of this poor quality material are;

1. Private nursery entrepreneurs,
2. IRAD agents and
3. NGO's.

These suppliers must be very ignorant about the hybrid nature of Tenera and also they don't hold any liability or guarantee of the quality of material they sell to farmers. With the tight security that surrounds seed production processes and the manner with which data is computerized at all the stages, it becomes very difficult for an IRAD seed production agent to steal. Hence, they will only collect loose nuts from seed plots that are a consequent of free pollination and germinate them for their clients. Farmers supplied by government services especially the Ministry of Agriculture and Rural Development and some of its specialized development projects all received good quality material. This is because of their awareness of the existence of different varieties of oil palm that are indistinguishable at the seed stage. Also, their stability in their work place gives them the liability to supply good quality planting material. Thus, this is the only means now available which can assure the distribution of seeds produced in research centres since all of these centres (PAMOL and IRAD/CEREPAH La Dibamba) are enclaved.

E. Recommendations

The 2005 seed law should be reinforced which insists in the fact that individuals engaging in the seed and seedling distribution should be given licences and their nurseries frequently checked by experts from the research institutes and MINADER. If they are caught distributing bad quality seed, then they shall be tried in court and punished according to this law. CEREPAH and PAMOL should enter into agreement with other government agencies like the divisional delegations of MINADER, IRAD stations and other government projects to establish decentralized nurseries in their localities. Also, they can open up seed shops in the major towns of Douala, Yaoundé and Bamenda for smallholder farmers.

F. Acknowledgement

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