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by Vita Meylani

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The Development of Inorganic Fertilizer and Bio-Fertilizer Combination and the Effectiveness of Application on the Growth and Production of Red Chili

Rudi Priyadi[1], Ade Hilman Juhaeni[1], Vita Meylani[2*], Ahmad Fudholi[3,4]

[1] Department of Agrotechnology, Faculty of Agriculture, Universitas Siliwangi, Tasikmalaya 46115, Indonesia
[2] Department of Biology Education, Faculty of Education and Teacher Training, Universitas Siliwangi, Tasikmalaya 46115, Indonesia
[3] Solar Energy Research Institute, Universiti Kebangsaan Malaysia, Bangi Selangor 43600, Malaysia
[4] Research Centre for Electrical Power and Mechatronics, National Research and Innovation Agency (BRIN), Bandung 40135, Indonesia

Corresponding Author Email: vibriovita@unsil.ac.id

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ABSTRACT

Red chili (*Capsicum annum* L.) is one of the most important horticultural crops, but its productivity remains relatively low. This study was performed to determine the effect of the interaction between the dose of inorganic fertilizer NPK Phonska and the concentration of the biological fertilizer M-Bio on the growth and yield of red chili. An experiment was conducted using the factorial randomized block design with two factors and three replications. Ten plants for each replication of combined factors were used. Factor I consisted of four doses of NPK (i.e., 200, 300, 400, and 500 kg/Ha), and factor II consisted of four concentrations of M-Bio (i.e., control or 0, 10, 20, and 30 mL/L). An interaction was observed between the NPK dosage and the M-Bio concentration on the fruit weight per plant and fruit yield per hectare. However, no interaction was found between the doses of the two fertilizers on the leaf area index, net assimilation rate, and plant growth rate. The interaction of M-Bio (30 mL/L) and NPK fertilizer (400 kg/Ha) increased the chili yields, and M-bio (20 mL/L) plus NPK (300 kg/Ha) significantly increased chili yields and showed the best result.

1. INTRODUCTION

Red chili (*Capsicum annum* L.) is one of the most important horticultural crops cultivated commercially because of its reasonably complete nutritional contents, consisting of high amounts of vitamin C, carotene, potassium (K), magnesium (Mg), and iron (Fe) [1]. In addition, red chili has high economic value and potential as an export commodity [2]. The need for red chilies has been continuously increasing annually, consistent with the growing population and the development of the food industry that requires red chili raw materials [3]. The commodity of red chili is also most often the subject of interesting discussions in the community because its price can soar very high at certain times.

Cultivating red chili has many challenges because this plant is vulnerable to weather conditions and pest and disease attacks. The selection of superior seeds and fertilization are also factors for the successful cultivation of red chili [4]. Given the up-and-coming prospect of red chili, these plants should be managed with proper, intensive, and prefigure cultivation. One of the efforts to increase chili productivity is improving cultivation techniques through a fertilization system. Fertilization is performed because not all soil is suitable for plant growth. In general, agricultural soils do not provide quickly and sufficiently all nutrients that plants need for optimal development. Therefore, production can only be increased if plant nutrients are augmented for optimal growth, either by liming or fertilization [5].

Emir [6] discussed that plants require sufficient nitrogen (N), potassium (P), and K to synthesize organic materials, such as amino acids and nucleic acids, and energy-related materials, such as ADP and ATP. The balanced application of N, P, and K fertilizers affect plant growth. However, in response to incentives to increase chili production, farmers apply inorganic fertilizers at high doses, which often exceed the recommended amount. Thus, negative impacts, which are usually ecological, health, socio-cultural, and economic effects, of the application of inorganic fertilizers have emerged. Continuous use of chemical fertilizers can also disrupt the soil's chemical balance, resulting in declined soil productivity [7].

Inorganic fertilizers provide large quantities of nutrients for plants, and organic matter maintains the function of the soil to facilitate the absorption of these nutrients. Thus, it should also balance inorganic fertilizers with organic fertilizers [8]. During plant growth, in addition to providing inorganic fertilizers for chili plants, the use of biological/microorganism fertilizers is also essential to increase chili productivity because of its benefits. These fertilizers make inorganic/chemical fertilizers effective, significantly expanding the availability of N and P in the soil to enhance crop yields. Tombe and Sipayung [9] showed that they could reduce chemicals in plant cultivation by utilizing microorganisms to increase plant resistance to diseases and produce organic fertilizers that can substitute for inorganic fertilizers.

Developing agricultural cultivation technology by utilizing beneficial microbes, more popularly known as bio-fertilization, can reduce the adverse effects of inorganic fertilizers. In principle, bio-fertilizers comprise a single culture or a mixture of several microorganisms. Applying these compounds in the laboratory and the field has yielded promising results. One way to increase the growth and production of chili plants is to use biological fertilizers to enhance soil fertility and the efficiency of inorganic fertilizers to create sustainable agroecosystem fertilizers [10]. Organic farming and tillage have been found to promote soil health by increasing microorganisms' quantity, diversity, and activity [11]. According to Keshavarz et al. [12], there is a considerable difference in maize output under stress conditions between biofertilizers and not. A promising, supplementary strategy for reducing Sclerotinia illness is biological fertilizer containing Bacillus isolates [13]. Locating compatible partners is vital, i.e., a specific plant genotype and a specific Azotobacter strain that would develop a good association ensure the high effectiveness of biofertilizers [14]. *Lactobacillus* sp. strains combined with *Rhodopseudomonas* sp., *Actinomycetes* sp., and *Streptomyces* sp. can be utilized as a biofertilizer to improve P and K content [15]. Microbial consortia (Lactobacillus, Pseudomonas, Bacillus, Saccharomyces, Rhizobium, Azotobacter, Azospirillum, and Cellulomonas) make up bio-fertilizer [16].

Furthermore, M-Bio is one of the bio-fertilizers that have been widely used in various agricultural commodities. From the Laboratory of Soil Chemistry and Plant Nutrition (2020), M-Bio contains microbial cultures, namely, *Azotobacter* sp., *Bacillus* sp., *Lactobacillus* sp., *Saccharomyces* sp., and P-solubilising microorganisms. These microbes work together and complement each other to ferment the bacteria. This study aims to determine the effect of the interaction between the dose of inorganic fertilizer NPK Phonska and the concentration of the biological fertilizer M-Bio on the growth and yield of red chili.

2. MATERIAL AND METHODS

From June 2020 to December 2020 (one planting season), this study was performed on a new campus land, the Faculty of Agriculture, Universitas Siliwangi located in Mugarsari Village, Tamansari District, Tasikmalaya City. The materials were: Tanjung 2 variety red chili; M-Bio; Organic fertilizer (subur ijo); and Inorganic fertilizer NPK Phonska (15:15:15). The tools were a hose, sprayer, stake, measuring cup, bucket, ruler, stationery, leaf area meter, and other cultivating red chili plants. The experimental design was a factorial randomized block design with two factors and three replications, with ten plants for each replicate of the combined factors. The factor consisted of four doses (k1, k2, k3, and k4) of inorganic fertilizer (K) at 200, 300, 400, and 500 kg/Ha. Factor II consisted of four concentrations (h0, h1, h2, and h3) of biological fertilizer at 0, 10, 20, and 30 mL/L, respectively. The experiments plot is shown in Figure 1.

The observed data were processed using statistical analysis and entered into the variance list to determine the level of significance of the F test. If specified a significant effect, the data were further tested with Duncan's Multiple Range Test at an error level of 5% as in Eq. (1) [17]:

$$LSR = (\alpha.dbg.p).S_x \tag{1}$$

To explain the variation in yield, study plant growth by calculating the growth characteristics, namely, leaf area index (LAI), net assimilation rate (NAR), and plant growth rate (PGR). To determine the growth characteristics, weighed the dry weight of the plant (W). The chili plants were air-dried, dried in the sun, and in the oven at 80°C for 48 h until a constant dry weight value (g/plant). The leaf area was measured using a leaf area meter by field and scanned. The data are recorded and expressed in square centimeters.

Figure 1. Plot experiments

Determined the dry weights and leaf areas from the plant samples taken from experimental plots at various time intervals. Plants were sampled four times at 25, 29, 33, and 37 days after planting (DAP). One plant was used from each experimental plot at each observation point. Thus, four plants per plot were tested. The parameters observed according to Gardner et al. [18] were determined as follows.

2.1 LAI

The LAI is the ratio between the leaf surface area (top) to the land covered by the plant canopy. This index describes the ability of plants to absorb solar radiation for photosynthesis as follows:

$$LAI = \frac{LA}{GA} \tag{2}$$

where, LA is the total leaf area, and GA is the area of the land where the plant is grown.

2.2 NAR

This parameter expresses the rate of increase in the plant dry weight per unit leaf area per unit time. NAR describes the net photosynthesis rate (plant capacity to accumulate dry matter) per square meter and day in 4 days. NAR was calculated by Eq. (3):

$$NAR = \frac{W_2 - W_1}{A_2 - A_1} \frac{LnA_2 - LnA_1}{T_2 - T_1} \tag{3}$$

where, W_1 is the dry weight at time T_1, W_2 is the dry weight at time T_2, A_1 is the leaf area at time T_1, A_2 is the leaf area at time T_2, T_1 is the initial observation time in a time interval and T_2 is the final observation time in a time interval.

2.3 PGR

This parameter shows the addition of the dry weight of the plant community in a unit of land per unit of time as in Eq. (4):

$$LTT = \frac{(W_2 - W_1)}{P(T_2 - T_1)} \tag{4}$$

where, W_1 is the dry weight at time T_1, W_2 is the dry weight at time T_2, T_1 is the initial observation time in a time interval, T_2 is the final observation time in a time interval and P is the area of the land where the plant is grown (planting distance [$p \times l$]).

2.4 Number of fruits per plant and fruit weight per plant

Determined this parameter by counting the fruit from each sample plant. This step was performed after harvest. The fruit weight was decided only on the sample plants harvested and then weighed.

2.5 Fruit yield per hectare (t/Ha)

This parameter is the weight measurement based on the yield of the fruit, and this value was then converted to tons per hectare as follows:

$$Yield\ per\ hectare = \frac{Area\ of\ one\ hectar}{area\ of\ spacing} \times Fruits\ yield\ per\ plants \times 80\ \%$$

At the time of tillage, NPK Phonska (15,15,15) was applied according to the different treatment doses in each bed. This inorganic fertilizer consists of several macronutrients, namely, N (15%), P (15%), K (15%), and sulfur (S, 10%), and maximum water content of 2% [19].

M-Bio (CV Insan Lestari) was dissolved and adjusted according to the designed concentrations. Then, the doses were applied at 7, 14, and 21 DAP by watering directly to the plant roots. This fertilizer is a mixture of beneficial microorganisms as follows: *Azotobacter* sp., 1.5×10^8 CFU/mL; *Bacillus* sp., 3.4×10^9 CFU/mL; *Lactobacillus* sp., 8.1×10^5 CFU/mL; *Saccharomyces* sp., 1.0×10^6 CFU/mL; N-fixing microorganisms, 1.1×10^9 CFU/mL; and P-solubilising microorganism, 1.9×10^8 CFU/mL.

2.6 *Azotobacter* sp.

Azotobacter is a bacterium commonly found in soil, water, and sediments. These bacteria are known to bind N2 freely [20]. *Azotobacter* has a complete mechanism as a potential microbe, namely, providing N, phytohormones, and antifungals and can increase plant growth by fixing N [21].

2.7 *Bacillus* sp.

Bacillus sp. is a rod-shaped bacterium, Gram-positive, motile and aerobic, and produces spores that are usually heat-resistant. These bacteria produce various protease enzymes and other enzymes that can degrade organic compounds, such as protein, starch, cellulose, hydrocarbons, and agar. *Bacillus* sp. can produce antibiotics and play a role in nitrification, denitrification, and nitrogen fixation [22].

2.8 *Lactobacillus* sp.

Lactobacillus sp. is a group of bacteria generally used to process probiotic foods and stimulate plant growth. These bacteria can also decompose organic matter or plant remains. *Lactobacillus* sp. is one of the anaerobic bacteria that produce lactic acid because this species can convert lactose and various sugars into lactic acid [23].

2.9 *Saccharomyces* sp.

Saccharomyces sp. is a type of yeast that can convert glucose into ethanol and CO_2. These species include unicellular fungi that cause fermentation to produce various enzymes and hormones as bioactive compounds for plant growth. *Saccharomyces* sp. can act as a natural stimulator containing proteins, carbohydrates, nucleic acids, lipids, many minerals (e.g., P, K, Na, Fe, Mg, S, Zn, Mn, Cu, and Si), hormones, thiamine, riboflavin, pyridoxine and other growth regulators (e.g., biotin, B_{12}, and phosphate-solubilizing folic acid) [24].

3. RESULTS AND DISCUSSION

3.1 Leaf area index (LAI)

There is no interaction between the dose treatment of inorganic fertilizers and the concentration of the biological fertilizers on the LAI, as shown in Figure 2. However, the inorganic fertilizer dose had a significant effect on the LAI in the period 29-33 DAP with NPK (500 kg/Ha) or the equivalent of 12.5 g/plant. According to Duaja et al. [25], LAI can reflect plants' amount of light interception. LAI has been closely related to the shape and distribution of leaves in the canopy and growth and the increase in leaf canopy width at the beginning of plant growth.

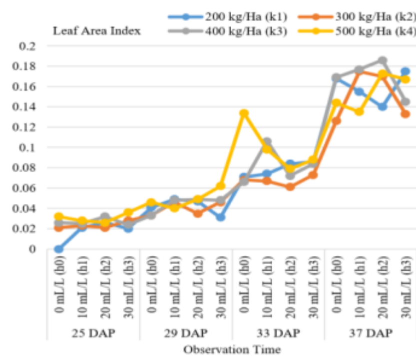

Figure 2. Effect of the dose of inorganic fertilizer and concentration of biological fertilizer on the leaf area index at 25, 29, 33, and 37 DAP

One factor that influences the LAI is the supply of nutrients, including N, which affects the leaf area. Elemental N in the NPK fertilizer can stimulate the vegetative growth of plants, especially the leaves [25]. In addition, N plays a role in forming the green leaf substance (chlorophyll), which is very important for photosynthesis. Thus, elemental N in the NPK fertilizer tended to be well absorbed from 29 DAP to 33 DAP. [26] showed that increasing the dose of the N fertilizer had a significant effect on the canopy of chili plants. Thus, an adequate supply of N is essential for vegetative growth and the desired yield.

3.2 Net assimilation rate (NAR)

The statistical analysis results showed no interaction between the dosage of inorganic fertilizers and the concentration of biological fertilizers on the NAR, as shown in Figure 3. The doses of inorganic fertilizers and concentrations of natural fertilizers had no significant effect on the NAR at various observation periods.

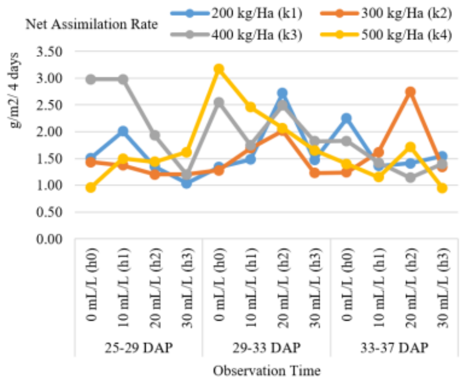

Figure 3. Effect of the dose of inorganic fertilizer and concentration of biological fertilizer on the net assimilation rate (g/m²/day4) at 25–29, 29–33, and 33–37 DAP

At the beginning of growth, the NARs of all treatments increased and then decreased with the increasing age of chili. The increase in the LAB value at the beginning of development was inferred because, at that time, the number of leaves and leaf area were still adequate. The plant leaves had not yet covered each other at this time point. Thus, the intercept of solar radiation by chili plant leaves remained high, increasing the photosynthetic apparatus. Siaga et al. [27] stated that the NAR is higher during the early vegetative stage when the plants are still small, and some leaves are exposed to direct solar radiation. Young leaves at the treetops absorb the most radiation, have high CO_2 rates, and translocate photosynthate to other plant parts. By contrast, older and sheltered leaves in the lower canopy have low CO_2 rates and provide little photosynthate to other plant parts.

When the plant gets bigger, the number of leaves and surface area also increases at the next age. In this condition, the leaves are shaded from each other, causing a decrease in leaf area that can intercept sunlight. This phenomenon results in a reduction of the accumulation rate, thereby decreasing NAR. This condition is by Masabni et al. [28] that the leaf area increases, the NAR is lower at the generative stage. Still, a high rate of photosynthesis and the assimilation activity decreases.

3.3 Plant growth rate (PGR)

The dry weight of the plant can measure the PGR. The greater the dry weight of the resulting plant, the greater the value of the PGR will be. Figure 4 shows no interaction between the dosage of inorganic fertilizers and the concentration of biological fertilizers on the PGR at various ages of observation. However, the dose of inorganic fertilizer independently affected the plant growth rate at 29-33 DAP but had no effect during 25-29 DAP and 33-37 DAP.

Similar to the NAR growth, the PGR at the beginning of development until 35 DAP increased and then decreased at the next transition period. The interception of solar radiation determines PGR. Thus, increasing the intercept of solar radiation by chili plants will increase the rate of photosynthesis. Increased photosynthesis, followed by the absorption of water and nutrients, will stimulate the formation of plant dry matter. According to Siaga et al. [27], the PGR is faster in the vegetative phase in the early weeks and then gradually decreases after the chilies reach the peak of the flowering period. Villar et al. [29] reported that PGR is more regulated by physiological activities (i.e., photosynthesis and respiration).

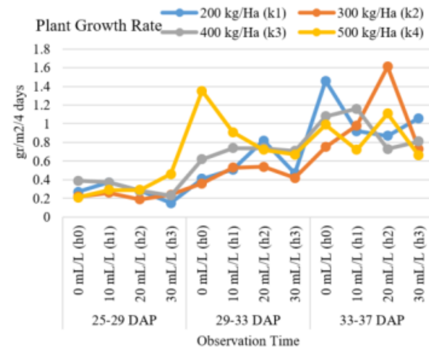

Figure 4. Effect of the dose of inorganic fertilizer and concentration of biological fertilizer on the plant growth rate (g/m²/4 days) during 25-29, 29-33, and 33-37 DAP

3.4 Number of fruits per plant

No interaction was found between the dosage of inorganic fertilizers and the concentration of biological fertilizers on the number of fruits per plant. The treatment of inorganic fertilizer dosage and concentration of natural fertilizers had no significant effect on the number of fruits per plant, as shown in Figure 5.

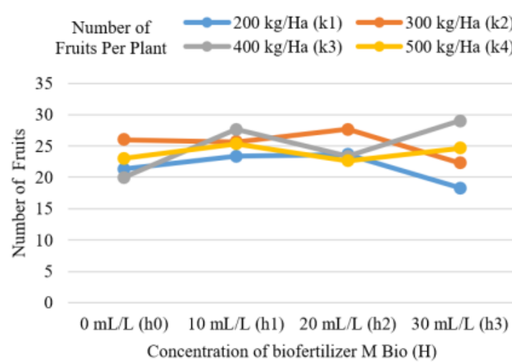

Figure 5. Effect of the dose of inorganic fertilizer and concentration of biological fertilizer on the average number of fruits per plant

The number of chilies per plant showed the same results between the treatment and the control. Inorganic fertilizers (200 kg/Ha) at various biological fertilizers showed the same effect on the number of fruits per plant compared with the other treatments (300, 400, and 500 kg/Ha). M-Bio at 0 mL/L plus various levels of inorganic fertilizer provided the same effect on the number of fruits per plant compared with other doses of M-Bio (10, 20, and 30 mL/L).

Even without the provision of biological fertilizers, the application of inorganic NPK fertilizers by as much as 200 kg/Ha is assumed to be sufficient for the nutrient needs, especially the nutrients N, P, and K, of chili plants in the formation of fruit. This result is in line with Hardjowigeno [30], who reported that applying the three nutrients K in plants can accelerate flowering, development of seed and fruit, and help the formation of carbohydrates, fats, proteins, and various other compounds. Therefore, given that sufficient nutrients had been provided by the NPK dose of 200 kg/Ha, further increase in NPK dose did not improve the number of fruits.

3.5 Fruit weight per plant (g/plant) and per hectare (tonnes/Ha)

An interaction was found between the dose of inorganic fertilizer and concentration of biological fertilizer on the fruit weight per plant (g/plant) and per hectare (tonnes/Ha). The concentration of natural fertilizers significantly affected the fruit weight per plant and hectare. The dose of the inorganic fertilizers had no significant effect on the fruit weight per plant and per hectare, as shown in Figures 6 and 7, respectively.

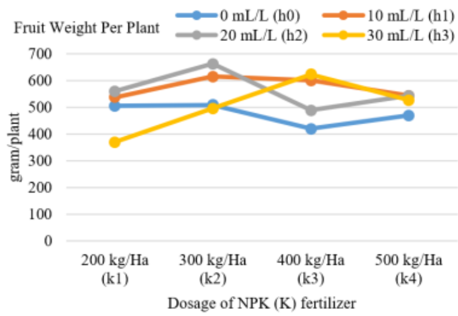

Figure 6. Effect of the dose of inorganic fertilizer and concentration of biological fertilizer on the chili fruit weight per plant (g/plant)

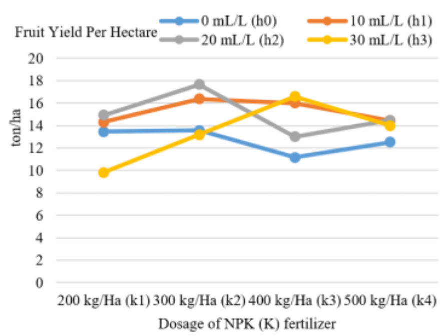

Figure 7. Effect of the dose of inorganic fertilizer and concentration of biological fertilizer on the chili fruit yield per hectare (ton/ha)

Hence, interaction occurred when M-Bio (30 mL/L) plus NPK (400 kg/Ha) was applied, and the application of M-Bio (20 mL/L) plus NPK (300 kg/Ha) was significantly increased yield. The application of biological fertilizers can increase the weight of chili fruit compared with that without natural fertilizers. According to Waskito et al. [31], the soil or organic fertilizer enriched with micro-bio activators can increase the yields of chili plants. Microbes that function as biological fertilizers are significant for the availability and solubility of nutrients needed by plants for growth and increased profits. Organic matter that is already available in the soil and then augmented with biological fertilizer can accelerate decomposition to facilitate the absorption of nutrients by plants and cause the ground to become looser and have better plant growth.

Some microbes in M-Bio are *Lactobacillus* sp. and *Bacillus* sp. (cellulolytic bacteria), which are groups of bacteria for probiotics and antibiotics. These probiotic microbes can produce lactic acid and cellulolytic bacteria that produce cellulase enzymes, which help in the decomposition of soil organic matter. They break down cellulose and lignocellulosic fiber components from available organic matter to increase soil nutrients, the diversity of beneficial microbes in the soil, and the soil's physical, chemical, and biological properties [4, 32].

In addition, treatment with M-Bio, which contained bacteria that could dissolve P (i.e., phosphate-solubilizing bacteria, such as *Pseudomonas* sp.), could increase the available P in the soil. Susila [33] showed that some isolates of phosphate-solubilizing bacteria could quantitatively increase available P due to the phosphatase enzyme activity that dissolves organic phosphate into available phosphate. Elfiati [34] stated that some of these phosphate-solubilizing bacteria could increase the availability of P for plants and produce various kinds of growth regulators, such as gibberellin and indole acetic acid, which can affect plant growth.

The application of biological fertilizers can also increase the activity of microorganisms in the soil, which will enhance the availability and absorption of nutrients by plants. Waskito et al. [31], Kalay, and Hindersah [35] explained that biological fertilizers increase the essential macronutrients (N, P, and K). And it can reduce the use of NPK fertilizers up to 30% can improve the quality and quantity of horticultural crop yields.

Wardhani et al. [36] showed that some nutrients needed by plants could be supplied by the bacteria in biological fertilizers that can fix N from the air and phosphate-solubilizing microbes that can mine P in the soil into available P for plant growth to save the use of chemical fertilizers. The influence factor of the weight of fruit is optimal nutrients, the ability of microorganisms to accelerate the decomposition of organic matter and activate hormones. Such conditions are beneficial for the plants to grow and absorb nutrients optimally. Expanding the fruit weight will impact crop yields [37]. During the generative phase, starting from fruit formation, such as the number of fruit and fruit weight, this cannot be separated from the role of nutrients in the soil and the addition of fertilizers. In this phase, macronutrients P and K play an active role because P elements accelerate flowering, ripening seeds, and fruit formation. Elemental K strengthens the plant body parts, such as leaves, flowers, and fruit that do not fall easily, increasing plant resistance to drought and disease and improving seed quality [38]. Dubey et al. [39] showed that the fulfillment of N, P, K could increase the number of fruits, fruit weight, and yield of chili plants.

4. CONCLUSIONS

The interaction between the dosage of NPK and the concentration of M-Bio on the fruit weight per plant and fruit yield per hectare was found. However, determined no interaction between these parameters on the LAI, NAR, and PGR. The exchange was observed when M-Bio (30 mL/L) plus NPK (400 kg/Ha) was applied, increasing chili yields. The application of M-Bio (20 mL/L) plus NPK (300 kg/Ha) increased the chili yields significantly and showed the best result. Thus, applying M-Bio (20 mL/L) and NPK (300 kg/Ha) for chili cultivation is necessary. Further studies are needed to address pests and diseases. In addition, prevention and control efforts are required from the beginning of planting so that growth is not disturbed and the yield of red chili plants is increased.

REFERENCES

[1] Jayakumar, N., Paulraj, P., Sajeesh, P., Sajna, K., Zinneera, A. (2019). Application of native phosphate solubilizing bacteria for the use of cheap organic and inorganic phosphate source in agricultural practice of Capsicum annum (Chili)-A pilot scale field study. Materials Today: Proceedings, 16: 1630-1639. https://doi.org/10.1016/j.matpr.2019.06.028

[2] Nurlenawati, N., Jannah, A. (2010). Respon pertumbuhan dan hasil tanaman cabai merah (Capsicum annuum L.) varietas prabu terhadap berbagai dosis pupuk fosfat dan bokashi jerami limbah jamur merang. Agrika, 4(1): 9-20. https://doi.org/10.31328/ja.v4i1.144

[3] Soelaiman, V., Ernawati, A. (2013). Pertumbuhan dan perkembangan cabai keriting (Capsicum annuum L.) secara in vitro pada beberapa konsentrasi BAP dan IAA. Buletin Agrohorti, 1(1): 62-66. https://doi.org/10.29244/agrob.1.1.62-66

[4] Wijayanto, A. (2015). Untung selangit budidaya 10 sayuran paling favorit. Yogyakarta: Araska.

[5] Nazariah. (2009). Pemupukan tanaman kedelai pada lahan tegalan. Balai Penelitian Tanah, Bogor.

[6] Emir, M. (2016). Pengaruh aplikasi pupuk organik dan anorganik terhadap pertumbuhan dan hasil tanaman cabai besar (Capsicum Annuum L.). Doctoral dissertation, Universitas Brawijaya. http://repository.ub.ac.id/id/eprint/131102.

[7] Wijayanti, M., Hadi, M.S., Pramono, E. (2013). Pengaruh pemberian tiga jenis pupuk kandang dan dosis urea pada pertumbuhan dan hasil tanaman cabai (Capssicum Annum L.). Jurnal Agrotek Tropika, 1(2): 172-178. http://dx.doi.org/10.23960/jat.v1i2.2028

[8] Yuwono. (2007). Kompos. Jakarta: Penebar Swadaya.

[9] Tombe, M., Sipayung, H. (2010). Bertani Organik dengan Teknologi Biofob. Yogyakarta: Lily Publisher.

[10] Siahaan, C.D. (2017). Uji efektifitas pupuk hayati pada tanaman cabai rawit (Capsicum frutescens L.). Doctoral dissertation, Universitas Brawijaya.

[11] Tahat, M.M., Alananbeh, K.M., Othman, Y.A., Leskovar, D.I. (2020). Soil health and sustainable agriculture. Sustainability, 12(12): 4859. https://doi.org/10.3390/su12124859

[12] Keshavarz, Y., Alizadeh, O., Sharfzade, S., Zare, M., Bazrafshan, F. (2020). The effect of biological fertilizer and salicylic acid on the physiological and biological characteristics of corn under drought stress. EurAsian Journal of BioSciences, 14(1): 1603-1612.

[13] Li, Y., Qin, L., Roberts, D.P., Hu, X., Xie, L., Gu, C., Liao, X. (2020). Biological fertilizer containing Bacillus subtilis BY-2 for control of Sclerotinia sclerotiorum on oilseed rape. Crop Protection, 138: 105340. https://doi.org/10.1016/j.cropro.2020.105340

[14] Wani, S.A., Chand, S., Wani, M.A., Ramzan, M., Hakeem, K.R. (2016). Azotobacter chroococcum–a potential biofertilizer in agriculture: An overview. Soil Science: Agricultural and Environmental Prospectives, 333-348. https://doi.org/10.1007/978-3-319-34451-5_15

[15] Amrullah, S., Amin, M., Ali, M. (2021). Converting husbandry waste into liquid organic fertilizer using probiotic consortiums (Lactobacillus sp., Rhodopseudomonas sp., Actinomycetes sp., Streptomyces sp.). In IOP Conference Series: Earth and Environmental Science, 679(1): 012001. https://doi.org/10.1088/1755-1315/679/1/012001

[16] Criollo, H., Lagos, T., Piarpuezan, E., Pérez, R. (2011). The effect of three liquid bio-fertilizers in the production of lettuce (Lactuca sativa L.) and cabbage (Brassica oleracea L. var. capitata). Agronomía Colombiana, 29(3): 415-421.

[17] Gomez, K.A., Gomez, A.A. (2007). Prosedur Statistik untuk Penelitian Pertanian. Jakarta, UI Press.

[18] Gardner, F.P., Pearce, R.B., Mitchell, R.L. (1985). Physiology of Crop Pants. Iowa State, University Press.

[19] Ardhi, K. (2018). Pupuk NPK phonska, fungsi dan manfaatnya untuk tanaman. Dinas Pertanian dan Peternakan Kecamatan Seririt Kabupaten Buleleng. https://bulelengkab.go.id/detail/artikel/pupuk-npk-phonska-fungsi-dan-manfaatnya-untuk-tanaman-13, accessed on January 24, 2020.

[20] Gurikar, C., Naik, M.K., Sreenivasa, M.Y. (2016). Azotobacter: PGPR activities with special reference to effect of pesticides and biodegradation. In Microbial Inoculants in Sustainable Agricultural Productivity, pp. 229-244. https://doi.org/10.1007/978-81-322-2647-5_13

[21] Reginawanti, H., Kalay, M., Talahaturuson, A., Lakburlawal, Y. (2018). Bakteri pemfiksasi nitogen azotobacter sebagai pupuk hayati dan pengendali penyakit pada tanaman kacang panjang. Jurnal Ilmu Pertanaian Agric, 30(1): 25-32.

[22] Muis, S.D.A. (2016). Prospect of bacillus subtilis as a biological control agent of soilborne pathogens on maize. Jurnal Litbang Pertanian, 35(1): 37-45.

[23] De, S., Atanupramanik, Kr, A., Das, Bera, M.K. (2018). Study the effects of seed germination and plant growth promoting activity of Lactobacillus sp. International Journal of Research in Pharmacy and Pharmaceutical Sciences, 3(2): 1-3.

[24] Farrag, D.K., Omara, A.E.D., Khafagi, I.F. (2016). Impact of spraying with saccaromyces cerevisiae and some commercial nutrients on lettuce plant (Lactuca Sativa L.) productivity and prevention of some insect pest. International Journal of Plant and Soil Science, 11(62): 1-11. http://dx.doi.org/10.9734/IJPSS/2016/27177

[25] Duaja, M.D., Arzita, Redo, Y. (2012). Analisis tumbuh selada (Lactuc Sativa L) pada perbedaan jenis pupuk organik cair. 1(1): 33-41.

[26] Islam, M.R., Sultana, T., Haque, M.A., Hossain, M.I., Sabrin, N., Islam, R. (2018). Growth and yield of chilli influenced by nitrogen and phosphorus. Journal of Agriculture and Veterinary Science, 11(5): 54-68.

[27] Siaga, E., Lakitan, B., Bernas, S.M., Wijaya, A., Lisda, R., Ramadhani, F., Widuri, L.I., Kartika, K., Meihana, M.

(2018). Application of floating culture system in chili pepper (Capsicum annum L.) during prolonged flooding period at riparian wetland in Indonesia. Australian Journal of Crop Science, 12(5): 808-816. https://doi.org/10.3316/informit.733013846867389

[28] Masabni, J., Sun, Y., Niu, G., Del Valle, P. (2016). Shade effect on growth and productivity of tomato and chili pepper. HortTechnology, 26(3): 344-350.

[29] Villar, R., Maranon, T., Quero, J.L., Panadero, P., Arenas, F., Lambers, H. (2005). Variation in relative growth rate of 20 Aegilops species (Poaceae) in the field: The importance of net assimilation rate or specific leaf area depends on the time scale. Plant and Soil, 272(1): 11-27. https://doi.org/10.1007/s11104-004-3846-8

[30] Hardjowigeno, S. (2015). Ilmu Tanah. Akademika Pressindo, Jakarta. ISBN: 978-979-8035-56-2.

[31] Waskito, H., Nuraini, A., Rostini, N. (2018). Respon pertumbuhan dan hasil cabai keriting (Capsicum annuum L.) Ck5 akibat perlakuan pupuk NPK dan pupuk hayati. Kultivasi, 17(2): 676-681.

[32] Priambodo, S.R., Susila, K.D., Soniari, N.N. (2019). Pengaruh pupuk hayati dan pupuk anorganik terhadap beberapa sifat kimia tanah serta hasil tanaman bayam cabut (Amaranthus Tricolor) di tanah inceptisol Desa Pedungan. Jurnal Agroekoteknologi Tropika (Journal of Tropical Agroecotechnology), 8(1): 149-160.

[33] Susila, K.D., Sudana, I.M., Ristiatin, N.P., Adnyana, I.M. (2016). Phosphatase activity and phospatate solubility by phosphate solabilizing rhizobacteria in volcanic soils of pancasari, bali. International Journal of Bioscoences and Biotechnology, IV(1): 39-48.

[34] Elfiati, D. (2005). Peranan mikroba pelarut fosfat terhadap pertumbuhan tanaman. Universitas Sumatra Utara.

[35] Kalay, A.M., Hindersah, R. (2016). Efek pemberian pupuk hayati konsorsium terhadap pertumbuhan dan hasil tanaman sawi (Brassica juncea L.). Jurnal Agroekoteknologi, 8(2): 131-138.

[36] Wardhani, S., Purwani, K.I., Anugerahani, W. (2014). Pengaruh aplikasi pupuk hayati terhadap pertumbuhan dan produktivitas tanaman cabai rawit (Capsicum frutescens L.) Varietas Bhaskara di PT Petrokimia Gresik. Jurnal Sains Dan Seni Pomits, 2(1): 1-5.

[37] Setiawan, J.A., Maghfoer, M.D., Nihayati, E. (2016). Application of manure, nitrogen fertilizer, and EM4 to improve growth and yield of red chili (Capsicum annuum L) on an Alfisol. Journal of Degraded and Mining Lands Management, 3(2): 535-542. http://dx.doi.org/10.15243/jdmlm.2016.032.535

[38] Lingga, P. (2007). Petunjuk penggunaan pupuk. Jakarta: Penebar Swadaya.

[39] Dubey, A.K., Singh, D., Rajput, P.S., Kumar, Y., Verma, A.K., Chandraker, S.K. (2017). Effect of NPK on plant growth, yield and quality of Capsicum (Capsicum annum L.) cv Swarna Under Shade Net Condition. Int. J. Curr. Microbiol. International Journal of Current Microbiology and Applied Sciences, 6(3): 1085-1091. http://dx.doi.org/10.20546/ijcmas.2017.603.125

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