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Flowering of *Chrysanthemum* sp. in pot at various concentrations of corn extract and paclobutrazol

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Abstract. The purpose of this study was to study the effect of application of corn extract and paclobutrazol on the flowering of chrysanthemum (*Chrysanthemum* sp) in pots. The research was carried out in a plastic house, Pattapang Village, Tinggi Moncong District, Gowa Regency, South Sulawesi Province, from July to October 2015. The research was conducted in the form of a two-factor factorial using a randomized block design. The first factor was the concentration of corn extract consisted of 0, 50 mL L⁻¹, 100 mL L⁻¹, and 150 mL L⁻¹. The second factor was paclobutrazol with a concentration consisted of 0, 30 mL L⁻¹, 60 mL L⁻¹. The results show that application of paclobutrazol 60 mL L⁻¹ gave the shortest stalk length (4.40 cm) and the longest vase life (23.08 days).

1. Introduction

The agricultural sector has an important role for the Indonesian economy [1]. The agricultural sector consists of the food crops sub-sector which includes rice crops and horticulture. Horticulture is one part of the agricultural sector that can be used as a source of economic growth in Indonesia in the future. The development of ornamental plant production in Indonesia continues to increase. This condition illustrates that currently the people of Indonesia already know the benefits of ornamental plants.

Potted chrysanthemum is a plant that is widely used in various events. Chrysanthemum is much needed by florists, decorators, hotels, catering, offices and decoration in the house. This shows that chrysanthemum plants in pots have quite wide market opportunities for marketing and quite promising business opportunities. Chrysanthemum (*Chrysanthemum* sp.) is an ornamental plant that currently has a high demand that is used as one of the businesses in the field of ornamental plants that promises large profits as cut flowers and potted flowers. The advantages of potted chrysanthemums are clustered flowers, unique and longer display capacity (long lasting) so that it becomes one of the world's export commodities compared to cut flowers.

Chrysanthemum is very popular by the public because of the many types, shapes and colours of flowers. In addition to the shape of the crown and the number of flowers in the stalk, the colour of the flower is also the choice of consumers and in general consumers prefer red, white and yellow as the basic colour of chrysanthemums. Nowadays consumers tend to like potted flowers that are not too tall with stems and segments, lush leaves and flowers grow uniformly and compactly. Therefore, in the achievement of increasing community needs for chrysanthemum plants in pots, it is necessary to



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maintain the quality and durability of the flower by using nutrients from liquid organic fertilizer and growth regulators.

Complex organic compound that can be used is corn extract as it can cause chrysanthemum leaves to become lush and greener. Corn extract contains natural cytokinins which can slow down the senescence of leaves in whole plants due to this anti-aging effect. The chrysanthemums are sprayed with cytokines to keep the flowers fresh. According to Harjadi [2], application of 50 mg L⁻¹ young corn extract has a very good influence on root formation compared to administration of 0.2 ppm NAA, because young corn extract contains amino acids, carbohydrates, vitamins, minerals, and growth regulators of auxin and cytokinin that can meet nutrient elements needed by plants. Natural auxin is found in the filtrate of young corn kernels or called milk stage [3].

Application of growth regulators is carried out to obtain a good and beautiful chrysanthemum pot with a canopy that is not too high and flowers that are uniform and compact. One way to do this is by applying growth regulators to plants, especially those that inhibit vegetative growth of plants, namely paclobutrazol. The working principle of paclobutrazol is to inhibit the oxidation reaction between kauren and kaurenoic acid in the synthesis of gibberellins, so that there is an emphasis on plant stems and can accelerate the flowering period. However, this happens because the effect of administration of paclobutrazol varies in each plant. According to Santiasrin [5], paclobutrazol can provide a significant influence in inhibiting the vegetative growth of glloxinia plants for plant height, leaf length increase, leaf width increase, flower diameter and number of leaves.

Research by Herlina and Sutarna [6] showed that use of paclobutrazol through leaves at a concentration of 60 ppm can reduce the height of chrysanthemum Sandra and Rage varieties, but at a concentration of 20 ppm makes Chrysanthemum Surf variety more compact and flowering faster. Paclobutrazol can also suppress crowns and increase root growth. Spraying paclobutrazol on potatoes has a shortening effect on plants and reduces tuber diameter per plant on the production of mini Ponti potato tubers in Red Pontiak [7]. According to Wattimena [8], administration of paclobutrazol in low concentrations can enhance plant resistance to disease. Based on the description above, it is necessary to conduct a research using natural growth regulators contained in corn kernels by combining it with paclobutrazol.

2. Methodology

2.1. Experimental design

This research was carried out from July-October 2015 in a plastic house in Pattang Subdistrict, High Moncong District, Gowa Regency, South Sulawesi Province. The study site located with an altitude of ± 1500 meters above sea level and average temperatures ranging from 18-26 °C. The research was carried out in the form of a factorial experiment of two factors arranged according to the randomized block design as an environmental design. The concentration of young Corn Extract (J) was placed as the first factor consisting of four levels namely Control (0 mL L⁻¹), 100, 50, and 150 mL L⁻¹. The second factor was Paclobutrazol (P) concentration which consisted of three levels, namely Control (0 mL L⁻¹), 30, and 60 mL L⁻¹. Each treatment combination was repeated three times resulted in a total of 36 experimental units. In each unit of the experiment there are two plants so that 72 chrysanthemum seedlings.

2.2. Preparation of the corn extract

Initially, young sweet corn kernels were removed from the cob, then mixed with distilled water gradually at a ratio of 1: 1 while blending, and then added with sugar. The mix then filtered using a filter cloth then stored in a translucent closed container. After 5 days, the lid of the container was opened to remove existing gases and closed again. The container lid was opened every two days. Fermentation was allowed to take place to 15 days. Then the liquid and solid were separated with a centrifuge for 15 minutes. The liquid in the form of corn extract was placed into a covered bottle protected by light, and stored in a refrigerator.

2.3. Preparation of the growing media

The media used in this study was a mixture of soil, chicken manure and husk charcoal in a ratio of 3: 1: 1 which was put into a pot. The media was saturated with water and left for one week to be ready for planting and arranged according to treatment.

2.4. Planting

Seedlings from shoot cuttings that have been sown for 28 days are ready to be transferred to the pot. After planting, the soil around the stem was compacted then doused with water until it is quite wet or moist. Planting was done in the morning.

2.5. Application of the corn extract and paclobutrazol

Corn extract was sprayed on the whole plant with intervals of spraying once a week at the age of 2, 3, 4, and 5 weeks after planting (WAP), carried out by adjusting the condition of the plant to wet. Paclobutrazol application is carried out on leaves and stems at ages 6 and 7 WAP during growth with a concentration of 0 mL L⁻¹, 30 mL L⁻¹, and 60 mL L⁻¹, with the time of application carried out in the morning by adjusting the condition of the plant to wet.

2.6. Observation and data analysis

Parameters observed was the quality of chrysanthemum flower including flower diameter, stalk length, vase life, and the start of flower colour changes. Data was analysed using analysis of variance (ANOVA) and followed by the Least Significance Difference (LSD) test at $\alpha=0.05$ if there is a significant effect of the treatments.

3. Results

3.1. Flower diameter

Based on the analysis of variance, application of different concentration of corn extract and paclobutrazol had no significant effect on flower diameter. Figure 1 shows that the diameter of the chrysanthemum flower in this recent study were not significantly differed among the paclobutrazol treatments ranged 5 – 5.5 cm.

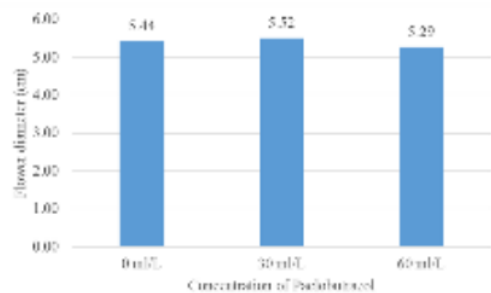


Figure 1 Flower diameter (cm) of Chrysanthemum at different concentration of Paclobutrazol.

3.2. Stalk length

The variance analysis also show that the interaction of paclobutrazol with corn extract did not significantly affect the average length of the flower stalk (cm). Meanwhile, paclobutrazol had a very significant effect and corn extract had no significant effect. LSD test results at the 0.05 level (table 1)

show that the control treatment of paclobutrazol (P0) resulted in the highest stalk length of 8.18 cm and significantly different from all treatments. Shortest stalk length found in the paclobutrazol (P1) treatment of 60 mL L⁻¹ (4.40 cm).

Table 1 Average of stalk length (cm) of Chrysanthemum flower at different concentration of corn extract and paclobutrazol.

Paclobutrazol	Corn extract				Mean	LSD _{0.05}
	J0 (0 mL L ⁻¹)	J1 (50 mL L ⁻¹)	J2 (100 mL L ⁻¹)	J3 (150 mL L ⁻¹)		
P0 (0 mL L ⁻¹)	8.00	8.13	8.47	8.13	8.18 c	
P1 (30 mL L ⁻¹)	6.57	6.17	6.27	5.73	6.18 b	0.90
P2 (60 mL L ⁻¹)	4.40	4.40	4.33	3.77	4.40 a	

The numbers followed by different letters mean significantly different at the LSD test at $\alpha=0.05$.

3.3. Vase life

Variance analysis showed that the interaction of corn extract with paclobutrazol had no significant effect on the vase life of the chrysanthemum flowers. The vase life was significantly affected by the paclobutrazol concentration. The LSD test results at the level of 0.05 (table 2) shows that the treatment of paclobutrazol provided the longest vase life of 23.08 days (P2) and was significantly different from all paclobutrazol treatments. Shortest vase life of 19.17 days found in control treatment (P0).

Table 2 Average of vase life (days) of Chrysanthemum flower at different concentration of corn extract and paclobutrazol.

Paclobutrazol	Corn extract				Mean	LSD _{0.05}
	J0 (0 mL L ⁻¹)	J1 (50 mL L ⁻¹)	J2 (100 mL L ⁻¹)	J3 (150 mL L ⁻¹)		
P0 (0 mL L ⁻¹)	18.33	17.67	20.67	20.00	19.17 a	
P1 (30 mL L ⁻¹)	21.00	22.33	22.67	20.00	21.50 ab	3.41
P2 (60 mL L ⁻¹)	23.07	23.67	23.33	22.67	23.08 b	

The numbers followed by different letters mean significantly different at the LSD test at $\alpha=0.05$.

3.4. Start of flower colour changes

The variance analysis showed that the concentration of corn extract and paclobutrazol had no significant effect on colour changes (days). Figure 2 shows that the longest period until changes was detected on the flower colour was found in the use of 50 mL L⁻¹ corn extract and 60 mL L⁻¹ paclobutrazol (10.67 days) While the earliest colour changes observed on the chrysanthemum flower was on paclobutrazol control and the application of 50 mL L⁻¹ of corn extract concentration (7.33 days).

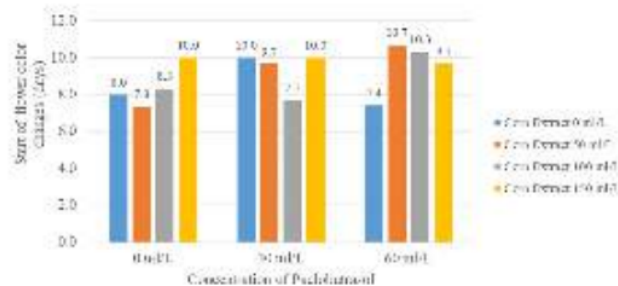


Figure 2 Period to start of Chrysanthemum flower colour changes (days) at different concentration of corn extract and paclobutrazol.

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4. Discussion

The results of the variance test showed that the treatment of paclobutrazol significantly affected the stalk length and the vase life of chrysanthemum flowers. The treatment of paclobutrazol 60 mL L⁻¹ provided the shortest flower stalk length (4.40 cm) and is able to provide longest vase life (23.08 days). This is because paclobutrazol is a growth regulator that can inhibit vegetative growth and can stimulate flowering [4]. According to Lizawati [9], the use of substances that are growth inhibiting can stimulate flowering. Growth inhibiting agents such as paclobutrazol daminozide, cycocel and morphactin can induce flowering but do not spur the development and appearance of flowers.

Corn extract 50 mL L⁻¹ can provide longer flower resistance (10.67 days). This is presumably because corn extract contains natural cytokinins that can inhibit aging when applied to plants. This is supported by the results of the analysis of corn seeds obtained by cytokinins (53.94). In addition, corn extract also contains nutrients needed by plants, namely macro nutrients, mainly P which functions to stimulate the freshness of flowers. Based on the composition analysis on the content of young corn seeds, obtained the element P (71.66) which is able to stimulate the flowering of chrysanthemum plants. Soepardi [10] stated that the role of phosphorus is important for cell growth, formation of fine roots and root hair, strengthening straw so that plants do not easily fall, improving plant quality, flower, fruit and seed formation, and strengthening resistance to disease. Phosphorus also plays a role in the growth of seeds, roots, flowers and fruit. Ulfa [11] suggested that a variety of plants contain bioactive compounds that can be extracted as growth regulators (auxins, gibberellins and cytokinins) including extracts of compounds from corn kernels. Corn seed extract has a concentration of growth regulating compounds such as auxin 1.67 ppm, gibberellins 41.23 ppm, and cytokinin / zeatin 53.94 ppm.

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5. Conclusion

Based on the results obtained, it can be concluded that use of paclobutrazol 60 mL L⁻¹ can provide longest vase life and the shortest stalk length.

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