

# Effect of Cycocel Concentration on Result of Mini Potato Tubers (*Solanum tuberosum* L.) in Hydroponic Substrate

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## ABSTRACT

This study aimed to determine the effect of cycocel on mini potato tuber yield at various concentrations. Preparation of potato plant has done at plant tissue culture laboratory, Faculty of Agriculture, University of Jember, in February-April 2016 and field experiments was carried out at Jampit Village, District Sempol, Bondowoso, May to September 2016. The research method used is Complete Random Design (RAL) single factor. Factor concentration of cycocel consisting of five levels, namely: 0 ppm (C0), 500 ppm (C1), 1000 ppm (C2), 1500 ppm (C3), and 2000 ppm (C4), with six replications. The results showed that the plant which treated by cycocel 2000 ppm has a shorter plant height of 27.40 cm, lower plant fresh weight 35.62 grams, and the higher number of tubers 15,83 compared to the others factors. On the other variables cycocel has no significant effect, on number of stems and total weight of tubers per plant.

**Keywords:** Hydroponic, mini tubers, cycocel concentrations, potato plant, granola

## Article History

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## 1. Introduction

*Solanum tuberosum* L. is one of most popular as top five staple food in the world to supply our carbohydrate. Those five are rice, wheat, potato, buckwheat, and also corn. Potatoes is secondary staple in Indonesia, it has high demand in entire year. The quality of potato seeds is a major factor in determining the yield of potato production. The availability of national certified potato seeds currently only reaches 6% of the total requirement of 128.6 thousand tons of seeds per year (Directorate General of Horticulture in Dianawati et al., 2013). This causes low productivity of potatoes, so the results obtained by farmers are not yet optimal. One effort to obtain quality seeds can be obtained through tissue culture methods and continued with rapid propagation techniques through planting macro cuttings in the field (Siska et al., 2010).

The alternative that can be done is to produce mini potato tuber (G0) as a source seed, can be done with the cultivation method of substrate hydroponic plants with the aim to multiplication of mini tubers as seeds. In this technique, plants are planted on non-soil media. There are many advantages to the use of hydroponic methods in the production of potato seed base compared to more conventional methods, including a higher level of multiplication of mini tubers, no risk of physiological disease contamination, no need for soil sterilization, and an easier management system (Correa et al., 2009).

Regulatory substances are also one of the determinants of tuber formation, including gibberellins, cytokines and inhibitors or often known as retardants. Growth regulators (PGR) are basically non-nutritional organic compounds which in low concentrations are able to encourage, inhibit and change plant growth and development. Provision of growth regulators must be at the right concentration, in order to encourage plant growth and mini tuber formation. Growth inhibitors have a function to suppress the elongated growth of buds and form short branches. Giving cycocel can cause the extension of the cell extension, especially in the sub-apical meristem area that inhibits plant height. According to Siska (2010) states, the addition of growth inhibitors will reduce the negative effects of gibberilin biosynthesis. The results of the study Pangaribuan et al., (1995), giving cycocels at weeks 3 and 5 have been able to increase the number of stolons that form more tubers. Based on this background, it is necessary to conduct a study or research entitled "Effect of Cycocel Concentration on the Production of Potato Mini Tubers (*Solanum tuberosum* L.) in Hydroponic Substrate".

## 2. Methods

The study was carried out in the tissue culture laboratory of the University of Jember in February - April 2016 and in the screen house of Jampit Village, Sempol District, Bondowoso Regency, in May - September 2016. The research method used was a single factor Randomized Complete Design (CRD). Cycocel concentration factors

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consisting of 5 levels, namely: 0 ppm (C0), 500 ppm (C1), 1000 ppm (C2), 1500 ppm (C3), and 2000 ppm (C4), with 6 replications.

The experiment was conducted with several stages including:

### 2.1. Preparation

Phase one of the study was to produce plantlets of prospective seedlings of the Granola variety, in the plant tissue culture laboratory. Planlet production is carried out in a sterile (in-vitro) environment in laminar air flow (LAF). The step in multiplying plantlets begins with cutting the planting material (explant) from the culture bottle carefully using scissors or scalpel. Take a plantlet bud and put it into a petri dish, then add enough distilled water and 7 drops of betadine. Remove the sterilized explant with a solution of betadine and distilled water in an empty petri to drain it. Cut the explant into several sections with a cutting length of 2-3 cm. Plant explants into new culture media using tweezers. One bottle of culture media was filled with three plant explant stems. Culture media that had been filled with explants were then placed in the incubation chamber. Maintain clean storage shelves and spray alcohol every day on the surface of culture bottles in an effort to avoid the growth of fungi / bacteria that cause contamination. Planlets that have grown normally and have more than 2 pairs of leaves and roots, are acclimatized on sterile sand media, provided there is no contamination in the previous in vitro culture. Harvesting can be done when the plants have ready harvest criteria. The first criterion is the tuber has matured, which is 110 days old on granola varieties. The leaves and stems have yellowed, tuber skin is not easy to peel or blister when pressed. After harvesting the tubers can be directly selected or graded then taken and stored in a warehouse as a prospective seed.

### 2.2. Field Experiment

Adapt plantlets in a new field condition for 3 days, then plant the seeds of potato plants in a hydroponic substrate (sand) medium. Perform treatment by giving watering nutrient solution 2 times a day. The spraying treatment of retard and cycocel on plants was carried out when the plants were aged 3 MST and the second spraying was 5 MST. Cycocel treatment was carried out twice, when the plants were 3 and 5 MST. Cycocel is sprayed on the entire surface of the plant concentration of 0 ppm, 500 ppm, 1000 ppm, 1500 ppm, 2000 ppm.

## 3. Result

The result of research can see in Table 1

**Table 1. Rekapitulation F-value for each dependent variable**

No	Variabel	F-Hitung	F-tabel	
			5%	1%
1	Height	6,99**	2,76	4,18
2	Twig	1,01		
3	Wet weight of plant	10,07**		

4	total wet weight tuber/plant	0,62
5	Total tuber/plant	3,13*

\*\*have significant diference, \*insignificant different

**Table 2. Toral tuber base on grade per each plant**

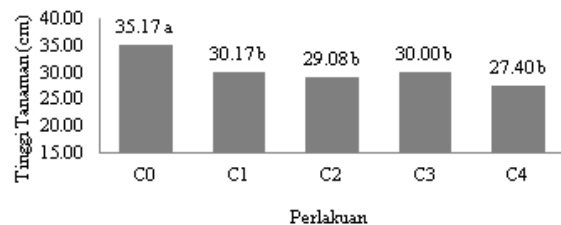
Treatment	S	M	L
C0	5,00	4,83	1,33
C1	5,33	7,83	1,00
C2	6,83	5,17	0,83
C3	6,50	6,83	1,16
C4	8,00	7,00	0,83

Note : C0= 0 ppm, C1= 500 ppm, C2=1000 ppm, C3=1500 ppm, C4= 2000 ppm.

The treatment of 2000 ppm cycocel spraying showed better results in reducing plant height, plant fresh weight, and increasing the number of tubers per plant with a smaller size. This shows that the initial cycocel treatment can increase tuber formation faster than without cycocel treatment.

## 4. Discussion

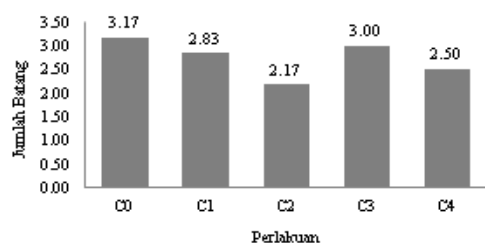
Hormones play an important role both in encouraging and increasing various activities in the plant body. In this research, the treatment of retardan spraying with the trademark cycocel was given to plants aged 3 and 5 MST.



**Figure 1. Height of potato plant**

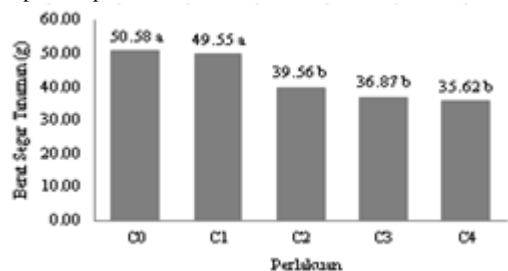
The observation of plant height showed very significant different tendencies. Shorter plant height in plants that are applied cycocel is different from plants that are not applied cycocel (C1) which has a higher plant height. Cycocel treatment with a concentration of 2000 ppm showed the highest plant height results. This shows that cycocel affects the height of potato plants, the lower growth of plant height is thought to be due to the inhibition of gibberellin's biosynthesis. Gibberellins are a type of hormone that functions to increase cell division and cell enlargement in plants. The performance of cycocel with gibberellins is antagonistic so that the treatment of cycocel in plants can inhibit plant height growth. Kashid et al. (2010) stated that cycocel is an anti-gibberellin inhibitor, which is a dwarfing agent and its spraying on plants will cause gibberellin deficiency which will ultimately reduce growth by inhibiting geranyl

pyrophosphate to coonyl pyrophosphate which is the initial stage of giberellin synthesis.



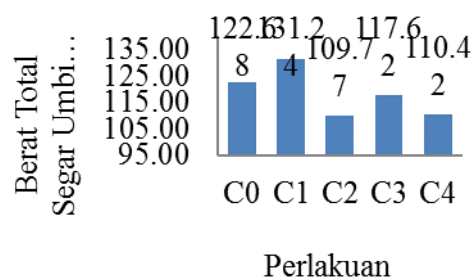
**Figure 2.** Total twig of potato plant

In the observation variable of the number of potato plant stems, according to the results of the analysis of variance stated no significant difference between plants treated with cycocel with plants that were not applied cycocel. This is presumably because the number of stems on potato plants is not affected by cycocel. Cycocel affects the height of potato plants because the biosynthesis of gibeletin is inhibited. In the observations made in the study, the transfer of photosynthate results did not affect the number of stems formed in plants, but were transferred to other parts of plants that needed them.



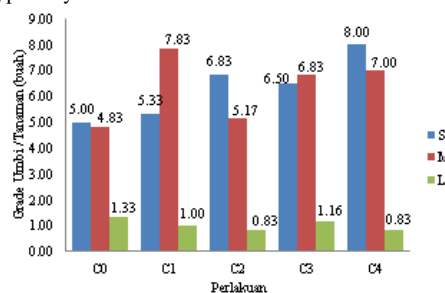
**Figure 3.** Wet weight of potato plant

The results of observations of fresh plant weight, cycocel administration stated that the results were not significantly different after further testing, but the fresh weight of plants decreased with increasing concentrations of cycocel applied to plants. It is suspected that cell elongation in plants experiences inhibition and decreases in vegetative growth which decreases causing the plant's fresh weight to be smaller. The mechanism of action of cycocels can be absorbed by plants through leaves, stem tissue or roots, then transported in the xylem to the apical growing point. Upon reaching the sub-apical meristem, this active compound will inhibit the production of gibberellins by inhibiting the oxidation of kaurene to kaurenoic acid which is a cytochrome P 450 being a catalyst for reaction in microsomes (Arteca in nuraini, 2015). The same results were delivered by Mustafa et al., (2014), the retardant application of paklobutrazol in kalosi potato varieties at a dose of 1 ml / 1 and 3 ml / 1 had lower leaf fresh weight compared to plants that were not applied to paklobutrazol ie control.



**Figure 4.** Totl weight tuber of potato plant

In the observation variable of total fresh weight of tubers per plant according to the results of the analysis of the variance stated no significant difference between plants treated with cycocel with plants that were not applied to cycocel, but the total fresh weight data of each plant showed that plants applied with cycocel had a total fresh weight that was more fresh small compared to plants that are not applied with cycocel. This is presumably due to the size of the tubers that form on plants are not the same. Endogenously gibberellins cause inhibition of mini tubers formation, so that the results of photosynthate translocation in plants are widely used for tuber enlargement resulting in a higher total fresh tuber weight. Unlike plants that are applied with cycocels which have a lower total weight, because photosynthate is widely used for tuber formation as a response to inhibition of gibberellin's biosynthesis in plant bodies that affects tuber formation. According to Sakyia et al. (2013), the use of cytokinins alone is not enough, the addition of retardants or growth inhibitors is also needed to inhibit and suppress the activity of gibberellins, so that this inhibition can accelerate and focus energy for the formation of sweet potatoes. The distance between the source to the sink gives a real influence on the results of photosynthate translocation in the body of the plant, allegedly the closer the distance between the source to the sink, the rate of photosynthate translocation in the body of the plant is faster. Strengthened by the results of the study stated by Eristo and Ikhwan, (2014), the effectiveness of photosynthate translocation depends on the distance between the source and the user, the low height of the plant will shorten the distance between the source and the user thereby increasing photosynthate translocation



**Figure 5.** Tuber grade of plant

In plants that are not applied cycocels tend to produce higher class L bulbs compared to plants that are applied cycocels. It is suspected that the formation of mini tubers in these plants is longer due to the phegetative phase which is not inhibited so that the tubers produced in plants without cycocel application are less. In line with the results of the study, Pangaribuan et al. (1995) reported that cycocel application could increase

the number of tubers formed with application time at the age of 3 and 5 MST (3.3 fruits / plant) more than in controls (1.37 fruits / plant). In accordance with the statement of Kashid et al. (2010), an increase in crop production with retardant applications results in shorter plant height, but is very useful in the efficiency of increasing translocation of photosynthate results to food storage and seed filling. Siska et al. (2010) reported the results of their study that the application of cycocel with a concentration of 1500 ppm increased the production of mini potato tubers with an average number of 4.50 per crop. In the principle of seed germination, a large number of tubers is more concerned than producing tuber weights. In the research data, the S and M class tubers dominate much on the yield data, in contrast to the class L bulbs, only a small portion of each treatment. Directorate of horticultural seeding (2014), stipulates that G0 mini tuber production is exempted from the expected tuber grade, for G0 seed class the factor observed when examining tubers is that there is a mixture of other varieties, OPT attacks and mechanical damage

## 5. Conclusion

- Application of cycocel in potato plants has a significant effect in reducing plant height and plant fresh weight
- Cycocel treatment with a concentration of 2000 ppm produces more tubers up to 15.83 fruits / plant than other treatments. Please make sure that you use

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