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Effect of Foliar Organic Fertilizer on Caisim (*Brassica Junceae* L) Growth and Yield

Sugeng Haryanto[1*], Helda Sabban[1]

[1] *Agrotechnology Program, Faculty of Agriculture, Universitas Khairun, Indonesia, Haryantosugeng228@gmail.com*

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ABSTRACT

The Caisim vegetable crop (Brassica chinensis) is a commodity that has commercial value and is a favorite commodity for some people in Indonesia. The demand for Caisim crop is expected to increase along with population growth with increased purchasing power. Moreover, Caisim crops are easily available in the market. The study determines the effect of treatments of foliar organic fertilizer application time on growth rate and production rate of Caisim (Brassica juncea L) crops. The research carries out in Gambesi, South Ternate from July to September 2020. Caisim crops in the beds are treated with morning fertilizing using foliar fertilizer. The research uses a randomized block design of 5 treatments and 3 replications. The 15 treatment units, namely P0 = without fertilization (control), P1 = application time at 6.00 - 7.00 WIT, P2 = application time at 7.00 - 8.00 WIT, P3 = application time at 8.00 - 9.00 WIT, and P4 = application time at 9.00 - 10.00 WIT. All treatments (P1, P2, P3, and P4) use the same dose of 2 cc/liter of water. The results indicate that the treatment P1 (6.00 - 7.00 WIT) has an excellent effect on fertilizer application times because it has a significant effect on crop height, the number of leaves, leaf area, and fresh weight compared to treatment P0, P2, P3, and P4.

Keywords: Time, Liquid Fertilizer, Caisim

ABSTRAK

Tanaman sayuran Caisim (Brassica chinensis) merupakan komoditas yang memiliki nilai komersial dan disukai sebagian masyarakat Indonesia. Permintanan akan tanaman Caisim diperkirakan akan meningkat seiring dengan pertambahan jumlah penduduk dengan daya beli masyarakat yang meningkat serta tanaman Caisim mudah di dapat di pasar. Tujuan di laksanakan penelitian ini yakni untuk mengetahui perlakuan waktu pemberian pupuk organik daun terhadap tingkat pertumbuhan dan produksi tanaman Caisim (Brassica juncea L). Tempat Gambesi Ternate Selatan berlangsung bulan Juli – September 2020. Caisim di bedengan dengan perlakuan waktu pagi hari pemberian pupuk organik daun. Rancangan acak kelompok 5 perlakuan dan 3 ulangan, dan 15 unit perlakuan adalah P0 = tanpa pupuk (kontrol), P1 = waktu pemberian jam 6.00–7.00 WIT, P2 = waktu pemberian jam 7.00–8.00 WIT, P3 = waktu pemberian jam 8.00–9.00 WIT, dan P4 = waktu pemberian jam 9.00–10.00 WIT. Baik P1, P2, P3, dan P4 semuanya menggunakan dosis yang sama yakni 2 cc/liter air. Hasil penelitian menunjukan bahwa perlakuan P1 (Pukul 6.00 – 7.00 WIT) memberikan pengaruh sangat baik pada waktu pemberian pupuk, karena dapat memberikan pengaruh yang nyata terhadap tinggi tanaman, jumlah daun, luas daun, dan bobot segar di bandingkan dengan perlakuan P0, P2, P3 dan P4.

Kata Kunci : Waktu, Pupuk Cair, Caisim

INTRODUCTION

Caisim (*Brassica chinensis*) vegetable crop is a commodity with commercial value and a favorite commodity for some people in Indonesia. The crop demand is expected to increase along with population growth and an increase in community's purchasing power. Moreover, the crop is easily available in the market.

Indonesia is a suitable place for vegetable farming, especially Caisim crops. According to Haryanto *et al* (2006), Indonesia has a potential for vegetable cultivation. Caisim crop cultivation techniques can be improved through timely fertilization. Caisim crop fertilization carries out in the morning or afternoon using liquid organic fertilizer applied to crop leaves.

The application of liquid organic fertilizer to Caisim crop leaves with an appropriate time interval results in more nutrients available to be absorbed by the crops; thus, fulfill elements needed for its better growth and development and affect the crop yields. Isdarmanto in (Ria & Asmuliani, 2017) states that crops require more nutrients with increased metabolism productivity due to the crop requirement during its growth and development.

Previous studies indicate that the liquid organic fertilizer application to leaves provides better crop growth and yield compared to soil application. In a study by Nurhayati in Kurniawati et al (2015), liquid organic fertilizer application in different time intervals has a significant effect on potato crop height at 4 WAP (weeks after planting) and tuber weight. Hamdani in (Kurniawati et al., 2015) affirms that the liquid organic fertilizer application has a significant influence on the flower to young capsules, number of fruits per crop, fruit weight per crop, yield per plot, and yield per hectare, and increases the production yield of cucumber crops. The result is supported by Nuryenti *et al.* (2016) that fertilization on leaves accelerates the effect than through roots; fertilizer applied is liquid fertilizer. Similarly, (Schroth, 2005) asserting that plants that acquire nutrients in an optimal amount and at the right time will grow and develop optimally.

Appropriate liquid organic fertilization on Caisim crop leaves is related to the stomata opening and closing process that is affected by the crop itself, which is its metabolism process. Salisbury & Ross (1995) reveals several factors influencing the opening and closing of stomata namely, external and internal factors. The external factors include sunlight intensity and concentration of CO2 and abscisic acid (ABA). Sunlight stimulates cover cells to absorb K+ ions and H2O causing stomata to open in the morning. The low concentration of CO2 in leaves affects the opening of stomata. The internal factors consist of a biological clock that stimulates ion absorption in the morning that results in the opening of stomata and ions release in the evening that closes the stomata. The current research identifies the effect of application time of leaf organic fertilizer on Caisim (*Brassica juncea L*) crop growth and production.

RESEARCH METHODOLOGY

The research was conducted in a field at Gambesi Village, South Ternate Sub-district, Ternate City from July to September 2020.

Research Design

The research employed a randomized block design (RAK) that consisted of 5 treatments and 3 repetitions; therefore, there were 15 treatment units. The treatments included P0 = without fertilizer (control); P1 = application time at 6.00 – 7.00WIT in the morning with a dose of 2 cc/liter water; P2 = application time at 7.00 – 8.00 WIT in the morning with a dose of 2 cc/liter

water; P3 = application time at 8.00 – 9.00WIT in the morning with a dose of 2 cc/liter water; and P4 = application time at 9.00 – 10.00 WIT in the morning with a dose of 2 cc/liter water.

Referring to the design, the mathematical formula of the simple randomized block design according to Hanafiah (2001):

$$Y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij} \quad \text{.... (1)}$$

where:

Y_{ij} : observation results in repetition I, II, and III
μ : expected mean value
α_i : effect of treatment i^{th}
β_j : effect of group j^{th}
ε_{ij} : experimental error of treatment from i^{th} treatment to j^{th} repetition

Research Implementation

Land Cultivation

Land cultivation carried out using hoes and shovels. Beds or plots were prepared in a size of 1.20 m x 1.50 m. Chicken manure was applied to the soil as basic fertilizer and was applied equally at a dose of 10/kg per bed.

Seeding/nursery

Seeding was conducted using smoothed soils by putting the soil into a 5 cm ice plastic bag. After 3 days, the plastic bags were cut to a size of 5cm and neatly arranged. Caisim crop seeds were put into each cut plastic (baby polybag) about 2−3 seeds/plastic bag. The seeding lasted for 14 days or until each seedling had 3−4 leaves and ready to transport to the beds.

Crop planting and maintenance

Crop planting was conducted when caisim crops were at the age of 14 days. The seedlings were carefully transported to beds prepared with a spacing of 25 cm x30 cm; hence, there were 20 crops/beds. The caisim crop maintenance included watering, fertilizing, weeding, removing dead and dying crops, pile up, pest and disease control, and harvesting.

Data Analysis

Observation data were analyzed using analysis of variance (Anova). If there were treatments with a significant effect it followed by a least significant difference test where $\alpha = 0.05$.

RESULT AND DISCUSSION

Crop Height

Results of variance analysis indicate that the application of foliar organic fertilizer at different morning times on Caisim crop had a significant effect on Caisim crop height parameter at 14 DAP (days after planting) and 28 DAP as shown in Table 1.

Table 1. Effect of Application Time of Foliar Organic Fertilizer on Caisim Crop Height (cm)

Treatment	Mean of Height	
	14 HST	28 HST
P0 (control)	22.50 a	26.58 a
P1 (at 06.00 – 07.00WIT)	23.58 b	27.58 b
P2 (at 07.00 – 08.00 WIT)	23.50 b	27,.42 b
P3 (at 08.00 – 09.00 WIT)	23.42 b	27.33 b
P4 (at 09.00 – 10.00 WIT)	22.58 a	26.67 a
LSD5%	**0.37**	**0.42**

Note: Mean numbers followed by the same notation indicate insignificant difference in LSD test at 5 % level.

Data of Caisim crop height in Table 1 indicate crop height at 14 and 28 DAP. Treatment P1 (at 6.00 – 7.00 WIT) had higher crop height than all treatments. It was assumed that P1 treatment is an optimal application time of natural foliar fertilizer, as at this time stomata on leaves are open; thus, foliar fertilizer given to the crops could be optimally absorbed and affects the crop height.

Internal and external factors affect the opening and closing process of stomata (Haryanti & Meirina 2009). Stomata surface will influence the absorption of nutrients; therefore, when foliar fertilizer is applied to the crop it will affect the crop growth. One of the elements required by a crop to accelerate its growth and growing points is the synthesis of amino acids and protein (Dhani, Wardati, & Rosmimi 2013). Lakitan further explained that physiological processes in plant growth can be stimulated using liquid fertilizers (Lakitan 2002). This result is supported by Plaster (2013) that sufficiently available nitrogen could stimulate the vegetative growth of vegetable crops. Similarly, Siska (2000) stated that nitrogen is a nutrient that has a significant role as it serves to spur plant growth and accelerate the increase in plant size.

Number of Crop Leaves

The variance analysis results suggested that the application of foliar organic fertilizer at different morning times on Caisim crop had a significant effect on the parameter of the number of leaves of caisim crop at 14 and 28 DAP as indicated in Table 2.

Table 2. Effect of Foliar Organic Fertilizer Application Time on Number of Caisim Crop Leaves

Treatment	Mean of Number of Leaves	
	14 DAP	28 DAP
P0 (Control)	5,50 a	6,25 a
P1 (at 06.00 – 07.00 WIT)	6,67 b	7,92 c
P2 (at 07.00 – 08.00 WIT)	6,58 b	7,42 bc
P3 (at 08.00 – 09.00 WIT)	5,92 ab	6,92 ab
P4 (at 09.00 – 10.00 WIT)	5,67 a	6,42 a
LSD5%	**0,78**	**0,82**

Note: Mean numbers followed by the same notation indicate insignificant difference in LSD test at 5 % level.

Data of Caisim crops' number of leaves in Table 2 indicates the crops' number of leaves at 14 and 28 DAP. Treatment P1 (at 6.00 – 7.00 WIT) had more leaves than other treatments. It was assumed that leave stomata were open; thus, the foliar fertilizer applied to the crops could be optimally absorbed that affected the crop's number of leaves. The process of nutrient absorption through leaves depends highly on the closing and opening of leaf stomata (Sukma & Setiawati, 2010). Foliar fertilizer contains micro and macronutrients that complement

natural nutrients in the soil (Naemah et al.. 2018). The nitrogen element in natural organic fertilizers comes from nutrients sprayed on the surface and will continue to the leaf tissues. The acceleration of leaf organ formation depends on photosynthesis (Prasetya, Kurniawan, & Febrianingsih 2009). Nitrogen nutrients strongly affect vegetative growth, especially on the leaf length and crop stem (Hamli, Iskandar & Ramal 2015). The abundance availability of nitrogen nutrients could accelerate leaf growth to dark green in color and enlarge the crop stem. This situation will have an implication on vegetative growth that relies on the stimulus process from N nutrients (Rahmah, Izzati & Parman 2014).

Crop Leaf Area

The variance analysis results indicated that the effect of various morning times of foliar organic fertilizer application on Caisim crop was significantly different on Caisim leaf area parameter at 14 and 28 DAP as shown in Table 3.

Table 3. Effect of Application Time of Foliar Natural Organic Fertilizer on Caisim Crop Leaf Area (cm)

Treatment	Mean of Leaf Area	
	14 DAP	**28 DAP**
P0 (Control)	64.89 a	139.15 a
P1 (06.00 – 07.00 WIT)	89.41 b	228.80 b
P2 (07.00 – 08.00 WIT)	89.03 b	224.27 b
P3 (08.00 – 09.00 WIT)	74.35 ab	191.53 ab
P4 (09.00 – 10.00 WIT)	68.20 a	170.46 ab
LSD5%	**18.15**	**61,10**

Note: Mean numbers followed by the same notation indicate insignificant difference in LSD test at 5 % level.

Data of Caisim crop leaf area in Table 3 indicate the crop's leaf area at 14 and 28 DAP. Treatment P1 (at 6.00 – 7.00 WIT) had a larger leaf area than other treatments. This was due to the treatment P1 that was the best fertilizer application time because it was assumed that leaf stomata are open during that time thus crops could optimally absorb the fertilizer and it affects the crop's leaf area. The optimum entry of nutrients through the leaf surface from the application of foliar fertilizer affects crop vegetative (Suradinata, Nuraini & Setiadi, 2012). Further, Lakitan (2011) stated that the lack of N nutrients causes crop abnormal growth, and vice versa; therefore, crop growth and development processes highly depend on ideal N nutrients. Crops acquire protein from micro and macronutrient. If the protein acquired by the plant is sufficient then it impacts the increasing of leaf surface that full of chlorophyll (Rakhmiati & Fahrurrozi, 2003).

Crop Fresh Weight

The variance analysis results suggested that the effect of various morning times of foliar organic fertilizer application on Caisim crop was significantly different on Caisim fresh weight parameter at harvest time as indicated in Table 3.

Table 4. Effect of Application Time of Foliar Natural Organic Fertilizer on Caisim Crop Fresh Weight at Harvest Time (gram)

Treatment	Mean of Fresh Weight
P0 (Control)	188.33 a
P1 (06.00 – 07.00 WIT)	269.17 b
P2 (07.00 – 08.00 WIT)	260.08 b
P3 (08.00 – 09.00 WIT)	221.42 ab
P4 (09.00 – 10.00 WIT)	188.50 a
LSD5%	**60.53**

Note: Mean numbers followed by the same notation indicate insignificant difference in LSD test at 5 % level.

Data of Caisim crop fresh weight in Table 4 indicate the crop's fresh weight at 14 and 28 DAP. Treatment P1 (at 6.00 – 7.00 WIT) had crop fresh weight that was heavier than other treatments. This was due to the availability of nutrients in fertilizer application treatment in the morning was sufficient for the crop optimum productivity because of the morning sunshine. A plant needs sunlight for photosynthesis, without the sun, the process will not occur (Song, 2012). Water absorption and photosynthesis accumulation in leaves influence wet weight to transport overall crop parts. Dwidjoseputro (2005) affirmed that photosynthesis will run smoothly with sufficient nutrient availability; hence, the photosynthesis results will affect an increase in the crop's fresh weight. Crop's fresh weight level will influence the level of leaf area (Prasetya, Kurniawan & Febrianingsih, 2009).

Air Temperature Observation

The results of air temperature observation suggested that the effect of the application time of foliar fertilizer on air temperature in every treatment (Appendix 19). The mean of air temperature (^{0}C) in Caisim crop with the treatment of various morning times at the observation time is presented in Table 5.

Table 5. Mean of Temperature (^{0}C) in Caisim Crops with Treatments of Various Morning Times

Treatment	Minimum Temperature	Maximum Temperature
P1 (06.00 - 07.00 WIT)	**24.48**	**27.33**
P2 (07.00 - 08.00 WIT)	**25.74**	**32.11**
P3 (08.00 – 09.00 WIT)	**27.48**	**32.70**
P4 (09.00 – 10.00 WIT)	**28.22**	**35.00**

Data of the mean of air temperature in Table 5 indicate that treatment P1 (at 6.00–7.00 WIT) had a mean of the minimum temperature of 24.48^{o}C and maximum temperature of 27.33 ^{o}C, which was lower than treatment P4 (at 9.00–10.00 WIT) that had a relatively high mean of the minimum temperature of 28.22^{o}C and maximum temperature of 35.00 ^{o}C. The lowest mean of temperature in Treatment P1 (at 06.00-07.00 WIT) suggested the highest Caisim crop parameters (height, number of leaves, and leaf area, and crop fresh weight). Whereas, the highest mean temperature found in treatment P4 (at 09.00-10.00 WIT) indicated the lowest Caisim crop parameters (height, number of leaves, and leaf area, and crop's fresh weight). It was estimated that high temperature will influence water availability; hence, leaf stomata will close if there is a difference in moisture content in a space between cells and in the air (Purwanti, 2008). Lestari (2006), further stated that stomata serve as a medium for plant adaptation in plant water critical conditions. According to Purwaningsih (2017) when turgor

pressure is lower than its maximum value then the plant experiences water deficit or deficiency; hence, it will affect leaf stomata closure. The stomata closure and physiological decreased of plant stomata occurred due to the decrease in the rate of water loss in draught critical state (Subantoro, 2014). Therefore, at high temperature (≥ 32°C) this will influence water availability and in the end, Caisim crop growth and development (Rodríguez et al., 2015).

CONCLUSION

Based on the research results and discussion, it can be concluded that treatment P1 (at 6.00 – 7.00 WIT) provided a better effect than treatments P0, P2, P3, and P4. This was due to the treatment P1 that had a significant effect on crop height, number of leaves, leaf area, and fresh weight of Caisim (*Brassica juncea L.*).

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