Study of artificial irradiation arrangement and pinching age on chrysanthemum

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Abstract. The study was conducted to determine the effect of artificial irradiation setting time, pinching age, and their interactions on the growth and yield of chrysanthemum. The research method uses factorial Complete Randomized Group Design with 2 factors. The first factor is the treatment of growth cut point age (U) consisting of three age levels (1, 2, and 3 weeks after planting), and the second factor is the setting time of artificial irradiation (W) consisting of four levels (1, 2, 3, and 4 hours per 35 days). The results showed that the treatment of cutting point of growing age had significant effect to very real on all parameters observed except in secondary branch diameter, while the treatment of artificial exposure time was not significant on all parameters observed. The interaction had a significant effect on very real on all parameters observed except in the secondary branch diameter. The intercept between the cutting point of age 1 week after planting and artificial irradiation setting 4 hours per 35 days resulted in the average weight of flower stalk, flower diameter, and economic weight of the highest secondary branches respectively 127.398 g, 6.733 cm, and 122.489 g, increased by 29.63%, 30.69%, and 33.30%, respectively when compared with the lowest treatment.

1. Introduction
Chrysanthemum (Dendranthema grandiflora, Tzvelev Syn.) is one of the leading floriculture products developed in several centers to meet the domestic market. The use of chrysanthemum in each flower arrangement is very dominant until it reaches 30-65%. It is prospective enough to continuously develop both the quality, quantity and the development of the chrysanthemum business industry. This is an exciting opportunity for people who want to develop a chrysanthemum business [1]. Cultivation of chrysanthemum concentrated in Java Island has now spread to Bali. Chrysanthemum flower is a commodity that has high economic value so it has the potential to be developed commercially as a basic component in agribusiness either as cut flowers, ornamental plants in pots, or medicinal plants [2].

The development of ornamental plant farming will have an impact on the emergence of other complementary industries such as fertilizer and medicine industry, ornamental plants, flower pots, and ornamental plant media. Cut flower production experienced an average increase of 31.6% per year, the total production of 9 types of cut flowers, the largest production is chrysanthemum (64.79%) with chrysanthemum production growth of 43.2% per year greater than the average cut flowers [3].

Chrysanthemum production, especially Bali, has not been able to meet the market demand because its productivity is still low and the area of the plantation is still managed by certain farmers only. The farmers who cultivate chrysanthemum in Bali are only concentrated in two districts of Buleleng and Tabanan and two villages of Pancasari and Kembang Merta, especially chrysanthemum farmers (Bali)
problems encountered include the suitability of agro climate to impact on pest and disease attacks, poor production process causing the low quality of flowers, the provision of planting materials (stek) coming from outside Bali often does not guarantee the continuity and quality so that impact on consumer confidence. While on the one hand, Bali is a prospective tourism destination for the development of this commodity [4, 5].

Potential areas have not been planted by ornamental plants, due to various considerations such as those located far from the marketing center, there is no adequate infrastructure, limited knowledge of cultivation, harvesting, and post-harvest handling. Increased production through intensification often encountered problems such as the provision of planting material (cuttings), plant spacing, soil moisture regulation with mulch, determination of optimum dosage of organic and inorganic fertilizer, post-harvest (sorting, grading and packaging) and management of production system. Cultivation factors are the cause of low production and quality of chrysanthemum that affect the selling price of chrysanthemum as cut flowers [6].

Chrysanthemum business has now spread to Bali, which means that the development of ornamental plants in Bali in the future is quite good because it is supported by natural resources as well. This reflects that, on the one hand, the interest of ornamental plants growers and on the other hand the demand for ornamental plants also increased. This increase is due to Bali as a tourism area and socio-cultural conditions of Balinese people who wear flowers as a complementary means of religious ceremony in addition to other purposes [1].

Based on the above, the Artificial Irradiation Arrangement and Pinching research on Chrysanthemum which is one of the cultivation components in the special maintenance of chrysanthemum farming, will be used by farmers to support the production and quality of chrysanthemum flowers as well as to increase the competitiveness of farmers’ income. The purpose of this study was to determine the effect of artificial irradiation time, pinch age, and its interactions on the growth and yield of chrysanthemum.

2. Material and methods
The study is located in Pancasari Village, Sukasada District, Buleleng Regency, in a greenhouse with an altitude of 1,247 meters above sea level and an average temperature of 17-20 °C. Materials used chrysanthemum cuttings, cow manure, insecticides and fungicides.

The research method used factorial Randomized Completely Block Design in the greenhouse, the data obtained were analyzed by multiform analysis and continued with LSD distance test for single factor and 5% Duncan for the interaction effect. The factors observed were: the age of cutting point of growth (U) consisting of three levels each: age 1 week after planting (U\(_1\)), age 2 weeks after planting (U\(_2\)), and age 3 weeks after planting (U\(_3\)), and the second factor is artificial irradiation time setting, consisting of four levels: 1 hour per 35 days (W\(_1\)), 2 hours per 35 days (W\(_2\)), 3 hours per 35 days (W\(_3\)), and 4 hours per 35 days (W\(_4\)).

3. Results and discussion
The significance effect of the age of growth point (U), artificial exposure time (W) and its interaction (UxW) on all parameters observed in chrysanthemum plants can be seen at Table 1. Mean influence between age with growing point (U) the size of artificial irradiation (W) to the height of the secondary branch, the number of secondary branches, the length of the secondary branch flower, the weight of the secondary branch stem, and the diameter of the secondary branch are presented at Table 2, 3, 4, 5, 6, and 7.
Table 1. The significance of the age-cutting effect of pinching age (U) and artificial exposure time setting (W) and its interaction on all observed variables.

| No | Variable                                      | Treatment                  |
|----|-----------------------------------------------|----------------------------|
|    |                                               | U  | W    | U x W |
| 1  | Secondary branch height (cm)                  | ** | ns   | **    |
| 2  | Number of secondary branches (stems)          | *  | ns   | **    |
| 3  | Secondary branch diameter (cm)                | ns | ns   | ns    |
| 4  | The length of the secondary branch flower (cm)| ** | ns   | **    |
| 5  | Flower diameter of the secondary branch (cm)   | ** | ns   | **    |
| 6  | Flower diameter of the secondary branch (cm)   | ** | ns   | **    |
| 7  | The economical fresh weight of secondary branch flowers (g) | ** | ns   | **    |

Note: * = significant (P<0.05); ** = highly significant (P<0.01); ns = not significant (P≥0.05)

Table 2. Effect of interaction between age of cutting point of growth (U) and artificial exposure time (W) setting to height of secondary branch (cm).

| Treatment                      | Artificial exposure time setting (W) |
|--------------------------------|-------------------------------------|
| Age cutting point growing (U)  | 1 hour / 35 days | 2 hour / 35 days | 3 hour / 35 days | 4 hour / 35 days |
| 1 week (U1)                    | 78.227 bcd       | 84.610 bcd       | 89.810 bcd       | 125.187 a        |
| 2 week (U2)                    | 72.720 cd        | 78.587 bcd       | 82.810 bcd       | 92.373 b         |
| 3 week (U3)                    | 69.637 d         | 72.627 cd        | 80.637 bcd       | 91.157 bc        |

Note: The numbers followed by the same lowercase letters in the same column, did not differ significantly in the Duncan test of 5%.

Table 3. Effect of interaction between age of cutting point of growth (U) and artificial exposure time setting (W) number of secondary branch (stem).

| Treatment                      | Artificial exposure time setting (W) |
|--------------------------------|-------------------------------------|
| Age cutting point growing (U)  | 1 hour / 35 days | 2 hour / 35 days | 3 hour / 35 days | 4 hour / 35 days |
| 1 week (U1)                    | 2.723 abcd       | 2.557 abcd       | 3.003 abc        | 3.557 a          |
| 2 week (U2)                    | 2.110 d          | 2.553 abcd       | 2.723 abcd       | 3.223 ab         |
| 3 week (U3)                    | 2.223 cd         | 2.407 bcd        | 2.443 bcd        | 2.887 abc        |

Note: The numbers followed by the same lowercase letters in the same column, did not differ significantly in the Duncan test of 5%.

Table 4. Effect of interaction between age of cutting point of growth (U) and artificial exposure time setting (W) length of flower of secondary branch (cm).

| Treatment                      | Artificial exposure time setting (W) |
|--------------------------------|-------------------------------------|
| Age cutting point growing (U)  | 1 hour / 35 days | 2 hour / 35 days | 3 hour / 35 days | 4 hour / 35 days |
| 1 week (U1)                    | 77.693 bc        | 85.907 bc        | 85.907 bc        | 128.067 a        |
| 2 week (U2)                    | 74.773 bc        | 80.587 bc        | 80.587 bc        | 89.707 b         |
| 3 week (U3)                    | 71.757 c         | 71.760 c         | 71.760 c         | 83.500 bc        |

Note: The numbers followed by the same lowercase letters in the same column, did not differ significantly in the Duncan test of 5%.
The result of the statistic analyst showed that there was a very significant interaction effect (P <0.01) between the age of cutting point of growth and the time of regulation of artificial light on all parameters observed except in the secondary branch diameter had no significant effect (P> 0.05). While the influence of the age of cutting point of growth significantly (P <0.05) to very real (P <0.01) to all parameters observed except in the secondary branch diameter. Artificial light time settings give no significant effect on all observed parameters.

The interaction between the cutting age of the growing point one week after transplanting with the artificial irradiation time of 4 hours per 35 days resulted in the mean secondary branch height, secondary branch count and the length of the highest secondary branching stalks of 125.187 cm, 3.557 bars, respectively 128.067 cm, and significantly different with the lowest treatment average that is at the interaction between cutting age of growing point 3 and 2 weeks after planting a time of setting of artificial light 1 hour per 35 days equal to 69.637 cm, 2.110 stems and 71.757 cm, respectively 44.37%, 40.68%, and 75.20%. Cutting the point of growing early allows the secondary branch to grow and develop faster because the stem is in a youthful tissue condition when compared with a cut at the age of three weeks after planting. The addition of good light is done for 4 hours a day because the addition of light 4 to 5 hours a day can increase the length of the flower stalk when compared with the addition of light 2-3 hours a day [7]. The difference in the length of the addition of light does not affect the growth

### Table 5. Effect of interaction between age of cutting point of growth (U) and artificial exposure time setting (W) weight of secondary branch flower (g).

| Treatment            | Artificial exposure time setting (W) |
|----------------------|-------------------------------------|
| Age cutting point growing (U) | 1 hour / 35 days | 2 hour / 35 days | 3 hour / 35 days | 4 hour / 35 days |
| 1 week (U₁)          | 111.433 bc          | 118.583 ab       | 122.305 ab       | 127.398 a        |
| 2 week (U₂)          | 90.983 fg           | 100.900 defg     | 102.573 cdef     | 103.327 cde      |
| 3 week (U₃)          | 89.650 g            | 94.032 defg      | 99.243 defg      | 105.623 cd       |

Note: The numbers followed by the same lowercase letters in the same column, did not differ significantly in the Duncan test of 5%.

### Table 6. Effect of interaction between age of cutting point of growth (U) and artificial exposure time (W) diameter of secondary branch (cm).

| Treatment          | Artificial exposure time setting (W) |
|--------------------|-------------------------------------|
| Age cutting point growing (U) | 1 hour / 35 days | 2 hour / 35 days | 3 hour / 35 days | 4 hour / 35 days |
| 1 week (U₁)        | 4.500 cde            | 4.967 abcd       | 5.067 abc        | 5.733 a          |
| 2 week (U₂)        | 3.667 e              | 4.233 de         | 4.267 cde        | 4.033 de         |
| 3 week (U₃)        | 3.867 de             | 5.500 abc        | 4.667 bcd        | 5.600 ab         |

Note: The numbers followed by the same lowercase letters in the same column, did not differ significantly in the Duncan test of 5%.

### Table 7. Effect of interaction between age of cutting point of growth (U) and artificial exposure time (W) of fresh weight economical interest of secondary branch (cm).

| Treatment            | Artificial exposure time setting (W) |
|----------------------|-------------------------------------|
| Age cutting point growing (U) | 1 hour / 35 days | 2 hour / 35 days | 3 hour / 35 days | 4 hour / 35 days |
| 1 week (U₁)          | 103.217 bc           | 105.822 bc       | 109.346 b        | 122.489 a        |
| 2 week (U₂)          | 94.343 bc            | 97.950 bc        | 98.167 bc        | 93.220 c          |
| 3 week (U₃)          | 81.700 d             | 95.497 bc        | 96.457 bc        | 97.523 bc        |

Note: The numbers followed by the same lowercase letters in the same column, did not differ significantly in the Duncan test of 5%.
of plant height, stem circumference, wet weight, and dry weight, but the addition of light can maintain the vegetative phase of the chrysanthemum flower [8].

The highest average yield of stalk weight, flower diameter, and economical weight of secondary branch interest also occurred at the interaction between cutting age of growing point one week after planting with artificial irradiation time setting 4 hours per 35 days i.e. 127.398 g, 6.733 cm, and 122.489 g. Affect the interaction between cutting age of growth point two and three weeks after planting with artificial exposure time 1 hour per 35 days with the lowest average that is 89.65 g, 4.667 cm, and 81.70 g, and an increase of 29.63%, 30.69%, and 33.30%, respectively. Discharge of apical growing point (Pinching) serves to stimulate the growth of axillary buds for branching crops. In chrysanthemum plants for the production of new axillary buds that grow into new branches are kept to flowering. This is done to increase the number of flowers per plant produced so that the flowers are more visible and compact than the flowers are maintained with a single crop (Single stem) [9]. Chrysanthemum is a short facultative short-term plant, this characteristic implies that chrysanthemum plants will be induced to enter the generative phase and flowering if the length of the day received crop shorter than Critical Daylight (CDL). If the length of days, the chrysanthemum plants receive in the juvenile period is longer than the CDL will maintain its vegetative phase. Based on the characteristics of the chrysanthemum, to maintain high plant standard (long flower stalk) on chrysanthemum flower, the plants are kept in the vegetative phase for a certain time to grow to a certain height with artificial irradiation applications [10, 11].

4. Conclusion
The interaction between the cutting point treatment gave a significant effect on all parameters observed except in the secondary branch diameter. The average economic weight of the highest secondary branch interest occurred at the interaction between the age of cutting point of growing one week after planting with artificial irradiation time setting 4 hours per 35 days i.e. 127.398 g and the lowest at the interaction between cutting age 3 weeks after planting with one-hour time setting per 35 days at 81.700 g and an increase of 29.63%.

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References
[1] Direktorat Budidaya dan Pascapanen Florikultura 2013 Profil Krisan (Dirjen Hortikultura, Kementrian Pertanian)
[2] Rukmana H R 1997 Krisan (Yogyakarta: Penerbit Kanisius)
[3] Sekretariat Jendral Kementerian Pertanian 2014 Pusat Data dan Sistem Informasi Pertanian
[4] Arjana I G M, Situmeang Y P and Suaria I N 2015 International Journal on Advanced Science, Engineering and Information Technology 5(5) 350-354
[5] Arjana I G M, Situmeang Y P, Suaria I N, and Mudra N K S 2015 International Journal on Advanced Science, Engineering and Information Technology 5(6) 407-409
[6] Darti 1992 Tanaman dan Budidaya Tanaman Hias (Jakarta: PD. Mahkota)
[7] Yoginugraha P P I, Wijaya I M A S, & Nada I M 2017 Jurnal BETA (Biosistem dan Teknik Pertanian) 5(1) 35-44
[8] Ariesna F D, Sudiarso and Herlina N 2014 Jurnal Produksi Tanaman 2(5) 419-426
[9] Marwanto B, Suhardi Y, Sulyo K. Effendie and Y. Hilman 2006 Teknologi Produksi Krisan. Pengembangan Hortikultura Badan Penelitian dan Pengembangan Pertanian
[10] Balai Penelitian Tanaman Hias 2006 Teknologi Produksi Krisan (Pusat Penelitian dan Pengembangan Hortikultura Badan Penelitian dan Pengembangan Pertanian)
[11] Arjana I G M and Rudianta I N 2018 Development of Varieties of Spray from Production Plants
and Utilization Waste in the Agribusiness Cultivation Chrysanthemum Cut Flower. In *Proceedings of the 1st Warmadewa Research and Development Seminar (WARDS). European Alliance for Innovation (EAI)*