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Improved quality of lisianthus (*eustoma grandiflorum* raf.)Shinn.with plant spacing and *pinching* frequence

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Lisianthus (*Eustoma grandiflorum* Raf.) is an ornamental plant with a remarkable bloom, long stems, and an extended vase life that is mainly cultivated for sale as cut flowers. Nowadays in Indonesia, production of lisianthus is feasible but in small scale. Plant spacing is one of the factor that could affect the growth of lisianthus. In the one stalk of lisianthus could produce 2-3 flowers. Particular treatment can increase the number of flowers per branch by *Pinching* frequence. This research aimed to study the interaction between plant spacing and *pinching frequence*, to know suitable plant spacing for Lisianthus, and the effect of *pinching* frequency (*Single pinching* and *Double pinching*). This research was conducted at Sidomulyo village, Batu from February 2017 until May 2017, with an altitude of approximately 800 m asl and daily mean temperature 15-25 °C. The experiment was using Factorial Randomized Block Design (FRBD) with 2 factors and 3 replications. The results of this research showed that plant spacing with pinching treatment had a significant effect to increase the growth of lisianthus better than without pinching. Plant spacing 10 cm x 10 cm (J1) is the best spacing treatment to be applied, due to it could provide high quality of lisianthus flowers that met to grade A. The best pinching frequency was double pinching (P2) because it had the optimum flowering,

Keywords: Lisianthus, Plant Spacing, Pinching, Grade

INTRODUCTION

Lisianthus (*Eustoma grandiflorum*) is a North American wild flower, native to central and southern US and mainly inhabits the moist prairies from Nebraska to Colorado and Texas (Shinners, 1957; Wood and Weaver, 1982; Halevy and Kofranek, 1984). Modern cultivars offer a wide range of colors as well as a variety of bicolor and due to these characters along with excellent keeping quality lisianthus got huge consumer acceptance all over the world (Jamal et al., 2010). In 1995, Lisianthus was ranked 11th in the Dutch flowers market (Ledger et al., 1997). Lisianthus has been a very popular cut flower because of its floral colours and long vase life and is a leading cut flower in Japan with sales of more than 129 million stalks in 2001, and was included in the list of top 10 cut flowers in Europe with a selling rate of at least 122 million stalks. Hankis et al., (2009), stated that in 2001 the wholesale price for a pack of lisianthus with 10 stalks was $10, and for premium quality per stalk was $1.50. (Takeda, 1994; Hisamatsu et al., 1998; Harbaugh, 2007). Therefore, this is certainly a good prospect for Indonesia to improve the revenue by developing the cultivation of lisianthus as cut flowers.

Carvalho et al., (2002), stated that the higher the plant density per unit area, will be the lower number of flower buds produced. The farmers who cultivating lisianthus were using plant spacing

of 10cmx10cm because the farmers might think, if the higher plant population per unit area will increase the revenue, but the fact is the increased population will lower the quality of lisianthus. Plant spacing also will affect the production of a plant because it associated with the availability of nutrients, sunlight and space for plants to grow. The function of pinching is to stimulate the growth of axillary shoots or an embryonic shoot which lies dormant at the junction of the stem and petiole of a plant. It arises exogenously from outer layer of cortex of the stem for the formation of branching, thus will increase the total number of flowers. The research of Dalal et al., (2006), showed that using double pinching treatment could increase the number of flowers per branch higher than without pinching. The pinching application consists of single pinching and double pinching. Wuryaningsih et al., (2008), stated that single pinching and double pinching will affect the total number of flowers production. Nowadays, the customer needs are cut flowers with a lot of flowers

For increasing the lisianthus production, the research of plant spacing and pinching frequency are needed. Thus, the cultivation of lisianthus could get the optimum results with the best quality of flowers. The application of pinching on the lisianthus could increase the number of branch, so that the number of flowers could be more than three flower buds.

MATERIALS AND METHODS

The research was conducted at the screen house located in village of Sidomulyo, Batu, with an altitude of ± 800 m asl from February 2017 until May 2017. The tools were used including hoe, fork-hoe, net, ruler, bross, and LAM (Leaf Area Meter) to measure leaf area, analytical scales, and oven. The materials were used during this research include varieties of Lisianthus Blue obtained from PT. Bina Usaha Flora, Bogor, soil, NPK with a ratio of 18-18-18, Proclaim 5SG (pesticide), Stargibb (ZPT) with active material of GA3, and Basamid G. (herbicide).

The experiment was using Factorial Randomized Block Design (FRBD), with 2 factors, that consist of plant spacing and pinching frequency. The first factor was plant spacing, which consisted of three levels:

1. J1 plant spacing of 10cmx10cm
2. J2 plant spacing of 15cmx15cm
3. J3 plant spacing of 20cmx20c

The second factor was pinching frequency, which consisted of three levels:

1. P0 non pinching
2. P1 single pinching
3. P2 double pinching

Each unit of experiment was repeated three times to obtain 27 units trial.

Single pinching treatment were done when the plant at 3 week after transplanting or the plant height about 20 cm, and the second times of pinching application were done after the first pinching, and had grown becoming a new branch and the branch lenght were 10 m, then the second pinching could be done.

The observations also included of growth parameter by non-destructive and yield components. For non destructive observations were including of plant height, number of leaf, leaf area, number of branch, fresh weight and total plant dry weight. The growth observation were done every 2 weeks after transplanting until harvest time. The yield observation were including the flowering period, number of flower, bloom diameter, harvest period, and vase life.

The data obtained were analyzed by analysis of variance (F test) at 5% level. If there were significance difference, the analysis will be continued with LSD at 5% level.

RESULTS AND DISCUSSION

Treatment with plant spacing of 10cmx10cm had higher plant height compared to 20cmx20cm. The double pinching application had the highest plant height and higher number of flowers compared with non pinching and single pinching. Based on the criteria of grade determination according to Slaman Quality Flower (2012), showed that the best criteria of lisianthus are having a plant height about 65-75cm with the number of flowers per plant is more than 3 flowers. In this study the using of plant spacing is suitable to increase the plant height, but if pinching could not be done then the number of flowers of lisianthus will be below the quality standard for grade A. However, pinching treatment will delay the harvest time, because after pinching, the new branch will grow and extend the vegetative phase, so it will delay the generative phase. Therefore in the single pinching and double pinching treatment, flower initiation and harvest period were longer than non pinching treatment.

Plant Height, Number of Leaves, and Leaf Area

Treatment of plant spacing and pinching frequency provides a significant interaction to

plant height. Plant spacing and pinching frequency significantly affect number of leaf and leaf area on harvest observation. Figure 1 presents a graph for the plant height parameter.

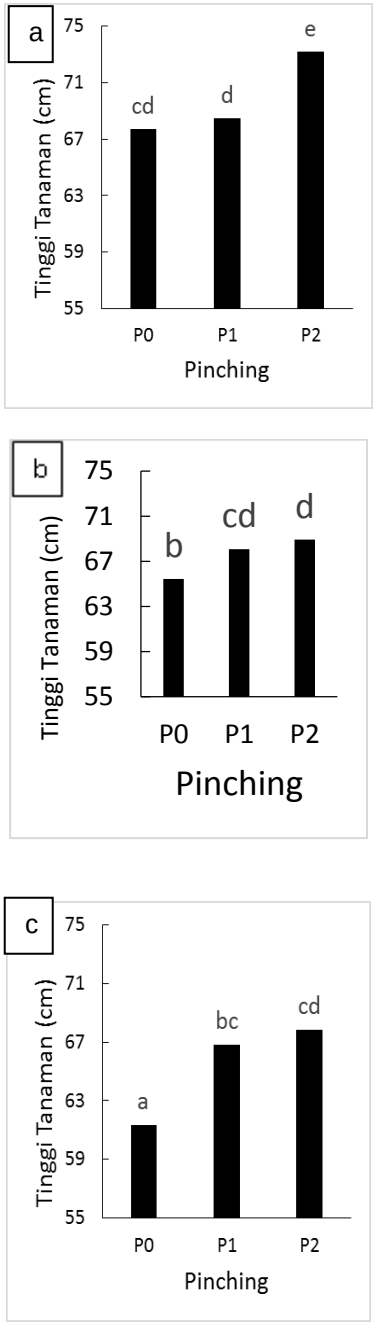

Figure 1. **Means of plant height on the plant spacing and pinching frequency; a. Plant spacing 10cmx10cm, b. Plant spacing 15cmx15cm, c. Plant spacing 20cmx20cm**;
P0 = Non Pinching, P1 = Single pinching, P2 = Double pinching.

Treatment with plant spacing of 10cmx10cm with double pinching (J1P2) showed the highest plant height. While the plant spacing 20cmx20cm had the highest number of leaves compared to plant spacing of 10cmx10cm and 15cmx15cm. Wider plant spacing also gave a higher leaf area compared to a tight spacing. Table 1 shows the data of number of leaf, leaf area, number of branches and total plant dry weight. Mawazin and Suhaendi (2008), stated that the spacing arrangement affects the amount of light intensity and nutrient availability for the plant. The longer the distance of planting, the higher light intensity and nutrient availability for individual plants, because if the number of plants are less, the intraspecific competition between plants will be low, so the light intensity and nutrient uptake to the plant will be optimum. Athani et al., (2009), stated that the increasing number of leaves and functional leaf area on a larger plant spacing could reduce the competition for moisture and sunlight and the emergence of leaves will decrease when very close cultivation because of lower temperatures in the canopy.

The treatment of double pinching (P2), according to Wuryaningsih et al., (2008) in the research on carnation plants, that the largest flower stalk was obtained from planting with double pinching method. This indicates that despite the growing dominance of growth among post-pinching buds, the growing number of lateral shoots grown on double pinching also means that vegetative organs like leaves as a site for photosynthesis are also more commonly formed. This increase in photosynthesis area ultimately contributes to an increase in the length of the harvested flower stalk. Double pinching treatment also had the highest leaf area value compared to non pinching and single pinching. Double pinching treatment also has a higher number of branches that will increase the number of leaves which certainly affect the value of leaf area.

Number of Branches

Table 1 shows that aanalysis of variance on plant spacing was not having significant effect to the number of branches, but the pinching frequency had a significant effect on the number of branch. The difference number of branches in each treatment is shown in Figure 4. Based on the data in Figure 4. It shows that double pinching trhad more number of branches than non-pinching and single pinching treatment.

Table 1. **Number of Leaves, Leaf Area, Number of Branch and Total Plant Dry Weight on the Treatment of Plant Spacing and *Pinching* frequency**

Treatment	Number of Leaves (per plant)	Leaf Area (cm^2/plant)	Number of Branch (per plant)	Total Plant Dry Weight (g/plant)
Plant Spacing 10cmx10cm	57,63a	1304,06a	2,26	13,19a
Plant Spacing 15cmx15cm	60,93a	1456,29ab	2,37	15,61ab
Plant Spacing 20cmx20cm	70,22a	1633,76b	2,33	20,10b
Non Pinching	54,48a	1224,01a	1,00a	12,98a
Single pinching	62,59b	1475,89ab	2,00b	16,30ab
Double pinching	71,70c	1694,22b	3,96c	19,61b

Descriptions: Means followed by the same letter at the same age on the column showed no significant difference based on LSD test at level 5%

Winardiantika (2012) stated that shoots prunning or pinching could eliminates the apical dominance that encourages the emergence of lateral branches and reduces the number of segments in the main stem. Raden (2009) also stated that shoot pruning can increase the number of branches significantly. So there are more lateral branches emergences due to the pinching treatment. If there are many lateral branches, the more number of leaves could be produced. In case of without pinching plant exhibits it normal vegetative growth. For that the pinched plant cannot accomplish vegetative growth and the ultimate results were the shortest plant compared to without pinching (Habiba et al., 2012).

Total Plant Dry Weight

The results showed that the plant spacing and pinching frequency gave a significant effect on the total plant dry weight. Table 1 shows the relation of total plant dry weight with plant spacing and pinching frequency. The widest plant spacing of 20cmx20cm (J3) had the highest total plant dry weight compared to plant spacing 10cmx10cm (J1) and 15cmx15cm (J2)

This is because plant spacing 20cmx20cm had the highest leaf area, so it will affect the plant dry weight. Lestari et al., (2008), stated that there is an increase in plant height and leaf area followed by the increasing of fresh weight and plant dry weight. This is consistent with this research, if there was a significant increase in leaf area with larger plant spacing compared to the dense plant spacing. Double pinching treatment had the highest total plant dry weight because it could increase the number of branches, leaf area, number of leaves, and number of flowers compared to single pinching and non-pinching treatments. Irawati and Setiari (2006) stated that shoots pruning on patchouli could increase the plant dry weight because it could increase plant length and number of lateral buds.

Yield Component

The observations of yield component were including flower initiation, total number of flowers, flower bloom diameter, harvest age, and vase life. Figure 2 shows the means of various parameters of the results component. The pinching frequency treatment had a significant effect on the flower initiation, but treatment of plant spacing showed no significant difference on the flower initiation period. Wuryaningsih et al., (2008) stated that the density of plants and intraspecific competition caused by plant density was not affecting the flower initiation period. Plant spacing of 20cmx20cm has the highest total number of flowers compared to plant spacing 10cmx10cm and 15cmx15cm. Similiar result was also found in the chrysanthemum research of Carvalho et al., (2002), stated that the higher plant density per unit area, the lower number of flowers per branch will be produced. The total number of flowers with double pinching (P2), had the highest total number of flowers. Wuryaningsih et al., (2008) stated that the highest total number of flowers is produced on plants with double pinching (P2). On the treatment of non-pinching (P0), had fewer number of branch than pinching treatment, that reduce the total number of flowers. The widest plant spacing had the largest flower diameter compared to a dense spacing. Handayati and Sihombing (2012) research on Chrysanthemums,

showed that plant spacing could increases the bloom diameter and the number of flower blooms.

The pinching treatments were affects the harvest periods, which in double pinching treatment had longer harvest period compared to single pinching and non-pinching because double pinching treatment has longer vegetative phase. Treatment of plant spacing and pinching frequency were significantly affecting the vase life of Lisianthus. The total number of blooming flowers on a wide spacing would produce a higher number of flowers compared to a dense spacing. The vase life in Lisianthus will be longer because the flower blooms will wilt one by one, and when in one stalk has a lot of flowers then it will certainly extend the vase life.

YIELD QUALITY OF LISIANTHUS

Lisianthus with grade A were obtained from almost all treatments, except for treatment with plant spacing of 10cmx10cm combined with non-pinching (J1P0) and plant spacing of 20cmx20cm with non-pinching (J3P0). This is because on the treatment of J1P0 were without pinching, thus the number of flowers per plant in Lisianthus were low. Treatment of J3P0 on the plant height parameter was not meet the criteria of grade A. Slaman's Quality Flower (2012), stated that in Lisianthus there are several grades; large grade (A), second grade (B), and third grade (C). The criteria for grade A is plant height of 65-75cm with 3-5 flower buds. Then for grade B with plant height 55-65cm and the number of flower buds are 2-3 flowers per plant, and for grade C plant height less than 55cm with the number of flowers bloom is 1 flower.

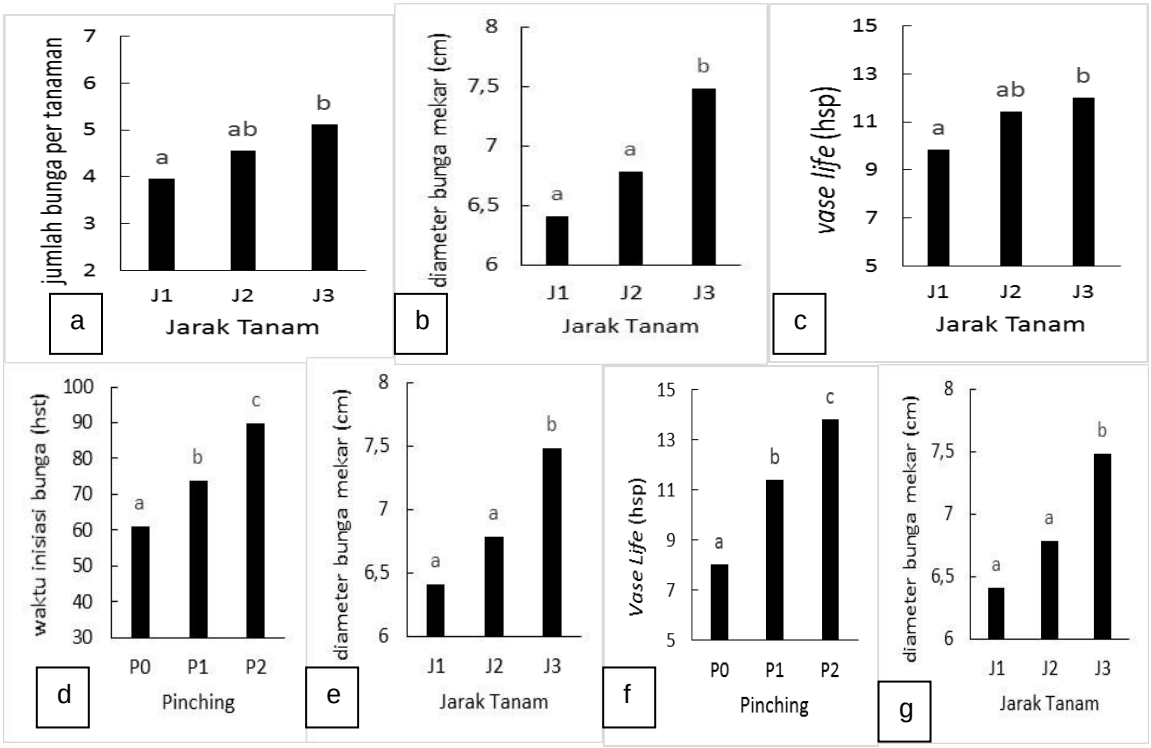

Figure 2. Graph of yield component ; a. Plant spacing with number of flowers, b. Plant spacing with flower bloom diameter, c. Plant Spacing with vase life, d. Pinching with flowering period, e. Pinching with total number of flowers, f. Pinching with vase life, g. pinching with harvest period; J1 = Plant Spacing 10cmx10cm, J2 = Plant Spacing 15cmx15cm, J3 = Plant Spacing 20cmx20cm, P0 = *non pinching,* P1 = *single pinching*, P2 = *double pinching*.

Table 2. Criteria of Grade Lisianthus on Treatment of Plant Spacing and Pinching Frequency

Treatment	Plant Height (cm)	Number of Flowers (per plant)	*Grade*
J1P0	67,72	2,33	B
J1P1	68,5	4,11	A
J1P2	73,17	5,44	A
J2P0	65,44	3,22	A
J2P1	68,06	4,67	A
J2P2	68,92	5,78	A
J3P0	61,33	3,44	B
J3P1	66,83	5,11	A
J3P2	67,83	6,78	A

Description, Means followed by the same letter at the same age on the column showed no significant difference based on LSD test at level 5%

JIP0= Plant Spacing 10cmx10cm combined with non pinching, J1P1 = Plant Spacing 10cmx10cm combined with single pinching, J1P2 = Plant Spacing 10cmx10cm combined with double pinching, J2P0 = Plant Spacing 15cmx15cm combined with non pinching, J2P1 = Plant Spacing 15cmx15cm combined with single pinching, J2P2 = Plant Spacing 15cmx15cm combined with double pinching, J3P0 = Plant Spacing 20cmx20cm combined with non pinching, J3P1 = Plant Spacing 20cmx20cm combined with single pinching, J3P2 = Plant Spacing 20cmx20cm combined with double pinching.

CONCLUSION

The wider plant spacing was not affect the quality of the flowers. The result of this research showed that plant spacing 10cmx10cm were having plant height of Lisianthus that meets the criteria of grade A. However, if the pinching treatment had not been done, it will reduce the number of flowers, so the amount of flowers will be less than 3 buds and it did not meet the quality of grade A. Thus, pinching treatment are necessary to increase the amount of flowers.

The amount of flower will affect the vase life, which can extend the vase life about 5 days compared with non-pinching. Double pinching treatment (P2) is the best treatment to improve the flowering, but the double pinching treatment (P2) could delay the harvest period. Non pinching treatment can be harvested about 84-88 dap, then single pinching (P1) treatment can be harvested about 98-102 dap, and double pinching (P2) treatment can be harvested about 112-115 dap.

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CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Sitawati as the initiator of the research idea and reviewed the manuscript. EEN reviewed the manuscript. And MD as technical implementation

REFERENCES

Athani. S.I. Revanappa dan P.R Dharmatti. 2009. Effect of Plant Density on Growth and Yield in Banana. Department of Horticulture. University of Agricultural Sciences. India. *Karnataka Journal Agriculture* Science. 22(1):143-146.

Carvalho, S. M. P., E. Heuvelink and O. Kooten, van. 2002. Effect of Light Intensity, Plant Density And Flower Bud Removal On The Flower Size and Number In Cut Chrysanthemum. Acta Horticulturae (2002) 593. *Proceedings of the 4th International Symposium on Models For Plant Growth and Control in Greenhouses: Modeling for the*

21st Century: Agronomic and greenh Crop Models, Beltsville, Maryland, USA, 25-29 March 2001 - p. 33-35.

Dalal, S. R., D. R. Nandre, S. G. Bharad, S. Utgikar and R. D. Shinde. 2006. Effect of Pinching on Carnation cv. Yellow Solar under polyhouse condition. University Departement of Horticulture. India. Internat. Journal Agriculture. 2(2):356-357.

Habiba, S.U., M.S. Islam and A.F.M. Jamal Uddin. 2012. Influence of terminal bud pinching on growth And Yield of chrysanthemum, (Chrysanthemum indicum L). Journal of Bangladesh Academy of Sciences. 36(2): 251-255

Halevy, A. H. and Kofranek, A. M. 1984 Evaluation of Lisianthus as a New Crop. Hort. Science. 19: 845-847

Handayari, W. dan D. Sihombing. 2012. Pengaruh Kerapatan Tanam dan Kualitas Benih Krisan Bunga Potong Terhadap Perkembangan Penyakit Karat Daun dan Hama Penggorok Daun. *Prosiding Tanaman Hias*. Balai Pengkajian Teknologi Pertanian Jawa Timur. Malang. Hal345.

Hankins, A., 2009. Lisianthus (Eustoma Grandiflorum), A New Species for the Cut Flower Market. Extension Specialist-Alternative Agriculture. Virginia State University. *Virginia Cooperative Extension.* 2906-1312

Harbaugh, B. K. 2007. Lisianthus – Eustoma grandiflorum. www.books. google.co.id. [20 Nopember 2016].

Hisamatsu, T., Koshioka, M., Nishijima, T., Mander, L.N., 1998. Identification of endogenous gibberellins and theirrole in rosetted seedlings of Eustoma grandiflorum. J. Japan. Soc. Hort. Sci. 67 (6), 866–871 (in Japanese, with English summary).

Irawati H., Setiari N. 2009. Pertumbuhan Tunas Lateral Tanaman Nilam (*Pogostemon cablin* Benth.) Setelah Dilakukan Pemangkasan Pucuk pada Ruas yang Berbeda. *Jurnal Anatomi Fisiologi*. ISSN. 17(2):pp.9-10.

Jamal Uddin, A.F.M., Islam, M.S., Mehraj, H., Roni, M.Z.K., and Shahrin, S. 2010. An Evaluation of Some Japanese Lisianthus (Eustoma grandiflorum) Varieties Grown in Bangladesh. The Agriculturists. 11(1): 56-60

Ledger, S. E., S. C. Deroles, D. G. Manson, J. M. Bradley, dan N. K. Given. 1997. Transformation of Lisianthus (Eustoma grandiflorum). *Plant Cell Reports* 16:853.

Lestari, G. W., Solichatun, dan Sugiyarto. 2008. Pertumbuhan, Kandungan Klorofil, dan Laju Respirasi Tanaman Garut (Maranta arundinacea L.) Setelah Pemberian Asam Giberelat. *Bioteknologi*. 5(1):1-9.

Mawazin dan H. Suhaendi. 2008. Pengaruh Plant Spacing Terhadap Pertumbuhan Diameter Shorea parvifolia Dyer. *Jurnal Penelitian Hutan dan Konservasi Alam*. 5(4):381-388

Raden, I., B.S. Purwoko, Hariyadi, M. Ghulamahdi, dan E. Santosa. 2009. Pengaruh Tinggi Pangkasan Batang Utama dan Jumlah Cabang Primer yang Dipelihara Terhadap Produksi Minyak Jarak Pagar (*Jatropha curcas* L.). *Jurnal Agronomi Indonesia* 37(2):159-166.

Shinners, L. 1957. Synposis of the genus Eustoma (Gentianaceae). Southwest National 2: 38-43.

Takeda, T., 1994. Studies on rosette formation and bolting of seedlings and lateral buds of Eustoma grandiflorum. J. Japan. Soc. Hort. Sci. 63 (3), 653–662 (in Japanese, with English summary).

Winardiantika, V., D. Kastono, dan S. Trisnowati. 2012. Pengaruh Waktu Pangkas Pucuk dan Frekuensi Pemberian Paklobutrazol terhadap Pertumbuhan dan Pembungaan Tanaman Kembang Kertas (Zinnia elegans Jacq.). *Jurnal Universitas Gadjah Mada*. Fakultas Pertanian. 1(2):1-8.

Wood, C.E., Weaver, R.E., 1982. The genera of Gentianaceae in the Southern United States. J. Arnold Arbor. 63, 441–478.

Wuryaningsih, S., K. Budiarto, dan Suhardi. 2008. Pengaruh Cara Tanam dan Metode *Pinching* Terhadap Pertumbuhan dan Produksi Bunga Potong Anyelir. Balai Penelitian Tanaman Hias. Cianjur. *Jurnal Hortikultura*. 18(2):135-140.