The effect of NPK pearl fertilizer on the germination of green mustard seeds (Brassica juncea L.)

Ratna Dewi Wulaningsih, Agung Purwanto, and Cantika Choirunisa Anediaandrasari

Universitas Negeri Jakarta, Jakarta Timur, Indonesia
dewiwulaningsih.ratna@gmail.com

Abstract. Green mustard (Brassica Juncea L.) is one of the leafy vegetables that is not difficult to cultivate. Brassica Juncea L. is classified as a leafy vegetable plant that has high economic value and is very popular with the community. Green mustard grows well in soil with high nitrogen content. In addition to the N element, the P element, and the K element also play an important role in plant growth. NPK 16:16:16 fertilizer is a compound fertilizer that plants need. The method used is the experimental method, namely placing plants in a laboratory exposed to sunlight, and observing their development. Green mustard seeds are inserted into a planting medium in the form of fertile soil, which is placed in a shady place. Plants are watered using water every 7 days. The observation parameters observed are the percentage of germination and plant height. Plants planted in planting media with NPK addition treatment grow faster and better, compared to plants planted in planting media without NPK addition**.**

Keywords: NPK Fertilizer, Germination Percentage, Brassica juncea L.

1 Introduction

Green mustard is one of the horticultural plants whose leaves are utilized. The stems of green mustard are short and hard. Planting green mustard is not only easy to do but also produces results quickly because the planting to harvest time is short. The content of green mustard is vegetable protein, fat, carbohydrates, Ca, P, Fe, vitamin A, vitamin B, and vitamin C [1]. Green mustard or meatball mustard is generally planted in lowland and highland areas and harvesting is done at the age of 30-60 days after planting [2].

The cultivation of green mustard cannot be separated from the role of planting media. The right planting media will support the growth and development of green mustard well. The conversion of land in Indonesia from the agricultural sector to the non-agricultural sector affects the area of planting. One alternative for plant cultivation to overcome land limitations is the development of vegetable cultivation on narrow land, for example in urban areas. The development of vegetable plants in urban areas can be done by cultivating in pots, or polybags, or can also utilize used containers. The media used must be porous, light, and have good aeration to support optimal plant growth. In addition, the planting media must be easily obtained and affordable [3].

T. A. Aziz et al. (eds.), *Proceedings of the 4th Science and Mathematics International Conference (SMIC 2024)*, Advances in Physics Research 11,
https://doi.org/10.2991/978-94-6463-624-6_5

Plants can produce maximum yields if planted in the right soil and receive sufficient nutrient intake to support their growth and development. The nutritional needs of each type of plant are different, including mustard greens. To obtain optimal results, it is important to pay attention to the nutritional needs of mustard greens so that production is maximized [4].

Green mustard plants after germination will grow well in soil with high nitrogen content. Fertilizing with N elements in the soil can increase the height of mustard plants by 2.4 cm in each observation, and the wet weight of the plant by 1.3 g. In addition to N elements, K elements also play an important role in plant growth. Plant growth itself is a process of increasing mass and volume that is irreversible (cannot return to the origin) such as increasing the height, length, and width of plant parts. This occurs because of the increase in the number and size of cells. The growth of a plant can be measured and can be expressed in numbers or quantitatively. Plant growth cannot be separated from the existence of factors that influence both internal and external factors. Internal factors are factors that come from within the plant itself, such as genetic factors and hormones [5]

Fertilizer is one of the important inputs in plant cultivation. NPK perl fertilizer, which contains nitrogen (N), phosphorus (P), and potassium (K), is known as a fertilizer that can increase plant growth, including in the germination phase [6]. Nitrogen plays a role in the formation of chlorophyll and protein, phosphorus plays a role in the process of photosynthesis and root development, while potassium functions in regulating osmotic pressure and tissue formation [7]. The application of NPK pearl fertilizer is expected to increase the germination process of green mustard seeds, thus producing quality seedlings.

NPK 16:16:16 fertilizer is a compound fertilizer that contains at least 5 macro and micronutrients that are very much needed by plants. This fertilizer is in the form of pale blue granules that are useful for accelerating flowering and fruiting [8].

This study aims to determine the effect of giving NPK pearl fertilizer on the germination of green mustard seeds (Brassica juncea L.), especially in terms of germination speed and quality of the resulting seedlings. The results of this study are expected to provide useful scientific information in efforts to increase green mustard productivity through proper fertilization maintenance.

2 Method

The research method of the Effect of NPK pearl Fertilizer on Germination of Green Mustard Seeds (Brassica juncea L.) includes systematic steps to answer research questions with an experimental approach. In this case, the researcher manipulated the independent variable, NPK pearl fertilizer, to see its effect on the dependent variable, namely germination and early growth of green mustard seeds. This experiment was carried out under controlled conditions, where environmental factors such as water, light, and temperature were kept uniform.

2.1 Research design

The research design of the effect of NPK pearl fertilizer on green mustard seed germination (*Brassica juncea* L.) is a framework used to test and disseminate the impact of NPK fertilizer treatment on plant germination and growth parameters. This design generally includes an experimental quantitative approach with balanced treatments and controls.

2.2 Instrument

In the study on the effect of NPK pearl fertilizer on germination of mustard seeds (Brassica juncea L.), population and sample are important parts that must be explained clearly to ensure the validity of the research results. Population refers to all available mustard seeds that meet the criteria for good growth and germination. The mustard seeds selected are those that sink when placed in water.

Samples were taken from the population of green mustard seeds, with certain criteria relevant to the research objectives. The sample consisted of 40 seeds selected randomly (random sampling). In this study, the samples were divided into two main treatment groups: Samples with NPK pearl fertilizer treatment, namely green mustard seeds planted in planting media that received additional NPK fertilizer. Samples without NPK fertilizer treatment, namely seeds planted in planting media without NPK fertilizer, as a control. Measurements were made on seed germination parameters, such as germination percentage, germination rate, and plant height in the initial growth of both sample groups.

2.3 Procedure

The research instrument in the study of the effect of NPK pearl fertilizer on the germination of green mustard seeds (*Brassica juncea* L.) was used to measure and collect data relevant to the research objectives, namely, to determine the effect of fertilizer on germination and early plant growth. The instrument used in the study was a planting medium in the form of fertile soil.

The planting medium is used as a place for green mustard seeds to germinate. The planting medium must be in accordance with the needs of the seeds, namely fertile soil to grow well. The planting medium is treated with NPK pearl fertilizer for the treatment group, and without fertilizer for the control group.

2.4 Data analysis technique

The research results were analyzed descriptively to describe the average results, percentages, and distribution of data such as the average percentage of germination or shoot length in each group.

3 Result and Discussion

Based on the experiments and observations that have been carried out, it can be seen that the planting medium plays an important role in the growth of green mustard plants. The growth of plants planted in planting media with the addition of NPK on the seventh day has not shown any plant growth, while on the 14th day, plant growth has been seen, namely 12 seeds or 60% of the total seeds planted and an average plant height of 5 cm. Then on the 21st day, plant growth has been seen, namely 15 seeds have grown with a percentage of 75% of the total seeds planted and an average plant height of 8 cm. On the 28th day, plant growth was seen, namely 15 seeds had grown with a percentage of 75% of the total seeds planted and an average plant height of 17 cm.

Meanwhile, the growth of plants planted in planting media without the addition of NPK (control) namely in the first week there was still no germination, while on the 14th day, the plant growth was seen, namely as many as 6 seeds grew or 30% of the total seeds planted and the plant height was 2 cm. Then on the 21st day, the plant growth was seen, namely as many as 10 seeds grew with a percentage of 50% of the total seeds planted and a plant height of 5 cm. On the 28th day, the growth of mustard greens was seen, namely as many as 12 seeds grew with a percentage of 60% of the total seeds planted and a plant height of 14 cm. The number of Brassica juncea L. seeds that germinated and the plant height per week can be seen in Figures 1 and 2 below.

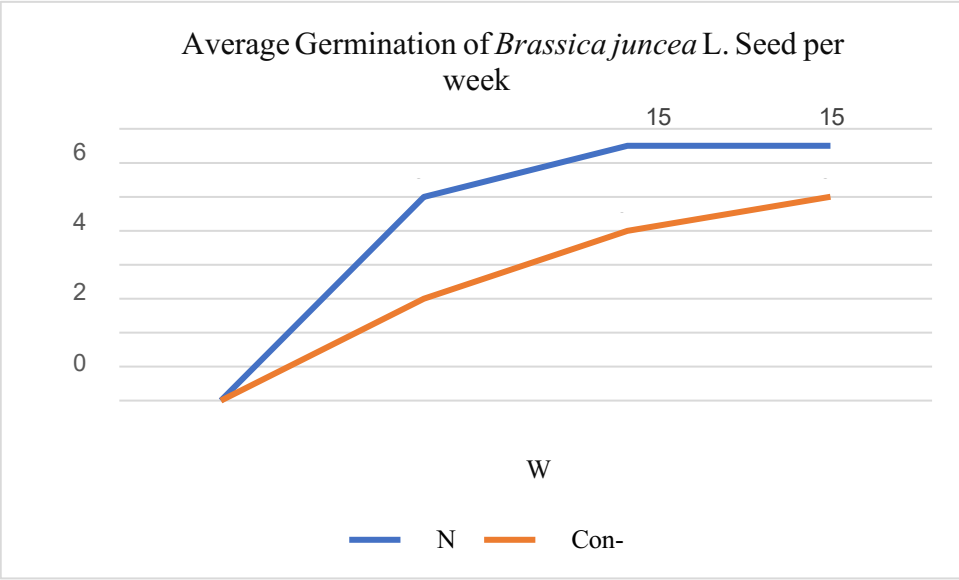

Fig. 1. Number of germinated Brassica juncea L. seeds

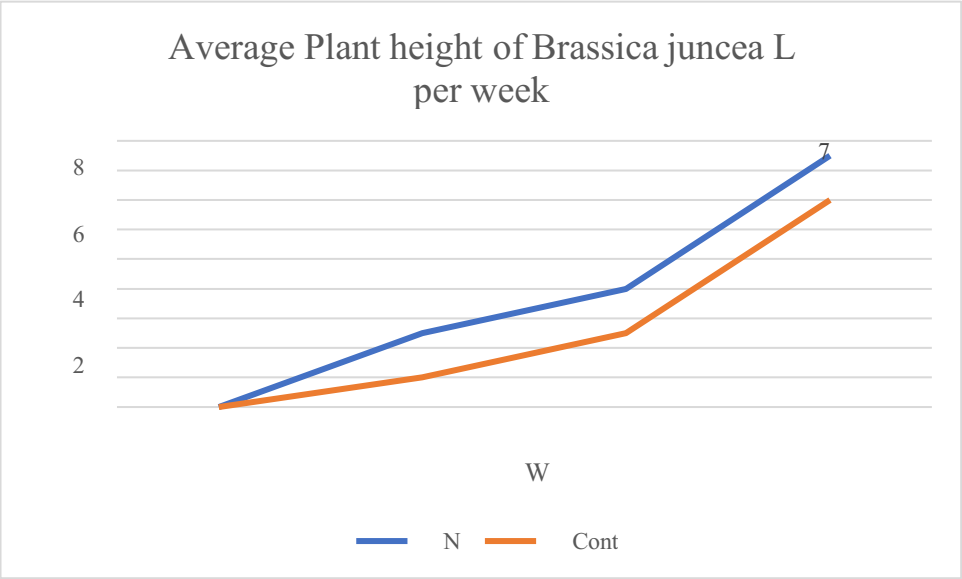

Fig. 2 Average height of Brassica juncea L. plants.

It can be seen that plants grown in media with the addition of NPK grow faster and better compared to plants grown in media without the addition of NPK. Plants that use NPK experience faster growth and development due to the availability of essential nutrients, such as nitrogen, phosphorus, and potassium, which support various physiological processes. Salisbury and Ross (1992) explained that plant growth is greatly influenced by the availability of macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), all of which are contained in NPK fertilizer. Nitrogen is important for the formation of chlorophyll, proteins, and enzymes involved in photosynthesis and plant metabolism. Phosphorus plays a role in the formation of energy (ATP), which is essential in various plant biochemical processes, including cell division and root growth. Potassium helps regulate osmotic pressure and water balance in plants, as well as supporting the function of stomata and enzymes [9].

In the context of the results of the experiments conducted, in the growing media with the addition of NPK, the mustard greens were able to grow faster and reach a greater height compared to the control media. As explained by Salisbury and Ross (1992), this is due to the role of nitrogen in increasing the process of photosynthesis, which produces more energy for growth. Phosphorus supports root growth, which is very important in the early stages of plant development, while potassium maintains water balance and strengthens the structure of plant cells so that plants can grow taller and faster [9].

Brady and Weil (2008) also emphasized the importance of nutrient balance in the planting medium. Soil or planting medium that is rich in nutrients will better support

optimal plant growth. In this experiment, the significant difference between plants in media with NPK and control media (without NPK) shows the importance of nutrients in improving the quality of the planting medium. According to Brady and Weil, media that lacks nutrients, such as the control media in this experiment, is unable to provide essential elements for growth, so plants experience delays in germination and growth [10].

In line with Brady and Weil's findings, media enriched with NPK fertilizer not only supported plant growth through better nutrient supply but also increased water use efficiency and root nutrient uptake. Therefore, the experimental results showing differences in plant height and germination rates between growing media with and without NPK confirm the importance of nutrient-rich media in maximizing plant growth.

Similarly, Taiz & Zeiger (2010) explained that plant growth is highly dependent on macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), which are found in NPK fertilizer. In this experiment, mustard greens grown in medium with NPK experienced faster germination and growth compared to plants grown in control media. Nitrogen

(N) plays an important role in the synthesis of chlorophyll and proteins that support photosynthesis so that plants in media with NPK can produce more energy for growth. Phosphorus (P) plays a role in energy production through ATP, which is very important for cell division and root growth. Potassium (K) helps maintain water balance in plant cells and activates various enzymes that support plant metabolism. Plants in media with NPK grow taller and faster because these elements are available in sufficient quantities [11].

One of the supporting factors in germination is the amylase enzyme that works in the endosperm to convert starch into sugar, which is then used by the embryo as a source of energy for growth. According to Lie (2007), the entry of water into the seed stimulates the activity of germination enzymes and increases the activity of the gibberellin hormone, which in turn triggers the embryo cells to undergo cell division (mitosis). This division causes the growth of the radicle which pushes the seed coat to break [12]. Panji (2018) added that water activates the gibberellin hormone which triggers the production of the amylase enzyme. This amylase functions to break down starch into sugar which is then used as material for embryo growth [13].

Plant height is closely related to the increase in the number and size of cells. This process is influenced by the rate of cell division that occurs in the meristem tissue, which forms and enlarges the growing cells. The activity of meristem tissue, especially at growing points such as stems, leaves, and root systems, plays an important role in vegetative growth. According to Taiz and Zeiger (2010), the rate of cell division in the apical meristem area affects plant height growth, which in turn increases the plant's ability to prepare vegetative organs, such as leaves, which are involved in the process of photosynthesis [11]

Optimal vegetative growth is essential to increase crop production, including mustard greens. Salisbury and Ross (1992) asserted that taller plants usually have a greater capacity to produce biomass because larger leaf sizes allow for better light absorption, thereby increasing photosynthetic efficiency. Therefore, taller plants can produce greater yields compared to shorter plants [9]

Factors such as nutrient availability greatly affect vegetative growth. According to Brady and Weil (2008), the availability of macronutrients such as nitrogen, phosphorus, and potassium is very important in supporting cell and tissue growth. These nutrients support cell division and tissue development in the root, stem, and leaf systems, which ultimately increases overall plant growth [10]

4 Summary

Based on the results of the study, it can be concluded that the planting medium with the addition of NPK fertilizer significantly increased the growth and development of green mustard plants compared to the planting medium without the addition of NPK. Plants grown in medium with NPK showed a faster growth rate, higher germination percentage, and better increase in plant height at each observation period (days 14, 21, and 28). This shows that the essential nutrients contained in NPK fertilizer, such as nitrogen, phosphorus, and potassium, play an important role in supporting cell division, tissue development, and increasing photosynthesis activity which leads to optimal plant growth.

Acknowledgments. The researchers would like to thank all the staff involved and those who have participated in this research.

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