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Application of Various Dosage Vermicompost and Shade on Growth and Yield of Lowland Cabbage

(Brassica oleraceae L. Varcapitata)

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Abstract: *Cabbage plant in Indonesia is one of the most cultivate horticulture commodities. Cabbage especially cultivate at upland with low temperature and adequate sunlight. The need for quality fresh cabbage is increasing so that increasing the distribution channels to consumers is expected to increase the freshness of vegetable compilation to consumers. High temperatures and low soil fertility constrain cabbage planting in the lowlands. Giving compost and shade to cabbage plants is recommended to increase lowland cabbage growth by modifying the microenvironment. This study used an experimental research method complete with a randomized block design consisting of two factors (different vermicompost and color doses) repeated three times. The first factor is the vermicompost dose consists of five levels (10 t ha-1, 15 t ha-1, 20 t ha-1, 25 t ha-1, 30 t ha-1) the second factor consists of two levels (without shade and use shade). The main observations observed in this study were plant height, age of cabbage head formation, fresh plant weight, cabbage head wet weight. The results of the observation data were then analyzed using analysis of variance (ANOVA) at the level of 5%. If the results of variance analysis are significant, the data than analysis with Duncan's multiple range test at the level of 5%. The results showed that application vermicompost and shade did not have an interaction effect on the growth and yield of cabbage plants. The application of vermicompost 25 t ha-1 independently affected plant height, plant fresh weight and cabbage head weight while the age of cabbage head formation was not affected by the two levels of treatment given. Modification of microclimate by providing shade in this study did not affect the parameters of growth and yield of cabbage plants.*

Keywords: *Altitude, microclimate, soil fertility*

INTRODUCTION

White cabbage (Brassica oleracea L. var. Capitata.) Is a popular vegetable in Indonesia consumed in fresh or cooked form. The content of vitamins and minerals in cabbage can help digestion and neutralize acidic substances [1].Public awareness of health and food safety has opened a new product segment, namely organic vegetables. Organic vegetables are a market term used as vegetable products that are grown using organic materials as nutrients or pesticides. Organic material as a source of fertilizer varies greatly, each having a different composition of micro-macro elements. A variety of organic pupil sources that can be used in fertilization, one of which is vermicompost (worm droppings). The use of vermicompost as an effort to increase production and quality of cabbage yields are still rare.

Vermicompost is the result of metabolism of earthworms, which is still contaminated with the rest of the media or feed in the cultivation of earthworms. The vermicompost has its advantages compared to other composts in general [2]. The application of vermicompost fertilizer (from cow dung, chicken, horse, and sheep) with a dose of 10 t ha-1 on mustard plants, showed that all types of vermicompost fertilizer could increase the N content and reduce C / N of latosol soil, increase N uptake, chlorophyll content, and

plant biomass. Among the four types of vermicompost fertilizer, vermicompost fertilizer from cow dung which gives the best influence, both on soil and on plants [3].Microclimate can be simply defined as the conditions around plants and animals to the limit of 2 meters above and below the object being observed. Microclimate is influenced by solar energy received from the atmosphere and the surface of the soil. Sunlight has a great influence on the growth of plants and other living creatures on the earth. Air humidity will change with changes in solar thermal energy, and air temperature will cause the plant to dry out. It is necessary to improve the environment of these white cabbage plants by manipulating the physical environment (microclimate) using shade. Shade is a material made of plastic or foam that covers the plant land with a certain height so that a microclimate environment is obtained [4].

The cabbage plants in coastal sandy land showed the initial growth of pots in dry season cabbage under the shade of sea cypress with light intensity 391 µmol per m2 per det gave an initial growth of 4 MST which was better than plants without shade light intensity 1,612.9 µmol per m2 per det [5]. The use of shade is expected to control the microclimate around white cabbage plants that are cultivated and can also reduce the intensity of light that is too high.

METHODS

This research was conducted from September to December 2014 at the UNPAD experimental garden, Ciparanje Village, Kec. Jatinangor, Kab. Sumedang, West Java. With an altitude of 700 m above sea level. The materials used in this study were seeds of White Cabbage (B. Oleraceae L var. Capitata) KK Cross variety, vermicompost fertilizer, paranet, furadan, nursery media, and nursery tray. The tools used are hoes, meters, scales, stirrers, sieves, labels, rulers, gloves, buckets, tweezers, sickles, and bamboo sticks (as shading net), temperature and humidity gauges.

This research was carried out with an experimental method using a randomized block design (RBD) factorial pattern with 2 factors and 3 replications. The first factor is vermicompost (V) fertilizer consisting of 5 levels, namely: v1 = 10 t ha-1; v2 = 15 t ha-1; v3 20 t ha-1; v4 = 25 t ha-1; v5 = 30 t ha-1 While for the second factor is the type of shade (N) consists of 2 levels, namely: n1 = without shade and n2 = shade net. These two factors obtained ten variations of combinations with replications three times.

Research procedures in the field include nursery, land preparation, shade installation, seed planting, crop maintenance, and harvesting.

1. The seeds are spread evenly on beds or seeding sites with a mixture of soil and vermicompost fertilizer (1: 1 w/w), then covered with banana leaves for 2-3 days. After 7 - 8 days, the seedlings are transferred into banana leaves or plastic pots with the same media (soil and sterile manure) [6]
2. Weeds that grow on land are cleaned first and then collected and buried. The soil is hoeed until it is loose and vermicompost is added as base fertilizer, then the soil surface is flattened and makes a plot or bed. Plant holes are made with a spacing of 60 cm x 40 cm (Research Center for Horticulture, 2013). The size of the plot is 300 cm x 160 cm with a distance between the plots of 100 cm. The total area of the study area is 39 m × 6.8 m = 265.2 m2
3. Installation of shade net is done by installing a bamboo pole in each corner of the plot, then installing shading nets by linking and gluing them to the supporting poles installed in each corner of the plot. Shade made wide follows the width of each plot, per building unit measuring x width = 1.6 m x 3 m, height 1 m. Each building construction unit, the roof is coated with shading net to get shade intensity according to the treatment.
4. Displacement is carried out if the seeds have strong roots. Seedlings from seeds or seeds are ready to be planted after 3 weeks of age or have 5 - 6 leaves [6].
5. Watering is done every day until the cabbage grows usually, then repeated as needed. If there is a dead plant, do the planting, and the planting is stopped after the plants are 10-15 days after planting. Weeding and watering are carried out together with the first and second fertilization. Weed control is carried out by removing weeds and other disturbing plants in beds.
6. Pest control is carried out in the event of an attack, using organic pesticides or controlling mechanically by hand [6]
7. Harvest is done at the age of 60 HST. Characteristics of sufficient age, the crop reaches the maximum size, solid and uniform, when snapped the fingers ring loudly. Ways to harvest white cabbage by pulling out the whole plant [6]

RESULTS AND DISCUSSION

Plant Height (cm)

The results of variance analysis of vermicompost application and shade on plant height (Figure 1) at ages 7, 21, 35 and 49 DAP. The vermicompost and shade application did not show an interaction effect on plant growth, but there were only independent effects of vermicompost application at age 21 and 35 DAP.

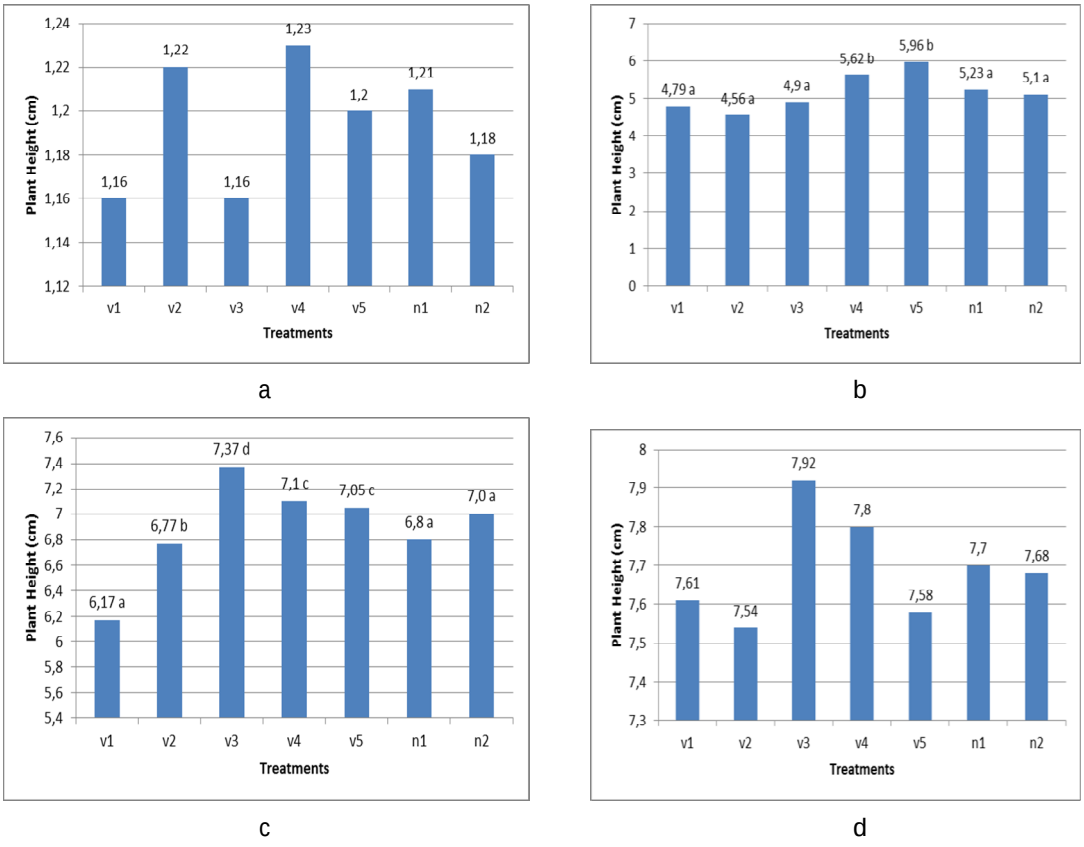

Fig 1: Plant Height Graph a. 7 DAP; b. 21 DAP; c. 35 DAP; d. 49 DAP

Remarks: Graph without number-letter (Figure 1 a & b) unsignificant effect (α=5%)
Graph with number-letter (Figure 1 c & d) Significant effect (α=5%)

The vermicompost treatment provides a real independent effect on the observations of plant height at the age of 21 and 35 HST. At the age of 21 HST, the most significant effect is shown by the level of 25 t ha-1 (V4) and the level of 30 t ha-1 (V5). With the highest average index is at level 30 t ha-1. This effect occurs because the application of vermicompost can provide complete nutrients and plant growth regulators needed by plants. The plant growth is consistent with the statement that vermicompost contains nutrients such as N, P, K, Ca, Mg and growth regulating hormones such as auxins, gibberellins, and cytokines to use in increasing growth [7]. Plants that are given phytohormones encourage plant size to be higher because of more cell division and the development of meristem tissue at the tip of the stem and on better intercalars [8].

The vermicompost treatment at 7 DAP and 49 DAP did not effect because 7 DAP the nutrients contained in vermicompost were still in the process of being reformed so that it was not available to be absorbed by plants. Vermicompost is an organic fertilizer, where the nature of organic fertilizer, in general, is slow release. The release mechanism of its elements adjusts to the pattern of nutrient absorption by plants [9]. Meanwhile, at the age of 49 DAP no effect was caused more because cabbage plants had entered a generative period where high growth did not go so significantly compared to the vegetative period. Nutrient absorption is relatively more in the vegetative phase of the plant [10].

Shade treatment based on Table 5 above does not give effect to all levels of plant height because white cabbage in the vegetative phase requires much light of increasing its growth, while the temperature and humidity conditions in the field are normal. Indirect light plays a role in the photosynthetic activity,

namely in terms of a substrate. Under the shade or below the surface of light water is a limiting factor for plant growth, photosynthesis is not effective which results in stunted plant growth [11].

Day of Initial Cabbage Head Developed (DAP)

The measurement of planting crop age is done after the age of 35 DAP until harvest, can be seen in Appendix 18. The results of the variance analysis showed that the treatment of vermicompost and shade did not provide interaction effects and independent influence on the age of crop formation.

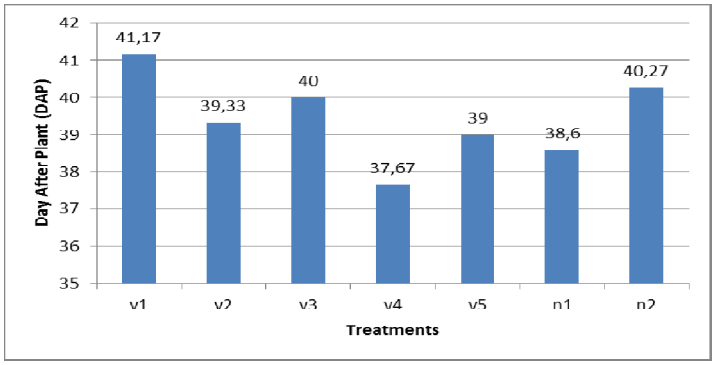

Fig 2: Graph of Initial Cabbage Head Developed Day After Plant (DAP)

All levels of both vermicompost and shade treatment did not have a significant effect on the age of crop formation. The unsignificat effect of crop formation is suspected because cabbage crop formation is more influenced by environmental factors and in this case temperature. The formation phase of cabbage in the cabbage is an important initial step towards the formation phase of white cabbage flowers. White cabbage requires a temperature of 5 - 10ºC for flower formation, for which cabbage is difficult to flower in Indonesia [12]. While the optimal temperature limit for crop formation is at temperatures <25 ºC [1]. So it can be said that the low temperature affects the formation of white cabbage crop. During the study the daytime temperature range was 25-30 ºC. At this temperature range, lowland cabbage is still tolerant in supporting good growth and yield but less optimal for crop formation. White cabbage can live at a temperature of 10-24 ºC with an optimum temperature of 17 ºC.

Plant Fresh Weight (gram)

The measurement of the fresh weight of cropping is done after harvesting. The results of the variance analysis showed that the treatment of vermicompost (V) and shade (N) did not have an interaction effect, but there was an independent effect of vermicompost treatment on fresh weight with plant weight at level 15 t ha^{-1} (v2), 25 t ha^{-1} (v4) and level 30 t ha^{-1} (v5).

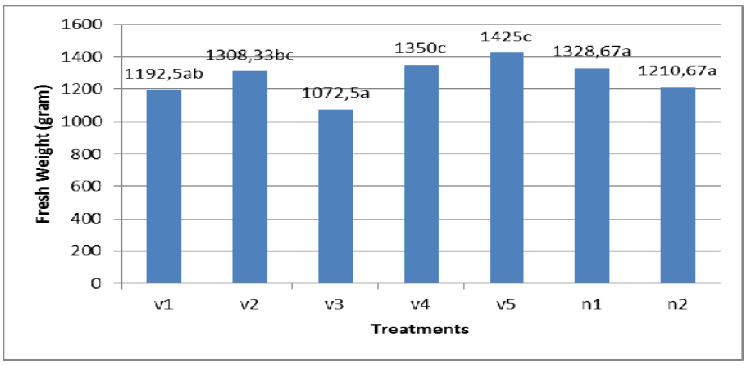

Fig 3: Fresh Weight of Cabbage Plant

Remarks: The average value in each column marked with the same letter shows no significant difference based on Duncan's Follow-up at 5% real level.

The most significant independent effect of vermicompost treatment is on the level of 25 t ha^{-1} (V4), and level of 30 t ha^{-1} (V5) to the fresh weight of plant stemmed where the highest average wet weight index is at the level of 30 t ha^{-1} (V5). This effect occurs because of the previous influence of the administration of vermicompost on plant height and number of leaves.

Fresh weight is measured by measuring the whole plant part. This means that fresh weight is supported by plant height and leaf number. The number of leaves and plant height is directly proportional to the size of the fresh weight of plants. The amount of leaves and plant height depends on the availability of nutrients absorbed. Vermicompost plays a role in providing nutrients and nutrients for plants.

The number of leaves and plant height are consistent with the statement of [7] that plant height and number of leaves affect the fresh weight of plant shoots. The higher the height of the plant and the more number of leaves, then the fresh weight of the canopy will increase. Vermicompost can increase the availability of nutrients of Ca, Mg and K of the surrounding soil as well as the presence of growth regulating substances such as auxin, stimulating leaf formation.

Vermicompost as an organic fertilizer can provide amino acid ingredients, protein and contain growing substances, namely auxins that play a role in stimulating root growth and are ready to build plant growth networks. Increased root growth and the formation of tissue - tissue in and leaves in large and large quantities can support an increase in the fresh weight of plants [13].

Fresh Weight of Cabbage Head (gram)

Measurement of the wet weight of the crop is done after harvesting. The results of the variance analysis showed that the vermicompost and shade treatment did not have an interaction effect but there was an independent effect of vermicompost treatment on the wet weight of crop heads at the level of 15 t ha^{-1} (V2), 25 t ha^{-1} (V4), and level 30 t ha^{-1} (V5).

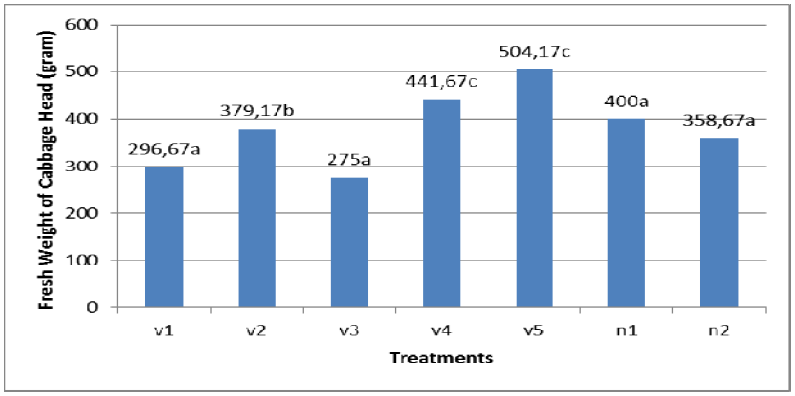

Fig 4: Fresh Weight of Cabbage Head Graph

Remarks: The average values in each column marked with the same letter show a non-significant difference based on Duncan's Follow-up at 5% real level.

Vermicompost treatment independently has a significant effect on the wet weight of the crop at the level of 25 t ha^{-1} (V4) and 30 t ha^{-1} (V5) where the highest average wet weight index is at the level of 30 t ha^{-1} (V5). This effect occurs because vermicompost contains N elements needed by plants for the formation and increases the number of leaves. Where is the role and function of N nutrients in plants is the formation and division of cells in leaves, stems, and roots. White cabbage is a collection of several solid leaves. The heavier the crop, the denser the number of leaves that form the crop. Crop density which is influenced by the number of leaves supported from nutrients contained in vermicompost. While nutrients that play a role in leaf formation and growth are N, Ca, Mg, and K contained in vermicompost.

The growth of white cabbage is consistent with the results of Zahid's (1994) study in [14] which states that vermicompost fertilizer contains various ingredients needed for plant growth, namely hormones such as gibberellin, cytokinin and auxin, and contains nutrients (N, P, K, Mg and Ca) and Azotobactersp which are nonsymbiotic N-fixing bacteria that will help enrich the N elements needed by plants.

Plants without vermicompost of nutrients contained in the soil do not increase, therefore the plants grow shorter because the cell division at the stem ends decreases and the formation of leaf branches becomes less than in plants given vermicompost. With reduced plant height, fewer leaves are formed. The results of plant assimilation also decrease, which will cause a decrease in the wet weight of the plant and the dry weight of the plant [8].

CONCLUSION

Based on the results of the study, it can be concluded that:

1. There was no interaction between vermicompost and shade treatment, but there was an independent effect of vermicompost treatment on plant height, the number of leaves, plant weight, and crop weight.
2. The treatment of vermicompost 30 t ha^{-1} (V5) was the best treatment which gave independent effect on plant height, number of leaves, fresh weight of plant stover and wet weight of the crop.

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