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PHYSIOLOGICAL RESPONSE OF SWEET CORN PLANTS OF THE TALENTA VARIETY AFFECTED BY MANGANESE (Mn) SUPPLY DURING THE GROWTH PHASE

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Abstract :
Manganese is one of the eight essential microelements for plants that are needed in the right amounts to achieve normal growth and yields. Manganese is involved in a number of physiological and metabolic processes of plants such as enzyme activation, protein synthesis, carbohydrate metabolism, lipids, auxin, nucleic acids, gene expression, and the development of reproductive organs. Micronutrients play a role in every phase of plant life starting from seeds, plant vegetative growth, and plant photosynthesis processes. The purpose of this study is to determine the role of Manganese in plant physiology starting from seed germination, plant growth and the rate of photosynthesis at the greening level of leaves. This study includes 4 treatments, namely P1 (Control), P2 (Priming), P3 (Spray), P4 (Priming + Spray). The experiment used a complete random design with each treatment repeated 3 times. The total experimental unit in this study is 12 tiles. The observation variables of this study are germination, plant height, number of leaves, and photosynthesis rate at the greenery level of leaves. Based on the results of the study, it is known that feeding at a concentration of 50 ppm with the p4 method (Priming + Spray) is able to increase germination, vegetative growth of plants and the greenness of plant leaves compared to other treatments. . These results show that the application of Manganese, especially through the priming + spray method of leaves, is effective in optimizing the initial phase of germination, growth and photosynthesis rate at the greening level of maize plant leaves.
Keywords : *Physiological Response of Sweet Corn, Manganese (Mn) Application, Plant Growth Phase.*

INTRODUCTION

Manganese (Mn) is included in the micronutrients because it is only needed in relatively small amounts (50 – 200 ppm) in plant tissues. Manganese is one of the eight essential microelements for plants that are needed in the right amount to get normal growth and optimal yields (Sadeghzadeh, 2013).

Micronutrients are involved in a number of physiological and metabolic processes of plants such as enzyme activation, protein synthesis, carbohydrate metabolism, lipids, auxin, nucleic acids, gene expression, and the development of the reproductive apparatus (Hafeez et al., 2012). Manganese is an essential micronutrient that every living organism needs and plays several important roles in life, growth, development, and exhibits an important role in normal physiological activity.

Manganese has an important role in the formation of chloroplasts, respiration, N metabolism and also (Munawar, 2011). Manganese also has an important role in the process of photosynthesis, ATP synthesis, RuBP carboxylase reactions, fatty acid biosynthesis, lipid and protein results, chlorophyll, secondary products as well as isoprenoid biosynthesis (Millaleo et al., 2010). Therefore, this study intends to examine the effect of manganese fertilization (Mn) on increasing plant growth. The specific role of Mn in optimizing the early phase of plant growth through the priming approach and application of leaves on plants is still not widely studied.

One of the most important roles of micronutrients in plants is their relationship to the various enzyme systems involved in the plant's defense mechanisms against pathogens. Micronutrients are also involved in a variety of metabolic activities in plants. Carbonate anhydrase, an enzyme that regulates the conversion of carbon dioxide into a reactive bicarbonate species for fixation into carbohydrates in these plants, is modified and/or regulated by micronutrients. In addition, micronutrients are components of several other enzymes, including superoxide dismutase and catalase, which protect plant cells from oxidative stress (Shehata et al., 2009).

Micronutrients affect the water relationship of plants, alter the conductance of the stomata, and play a role in protecting cells from the damaging effects of reactive oxygen species (Ghazi et al., 2022). Mn is a plant micronutrient that is involved in several physiological functions, if insufficient supply will reduce yields, the deficiency leads to micronutrient deficiency problems. Although the effectiveness of Mn has been reported for a number of plants, in-depth studies on the most effective application methods (nutripriming vs foliar) in plants are still limited

The priming technique is one of the techniques that can be used to improve and increase germination in acidic soil conditions. Seed priming is a physiological method that involves the process of seed hydration and is quite effective for increasing seed germination, early germination growth, and yield under stifled and unstrapped conditions. Seeds that are primed germinate faster and more uniformly than those that are not primed (Dawood, 2018). So that priming treatment can increase the viability and vigor of seeds when germinating in a suboptimal environment. According to Dalil (2014) there are various methods of seed priming: 1) hydropriming or soaking seeds in water; 2) halopriming or hydration in inorganic saline solutions such as KNO3; 3) osmopriming or soaking the seeds in a solution such as polyethylene glycol (PEG); 4) thermopriming or seed treatment with low or high temperatures; 5) matripriming or treatment of seeds with a dense matrix; 6) Biopriming or coating the seeds with bacteria. In addition, there is hormonal priming, which is that seeds can be primed with growth regulators such as Giberelin acid (GA3).

In addition to priming, there is also the foliar spray technique, which is a technique of applying nutrients or other substances directly to plant leaves, not through planting media such as soil. The goal is to provide nutrients or protection quickly and effectively, as the leaves can absorb these substances faster than the roots. Spraying micronutrients through leaves is more effective than root application because the application has a higher surface area, so nutrients can be absorbed more efficiently (La Bella et al., 2021).

Micronutrient application to leaves results in increased plant growth and yield (Fageria and Baligar, 2005). It has been observed that the application of micronutrients at 45 days after planting has the greatest correlation with crop yields (Slaton et al., 2005). Micronutrient spraying to leaves is a very advantageous method to improve yield, quality, and nutrient concentration in grains compared to soil applications, as this method avoids complex soil interactions that limit the absorption of micronutrients through plant roots (Mabesa et al., 2013). Based on research by Phattarakul et al. (2012) shows that spraying micronutrients into leaves leads to increased yield and content in larger grains. The application of micronutrients is able to increase dry matter and crop yields (Fageria et al., 2011). Spraying micronutrients into the leaves significantly improves yield, quality, and accumulation within the seeds (Yuan et al., 2013). Micronutrient spraying on leaves has a significant effect on all plant characteristics measured so that component values are found to be the highest (Guo et al., 2016).

This study aims to determine the role of Manganese in plant physiology starting from seed germination, plant growth and the rate of photosynthesis at the greenery level of leaves. This research is expected to provide an alternative strategy to increase corn productivity from the initial phase of growth.

RESEARCH METHOD

This research was carried out at the Experimental Garden of the University of Muhammadiyah Kotabumi, North Lampung Regency. This research was carried out from April 2024 to July 2024.

The ingredients used in this study are Manganese 50 ppm, Surrattan, Aquades, Corn Varieties Talenta. The fertilizers used are Urea, KCl and TSP-46 and the pesticides used are herbicides and insecticides. The tools used in this study are scales, measuring cups, test tubes, petridiscs, 1L drigen, plastic clips, opaque paper, clear plastic, trays, gallons of water, germinators, 16 L sprayers, SPAD. The experimental method used is an experimental method with the design used is a Perfect Randomized Group Design with four treatments P1 (Control), P2 (Priming), P3 (Spray), P4 (Priming + Spray), repeated three times so that there are 12 experimental units with 5 samples per experimental unit observed at 30 days after planting. The observation variables of this study are germination, plant height, number of leaves, and photosynthesis rate at the greenery level of leaves.

FINDINGS AND DISCUSSION

Research Results

1.1. Germination Power

Based on Figure 1, it can be seen that the response of seeds that are primed at Mn 50 ppm (P2) has the ability to germinate faster which is seen from day 2 (D2) to day 5 (D5) after planting, compared to seeds that are not primed (P1). This shows that seeds with treatment (P2) have metabolic activity to germinate faster because micronutrients can act as enzyme activators, especially hydrolase enzymes (Zastrow & Pecoraro, 2014). One of the enzymes that has hydrolase properties, initiates the formation of hormones in plants which of course is able to

spur germination initiation earlier and faster compared to seeds that are not given treatment.

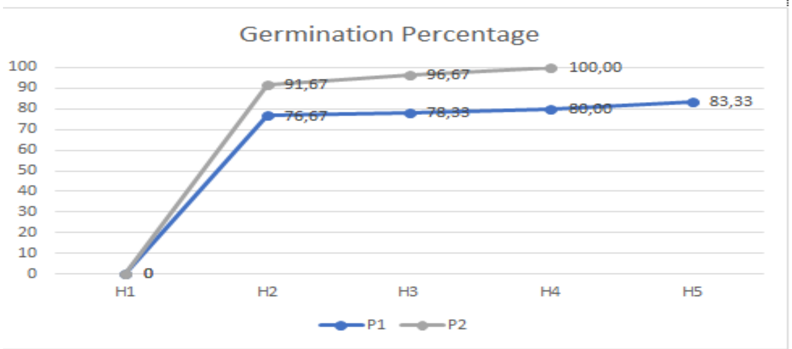

Fig.1. Graph of the germination percentage of Corn Seeds on Day 2 (H2) to 5.(H5). (P0= Control; P1= Priming 50 ppm).

Research by Tuiwong et al. (2022), applying seed priming treatment with a microsolution can increase the percentage of seed germination. In addition, according to Choukri et al. (2022), the application of nutripriming to seeds with a certain soaking duration can increase the germination percentage of different seeds compared to seeds without treatment at all.

1.2. Plant Height

The results obtained showed that the P4 treatment (Priming + Spray) had a significant influence on the average height of the plant. Figure 2 shows the average plant height observed at 30 days after planting (DAP), it was found that there was a pattern of increasing the average height of corn plants given P4 treatment compared to P1, P2, and P3 treatment. The existence of a tendency to increase plant height in plants treated with Mn shows the role of Mn itself as a catalyst in plant metabolic reactions. According to Choukri et al. (2022), micronutrients play a role in the formation of tryptophan, which is a precursor enzyme to auxins. Auxin itself plays a role in cell lengthening. The treated plants were thought to have better metabolism compared to the control plants.

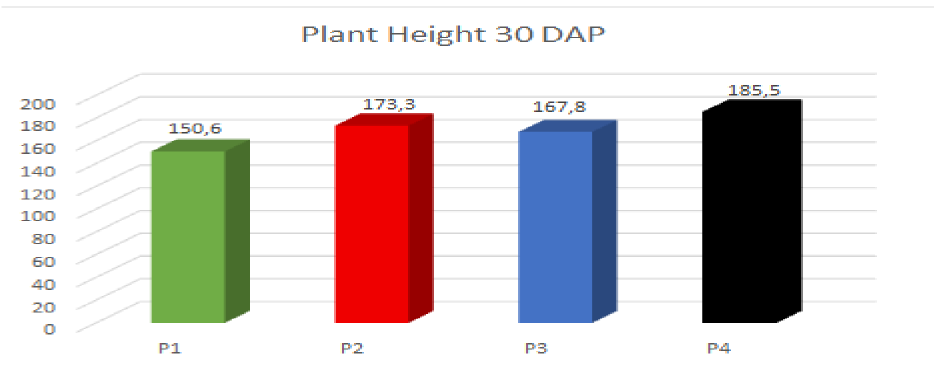

Fig.2. Height of maize plants 30 days after planting (P1= Control; P2= Priming; P3= Spray; P4=

Priming + Spray).

1.3. Number of Leaves

The results obtained showed that P4 treatment (Priming + Vegetative Spray) had a significant influence on the average number of plants. Figure 3 shows the average number of plant leaves observed at 30 days after planting (DAP), it was found that there was a pattern of increasing the average number of leaves of corn plants given P4 treatment compared to P1, P2, and P3 treatments. According to Zafar et al. (2022), there is an increase in the number of leaves when followed by foliar spraying after applying priming with a micronutrient solution in an environment with high salinity conditions.

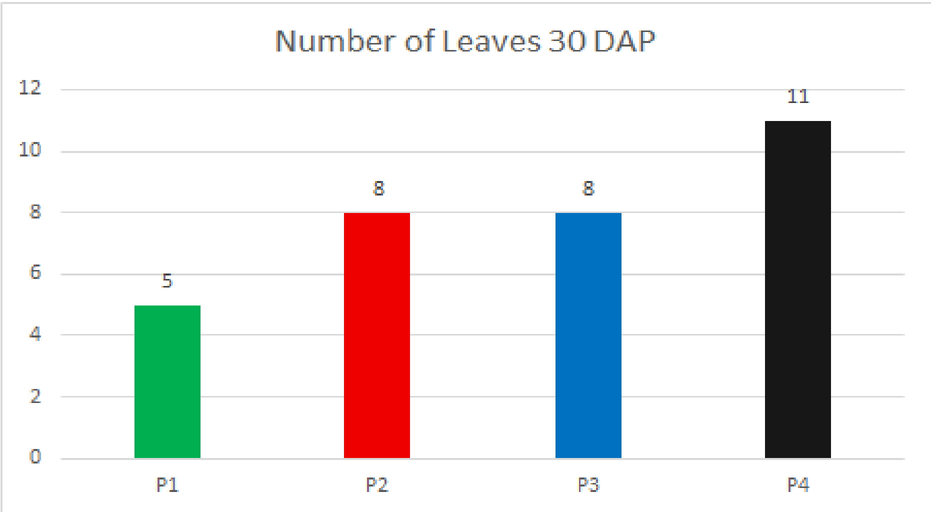

Fig.3. Number of leaves of maize plants 30 days after planting (P1= Control; P2= Priming; P3= Spray; P4= Priming + Spray).

1.4 Leaf Greenery Level

Photosynthesis is a process in green plants to organize organic compounds from carbon dioxide and water. The process of photosynthesis will only occur if there is light and through the intermediary of the green pigment chlorophyll located in certain cytoplasmic organelles called chloroplasts. Photosynthesis is the process of converting sunlight energy into chemical energy. This process is a very complex biochemical process, which is responsible for producing used energy or nutrients in the form of carbon dioxide (CO2) and water (H2O) under the influence of light that is converted into organic compounds that contain carbon and are rich in energy. Photosynthesis is a process of transformation, as photosynthesis converts light energy into chemicals in food. Sunlight waves themselves have a different spectrum, so the light that plants get in photosynthesis will be different.

Photosynthesis is a complex activity, influenced by many factors, both internal and external. Internal factors concern the condition of photosynthetic tissues/organs, chlorophyll, tissue age, other physiological activities such as transpiration, respiration and other physiological adaptations that are interrelated. External factors include climatic factors such as temperature, humidity, wind speed, rainfall, and also light factors, CO2 concentrations, O2, competitors, and pathogenic organisms. In addition, there are also factors that cause stress such as the availability of water, biocidal pollutants and other toxic substances. Excess conditions on various factors needed from the environment also affect photosynthesis. For example, metals - toxic heavy metals, biocides, SO2 and also O2.

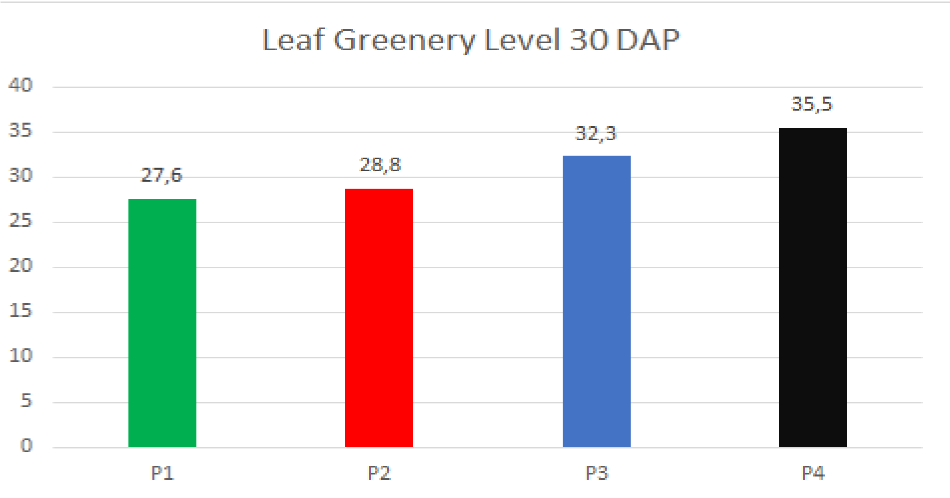

Fig.4. Greening level of maize plants 30 days after planting (P1= Control; P2= Priming; P3= Spray; P4= Priming + Spray).

The results of the observation of the rate of photosynthesis at the greening level of the leaves in this study can be seen in figure 4 which shows that the P4 treatment (Priming + Spray) has a higher assimilation rate compared to other treatments. This proves that the nutrient Mn has an influence in increasing the rate of plant photosynthesis. According to Fageria (2002), micronutrients also have a role as a catalyst for a metabolic reaction that can spur growth and photosynthesis rates.

The presence of Mn ions can cause the photosynthesis process in plants to run more smoothly. Increased photosynthesis activity also affects the increase in chlorophyll. The concentration of chlorophyll will be more concentrated so that the green condition of the leaves will also increase. This situation is because Mn plays an important role in the formation of chlorophyll (Dewantoro, 2017). The element Mn is abundant in acid-containing soils reaching toxic levels below pH 6.5 and is generally independent of acidic soils and deposits in alkaline soil layers (Suhariyono et al., 2005). Mn has an important role for plants. Mn plays an important role as an enzyme activator, including phosphate-transferring enzymes and enzymes in the krebs cycle. The element Mn is also important in oxidation-reduction reactions, metabolism of N, chlorophyll and carbohydrates. In addition, Mn is an important part of chloroplasts and participates in reactions that produce oxygen.

CONCLUSION

The conclusion of this study is that the administration of Manganese (Mn) with a concentration of 50 ppm with P4 (Priming + Spray) treatment is able to increase the variables of germination power, vegetative growth of plants and the rate of photosynthesis at the greening level of leaves

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