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STRATEGY OF USING EMPLOYEE FERTILIZER WITH BIOSFERTILIZER ON THE PERFORMANCE OF WHITE RAWIT CHILI AND LARGE RED CHILI

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Abstract- This study was to analyze the strategy of using biofertilizer fertilization labor in the cultivation of large red chilies and white bird's eye chilies, to determine labor efficiency, productivity, income, profit, and B/C ratio.The research was conducted at the experimental Garden IPB Tajur Bogor, Indonesia in February - June 2019.

The research method was with 4 treatments on 4 large red chili varieties and 4 varieties of white bird's eye chili.All treatments received inorganic fertilization and standard drum fertilizer, then added with biofertilizer X1, X2, combination X1 + X2, and control without biofertilizer.The research design was a randomized complete block design (RCBD) with 3 replications.

The results showed that the cultivation of large red chilies and white bird's eye chilies with standard inorganic fertilizers could generate profits with the B/C ratio in the control treatment of 1.63 times for white bird's eye chili and 2.27 times for large red chilies.The biofertilizer treatment was able to increase the production of fresh chilies, production value (income), and profits in white chili peppers and large red chilies.The biofertilizer treatment was also able to increase the productivity of fresh chilies with the highest yield of 15.9 tonnes/hectare of white chili in the X1 + X2 biofertilizer treatment and 15.8 tonnes/hectare of large red chilies in the X1 and X1 + X 2 biofertilizer treatments.The biofertilizer treatment was also able to increase the highest profit by 142% in the biofertilizer treatment for white bird's eye chilies and 18.95% for large red chilies, which was higher than the control gain.The increase in production value (income) from the biofertilizer treatment is greater than the additional cost of the biofertilizer material and the cost of fertilizing labor, so the use of biofertilizer is more profitable.

Keywords: white cayenne pepper, large red chili, productivity, income, profit, B/C ratio, inorganic fertilizer, and biofertilizer.

I. INTRODUCTION

Plantation productivity is expected to be able to produce optimal production, forthat it requires a proper plantation management strategy, namely the management of proper fertilizer use with biostimulants to increase production.Production management will at least be influenced by 3 aspects, namely plant material, growing environment (land), and crop management.In-plant management, there are aspects of nutrition (fertilizer) that greatly determine plant fertility. Salmiyati et al. (2013) stated that if plantations are managed by crop rules and requirements, it will affect productivity increases.The criteria that must be considered are the selection of land, planting material, technical management, harvesting, and the environment.It is different from research conducted by Andayani (2016) that the production factors of land, seeds, fertilizers, pesticides, and labor simultaneously have a significant effect on the production of red chilies while partially the production factors of fertilizers, pesticides, and labor affect an effect on production but production factors. land and seeds had no significant effect on red chili production.

Anggraheni et al. (2019) added that there are many ways to increase the quality and quantity of chili plant production, one of which is by improving cultivation techniques.The use of organic fertilizers such as compost and manure can improve soil texture and provide macro and micronutrients needed by chili plants.The findings were that the addition of compost provided the highest growth and yield, followed by maintenance with manure and control.As per Peng & Zhou's research (2019) to understand how farmers can be motivated to use environmentally friendly formula fertilizers, thereby reducing the use of chemical fertilizers, the findings are that the fertilizer formula can not only improve soil quality but also increase its value as collateral in loans.

Reddy & Hebbar (2018) have research to evaluate the efficiency of fertilizer use (evaluate the Fertilizer use efficiency / FUE) and economic assessment of red chilies.The finding is that water-soluble fertilizers in the vertigation system, as well as standard/normal fertilizers with mulch, are ideal for efficient use of fertilizers and maximum yield and economic value of chili plants. While the research conducted by Setiawan et al. (2015) to determine the effect of using goat manure and urea with EM4 and to get the best combination dose to increase growth and yield of red chilies showed that the combination of 50% N PKK + 50% N urea and EM4 at levels of 30 and 40 L / ha produced best and optimal plant height for branches and number of flowers.Meanwhile, EM4 at the level of 30 L / ha showed the best and optimal fruit weight with productivity of 12.27 t / ha.

Research by Budiargo et al. (2015) to analyze the efficiency of management and fertilization in the field. The findings were that the accuracy of the fertilization method was 85.4% for Urea and 80.6% for Borate, but it could be improved by maintaining sanitation, the size, and the circle shape of the standard fertilizer area disk.The score of the accuracy of the Urea dosage is 91.1%, therefore the company must use a standard measuring cup for each fertilizer.The accuracy of fertilizer types in fertilization has reached 100% for all types of fertilizers. Age and work experience of fertilizing the workforce have no real effect on performance.Efficient use of employees in the field has been achieved with a labor index of 0.1508 HK/ha.The findings show that the income of chili farming in one growing season per hectare using inorganic fertilizers is lower than using mixed fertilizers, the use of inorganic fertilizers costs Rp. 21,586,846 and mixed fertilizers Rp. 26,489,791. The R / C ratio of chili farming using organic fertilizers was 2.09 higher than using mixed fertilizers 2.03.

Based on the description in the previous research above, there are many various fertilizer management techniques, land locations, and various crop production in the field.Therefore it is necessary to conduct research to increase productivity, effective and efficient chili production value in the use of biofertilizers, fertilizer management strategies, and their effect on the value of productivity and profit in white chili and large red chilies in the field.

II. LITERATURE REVIEW

Many factors affect the effectiveness and efficiency of fertilizer management, including fertilizer time, type of fertilizer, the dosage used, method of application, and fertilizer power.Optimization of the implementation of each element of fertilizer management is carried out in a synergy and sustainable manner to maximize productivity.

According to Naresh et al. (2018) that fertilizers are substances added to the soil to improve health, increase plant growth and development, and plant productivity.Modern synthetic fertilizers consist mostly of nitrogen, phosphorus compounds, and potassium as well as secondary nutrients.However, the supply of these components in the soil is limited and when the crop is harvested it will decrease in number in the soil causing a reduction in crop quality and yield.

For this reason, the concept of health in the soil is an activity that supports the diversity of life in a dynamic ecosystem.Soil quality (health) is defined as the capacity of the soil to function within the boundaries of the ecosystem and land use, to maintain biological productivity, maintain environmental quality, and promote the health of plants and animals.Soil health and soil quality mean managing the soil in the best way to support the functions needed for plants without any degradation of the soil.

The relationship between soil quality, agricultural practices, long-term soil productivity, sustainable land management, and environmental quality is shown in the figure below.

Picture 1. The relationship of soil quality, environmental quality, and agriculture sustainability (Naresh et al., 2018).

Research by Alviana & Susila (2009) on hydro garden showed that the vegetative growth of chili plants planted with drip irrigation and polyethylene mulch increased linearly in fertilization applications up to a dose of 453 kg N / ha, 207 kg P2O5 / ha, 360 kg K2O / ha. anthesis time, ripe fruit time, weight per plant, diameter, and length of fruit were not affected by the dose of fertilization.Recommended optimum fertilizer dosage for var red chili cultivation. Prabu on Andosol Sukamantri (Ciapus Bogor) amounted to 237.07 kg N / ha, 108.33 kg P2O5 / ha, and 188.4 kg K2O / ha.

Research findings by Suherman et al. (2018) there is an effect of interaction and independent varieties and dosage of biological fertilizers on the growth and yield of chili plants in intercropping with TBM I palm oil.Also, at the CK5 variety level, the level of biofertilizer dosage of 200 mL/plant resulted in better plant height, canopy width, and the number of branches.In CB2 varieties, the dose level of 150 mL/plant gave a better interaction effect.Independently, the dose of biological fertilizer 150 mL/plant produced the best growth in plant height, canopy width, number of branches, fruit weight, and number of the fruit of chilies, while CK5 variety produced plant height, number of branches, length of fruit, and number of fruit. better than CB2.

a. Fertilization Technique

There are six fertilization technique approaches, namely 1) type of fertilizer, 2) dosage of fertilizer (Yuniarti, 2016), 3) how to apply fertilizer, 4) fertilization equipment, 5) use of fertilization labor, and 6) time of fertilization (IPNI), 2017).The method of applying fertilizer which is usually done by farmers is in 5 ways, namely sowing, hole, leaking, spraying, and dropping.The method of sowing fertilization is done by spreading fertilizer when the soil is cultivated or the plant has grown around the root surface of the soil.A fertilization hole is done with a hole in the soil with a burial device and the fertilizer is placed in a hole in the hole and covered with soil.Leaking is carried out by dissolving it with water than splashing it around the plants and it is usually done during the dry season or dry land.Fertilization spraying carried out on the leaves and stems of plants is usually in the form of a dilute fertilizer solution with a type of foliar fertilizer.Fertilization by dropping is fertilization that is carried out by installing a hose that is flowed along with irrigation and plant watering.

Research to improve fertilization efficiency with Starter Solution Technology (SST) was conducted by Latifah et al. (2016) the findings were that the STT was able to reduce the use of chemical fertilizers by up to 50%, while maintaining their productivity, to increase the net income of farmers.SST is an innovative technology that reduces fertilizers and at the same time increases the productivity of fertilizers.SST aims to provide a nutrient application to young plants before the root system develops to promote plant growth at a young age, thereby minimizing transplanting stress when plants are moved from a protected environment to an open environment.This often occurs disruption in growth because it affects the absorption of nutrients in the soil, such as disturbances in the root absorption system with SST, it will be helped quickly in nutrient absorption for the immediate formation of new roots and shoot growth.

Huq et al. (2010) conducted a study to assess the level of technical efficiency required for chili production and analyze the status of resource allocation for production.The study revealed that chili cultivation was very profitable where the net return rate for chili cultivation was Tk 73,164 / ha (Taka Bangladesh), while the BCR value was 1.93.However, all farmers have not reached the maximum yield potential limit, namely, the level of efficiency varies from 11-96% and the average efficiency is 77%.The use of advanced technology must work in synergy with the use of superior varieties and plant protection management to increase production.

b. Employee Fertilization Costs and Total Production Costs

Fertilization power (employee fertilization) is part of the fertilization management process. The contribution of fertilization power will greatly affect the quality of the fertilization implementation process and will affect the productivity of plants in the field.

The work requirements of each type of business will be different depending on the type of activity, the type of commodity cultivated, the level of technology, the intensity of the combination of production factors, the scale of the business, and the time.The results of research by Agung et al. (2010) show that cultivating red chilies requires 49 working days (HK), consisting of 26.5 HK of workers in the family and 22.5 HK of workers outside the family.Of the total workforce in the family, 19.1 HK came from male workers and 7.4 HK from female workers, while the labor outside the family consisted of 17.2 HK from male workers and 5, 3 HK originated from female workers. The amount of this labor is used for land cultivation, planting, maintenance (weeding, fertilizing, and spraying), harvesting, and transportation.

Labor is one of the important factors that must be considered in the production process, any reduction in labor means a reduction in production results.This is by the findings of Pranata & Damayanti (2016) in their research on the factors that influence the production of critical red chili farming with production factors including land area, use of urea, ZA, phonska, pesticides, and labor.The findings simultaneously showed that these production factors had a very significant effect on chili production, partially the coefficient of the labor variable was 0.098, meaning that for every 1% addition of labor, the production of curly red chilies would increase by 0.098% on the land area that did not increase.With an average land area of 0.28 ha of farmer respondents with an average use of 23.26 HK of labor, the labor conversion is 81.96 HK / ha.

The effect of the cost of production facilities and labor on the income of cayenne pepper has been carried out by research by Sofa et al. (2019).The findings show that cayenne pepper farming is profitable and that there is a very real effect of the cost of production facilities and labor on the income of cayenne pepper farming.

Research conducted by Afifah & and Lubis (2016) found that partially the level of education, number of dependents, and age did not have a significant effect on the productivity of harvest labor, while the length of work had a significant effect.Simultaneous regression testing shows the level of education, the number of dependents, age, and length of work have a significant effect on the productivity of harvest labor.

This is by Saptana et al. (2010) stated that managerial capability in the aspect of red chili cultivation can be seen from the application of farming technology which will be determined by education and experience.The managerial capability will be reflected in the output obtained when the production results after harvest.If the product obtained is close to the maximum potential of the best technology application (the best practice) in similar ecosystem conditions, it can be said that these farmers have managed their farming with high efficiency.In the results of his research, it was concluded that the achievement of the level of technical efficiency (TE) in large red chili farming was high, most (> 50%) had reached TE of more than 0.80.The estimation results using the SPF (TE Effect Model) by including the inefficiency factor (without including the risk element and by including the risk element) obtained an average TE value that is almost the same, namely 0.83 and 0.82, respectively.

c. Chili Cultivation Performance

Farming performance (cultivation) will be determined by production per unit area per planting season, production costs, and the price level of chili at that time.Production will be determined by the quality of the plant material (superior seeds), land quality, and crop management.According to research by Theresia (2018), the factors that influence chili production with a determination value (R2) of 0.839, this means that 83.9% of the variations that occur are influenced by the variable harvest area, red chili prices, cayenne pepper prices, and red chili consumption. , while another 16.1% is influenced by other variables.Simultaneously, all of the independent variables had a significant effect on the production of red chilies, while partially only the harvest area and consumption of red chilies had a significant effect on the production of red chilies.

Hutapea Research (2019) analyzes factors that affect productivity and factors that affect the profits of large red chili farming in Way Sultan District.The findings show that large red chili farming is influenced by NPK fertilizer, SP36 fertilizer, fungicide, labor, and seeds with a confidence level of 99%, 95%, 95%, 95%, and 99% which can increase the productivity of large red chili farming.The results of the profit function analysis show that the factor of land area, the price of NPK fertilizer, and normalized labor wages with the output price have a significant effect on the profits of large red chili farming.

Research by Mohd et al. (2016) that the cost-benefit analysis shows that the production costs for chilies using the fertigation system are as follows: under mulch RM 1.19 / kg (Malaysian Ringgit), with an open system RM 1.56 / kg and with a conventional system RM 2.03 / kg.Net income per season per hectare for growing chilies using the fertigation system under mulch is RM 105,654 and with open fertilization is RM 77,415 and with conventional methods RM 55,900.

d. Biofertilizer

Nutrients for the needs of many plants vary in types and functions, how to use, formulation, price, and effectiveness of these fertilizers. Biofertilizer is a biological fertilizer with a formulation of various functions, namely providing nutrition, increasing absorption, and protection against harmful microorganisms (pathogens) against plants. The content contained in biological fertilizers is soil microorganisms that can help fertilize the soil and facilitate the need for plant nutrients.

Biofertilizer is a fertilizer containing bacterial microorganisms with mutualism symbiosis. Plant growth-promoting bacteria (PGPB) include bacteria that live freely and form specific symbiotic relationships with plants, bacterial endophytes that can colonize some parts of plant tissue, and Cyanobacteria (Farrar et al. 2014). Although all bacteria differ from each other in various ways, they all exhibit the same mechanisms while promoting bacterial growth. Bacteria can promote growth directly by facilitating resource acquisition or modifying plant hormone levels and indirectly by reducing the inhibitory effects of various pathogenic agents on plant growth and development.

According to Surtiningsih (2015), biofertilizer is a fertilizer that contains a group of live microorganisms that are useful for plants and can provide nutrients to increase soil fertility and the quality of plant yields, through increasing biological activity that can be done with soil physical and chemical properties. These living microorganisms colonize the rhizosphere and the inside of plant cells and increase the supply of primary nutrients thus stimulating plant growth. The groups of microorganisms that are commonly used as active ingredients for biological fertilizers are nitrogen-fixing microbes, phosphate solvents, and degrading organic matter such as bacteria, yeast, and fungi that live in symbiosis / mutual benefit with plant roots.

Meanwhile, according to Chaniago (2016), biological fertilizers (biofertilizers) are soil microbes that can increase the availability and uptake of nutrients, increase resilience or protect plants from pests and diseases, produce compounds that can stimulate plant growth so that plant production increases. Biological fertilizers that are widely developed in Indonesia are (1) airborne N2 gas-fixing microbes, (2) phosphate solubilizing microbes, (3) potassium solubilizing microbes, (4) microbes that inhibit disease development (antagonists), (5) microbes that can remodel pollutant compounds in the soil (bioremediation) and (6) microbes that can break down organic matter in a short time (decomposers).

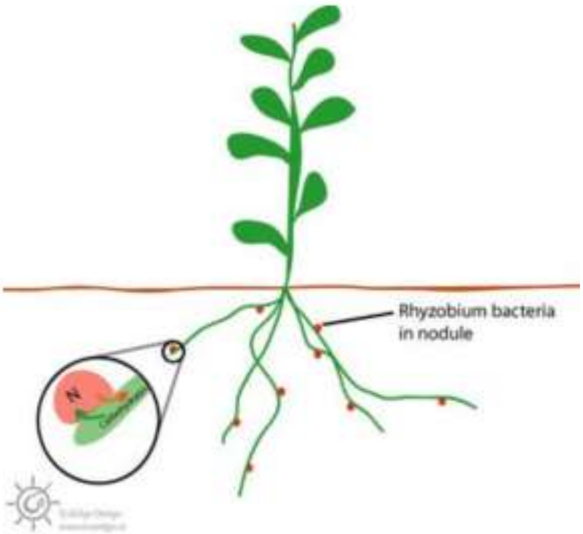

Figure 2. The relationship between bacterial symbiosis, coryza, and plant roots
(Barnes, 2009)

One type of organic fertilizer that contains degrading microbes is biological fertilizer and biogas sludge which is an organic fertilizer containing microbes and organic materials that can support the provision of nutrients for planting media (Wahyuningratri et al., 2017 and Siswanti & Lestari, 2019).

The existence of biofertilizers is an alternative fertilizer as a substitute for chemical fertilizers that have been able to increase food production but are not environmentally friendly, such as decreased fertility, plants become susceptible to disease, and are not friendly to soil micro-organisms (Mahanti et al., 2016). This requires a sustainable agricultural approach through the use of fertilizers and pesticides that are environmentally friendly (Pretty & Bharucha 2015).

It was reported that the use of biofertilizers increased yields by 10–40% by increasing the content of protein, essential amino acids, vitamins, and nitrogen fixation (Bhardwaj et al., 2014).

Besides that according to Mahanty et al. (2016) that the influence of various Rhizobia plant growths on plant growth and biocontrol. Rhizobium, Bradyrhizobium, Sinorhizobium, Azospirillum, Nostoc, Anabaena, Acetobacter, Bacillus megaterium, Azolla, Bacillus polymyxa and some are very common plant growth-promoting bacteria which help in increasing crop yields and plant growth.

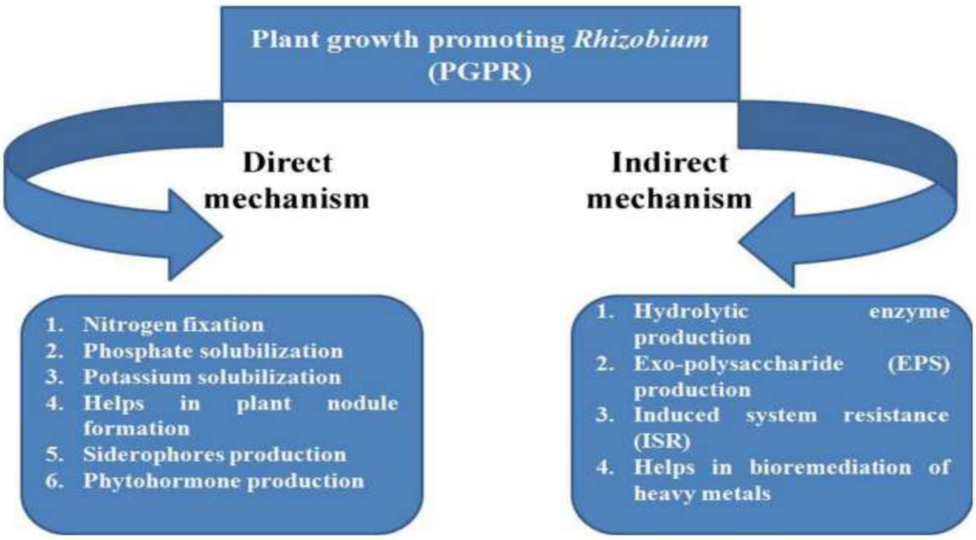

Figure 3. Mechanisms for rhizobacteria to aid plant development(Mahanty et al., 2016)

III. CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

The research conceptual framework based on the analysis of previous research and field phenomena can be shown as follows:

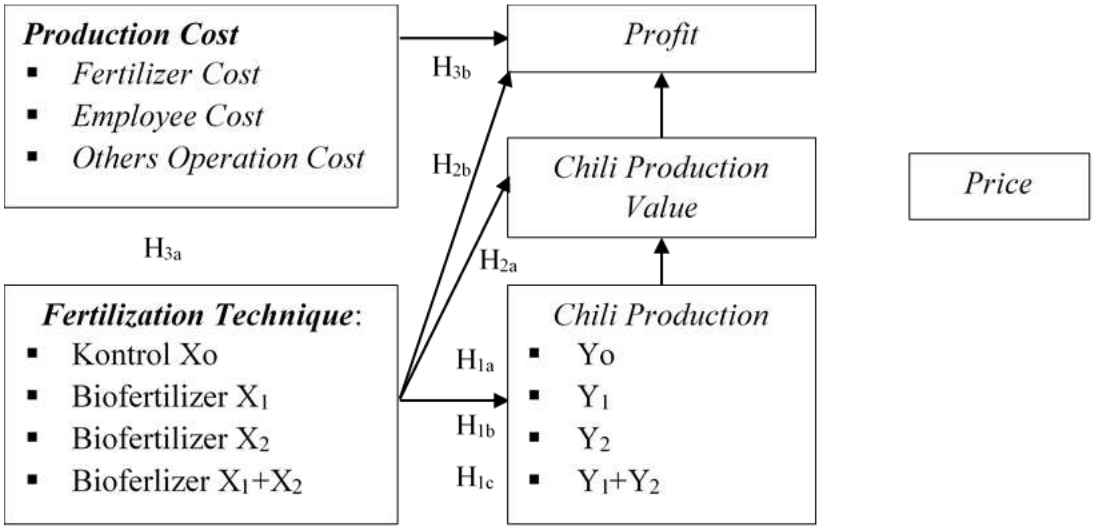

Figure 4. Conceptual framework of research in 2019

The Fertilization Employee Strategy is a fertilization strategy effort that is synergized with watering according to the type of fertilizer through a fertigation system to increase efficiency and support productivity. The fertilization Technique is a fertilization technique by adding biofertilizer and its combination to increase crop production.

a. Effect of Fertilization Technique on the addition of biofertilizer on-farm performance

A study on the comparative effect of fertigation techniques was carried out by Mohd et al. (2016) by comparing fertilization techniques with fertigation with mulch, open fertigation, and conventional fertilization on production costs. The findings were that fertilization techniques with fertigation on mulch resulted in the lowest cost (efficient) incurred, namely RM 1.19 / kg, followed by open fertilization without mulch of RM1.56 / kg and the conventional method of RM 2.03 / kg. So that the value of chili production that is highest is the fertilization technique with fertigation and the area covered by mulch.

Research conducted by Pandey et al. (2013) to determine the effect of drip irrigation, spacing, nitrogen treatment with fertigation, the findings were that drip irrigation increased chili fruit yields, net income, reduced weeds, and pests. The spacing of 30 cm closer will result in higher production (55.77%) than the spacing which is 45 cm more apart. Fertigation can reduce the level of pest infestation, save water and irrigation time. Also, it increases the maximum yield by 10.50 kg / m2 and increases the net profit by 60.30% compared to the overflow irrigation system (inundation).

The results of research by Chanthai & Wonprasaid (2016) reveal that fertilization with fertigation can increase the production and efficiency of fertilizer use compared to the application of stocked solid fertilizers. Fertilizer application with fertigation at 5 mm evapotranspiration (ETc) yields the highest yield and the most efficient use of water.
Research by Bhattarai & Joko Mariyono (2016) analyzed the economic aspects of chili in chili production centers in Central Java, namely three districts: Brebes, Magelang, and Rembang. The main findings are that chili peppers have a positive net return, have a relatively high economic risk, and intensive use of chemicals. Policies related to improving chili cultivation need to be formulated based on specific local constraints.

Research by Nurlaily et al. (2018) to determine the effect of the application of Agrimeth biofertilizer with Nitrogen-binding bacteria on the yield and population of Chile. The results showed that the application of Agrimeth for maintenance once a season produced the highest number of chilies (574 pc) and weight of chilies (2.09 kg) per plant per season, and significantly different from the treatment of Agrimeth application 2 and 3 times per season. The highest nitrogen-fixing bacteria population occurred in the grime treatment applied 3 times.

The findings of Siswanti & Lestari (2019) on the application of biological fertilizers and biogas sludge in various concentrations showed that the highest growth parameters and capsaicin content were obtained in curly red chili plants given 36 mL biogas sludge + 10 L / ha biological fertilizer. Thus, it can be concluded that the most appropriate dose of curly red chili is 36 mL of biogas sludge + 10 L of bio-fertilizer / ha.

Research on biological fertilizers with graded levels of inorganic fertilizers on the growth and yield of chilies has also been carried out by Kumbar et al. (2017). Two biofertilizer nitrogen fixers (Azospirillum lipoferum and Azotobacter chroococcum), two biofertilizer phosphates [VAM (Glomus fasiculatum) and PSB (Bacillus polymixa)] and one potassium mobilizer (Fraturia aurantea). The findings for the point of maximization of yield and the best treatment were NPK (100%) + Azospirillum + VAM + KM.

Berdasarkan analisis penelitian terdahulu tersebut maka dibangun hipotesis kelompok pertama dan kedua yaitu:

H1a: The use of biofertilizer X1 has the effect of increasing the production of chili cultivation.
H1b: The use of X2 biofertilizer has the effect of increasing the production of chili cultivation.
H1c: The use of X1 + X2 biofertilizer has the effect of increasing the production of chili cultivation.
H2a: The use of biofertilizer has the effect of increasing the production value (income) of chili cultivation.
H2b: The use of biofertilizer has the effect of increasing profits in chili cultivation.

b. Effect of Employee Fertilization Strategy on Production Value Performance.

According to Andayani (2016) that the production factors of land, seeds, fertilizers, pesticides, and labor simultaneously have a significant effect on the production of red chilies while partially the factors of production of fertilizers, pesticides, and labor affect production, but the factors of production of land and seeds do not. significant effect on the production of red chili. This is consistent with the research of Sofa et al. (2019) to determine the income of red chili farming and the effect of production facilities and labor costs on the income of red chili peppers. The findings were that red chili farming was profitable and there was a very real effect of the cost of production facilities and labor on the income of red chili farming.

The results of research conducted by Wijayanti (2017) show that production factors that affect the amount of production include land, seeds, manure, NPK, foliar fertilizers, calcium fertilizers, pesticides, and labor. Simultaneously the magnitude of the influence of production factors was 93.90% on the amount of red chili production, while partially the factors that influenced the production of red chili were seeds, manure, NPK, and pesticides. The production factor that is already efficient in use is NPK fertilizer. The production factors of seed and manure are not efficient yet, so their use needs to be added. The production factors for foliar fertilizers, calcium fertilizers, pesticides, and labor are not used efficiently, so their use needs to be reduced.

Research by Asravor et al. (2016) examines the productivity of selected agricultural inputs, the level of technical, allocative, and economic efficiency as well as the factors that determine the productivity efficiency of chilies. The result is that on average, chili farming is only 65.76% economically efficient, while the average technical and allocative efficiency is estimated at 70.97% and 92.65%, respectively. The study results also recommend policies and programs aimed at attracting young practitioners who join chili cultivation to provide an incentive package. Experienced chili farmers should try to supplement their knowledge with the consultancy services provided by extension officers. Policymakers should also focus on policies that will facilitate chili farmers' access to low-interest bank loans.

Based on the above analysis, the third group hypothesis is formulated, namely:

H3a: The use of biofertilizer has the effect of increasing labor costs and the total production cost of chili cultivation.

H3b: The increase in total production costs from the addition of biofertilizer affects increasing the profits of chili cultivation.

Metodologi Penelitian

The research was designed with the formulation of the research location, time, experimental design, methods, and data analysis. This research was conducted in the field to prove the effectiveness of the variable x on the effect of the y variable.

The location of the research was carried out in the Experimental Garden of IPB Tajur Bogor with an elevation of 342 m above sea level, flat land with inceptisol soil types that had undergone intensive soil cultivation and had often been used for seasonal crop planting. The time of the research was carried out in February - June 2019, which is still the rainy season period.

The research design used the Randomized Complete Block Design (RCBD) with 4 levels of treatment, namely standard fertilization treatment and control fertilization (without biofertilizer) and standard fertilization treatment (chemical + drum fertilizer) combined with the application of two specific types of biofertilizer on commodities. bird's eye chilies and large red chilies. Each treatment was repeated 3 times. In each experimental plot, there were 20 planting points as a sample of the chili plant population on both types of large red chili and cayenne pepper.

The varieties used are:

White Small chili

R1 = Rinta F1

R2 = Kara F1

R3 = Lentera F1

R4 = Dewata F1

Large Red Chili:

B1 = Balebat F1

B2 = Ababil F1

B3 = Darmais F1

B4 = Panex F1

The treatment combination is as follows:

1) Control treatment with standard chemical fertilization and manure.

2) Treatment of Biofertilzer X1 with a concentration of 2 g / l, leaked 200 ml / plant.

3) Treatment of Biofertilizer X2 with a concentration of 2 g / l, leaked 200 ml / plant.

4) Treatment of Biofertilizer X1 + X2 with a concentration of 2 g / l each, leaked 200 ml / plant.

The doses of standard fertilization applications are as follows:

1) Manure at a dose of 18 tonnes / ha, applied evenly as a basic fertilizer

2) N2 fertilizer with a urea dose of 300 kg/ha, applied by dissolving in water and then leaking it to each plant.

3) P2O5 fertilizer with SP36 dose of 600 kg/ha, applied evenly as a basic fertilizer.

4) K2O fertilizer with KCL dose of 300 kg. ha, applied by dissolving in water and then leaking it into each plant.

Variable Measurement

Measurement on variable x by weighing the biofertilizer weight used in each treatment (treatment) with three replications during one crop cycle (harvest) which is converted into one hectare.

Measurement of variable y by calculating all production costs, the cost of biofertilizer fertilization energy, total production costs, chili production yields, harvest income, and profit from each treatment, all of which are converted into one hectare.

Method of collecting data

Primary data collection was carried out on each parameter, namely production by weighing the fruit weight at the time of picking which met the quality criteria of certain market prices for each treatment and all replications. The production weight of chili for each treatment is calculated as a total until the harvest is completed then multiplied by a market price of chili at that time, which is converted into production value (income) of chili per hectare per chili growing season.

The number of production costs, the cost of fertilizing labor, and the cost of the type of biofertilizer are calculated in total until the planet completes one cycle or completes picking, for each treatment, which is also calculated to be converted into units of hectares per growing season of chilies.

Data analysis method

The collected data were compiled and recapitulated according to the parameters and treatments which were then tested in statistical analysis with the diversity test (ANOVA), the determinant test (R square), the Duncan Multiple Range Test (DMRT) to compare the results of each treatment with a significant level 5 %.

IV. RESULTS AND DISCUSSION

Rawit Chili Research

The results of research on production costs, biofertilizer application labor, total costs, chili production, income, and profit for each treatment for cayenne pepper can be seen in Table 3.1 below.

Table 1.Costs, production, fertilizing labor, total costs, production, income, and profits for each treatment of white bird's eye chili

Uraian	**Biaya Produksi (a)**	**Tenaga Kerja Aplikasi *Biofertilizer* (b)**	**Total Biaya (a+b)**	**Produksi Cabai (c)**	**Pendapatan (c x Rp 15.000.000)**	**Keuntungan**
	Rp/Ha	Rp/Ha	Rp/Ha	Ton/Ha	Rp/Ha	Rp/Ha
Kontrol	90.802.000	0	90.802.000	9,9 c	147.900.000	57.098.000
Biofertilizer X_1	93.502.000	6.050.000	99.552.000	13,6 ab	204.000.000	104.448.000
Biofertilizer X_2	92.602.000	4.550.000	97.152.000	12,1 bc	181.500.000	84.348.000
Biofertilizer X_1+X_2	95.302.000	6.050.000	101.352.000	15,9 a	239.100.000	137.748.000

The DMRT test number followed by the same letter shows no significant difference at the significant level of α 5%

The price of cayenne pepper is set according to the market price of IDR 15,000 / kg at the production location

From the table above 1, it shows that the lowest production cost occurred in the control treatment (Rp. 90,802,000 / Ha) because there was no cost of purchasing biofertilizer material, while the highest cost (Rp. 95,302,000 / Ha) was X1 + X2 biofertilizer treatment due to the combination of biofertilizer.

The labor cost required to carry out fertilization activities is under control because only standard fertilization is carried out and there is no additional energy for biofertilizer fertilization. While the highest cost of fertilizing power occurs in the X1 biofertilizer and X1 + X2 biofertilizer treatments, this is because in the combined biofertilizer application X1 + X2 does not increase the power load and will remain the same as the power load in the X1 biofertilizer treatment.

The total cost of production after the addition of the cost of biofertilizer fertilization energy is the highest in the X1 + X2 biofertilizer treatment because there is an additional cost of material for biofertilizer X1 + X2, besides that there is an additional labor load for the X1 + X2 biofertilizer application.

The highest yield of fresh chili was in the X1 + X2 biofertilizer treatment of 15.9 tonnes/ha, which was significantly different from the control and X2 biofertilizer, while the lowest was in the control treatment of 9.9 tonnes/ha and was not significantly different from the X2 biofertilizer. Meanwhile, the production of cayenne pepper X2 was not significantly different from the X1 biofertilizer at a significant level of α 5%.

It appears that the addition of a combination of biofertilizer X1 + X2 can increase the production of wet chili when compared to the control treatment, while the addition of the X1 biofertilizer treatment is not as strong as the effect of the addition of the X1 + X2 biofertilizer treatment on wet cayenne pepper production.

Income in the form of production value is derived from the calculation of the production tonnage of each treatment during one growing season cycle multiplied by the market price at the farmer level at that time. Considering that the quality is generally the same between treatments, there is no difference in price multiplying, namely Rp. 15,000 per kg. The calculation results show that the highest production value or income in the X1 + X2 biofertilizer treatment, amounting to Rp. 239,100,000 per hectare, while the lowest occurs in the control Rp. 147,900,000 per hectare considering that the production of wet weight produced is also the lowest.

The highest profit obtained from each treatment was also in the X1 + X2 biofertilizer treatment, amounting to Rp. 137,748,000 per hectare per planting season, while the lowest was still in control at 57,098,000, - per hectare per planting season.

Table 2. Profit Performance, B / C ratio, and Benefits to Control of White Cayenne Pepper

Uraian	**Total Biaya (a)**	**Pendapatan (b)**	**Keuntungan (b-a)**	**B/C Ratio (b/a)**	**Keuntungan Terhadap Kontrol**
	Rp/Ha	Rp/Ha	Rp/Ha	Kali	%
Kontrol	90.802.000	147.900.000	57.098.000	1,63	0,00
Biofertilizer X_1	99.552.000	204.000.000	104.448.000	2,05	82,93
Biofertilizer X_2	97.152.000	181.500.000	84.348.000	1,87	47,72
Biofertilizer X_1+X_2	101.352.000	239.100.000	137.748.000	2,36	142,25

Based on Table 2 above, it is known that control treatment using standard chemical fertilizers (inorganic) still provides benefits with a B / C ratio of 1.63 times the costs incurred. This shows that white cayenne pepper farming still has good prospects. This means that with an operating capital of 1,000 rupiahs, you will get a profit of 0.63 rupiahs (63%).

Meanwhile, the addition of the use of biofertilizer can increase the income and profit from the control treatment. The greatest increase was in the treatment of using biofertilizer X1 + X2, with a B / R ratio of 2.36 times, followed by the treatment of biofertilizer X1 and biofertilizer X2. This is consistent with the findings of Ardian et al. (2017) that the income of cayenne pepper farming with inorganic fertilizers is lower than using a combination of inorganic and organic. Meanwhile, the R / C ratio of cayenne pepper farming using organic fertilizers was 2.09 higher than using mixed fertilizers 2.03.

The biofertilizer treatment also increased the advantage when compared to the control treatment, namely the highest gain increase of 142.25% in the X1 + X2 biofertilizer treatment, followed by 82.93% in the X1 biofertilizer treatment and 47.72% in the X2 biofertilizer for control gain.

This is by the research of Singh et al. (2017) who conducted research using phosphate fertilizer and biofertilizer plant growth-promoting rhizobacteria (PGPR) and rhizobium. The finding was that the use of 40 kg P2O5 / ha gave the highest gross return, while the highest net profit and B / C ratio were in the treatment of 30 kg P2O5 P2O5 / ha. The combination of rhizobium + PGPR + 40 kg P2O5 / ha gave the highest gross yield while rhizobium + PGPR + 20 kg P2O5 / ha gave the highest net returns. Furthermore, the integrated use of rhizobium + PGPR + 20 kg P2O5 / ha provided a higher net return and a B / C ratio of 1.88 times when compared to a single application of 40 kg P2O5 / ha with a B / C ratio of 1.72 times. Thus, there is a net savings of 20 kg P2O5 / ha with the use of rhizobium + PGPR inoculation without affecting economic returns.

Thus from the description above, research on the cultivation of cayenne pepper in the Bogor location can be concluded as follows:

- Planting white cayenne pepper with the standard fertilization model is still profitable with a B/C ratio of 1.63 times that shown in the control treatment.
- Treatment with the use of biofertilizer X1, X2, and a combination of both X1 + X2 biofertilizers generally increased production and profit compared to control.
- The highest increase in cayenne pepper production was in the X1 + X2 biofertilizer treatment of 15.9 tons / ha, which was significantly different from the control and treatment of the X2 biofertilizer which was 12.1 tons/ha, and the X2 biofertilizer treatment was not significantly different from the X1 biofertilizer which amounting to 13.6 tonnes/ha of fresh white chili.
- The increase in production value (income) due to the use of biofertilizer can compensate for the additional cost of biofertilizer material and the cost of fertilizing labor so that the profit is even greater.
- The highest increase in profit in the X1 + X2 biofertilizer treatment was 142.25%, biofertilizer X1 was 82.93%, and biofertilizer X2 was 47.72% higher than the control's content.

Results and Discussion of Big Red Chili Research

The results of research on production costs, biofertilizer application labor, total costs, chili production, income, and profit for each treatment on large red chilies can be seen in table 3.3.

Tabel 3. Biaya, Produksi, Tenaga Kerja Pemupukan, Total biaya, Produksi, Pendapatan dan Keuntungan Untuk Masing-masing Perlakuan pada cabai merah besar.

Uranian	**Biaya Produksi**	**Tenaga Kerja Aplikasi *Biofertilizer***	**Total Biaya**	**Produksi Cabai**	**Pendapatan**	**Keuntungan**
	Rp/Ha	Rp/Ha	Rp/Ha	Ton/Ha	Rp/Ha	Rp/Ha
Kontrol	90.802.000	-	90.802.000	13,8 c	206.512.500	115.710.500
Biofertilizer X_1	93.502.000	6.050.000	99.552.000	15,8 a	237.187.500	137.635.500
Biofertilizer X_2	92.602.000	4.550.000	97.152.000	14,3 b	214.200.000	117.048.000
Biofertilizer X_1+X_2	95.302.000	6.050.000	101.352.000	15,8 a	237.450.000	136.098.000

The DMRT test number followed by the same letter shows no significant difference at the significant level of α 5%

NB: The price of large red chilies is set according to the market price of IDR 15,000 / kg at the production location

Based on the data in Table 3 above, it can be stated that the use of biofertilizer affects the additional cost of the biofertilizer material, and the manpower of the fertilizer application, causing the total production cost to increase in each treatment. The X1 + X2 biofertilizer treatment caused the highest increase in production costs, fertilizer labor, and total production costs compared to other treatments including control.

This is by Wahyuningratri's research (2017) to determine the effect of growth and yield of large chili (C. annum L.) on the application of biological fertilizers and the concentration and frequency of application of appropriate biological fertilizers on plant growth and yield. The findings in general, the application of the concentration and frequency of biological fertilizers did not affect the growth and yield of large chilies, however, the application of biofertilizer concentrations separately affected the yield of large chilies on the parameters of fresh fruit weight per plant and the number of fruit harvested. The application of a concentration of 5 ml/liter of biological fertilizer can increase 41.71% of the fresh weight of red chilies per plant and 43.90% in the number of fruits per plant. This is by the findings of Waskito (2018) on the effect of the interaction between NPK dose and biological fertilizer concentration only at plant height at 28 DAS and the best treatment is 100% NPK dose with 0.5% biological fertilizer concentration which can increase the number and weight of fruit.

Research Setiawan et al. (2016) to determine the effect of using goat manure and urea with EM4 and to get the best combination dose to increase growth and yield of red chilies, the findings were that the combination of 50% N PKK + 50% N urea and EM4 was at the level of 30 and 40 L / ha. produce the best height, branching, and flower number of plants. Separately, application of 25% N PKK + 75% N urea yielded 292.67 fruits per plant, fruit weight per plant of 389.08 g per plant, and fruit weight per hectare of 10.92 tonnes/ha. EM4 at a level of 30 L / ha showed the best and optimal fruit weight with a productivity of 12.27 tonnes/ha. The control showed better growth but not significant compared to the combination of 25% N PKK + 75% N Urea with EM4 at levels of 30 and 40 L / ha. The combination treatment resulted in a 26.01% fruit number, 21.53% fruit weight per plant, and 25.15% fruit weight per hectare higher than the control.

From table 3, it can be further described to calculate the B / CR ratio and the percentage increase in the benefit of the biofertilizer treatment compared to the control in Table 4 below.

Table 4. Performance of Profits, B / C ratio, and Benefits of Big Red Chili Control

Description	**Total Biaya (a)**	**Pendapatan (b)**	**Keuntungan (b-a)**	**B/C Rasio (b/a)**	**Kenaikan Keutungan Terhadap Kontrol**
	Rp/Ha	Rp/Ha	Rp/Ha	Kali	%
Kontrol	90.802.000	206.512.500	115.710.500	2,27	0,00
Biofertilizer X_1	99.552.000	237.187.500	137.635.500	2,38	18,95
Biofertilizer X_2	97.152.000	214.200.000	117.048.000	2,20	1,16
Biofertlizer X_1+X_2	101.352.000	237.450.000	136.098.000	2,34	17,62

From table 4, it can be seen that the control treatment with standard inorganic fertilization cultivation of large red chilies is beneficial, this can be seen from the very high B / C ratio, namely income of 2.27 times the production cost.

The biofertilizer treatment was able to increase the productivity of chilies and increase profits in the X1, X2, and X1 + X2 biofertilizer treatments, but the X2 B / C ratio of biofertilizer treatment was still low compared to the control treatment.

The biggest increase in profit was found in the X1 biofertilizer treatment of 18.95%, followed by the X1 + X2 biofertilizer treatment of 17.62% and the X2 biofertilizer treatment by 1.16% higher than the control gain.

According to the results of research by BI (2013) that the analysis of large red chili cultivation in Tasikmalaya, West Java is very profitable, with an investment capital of 84 million, the productivity of 14 tons/ha per planting season, with a B / C ratio of 4.48 times with a payback period of 2.04 years and an IRR of 63.19%.

Another study conducted by Damanik et al. (2013) found that the income of red chili farmers is IDR 172,765,913 per hectare per planting season, which is higher than the income of cayenne pepper farmers which is only IDR 121,387,040 per hectare per planting season. The R / C and B / C values of red chili farming were 3.24 and 2.25. Meanwhile, the R / C and B / C values for cayenne pepper farming were 1.96 and 1.01, respectively. Thus, large red chili farming is more feasible and economically developed than cayenne pepper farming.

Based on the analysis and discussion above, it can be concluded as follows:

- Planting red chilies with the existing fertilization standards is still very profitable with a B / C ratio of 2.27 times as indicated by the control treatment with the use of standard inorganic fertilizers. Likewise, treatment with a biofertilizer is even more profitable.
- The use of biofertilizer X1, X2, and a combination of the two biofertilizers X1 + X2 can increase the production of chili and increase profits compared to ordinary inorganic fertilization (control).
- The highest increase in chili production was in the X1 biofertilizer treatment and the combined treatment X1 + X2, each of which had 15.8 tonnes/ha of fresh red chili productivity, followed by the X2 biofertilizer treatment with the productivity of 14.3 tonnes/ha which was significantly different from the control.
- The use of biofertilizer can increase productivity so that it can increase income which in turn can compensate for the additional costs of biofertilizer material and the cost of fertilizing labor so that the profit continues to increase.
- The highest increase in profit in the X1 biofertilizer treatment was 18.95%; followed by X1 + X2 biofertilizer treatment of 17.62%, and biofertilizer X2 was 41.16% higher than the control content.

V. CONCLUSION

- Planting large red chilies is more profitable than white bird's eye chilies based on the B / C ratio obtained.
- The production of large red chilies and cayenne pepper and the benefits obtained from the treatment of using X1 and X2 biofertilizers are also higher in combination than the control treatment.
- Increased production, income, and profits with the Biofertilizer treatment on white chili peppers higher than large red chilies,
- The highest increase in chili production for cayenne pepper in the X1 + X2 biofertilizer treatment was 15.9 tons/ha, and for large red chilies in the X1 treatment and the combined X1 + X2 were 15.8 tons/ha, respectively.
- The biofertilizer treatment of cayenne pepper is more responsive, increasing the highest gain by 142.25% of the control gain than the biofertilizer treatment of large red chilies which is the highest of 18.95% of the control gain.
- The increase in production value (income) due to the use of biofertilizer can compensate for the additional cost of biofertilizer material and the cost of fertilizing labor so that the profit remains high.

Suggestions

Further research needs to be carried out in different planting seasons, namely dry (dry) season with different soil types, without mulch, and different soil heights.

Recommendation

- Biofertilizer is suitable for use as additional inorganic fertilizers and manure in large red chili and white bird's eye chilies.
- The best use with a combination of biofertilizer X1 + X2 with inorganic fertilizers and standard manure in large red chili cultivation and white bird's eye chili.
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