

**THE EFFECT OF *PLANT GROWTH PROMOTING RHIZOBACTERIA*
AND MANURE ON THE GROWTH AND YIELD OF SHALLOTS
(*Allium cepa* L.) IN A VERTICAL CULTURE SYSTEM**

THESIS

By

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**BACHELOR PROGRAM OF AGROECOTECHNOLOGY
FACULTY OF ANIMAL AND AGRICULTURAL SCIENCES
UNIVERSITAS DIPONEGORO
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L.) IN A VERTICAL CULTURE SYSTEM

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2. Setiap ide atau kutipan dari karya orang lain berupa publikasi atau bentuk lainnya dalam skripsi ini, telah diakui sesuai dengan standar prosedur disiplin ilmu.
3. Penulis juga mengakui bahwa skripsi ini dapat dihasilkan berkat bimbingan dan dukungan penuh dari Pembimbing yaitu : **Dr. Ir. Eny Fuskhah, M.Si.** dan **A'isyah Surya Bintang, S.P., M.Sc.**

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SUMMARY

NURUL AULIA KHOERUNNISA. 23020220140038. 2025. Influence *Plant Growth-Promoting Rhizobacteria* and Manure on the Growth and Yield of Shallot Bulbs (*Allium cepa* L.) in a Vertical Culture System. (Supervisors: **ENY FUSKHAH** and **A'ISYAH SURYA BINTANG**)

The study aims to examine the effect of administering PGPR and several type fertilizer pen to growth And results tubers onion red in vertical culture system. The research was conducted in Cipaisan, Purwakarta District, Purwakarta Regency, West Java 6°32'54.7"S 107°26'21.2"E and in the Laboratory of Ecology and Crop Production, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro on month July–September 2024. Analysis element Hara on soil and manure was conducted by the Lembang Agro Chemistry Laboratory, Bandung, West Java, analysis of the number of PGPR bacterial colonies was conducted by the *Indonesian Center for Biodiversity and Biotechnology* (ICBB) Laboratory of PT. Biodiversitas Bioteknologi Indonesia, and analysis of post-treatment nutrient content was conducted by the Vegetable Crop Agricultural Instrument Standardization Agency Laboratory, Lembang, Bandung, West Java.

The experimental design used was a factorial randomized block design. with factor First is concentration PGPR with 4 level The second treatment and factor is the provision of several types of manure with 3 levels of treatment. Each treatment repeated as much as 3 time, so that there is 36 experimental units. The parameters observed included plant height, number of leaves, total chlorophyll content, stomatal density, root length, number of tubers, tuber diameter, plant wet weight, tuber wet weight, and tuber dry weight (oven).

The results showed that the administration of PGPR concentration significantly affected the parameters of plant height, root length, tuber diameter, plant fresh weight, tuber fresh weight, and tuber dry weight (oven). Meanwhile, the application of manure significantly affected plant height and root length. However, there was no interaction between the two treatments on the growth and yield of shallot bulbs. The administration of PGPR concentration of 30 ml/L was not significantly different from PGPR 15 ml/L and PGPR 45 ml/L in the parameters of plant height and wet weight. The administration of PGPR concentration 30 ml/L give influence but No different real with PGPR concentration 45ml/L on parameter diameter tubers, weight wet tubers, And weight dried shallot bulbs (oven). The PGPR concentration of 45 ml/L was significantly different from the concentration PGPR 30 ml/L on parameter long root. Giving fertilizer Goat and rabbit pens did not differ significantly in the parameters of height and length of shallot plant roots.

The conclusion was that a PGPR concentration of 30 ml/L produced the highest and most efficient results for several growth parameters and shallot bulb yield. Goat manure was more efficient, applied in smaller amounts, with results comparable to rabbit manure.

INTRODUCTION

The author expresses his gratitude to the presence of God Almighty for His blessings and His gifts writer can carry out study and completing the thesis entitled "The Effect of *Plant Growth Promoting Rhizobacteria*" (PGPR) And Fertilizer Pen to Growth And Results Shallot Bulbs (*Allium cepa* L.) in Vertical Culture Systems." The purpose of writing this thesis is to contribute to the field of research, especially agriculture. about utilization PGPR as fertilizer biological And Fertilizer Manure derived from animal waste as organic fertilizer for shallots planted in a vertical culture system, and is one of the requirements for obtaining a Bachelor of Agriculture degree at the Faculty of Animal and Agricultural Sciences, Bachelor Program of Agroecotechnology, Universitas Diponegoro, Semarang.

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CHAPTER I

INTRODUCTION

1.1. Introduction

Vertical cultivation technique is one of the agricultural cultivation methods that done with plant in a way vertical or tiered. Technique vertical farming can be applied on land yard or land limited with utilize the field vertical as place cultivation (Kusumo *et al .*, 2020). Method Vertical farming is designed to optimize yard space, making it highly suitable for meeting household food needs, especially in urban areas with limited land. This system is suitable for densely populated settlements or limited land (Hidayati *et al.*, 2018).

Horticultural commodities such as shallots have great potential for cultivation. use technique vertical farming Because height interest public awareness of shallot consumption as an essential spice. However, shallot production, which is not comparable to demand, especially in urban areas, can be caused by the conversion of agricultural land to non-agricultural uses. The conversion of agricultural land to housing and economic centers has triggered a reduction in shallot cultivation land, resulting in suboptimal production (Harahap *et al .*, 2023). Therefore, the application of vertical cultivation techniques, using home gardens as planting land, is crucial. cultivation can become alternative solution in do cultivation in limited land with objective For fulfil need onion red in scale

household. Cultivating plants using vertical cultivation techniques increases the utilization of land yard House become more productive And profitable because results the harvest can be used For fulfil consumption daily and can be sold as a side business (Utami *et al .*, 2022).

Implementation cultivation vertical farming offer efficiency use land and increasing crop production. However, the effectiveness and productivity of the vertical farming method depends on maintenance plant in a way intensive, especially in managing the growing medium, because the growing medium is one of the determining factors for the success of vertical cultivation. The disadvantage of the vertical cultivation system is that it requires regular maintenance, especially for fertilization and watering (Putra *et al .*, 2019). Vertical cultivation techniques generally use a limited volume of growing medium, so the nutrient content can be depleted more quickly and fertility is easily reduced. The growing medium in a vertical cultivation system is the main key that determines the ability of plant roots to absorb nutrients from the limited growing medium (Damanik and Suryanto, 2018). One solution that can be implemented to optimize the management of the growing medium Planting is done by providing nutrients in the form of *Plant Growth Promoting Rhizobacteria* (PGPR) and manure so that the availability of nutrients and the fertility of the planting medium in the vertical culture system are maintained.

Proper administration of PGPR can increase the nutrient content of the planting medium and optimize the growth and yield of shallots in the system. vertical farming. PGPR 30 ml/L increase growth plant with

presentation increase 10% And increase parameter results tubers with presentation increase of 20% – 40% compared to the control treatment (Sagala and Aini, 2023). In addition PGPR, production onion red can improved with giving Animal manure is an excellent organic fertilizer for improving the physical, chemical, and biological properties of the soil (Aryani *et al .*, 2019). Rabbit manure increases the fresh and dry weight of bulbs, presumably due to the availability of N, P, and K, which contribute to the growth and development of shallots (Budias *et al .*, 2022).

Plant Growth Promoting Rhizobacteria (PGPR) as a biofertilizer supports plant growth plants with how to increase availability essential nutrients And fertility media planting. PGPR functioning as fixator nitrogen, phosphate solvent, and Indole Acetic Acid hormone producer (Jannah *et al.*, 2022). The provision of manure is useful as a source of organic material that helps maintain and improve the fertility of the planting medium. The combination of PGPR and manure can accelerate the decomposition process of organic matter, thereby increasing the availability of nutrients in the soil to improve plant growth and yield (Saputri *et al .*, 2022). Therefore, research on the effect of providing various concentrations of PGPR and several types of manure is necessary to optimize the management of planting media in vertical cultivation systems to maintain fertility. planting media, thus supporting plant growth and yields which will help meet the need for shallots, especially on a household scale.

1.2. Objective And Benefit

Objective from research This is as follows :

- 1. To examine the effect of PGPR administration on the growth and yield of shallot bulbs in a vertical culture system.**
- 2. To examine the effect of providing several types of manure on the growth and yield of shallot bulbs in a vertical culture system.**
- 3. To examine the interaction between the provision of PGPR and the provision of several types of manure on the growth and yield of shallot bulbs in a vertical culture system.**

Benefits of research this is as following :

- 1. Provides information regarding the effect of PGPR administration on the growth and yield of shallot bulbs in a vertical culture system.**
- 2. Give information related to the effect of fertilizer application pen on the growth and yield of shallot bulbs in the vertical culture system.**
- 3. Provides information regarding the effect of the interaction between the provision of PGPR and manure on the growth and yield of shallot bulbs in a vertical culture system.**

1.3. Research Hypothesis

Hypothesis from study :

- 1. Providing a PGPR concentration of 30 ml/L to shallot plants in the vertical culture system resulted in the highest and most efficient growth and yield of shallot bulbs.**
- 2. Providing rabbit manure fertilizer to shallot plants in the system vertical farming produce growth And results tubers onion highest red and efficient.**
- 3. There is an interaction between the administration of PGPR and manure on the highest and most efficient growth and yield of shallot bulbs.**

CHAPTER II

LITERATURE REVIEW

2.1 Plant Onion Red (*Allium cepa* L.)

Onion red is one of commodities featured which lots cultivated because it is used for various needs, from household to industrial. Red onions are a commodity superior which makes a significant contribution to the development of the regional economy, both in and outside country (Muhammadsyah *et al.* , 2016). Onion red have a variety benefits no just as flavoring flavor, but also beneficial for human health. Antioxidants and phytochemical compounds found in the leaves onion red beneficial For health heart, prevent risk cancer, smooth digestion, reduce blood sugar levels, rejuvenate the skin, and overcome premature aging (Bah *et al.* , 2012). Classification of shallots (*Allium cepa* L.) according to Linnaeus and Von (1753) is as follows: Kingdom : Plantae

Division : Magnoliophyta

Class : Magnoliopsida

Order : Aspargales

Family : Amaryllidaceae

Genus : *Allium* L.

Species : *Allium cepa* L.

The morphological characteristics of shallots can be seen in their root system, leaves, flowers, fruit, and bulbs. Shallots have a shallow, fibrous root system and branch roots. Shallots have fibrous roots with a disc-shaped stem covered with leaf sheaths, forming a pseudostem in the form of a bulb (Ami and Candra, 2019). Shallots have single, cylindrical leaves with pointed tips. Shallot leaves are light to dark green, elongated, cylindrical, and hollow (Fajjriyah, 2017).

Flower onion red including flower compound shaped bunch stemmed. Onion red own diverse color flower like colored white, purplish, white with lines green depends with its varieties, the flowers carry out self-pollination or cross-pollination with the help of pollinating insects (Kavitha and Reddy, 2018). The red onion fruit is round with a blunt tip. Fruit onion red shaped like capsule And containing seed Which Black in color (Elattar *et al.* , 2024). The bulbs are purplish red with a pungent odor. Shallot bulbs form from the base of the leaves, then form bulbs from the stem, which change shape and function (Simanjuntak, 2018).

Shallots have specific growing conditions for optimal growth. They can be cultivated in dry, sunny climates with temperatures ranging from 25°C to 32°C (Nugroho and Khoyriyah, 2023). Onion red can grow on plains low until tall that is 0 –1,000 meters above sea level (Harahap *et al.* , 2022). If there is an increase in rainfall or dry days rain which too tall can lower productivity and can

causes shallots to be attacked by *fusarium wilt disease* (Sholikin and Haryono, 2019). Shallots can grow well in crumbly soil texture. Soil with a crumbly structure, medium-high texture, good drainage and aeration and contains optimal organic matter and a soil pH of 5.6–6.5 (Rahmayanti, 2020). Shallots have varying fertilizer requirements depending on environmental conditions and the type of seed used. Fertilizer application with a dose of N 190 kg/ha, P₂O₅ 92 kg/ha, and K₂O 120 kg/ha and a planting distance of 15 × 20 cm is optimal for shallot bulb production and produces a dry bulb weight of 35.48 g/plant (Sumarni *et al.* , 2012).

There are many varieties that have been widely cultivated by farmers in Indonesia, such as the Bima Brebes, Sembrani, Sumenep, Trisula, and Maja Cipanas. Various varieties onion red Which endeavored farmer Which also adapted to the cultivation environment conditions including Kuning, Bangkok Warso, Bima Timor, Bima Sawo, Bima Brebes, Maja Cipanas, Engkel, Bangkok, Philippines, And Thailand (Rianti *et al.* , 2021). Variety Maja Cipanas is One of the varieties often used by farmers for cultivation because it does not require high business costs. Based on the results of the panelist acceptance test, it was found that that onion red varieties Maja Cipanas popular by panelists because it has a shape, size, color, and aroma that consumers like (Musaddad, 2017). However, the production of the Maja Cipanas variety of shallots tends to be low. Based on research, the Maja Cipanas variety shows the lowest productivity compared to the Selupu Merah and Batu Ijo varieties (Oktavia *et al.* , 2019). By Because That, required giving nutrition addition

like PGPR And fertilizer pen Which his hopes can support cultivation and increase the production of shallots.

2.1. Vertical Gardening System

Land agriculture Which experience change become settlement inhabitant or industrial sites significantly impact food productivity. The area of agricultural land continues to decline due to the frequent conversion of land into non-agricultural land. agriculture, while continuing happen improvement request agricultural products, one of which is onions red (Sakti and Sugito, 2018). Wide land harvesting and production of vegetable crops in DKI Jakarta is fluctuating, including 1,635 ha (2018), 1,685 Ha (2019), 1,535.1 Ha (2020), 1,569.85 Ha (2021), And 1,389.07 Ha (2022), and the area of shallot harvest decreased in 2022, namely 0.67 ha temporary on year 2021 that is 1.06 Ha (Wahyuni *et al .*, 2022). Land The increasingly limited agricultural land, especially in urban areas due to land conversion, will impact the availability of food for the community. Therefore, people in urban areas must started trying to meet their food needs independently (Fauzi *et al .*, 2016).

Alternative solution which can done in overcome problem The result of the conversion of agricultural land is to implement an urban farming system . Urban *farming* is one way to increase food access in region urban as well as as optimization potential yard House to avoid the conversion of agricultural land to non-agricultural land (Septya *et al .*, 2021). Implementation *urban farming* can done with system cultivation in a way

vertical farming. Vertical farming is technique cultivation Which done in a way upright by using PVC pipes or wooden shelves as a planting medium (Bria *et al .*, 2020). Vertical cultivation techniques can be an alternative for cultivating plants. area Which minimal land consequence over function land agriculture. System Vertical farming can be a solution to the difficulty of finding agricultural land that has been displaced by housing and industry (Hidayati *et al .*, 2018).

Cultivation plant in a way vertical farming No only suitable used by the community urban, but Also by farmer Which own land limited. Vertical farming system very suitable implemented for farmer or individual Which have limitations land, but want to do cultivation plant as much as- many (Munthe *et al .*, 2018). Technique cultivation vertical farming become solution for onion farmers red in Village Buluharjo consequence existence threat over function land into a housing complex (Pujiati *et al .*, 2021). The vertical cultivation system tends to be more friendly environment. Technique vertical farming more friendly environment because it tends to No use material chemistry And material experience For media plant it like fertilizer pen animal cattle, land, husk, And bamboo (Utami *et al .*, 2022). Cultivation in a way vertical farming own Lots superiority especially in maximizing land Which limited. Excess main cultivation vertically is save land, so that system This very suitable implemented For optimization of agricultural production on narrow land (Pujiati *et al .*, 2021). Other advantages is efficiency cost maintenance, cultivation can done When just, and give profit economy. Excess system vertical farming is No depends season certain, efficiency power Work, equipment, And maintenance

plants, and provide benefits because the cultivation results can be traded (Haqi *et al.*, 2022; Yanti *et al.*, 2018).

Previous research has shown that vertical cultivation is effective for small plots of land because it can increase land use efficiency. Vertical cultivation of mustard greens is 9 times more efficient than vertical cultivation. system plant beds on wide land 3.2 m^2 , total production vertical farming system as big as 9,360 g And total production of the raised bed system 6,396 g (Nur *et al.*, 2014). Results test show that implementation cultivation in a way Bench terrace vertical farming can double the yield of kale, mustard greens, and pak choy compared to conventional methods, namely 6.4 kg to 12.764 kg of kale, 8.768 kg to 17.512 kg of green mustard greens, and 6.720 kg to 13.024 kg for pak choy (Isnaeni and Ramadhan, 2021).

Vertical cultivation can become one of the options farming in narrow land without lowering productivity plant. Plant Vegetables such as green mustard greens, spinach, and chilies cultivated in *polybags* with a vertical culture system showed increased yields, namely green mustard greens 99 g, chilies 51.5 g, and spinach 85.25 g, compared to garden plots, namely mustard greens 74 g, chilies 45.67 g, and spinach 26.25 g (Ariati, 2017). Use method vertical farming For cultivation can be an opportunity for farmers to increase crop production. Pakcoy plants Which planted in a way vertical farming known get weight average/pipe 76.80 g/planting hole, total production in one harvest reaches 40 kg with productivity Which produced as big as 0.8 kg/hole plant, so that can become

potential for farmer groups to increase production in limited land conditions (Tobing *et al.* , 2023).

Vertical cultivation techniques require regular plant care, particularly fertilization and watering. The downside to vertical cultivation is that it requires regular maintenance and can easily be damaged if plants are moved carelessly (Nurjasmi, 2021). Fertilization is essential. done For still guard fertility media planting media plant In the vertical culture system, it is a growing place to support roots, because from this planting medium plants can absorb nutrients in the form of nutrients through their roots (Solikah *et al.* , 2019).

The addition of organic materials such as fertilizer to a vertical cultivation system can maximize crop yields and maintain the fertility of the vertical cultivation growing medium. The use of 25 kg of chicken manure and soil in a vertical cultivation system as an alternative form of land use and the application of organic farming has an impact on growth parameters and production per plant (100.67 g) and per vertical drainage channel (853.33 g) (Febryani *et al.* , 2022). Vertical cultivation will be more optimal for plant growth through the addition of fertilizer and nutrients to the growing medium. The addition of mycorrhizae, materials organic, And PGPR on media plant vertical farming can increase fresh weight tubers per plant And per m² as big as 23.08%, 34.87%, And 15.22% compared to just soil as a planting medium (Damanik and Suryanto, 2018).

2.2. Role *Plant Growth Promoting Rhizobacteria* (PGPR) on Shallot Cultivation

Plant Growth Promoting Rhizobacteria (PGPR) are a group of bacteria originating from the plant rhizosphere and are useful for stimulating plant growth. PGPR is consortium bacteria Which active colonize root Plants and function to increase plant growth, increase crop yields, and improve the fertility of cultivated land (Naikofi and Rusae, 2017). *Plant Growth Promoting Rhizobacteria* (PGPR) can be made by utilizing the roots of bamboo, mimosa, or mimosa plants. green beans. Utilization of bamboo root extract contain *Pseudomonas* bacteria *fluorescens* plays a role as PGPR which produces phytohormones such as IAA, cytokinins, gibberellins, and inhibits ethylene production, thereby increasing plant growth and yield (Setyawan *et al.* , 2022).

Another raw material that can be used to make PGPR is the mimosa pudica root. Microorganisms that colonize mimosa pudica roots include nitrogen-fixing *rhizobium* bacteria, *Bacillus* sp., and other bacteria. *Pseudomonas fluorescent* can dissolve phosphate (Istiqomah *et al.* , 2018). Another ingredient for making PGPR is the roots of legume plants, such as mung bean roots. Mung bean roots contain microorganisms such as *rhizobium* bacteria , or nitrogen-fixing bacteria, which can help provide nitrogen nutrients to support plant growth and development (Astija *et al.* , 2022).

The microorganism content in PGPR, such as nitrogen-fixing bacteria, has benefits for improvement quality soil. *Azotobacter* and *Azospirillum* are groups of bacteria that play a role in fixing N₂, producing the phytohormone IAA, gibberellin, and cytokinin (Siagian *et al.* , 2019). Bacteria from the genus *Bacillus* can dissolve phosphate elements so that they are available to plants. *Bacillus* And *Burkholderia* produce IAA, And enzyme *phosphomonoesterase* to dissolve phosphate absorbed in the form of Fe-P and Al-P compounds, thereby increasing the availability of soil phosphorus (Hafri *et al.* , 2020). Bacteria from the genus *Pseudomonas* play a role in dissolving phosphate and potassium nutrients so they can be absorbed by plants. *Pseudomonas bacteria* can help dissolve phosphate and potassium elements in the soil, thereby increasing the availability of P and K elements for plants (Firmansyah *et al.* , 2015).

Plant Growth Promoting Rhizobacteria (PGPR) has benefits as a *biofertilizer* or fertilizer biological For support production plant. Application PGPR as a *biofertilizer* plays a role in maintaining soil fertility, thereby influencing the photosynthesis process and increase vegetative growth of plants (Husnihuda *et al.* , 2017). *Plant Growth Promoting Rhizobacteria* (PGPR) as a *biofertilizer* is useful in providing nutrients for plants. The beneficial bacteria in PGPR act as *biofertilizers* , helping to maintain plant health by helping dissolve phosphate, fix nitrogen, and lengthen roots. plants, and as a biostimulant that helps distribution nutrition plant, so that growth And its development becomes optimal (Kania and Maghfoer, 2018).

The way *Plant Growth Promoting Rhizobacteria* (PGPR) works to increase growth and dissolve nutrients in the soil is that the bacteria will grow in the plant root area. The working mechanism of PGPR is by colonizing the plant root area, so that PGPR bacteria can synthesize auxin and cytokinin which stimulate growth and stimulate division. cell plant (Ula *et al.* , 2018). PGPR Also Work through nitrogen supply, solvent phosphate, And potassium so that can absorbed plant. PGPR helps the plant growth process by binding free N in the air so that it is available to plants. The PGPR group of bacteria can help the uptake process N free For fulfil need element Hara N on plant both directly and non-symbiotically (Jannah *et al.* , 2022).

The availability of nitrogen affects the availability of phosphorus which can help formation onion bulbs red. Ion phosphate more easy absorbed If nitrogen is available in the form of NO_3^- ions , phosphorus is needed by shallots for root development and bulb filling (Mubarok *et al.* , 2022). PGPR is used as a solvent for phosphorus which is often absorbed in the soil. Phosphate-solubilizing bacteria, especially *Pseudomonas fluorescens*, are commonly found in bamboo roots and are able to increase phosphorus solubility in the soil through colonization . rhizosphere root (Pratiwi *et al.* , 2017). PGPR Which succeed colonize roots plant will working with produce certain compounds For helps dissolution element Hara in land. PGPR Which contain bacteria solvent phosphate such as *Pseudomonas* sp., And *Bacillus* sp. capable dissolve phosphorus bound in in land

by releasing organic acids so that phosphorus can be accessed by plants (Permatasari and Nurhidayati, 2014).

Plant Growth Promoting Rhizobacteria (PGPR) Application The right fertilizer can help the growth, development, and yield of shallots. Applying PGPR with 30 ml of watering can significantly increase the weight of shallots. fresh total plant And produce average highest on tall plant growth, number and area of leaves, fresh and dry weight, number of bulbs, and bulb diameter (Novatriana and Hariyono, 2019). Administering PGPR at certain concentrations affects the growth and yield of shallot bulbs. A PGPR concentration of 30 ml/L can increase plant growth, namely plant length, amount leaf 42 HST until 10% And increase diameter tubers, fresh weight tubers, And per hectares as big as 20% – 40% (Sagala And Aini, 2023). The administration of PGPR 30 ml/L was not significantly different from PGPR 40 ml/L in plant height, but PGPR 40 ml/L give results best to heavy wet tubers shallots (Wijaya, 2021). PGPR 30 ml/L without adding catfish pond water showed the best results on the parameters highest plant height, bulb diameter, bulb weight, and dry weight of shallot roots (Mursyid *et al .*, 2023). The results of the study showed that the administration of PGPR 15 ml/L had the best effect on the number of shallot leaves (Monika *et al .*, 2025).

PGPR application is known to have a positive effect on shallot production. The best shallot bulb production was obtained with 30 ml PGPR and 20 tons/ha of rabbit manure, amounting to 7.73 tons/ha (Wahyuningsih *et al .*, 2017). PGPR provision 30 ml/L and manure

goat 25 tons/ha increase growth long plant And amount leaves, while PGPR 30 ml/L and goat manure 20 tons/ha increased yields heavy tubers (Jonah *et al .*, 2021). Giving PGPR 60 ml/L And fertilizer 30 tons/ha of cattle sheds had the highest significant difference in terms of growth parameters and production results plant as big as 15.09 ton (Kristianti *et al .*, 2021). Performance PGPR Its role as a *biofertilizer* can be optimized by adding organic materials such as manure as an energy source for microorganisms. The availability of nutrients can assist PGPR in carrying out their activities, thereby influencing plant productivity (Ningrum *et al .*, 2017).

2.3. Application Fertilizer Pen on Onion Red

Providing organic fertilizer in cultivation can be useful for maximizing plant growth and yield, and is an environmentally friendly fertilizer. environment. Fertilizer organic is fertilizer Which made from remainder The metabolism of living things that contains nutrients for plant growth (Abror *et al .*, 2018). Manure is an organic fertilizer derived from animal waste. Which mixed with material other like husk burn or *cocopeat* . Manure is organic fertilizer which can useful for providing nutrients for plants, improving the physical, chemical and biological properties of the soil (Sulistyaningsih, 2019).

Manure serves as a nutrient provider in the growing medium, thus supporting plant growth and development. capable increase quality fertility And structure land, so that

Roots will develop well and nutrient absorption will be maximized (Hidayati *et al* ., 2021). Adding manure is beneficial for improving soil properties through its association with microorganisms. Applying manure as organic matter can improve the physical, chemical, and biological properties of the soil through decomposer organisms that break down organic matter into humus (Sitorus *et al* ., 2023).

The use of manure has the advantage of being environmentally friendly compared to chemical fertilizers. Organic animal manure and organic farming are expected to be widely implemented to maintain soil function and quality and the cultivation environment (Suyitman *et al* ., 2019). Manure is *slow-release* , so nutrient loss due to leaching is less frequent. Fertilizer pen including fertilizer *slow release* Which release nutrients slowly with the help of decomposing bacteria, so that the loss of nutrients due to washing water more small happen (Nasution *et al* ., 2016). Fertilizer pen can be a source of plant nutrition for optimal results because the nutrients are available in time Which Enough long. Task main fertilizer organic is become a food source for plants so they can grow well and produce fruit (Basysya *et al* ., 2022).

Fertilizer pen can originate from dirt goat, cow, chicken, rabbit, horses, and other livestock. The manure content of each type varies; cow manure contains 0.4% N, 0.2% P, and 0.1% K, with a fairly high N content (Prasetyo, 2014). Cow manure is beneficial For help increase fertility media planting. Fertilizer

Cow sheds can improve the physical properties of the soil, increase infiltration, aeration, and percolation, as well as supply oxygen For growth root, so that support the growth of shallots (Supariadi *et al .*, 2017). Application of cow manure increase content material organic And availability element Hara in in the ground, so that it can support growth tubers onion red (Supariadi *et al .*, 2017).

The use of cow manure in shallot cultivation is highly beneficial because it can enhance plant growth. Several previous studies have shown that the use of cow manure can support shallot cultivation. Application of 20 tons of cow manure per hectare has been shown to affect plant height, leaf number, bulb number, bulb diameter, and bulb weight (Murjani and Isma, 2019). The use of 20 tons of cow manure per hectare significantly improved plant growth. tall plant on 4 – 8 MST And growth leaf onion red becomes more optimal (Prasetya and Maghfoer, 2021).

Proper application of manure can result in optimal bulb production. The 30 ton/ha treatment of cow manure produced the highest number of onion seedlings compared to the 15 ton/ha and 45 ton/ha treatments (Suciaty *et al .*, 2015). Observations of yield parameters showed that the manure pen cow 20 tons/ha produce weight fresh tubers, weight dry tubers, and optimal tuber diameter (Sagala and Aini, 2023). The results of the study showed that growth And production onion red highest obtained by providing 15 tons/ha of cow dung of 8.25 tons/ha (Marlina *et al .*, 2020).

Goat manure contains a high amount of nitrogen. Nutrient content in goat manure includes: N as big as 1.41%, P 0.54%, And K 0.75% (Muhammad *et al .*, 2017). Fertilization pen goat can increase quality land And will affects plant growth. Goat manure as a soil amendment can improve soil fertility physically, biologically, and chemically, thereby increasing crop yields (Hartati *et al .*, 2022). goats are useful for increasing availability element nutrients such as N and helps the absorption of nutrients so that it influences the process of formation and development of plant organs and supports plant production (Sudewi and Indriani, 2017).

Adding goat manure to shallot cultivation can support the growth and yield of shallot bulbs. Several studies have shown that goat manure is effective in increasing soil fertility. And results production. Giving fertilizer pen goat 25 tons/ha And PGPR at 30 ml increased leaf length and number, while a dose of 20 tons/ha increased shallot bulb weight (Yunus *et al .*, 2021). Goat manure at 25 tons/ha affected shallot leaf number, presumably due to its sufficient nutrient content for initial plant growth (Sularmi *et al .*, 2023).

The addition of goat manure not only increases growth, but also helps increase the productivity of shallot plants. Productivity highest obtained on treatment fertilizer pen 15 tons/ha

of 13.71 tons/ha, because goat manure contains more K than the element Hara other, so that beneficial For repair quality tubers shallots (Shofiah and Tyasmoro, 2018). The high content of N, P, and K nutrients in goat manure affects the process of cell division and multiplication, as well as plant organ formation. Application of 20 tons/ha of goat manure yielded better results, particularly in terms of fresh weight (13.98 tons/ha) and dry weight (12.11 tons/ha), as well as tuber diameter, compared to no fertilizer application (Kania and Maghfoer, 2018).

Rabbit manure is not yet widely used, but it contains Hara Which Enough For fulfil need Hara plant. Based on laboratory tests, rabbit manure contains 2.28% N, 2.31% P, and 1.34% K (Sitompul *et al .*, 2014). Rabbit manure can improve the fertility and looseness of cultivated land, thereby supporting plant growth. Rabbit manure improves soil fertility by making it more fertile, loose, providing sufficient oxygen, and promoting microbial growth, thus optimizing plant productivity (Januarti *et al .*, 2016).

Rabbit manure is able to provide the required macro nutrients by plant. A number of study show that fertilizer rabbit cage can increase fertility land And growth plant. Providing rabbit manure fertilizer can improve the quality of soil fertility so that the roots develop well and nutrient absorption will be wider (Rachman) *et al .*, 2021). Application fertilizer pen rabbit influential to

growth vegetative plant. Fertilizer pen rabbits are fast available and can absorbed with Good by plant, so that stimulate growth roots, height, and The number of leaves to increase the photosynthesis process in plants (Nugraha *et al .*, 2023). The addition of 1,500 g of rabbit manure fertilizer + 1,500 g of sand soil mixture had a significant effect on the growth of shallot plants (Anto, 2018).

The available nutrients can increase crop production. Providing rabbit manure can... retains water and nutrients in the plant's root zone, making macronutrients available for cell division and producing higher fresh weight (Tamot and Suryani, 2019). Rabbit manure at 30 tons/ha increased the fresh and dry weight of tubers, presumably due to the availability of N, P, and K. support the growth of shallots (Budias *et al .*, 2022). Giving fertilizer pen rabbit 20 tons/ha And PGPR 30 ml produces the best shallot bulb production (7.73 tons/ha), manure rabbit 20 tons/ha And PGPR 20 ml produce long plant the best, and fertilizer pen rabbit 20 tons/ha with PGPR 10 ml produce wide highest leaves (Wahyuningsih *et al .*, 2017).

CHAPTER III

MATERIAL AND METHOD

The research was conducted from July to September 2024, in Cipaisan, Purwakarta District, Purwakarta Regency, West Java 6°32'54.7"S 107°26'21.2"E, analysis of nutrient content of manure and pre-treatment soil was carried out by sending samples to the Lembang Agro Chemistry Laboratory, Bandung, West Java, analysis of the number of bacteria in PGPR was carried out at the ICBB (*Indonesian Center for Biodiversity and Biotechnology*) Laboratory of PT. Biodiversitas Bioteknologi Indonesia, analysis of nutrient content of post-treatment soil was carried out by sending soil samples to the Vegetable Crop Agricultural Instrument Standardization Agency, Lembang, Bandung, West Java and analysis of chlorophyll content and stomatal density was carried out at the Ecology and Plant Production Laboratory, Universitas Diponegoro.

3.1. Material Study

Material Which used in study consists of from tool And material. Tool used is ruler, scales digital, term push, glass measuring, meter, bottle, watering can, tarpaulin, container, jar, used gallon jug, knife, scissors, tray, stirring tool, pan, *polybag* , label marker, sieve, plastic, mortar and pestle, filter paper, pumpkin Erlenmeyer flask, cuvette, *spectrophotometer* , oven, envelope, rubber, tape, slides, microscopes and *cell phones* . The materials used are plant seeds (tubers) onion red varieties Maja Cipanas, land, husk burn, EM4, sugar,

bran, shrimp paste, fertilizer pen dirt cow, fertilizer pen dirt goat, and rabbit manure fertilizer, PGPR natural ingredients from bamboo roots, mimosa roots, and green bean roots, vertical culture racks, water, 80% ethanol, and clear nail polish.

3.2. Method Study

3.2.1 Design Test

This research is an experimental research with treatments in the form of providing *Plant Growth Promoting Rhizobacteria* (PGPR) and manure. This implemented with test factorial 4×3 with base randomized block design (RAK) consisting of 3 replications.

Factor First (A) consists of 4 level treatment that is :

A0: control

A1: PGPR 15 ml/l

A2: PGPR 30 ml/l

A3: PGPR 45 ml/l

Factor second (B) consist of 3 treatment level that is :

B1: cow dung manure (70 g/plant)

B2: fertilizer pen dirt goat (50 g/plant) B3: rabbit

manure fertilizer (60 g/plant)

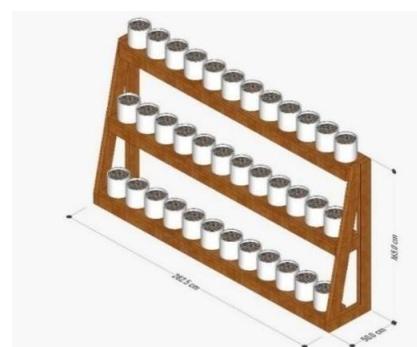
A combination of 12 treatments with 3 replications resulted in 36 experimental units. Each experimental unit consisted of 2 plants, so There are 72 plants used in the research.

3.2.2 Procedure Study

Procedure The research carried out included preparation of research tools and materials, making vertical culture racks, making PGPR starters and their breeding media, making animal manure fertilizer, preparing shallot bulb seeds and planting, pre-treatment soil nutrient analysis, analysis of bacterial content in PGPR, analysis of nutrient content in manure, application PGPR And fertilizer pen, maintenance, observation, harvesting, post-treatment soil nutrient analysis, and data analysis.

a. Making Vertical Shelves

Vertical farming system rack can using bamboo shelves, wood, or Other materials made in tiers or layers. Vertical shelves serve as a place to plant or place planting containers such as pots or *polybags* , thus saving cultivation space. The vertical shelves used are shown in Illustration 1.



Vertical Shelf

Rack vertical farming Which used is rack vertical farming Which made from wood and consists of 3 levels shaped like stairs with a length of 282.5 cm and a width of 50 cm. Tall between rack Which used range 60 cm. Distance between rack the wider one will get more sunlight, efficiency of use light, circulation air more Good, And influence growth and plant development (Pamungkas and Rahardjo, 2021).

b. Making The culprit PGPR (Plant Growth Promoting Rhizobacteria)

Making root cause PGPR (*Plant Growth Promoting Rhizobacteria*) carried out by preparing tools and materials including jars as containers for fermenting PGPR starter, plastic, rubber, scissors, knives, digital scales, bamboo roots, mimosa roots, root peanut green, as much as 250 g, and water. Root used for PGPR root cause soaked to in 1 L water which already cooked, then left alone for 3-4 days. If bubbles appear on the surface of the solution, the PGPR has been successfully cultured (Putri *et al* ., 2019). To make a PGPR culture, ingredients include 400 g of granulated sugar, 2 g of shrimp paste, 1 kg of rice bran, and 10 L of water. Cook until boiling, stirring to prevent sedimentation. The ingredients are cooled and the solution is then added to the mixture. Which has cold filtered. The culprit PGPR entered to in solution which has been filtered as much as 250 ml. The solution is stirred and put into a tightly closed container to ferment for approximately 14 days, and the container is opened every 2 day very, then stirred in a way slowly (Catfish *et al* ., 2021). Indicators of success in making PGPR are a brownish solution, the appearance of foam or bubbles, and the distinctive aroma of fermented cassava.

c. Making Fertilizer Pen

Making manure from animal waste is done by preparing the tools and materials used in making fertilizer, including tarpaulin, hoe, shovel, drums, dirt cow, dirt goat, dirt rabbit, husk burn, EM4, water, sugar. Dirt animal which used pounded moreover formerly so that The texture is smoother, especially for goat and rabbit manure. The fermenter is made in the form of mixture EM4 10 ml with 2 spoon sugar Which has dissolved to in 1 L water And stirred until evenly, Then left alone during overnight.

The livestock manure used was 15 kg and burnt rice husks 7.5 kg. Then, dough stirred in a way evenly, Then fertilizer left alone And entered into sacks or covered with tarpaulin for the fermentation process. The fermentation process is carried out during not enough more 15 – 30 day. Done opening And Stir the fertilizer every 2 days. Manure is used as the base fertilizer for the planting medium. that is 7 day before seeds moved plant And on moment plant aged 6 MST (Asri *et al .*, 2019). Addition of several types of manure based on needs element Hara N (nitrogen) on onion red that is equivalent with 190 kg N/ha, the calculation of N requirements for shallots is in Appendix 4.

d. Analysis Contents Nutrient Land Pre- Treatment

Analysis of nutrient content in pre-treatment soil was carried out by sending samples to the Lembang Agro Chemistry Laboratory, West Bandung Regency, Central Java. West. Contents nitrogen, phosphorus, potassium, And c-organic in land The content was measured in the planting medium before being given PGPR and manure. Analysis covering analysis level water (%), C-organic (%), Total (%), C/N, Total

(P_2O_5 HCl) (mg/100g), And Total (K_2O HCl) (mg/100g). Results analysis The nutrient content of pre-treatment soil is presented in Table 1.

Table 1. Results Analysis Nutrient Content Pre- Treatment Land

| Criteria Method | Parameters | Outcome Assessment | Testing |
|-------------------|-------------------|--------------------|---------|
| N (%) | Gravimetry | Currently | 0.35 |
| P_2O_5 (%) | Spectrophotometry | Very Tall | 0.281 |
| K_2O (%) | Kjeldahl | Very Tall | 0.074 |
| $C_{organic}$ (%) | Spectrophotometry | Tall | 4.89 |
| C/N | - | Currently | 14.0 |
| Level Water (%) | AAS | - | 13.56 |

Source: Content Analysis Results Soil Nutrients Pre-Treatment in Agro Chemistry Laboratory, 2024

Results analysis content Hara land pre-treatment show that The N value is included in the medium criteria with a value of 0.35%, the P_2O_5 value is included in the very high criteria with a value of 0.281% (281 mg/100 g), and the K_2O value is 0.074% (74 mg/100 g). This is in accordance with the soil analysis assessment criteria. Hall Testing Standard Instrument Land And Fertilizer (2023) that is mark N (%) with a range of 0.21-0.5% including moderate criteria, P_2O_5 and K_2O values > 60 (mg/100 g) is included in the high criteria, $organic\ C$ (%) with a range of 3-5% is included in the high criteria, C/N with a range of 11-15 is included in the medium criteria.

e. Analysis Contents Element Hara Manure

Testing content fertilizer pen done with send sample to the Lembang Agro Chemical Laboratory, West Bandung Regency, West Java. Content analysis Hara covering analysis C-organic (%), Total (%), C/N, Total (P_2O_5

HCl) (%), and Ktotal (K₂O HCl) (%). Results of nutrient content analysis in manure is presented in Table 2.

Table 2. Results Analysis Contents Hara Manure

| Test Method/Tool | Parameters | Manure | | |
|-----------------------------------|-------------------|--------|-------|--------|
| | | Cow | Goat | Rabbit |
| N (%) | SNI 7763: 2018 | 0.82 | 1.24 | 1.03 |
| P ₂ O ₅ (%) | Spectrophotometry | 0.94 | 1.11 | 1.42 |
| K ₂ O (%) | | 1.08 | 2.49 | 2.26 |
| C _{organic} (%) | SNI 7763: 2018 | 12.60 | 18.29 | 19.55 |
| C/N | - | 15.4 | 14.8 | 19.0 |
| Level Water (%) | SNI 7763: 2018 | 4.86 | 5.52 | 4.81 |
| pH | | 8.46 | 8.58 | 8.34 |

Source: Results of Nutrient Content Analysis of Manure in the Agro Chemistry Laboratory, 2024

Results analysis content Hara fertilizer pen show that macro nutrient analysis parameters, C/N ratio, pH, cow, goat, and rabbit manure, organic C of goat and rabbit manure, have content in accordance with SNI 7763:2018 solid organic fertilizer quality requirements (N+P₂O₅ + K₂O with a minimum of 2 %), C/N (maximum 25), pH (4–9), and organic C (minimum 15%). Meanwhile, the water content in manure still does not meet the standards because it is below 8-25%.

f. Analysis Amount Colony Bacteria PGPR

Analysis amount colony PGPR bacteria done with send sample to the ICBB Laboratory of PT. Biodiversitas Bioteknologi Indonesia, Bogor City, West Java. The content analysis was carried out in accordance with the minimum technical requirements for the quality of compound liquid biofertilizer content based on the Decree of the Minister of Agriculture. Agriculture Republic Indonesia No. 261/KPTS/SR.310/M/4/2019 (Attachment

7). Analysis amount colony bacteria use method *Total plate count* And *Pour plate* .
Result bacterial colony count analysis The natural PGPRs produced are presented in Table 3.

Table 3. Results Analysis Amount Colony Bacteria PGPR Rooting
Mimosa Bamboo, and Green Beans

| Unit Method | Parameters | | No. Identification Biofertilizer Liquid |
|-----------------------|--|--------|--|
| | | | 2408.06434 |
| P | ICBB/MU/12.001.13 Solvent Bacteria (<i>Plate Count, Pour Plate</i>) | CFU/mL | 1.33×10^8 |
| Bacteria Solvent K# | <i>Plate Count, Pour Plate</i> | CFU/mL | $< 1 \times 10^1$ |
| * Bacteria mooring N# | <i>Plate Count, Pour Plate</i> | CFU/mL | $< 1 \times 10^1$ |
| * | | | |

Note: #) Parameters are not accredited, *) Number of colonies is less than one time the lowest dilution (no growth at the lowest dilution)

Plant Growth Promoting Rhizobacteria (PGPR) from mixing bamboo roots, daughter Embarrassed, And peanut green produce colony bacteria solvent P by 1.33×10^8 CFU/mL. Based on results analysis amount colony bacteria solvent P has met the quality standards for liquid biological fertilizer according to the Decree of the Minister of Agriculture of the Republic of Indonesia No. 261/KPTS/SR.310/M/4/2019, namely $\geq 1 \times 10^6$ or 10^8 CFU/mL. Bacteria solvent P on PGPR experience Which made allegedly originate from manufacturing materials PGPR roots bamboo And daughter Embarrassed. Bacteria on roots bamboo, namely *Pseudomonas* Which can dissolve Hara P in land (Pratiwi *et al* ., 2017) and *Bacillus* Which play a role as agent PGPR (Sapialena *et al* ., 2023). Root Mimosa pudica has several bacterial genera such as *Bacillus*, *Pseudomonas*, and *Rhizobium* (Yuliani and Rahayu, 2016).

g. Preparation Seed tubers Onion Red

The shallot seeds used were Maja Cipanas variety shallot seeds. The shallot seeds were cleaned of any dirt, then cut about 1/3 of the end using a knife. This cutting was done to break dormancy. so that can speed up growth shoots so that growth can be uniform (Widodo *et al .*, 2024). Seed sowing of bulb seeds is carried out in 15×15 cm *polybags* by immersing the entire bulb in the planting medium. The shallot seedlings (4 weeks after planting) are then transplanted into the planting medium. plant vertical farming Which has made. Media plant Which used is vertical rack with 30×30 cm *polybag planting containers*.

a. Application PGPR (*Plant Growth Promoting Rhizobacteria*)

PGPR (*Plant Growth Promoting Rhizobacteria*) is applied through watering. PGPR is applied from transplanting until 10 weeks after planting, resulting in a total of seven applications. PGPR is applied by spraying 300 ml of PGPR solution per *polybag*. in a way evenly in around area roots plant in accordance with concentration treatment PGPR 0 ml/L (A0), 15 ml/L (A1), 30 ml/L (A2), and 45 ml/L (A3).

Maintenance Plant Onion Red

Maintenance is carried out by watering, replanting, weeding, And control pest disease plant. Plant doused on Morning and afternoon day or customized with condition land and plant stitching

This is one of the stages in shallot plant maintenance, namely replacing shallot plants that grow abnormally or die with new, healthy plants. Weeding is done by removing weeds or wild plants around the planting medium. Pest and plant disease control is carried out physically by removing plant parts attacked by plant pests (OPT) or diseases, including weeding and plucking leaves affected by pests.

b. Harvesting Plant Onion Red

Harvesting is carried out when the plants are 74 days old after planting. This is indicated by 70–80% of the leaves, a limp neck, shiny bulb skin, some bulbs protruding above the soil surface, and a fully filled, red bulb (Suryadi *et al.* , 2023). Harvesting is carried out carefully to avoid damaging the bulbs by uprooting the shallot plants and then cleaning them of dirt and soil.

c. Analysis Contents Element Hara Land Post- Treatment

Analysis content element Hara on land post treatment done by sending soil samples to the Vegetable Crop Agricultural Instrument Standardization Agency, Lembang, West Bandung Regency, West Java. The method used for analysis land post treatment between other Kjeldahl For analysis Total (%), FM spectrophotometry for C-organic (%) and P total (P_2O_5 HCl) (mg/100g), method flame FM For Total (K_2O HCl) (mg/100g), And analysis ratio C/N. The results of post-treatment nutrient content analysis are in Appendix 8.

3.2.1. Parameter Study

Parameter Which observed in the form of characteristics on phase vegetative And shallot production. Observed variables include:

a. **Plant height (cm)**

Plant height was measured from the ground surface to the tip of the plant's leaves using a tape measure in centimeters. Observations were made from 4 to 10 weeks after planting.

b. **Number of leaves (leaf/clump)**

Leaf number was measured by counting the number of leaves emerging above the soil surface, counting only the leaves that were still green. Observations were made from 4 to 10 weeks after planting.

c. **Contents Total Chlorophyll (mg/g)**

The chlorophyll content of shallot leaves was measured using a spectrophotometer. Chlorophyll measurements were carried out by weighing 0.25 g of shallot leaves and then pounding them with a mortar and pestle until smooth. The resulting mixture was added with 25 mL of 80% acetone and filtered. The filtrate was then entered into the cuvette and the absorbance results were observed at a length wave 645 mm And 663 mm.

Contents chlorophyll leaf calculated using the Arnon method (1949):

$$\text{Chlorophyll a} = [(12.7 \times A_{663}) - (2.69 \times A_{645})] \times V/1000 \times 1/W$$

$$\text{Chlorophyll b} = [(22.9 \times A_{645}) - (4.68 \times A_{663})] \times V/1000 \times 1/W$$

$$\text{Chlorophyll total} = [(8.02 \times A_{663}) + (20,20 \times A_{645})] \times V/1000 \times$$

$$1/W$$

Information :

A663 = Absorbance long wave 663 nm A645 =

Absorbance long wave 645 nm Unit = mg/g

d. **Density Stomata Leaf**

Observations of leaf stomatal density were conducted using clear nail polish applied to the outside of the leaf. After the polish dried, the print was removed using pieces of transparent tape. Then, the stomatal print on the tape was attached to a glass slide and observed under a microscope (Setyowati *et al .*, 2013). Observations were made using a microscope and the number of stomata with normal open, normal closed, and abnormal morphology was counted (Humami *et al .*, 2020). The number of stomata was then counted and the area of the field of view was calculated.

$$\text{Density stomata} = \frac{\text{Number of stomata}}{\text{Wide cross section}}$$

e. **Root Length (cm)**

Long root measured on moment harvest 74 HST with method clean plant roots from soil and dirt. Root length is measured from the base of the root to the tip of the longest root using a ruler or meter in centimeters.

f. **Average amount Tubers (bulbs/clumps)**

The number of bulbs that grew on each shallot plant was counted when the plants were harvested (74 days after planting).

g. **Diameter tubers (cm)**

Tuber diameter was measured per plant using a vernier caliper. Observations were made after the tubers were harvested (74 days after planting).

h. **Weight Plant Wet (g/clump)**

The wet weight of the shallot plants was measured using a digital scale. Weighing was carried out after the plants were harvested (74 days after planting).

i. **Wet Weight of Bulbs (g/clump)**

The wet weight of fresh tubers was measured using a digital scale. Weighing was carried out after the tubers were harvested (74 days after planting).

j. **Dry Weight Tubers (Oven) (g/clump)**

Weight dry tubers (oven) onion red weighed with scales digital after drying using an oven at 105°C for 48 hours. Observations were made after the tubers were harvested (74 days after planting).

3.3. Analysis Data

Data Which has collected processed through analysis variety And If If there is a significant difference, further testing will be carried out using *the Duncan Multiple Range Test*. on level 5%. Model linear Which explain every mark observation according to the 4x3 factorial experiment with a Randomized Block Design (RAK), namely as follows:

$$Y_{ijk} = \mu + \rho k + A_i + B_j + (AB)_{ij} + \varepsilon_{ijk}$$

Information :

Y_{ijk} = Observation value of the effect of giving PGPR (*Plant Growth Promoting Rhizobacteria*) level i-th And fertilizer pen level jth

- i = 1, 2, 3, 4 (amount of PGPR concentration)
 j = 1, 2, 3 (amount type fertilizer cage) μ
 = General average
 ρ_k = Group influence ke- k
 A_i = Influence factor treatment PGPR (*Plant Growth Promoting Rhizobacteria*) level i (i = 1, 2, 3,4)
 B_j = The influence of manure factors on level jth (j = 1, 2, 3)
 $(AB)_{ij}$ = Influence interaction factor PGPR level i-th And fertilizer j-th level cage
 ε_{ijk} = Influence error test Which caused by giving PGPR level i-th and j-th level of manure and k-th group

Hypothesis statistics Which tested :

1). **Influence factor giving PGPR (*plant growth promoting rhizobacteria*)**

$$H_0 : A_0 = A_1 = A_2 = A_3 = 0$$

(There is no effect of administering PGPR (*plant growth promoting rhizobacteria*) on the growth and yield of shallot bulbs).

$$H_1 : A_0 \neq A_1 \neq A_2 \neq A_3 \neq 0$$

There is influence giving PGPR (*plant growth promoting rhizobacteria*) on the growth and yield of shallot bulbs.

2). **Influence factor giving fertilizer cage H_0**

$$: B_1 = B_2 = B_3 = 0$$

(There is no effect of providing manure on the growth and yield of shallot bulbs).

$$H_1 : B_1 \neq B_2 \neq B_3 \neq 0$$

There is influence giving manure to growth and shallot bulb yield.

3). **Influence interaction factor giving PGPR (*plant growth promoting rhizobacteria*) and manure**

$$H_0 : (AB)_{ij} = 0$$

(There is no interaction effect between the administration of PGPR (*plant growth promoting rhizobacteria*) and manure on the growth and yield of shallot bulbs).

$$H_1 : (AB)_{ij} \neq 0$$

(There is an interaction effect between the administration of PGPR (*plant growth promoting rhizobacteria*) and manure on the growth and yield of shallot bulbs).

Data results study furthermore analyzed in a way statistics with *Analysis of Variance* (ANOVA) or analysis of variance to determine the effect of treatment. If results analysis variety show existence influence Which real then further testing will be carried out to differentiate the average between treatments using *Duncan Multiple Range Test* (DMRT) at 5% test level.

CHAPTER IV

RESULTS AND DISCUSSION

4.1. Compilation Results Analysis Variety and DMRT

The results of the analysis of variance for each research parameter on the effect of PGPR concentration treatment and type of manure in the vertical culture system on the growth and yield of shallot bulbs obtained results compiled in Table 4.

Table 4. Compilation Results Analysis Variety And DMRT Parameter Effect of PGPR Concentration and Type of Manure

| Parameter | Treatment | | |
|----------------------------|-------------|-------------|----------------|
| | PGPR (A) | Interaction | Fertilizer (B) |
| Tall plant | *(b/a/a/a) | *(b/a/a) | ns |
| Amount leaf | ns | ns | ns |
| Contents chlorophyll total | ns | ns | ns |
| Density stomata | ns | ns | ns |
| Long root | *(c/b/b/a) | *(b/ab/a) | ns |
| Amount tubers | ns | ns | ns |
| Diameter tubers | *(b/b/a/a) | ns | ns |
| Plant wet weight | *(b/a/a/a) | ns | ns |
| Wet weight tuber per clump | *(c/b/a/ab) | ns | ns |
| Weight dry tubers (oven) | *(c/b/a/ab) | ns | ns |

sign (*) = influential real; ns = no have a real impact on $\alpha = 0.05$

The PGPR concentration treatment factor in shallot plants had a significant effect on several observed parameters, including plant height, long root, diameter tubers, wet weight plant, weight wet tubers per clump, And weight dry tubers (oven) per clump. Factor treatment type fertilizer

Manure significantly affected plant height and root length. The interaction between PGPR concentration and manure type did not significantly affect any of the parameters.

Giving PGPR on plant onion red with concentration (15 ml/L, 30 ml/L, and 45 ml/L) can significantly influence several parameters because PGPR has benefits to support plant growth and development such as *biofertilizer* or biological fertilizer. PGPR as a *biofertilizer* can maintain soil fertility so that nutrients in the soil can be sufficient and will stimulate plant growth through the process of photosynthesis (Husnihuda *et al.* , 2017). The treatment of manure type has a significant influence on plant height and root length parameters because the application of manure can provide nutrients to optimize plant growth and development. Manure can improve the quality of soil structure and fertility that will affect root development so that it can develop well and nutrient absorption takes place optimally (Hidayati *et al.* , 2021).

The absence of interaction between PGPR concentration treatment and manure type is thought to be due to external factors such as soil fertility, fertility land, humidity air, intensity Rain, sunlight, and wind speed (Riry *et al.* , 2020). Soil fertility is one of the factors that influences plant growth and development. shallot plants in this study. The high content of P and K nutrients in the soil can accelerate availability on media plant, by because That No there is

The interaction between PGPR and manure. However, the application of PGPR and manure still had independent effects on shallot growth and yield. The lack of interaction between PGPR and manure applications is thought to be due to PGPR's ability to function optimally under certain conditions regardless of manure addition (Yusran *et al.* , 2024).

4.2. Plant Height

The results of the analysis of variance showed that there was no interaction effect between the application of PGPR concentration and manure on plant height. The application of PGPR concentration and manure had a significant effect ($P < 0.05$) on the height of shallot plants. The results of further testing using *the Duncan Multiple Range Test* on the application of PGPR concentration and manure on the parameters of shallot plant height are presented in Table 5.

Table 5. Height of Shallot Plants at 6 Weeks After Planting Due to PGPR Concentration and Type of Manure

| PGPR concentr ation | Manure | | | Average |
|---------------------------|--------------------|--------------------|--------------------|--------------------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | cm | | | |
| A0 (0 ml/l) | 23,80 | 22,47 | 26,58 | 24,28 ^b |
| A1 (15 ml/l) | 22,75 | 31,97 | 33,58 | 29,43 ^a |
| A2 (30 ml/l) | 26,33 | 36,17 | 34,67 | 32,39 ^a |
| A3 (45 ml/l) | 25,27 | 34,25 | 35,67 | 31,73 ^a |
| Rata-rata | 24,54 ^b | 31,21 ^a | 32,63 ^a | |

*Superscript different on line And column Which The same show different real according to Test *Duncan Multiple Range Test* ($P < 0.05$)

Results of plant height parameters with the provision of PGPR and fertilizer concentrations pen show results Which different real. Concentration PGPR 30 ml/L gave an average result of 32.39 cm, which was not significantly different from the concentration given. PGPR 45 ml/L And 15 ml/L that is 31.73 cm And 29.43 cm, but significantly different with giving concentration PGPR 0 ml/L that is 24.28 cm. In line According to research conducted by Yunus *et al* . (2021), a PGPR concentration of 30 ml/L provided the best growth with plant height parameters of 39.25 cm and leaf number of 34.70 leaves. The administration of a PGPR concentration of 30 ml/L showed an increase in plant height of 32.39 cm. This indicates that the application of PGPR on concentration 30 ml/L capable increase growth plant namely in plant length, number of leaves at 42 HST with an increase percentage reaching 10% (Sagala and Aini, 2023).

Results analysis amount colony bacteria PGPR Which made contain 1.33×10^8 phosphate-solubilizing bacteria, thereby increasing the plant's ability to absorb element Hara. PGPR capable increase absorption element Hara by dissolving phosphate, which produces hydrolytic enzymes that are expected to aid the phosphate dissolution process (Rosyida and Nugroho, 2017). The availability of macronutrients such as phosphorus plays a vital role in the physiological processes and development of plant cells, which will influence the growth of shallot plants. Nutrients that are essential in the preparation of network is phosphorus And potassium Which functioning in activate growth enzymes (Supriadi *et al* ., 2017).

The application of manure produced significantly different results in terms of plant height. Rabbit manure, which was 32.63 cm, was not significantly different from goat manure, which was 31.21 cm, but was different. real with giving fertilizer pen cow that is 24.54 cm. Results analysis of the N, P, K content of rabbit manure, namely 1.03%, 1.42%, and 2.26%, and fertilizer pen goat that is 1.24%, 1.11%, And 2.49%. Matter the This indicates that the nutrient content of both fertilizers is sufficient to support plant growth. This is in line with Anto's (2018) research, namely the addition of manure fertilizer. rabbit And mixture land sand influential real to high growth plant onion red. In line with study Yunus *et al .* (2021) namely goat manure and PGPR 30 ml/L have an effect on the growth of plant length plant. Fertilizer pen rabbit And goat can repair Soil fertility quality: if the growing medium is more fertile and loose, nutrient availability will increase. A growing medium with sufficient nutrients will support optimal plant growth and development. Goat and rabbit manure is beneficial for improving soil fertility physically, biologically, and chemically, thus optimizing plant productivity (Hartati *et al .*, 2022; Januarti *et al .*, 2016).

4.3. Amount Leaf

The results of the analysis of variance show that there is no interaction between the provision of concentration PGPR And fertilizer pen to amount leaf. Giving concentration PGPR And fertilizer pen No give influence in a way real

on the number of shallot leaves. The results of the analysis of variance for the application of PGPR and manure concentrations on the number of shallot leaves are presented in Table 6.

Table 6. Amount Leaf Plant Onion Red Age 6 MST Consequence PGPR Concentration and Type of Manure

| Concentration PGPR | Manure | | | Average |
|-----------------------|--------------------------|--------------|----------------|---------|
| | B1 (Cow) | B2 (Goat) | B3 (Rabbit) | |
| | -----strands/clumps----- | | | |
| A0 (0 ml/l) | 22.33 | 21.67 | 21.50 | 21.83 |
| A1 (15 ml/l) | 21.00 | 34.17 | 29.33 | 28.17 |
| A2 (30 ml/l) | 24.00 | 30.83 | 29.83 | 28.22 |
| A3 (45 ml/l) | 30.00 | 29.83 | 21.17 | 27.00 |
| Average | 24.33 | 29.13 | 25.46 | |

The application of PGPR and manure concentrations to shallot plants has not been able to significantly affect the number of shallot leaves. Nutrient absorption in shallot plants plant onion red was not affected by the administration of *rhizobacteria* at a specific time (Saskia *et al.* , 2022). This is because the PGPR produced only contained phosphate-solubilizing bacteria. The growth of plant leaves is also supported by sufficient nitrogen nutrients, so the help of nitrogen-fixing bacteria is needed to increase nitrogen availability to optimally influence leaf growth. This is also supported by the results of the pre-treatment soil N analysis (0.35%) which is included in the medium criteria and the N nutrient content of manure which tends to be lower than P_2O_5 and K_2O . Therefore, the role of bacteria mooring N Because the more Lots mooring nitrogen so

The higher the N nutrient available to plants, the more it can increase plant growth (Rohmah *et al.* , 2016).

The availability of nitrogen elements is needed in sufficient quantities. relatively big especially when phase vegetative, Because N is component main from various substance in plants. Element Hara nitrogen is element Hara Which very play a role important for plants in the vegetative growth phase (Triadiawarman *et al.* , 2022). Parameters amount leaf show results Which No influential real, even though on growth tall plant show results Which significant. Matter This This can be caused by the plant's need for different nutrients depending on its growth phase. In line with the statement of Siagian *et al.* . (2019) who stated that plant nutrient requirements during growth and development are not the same and require different times, this caused by Because there is various process growth with different intensities.

The insignificant effect on leaf number may be due to genetic factors in the shallot variety used. Research by Karo and Manik (2020) showed that at 6 weeks post-planting age, the Maja variety only had 29.45 leaves. The lowest compared to the Bima variety, which has 45.83 leaves, this indicates that the number of leaves is influenced by the genetic factors of each variety used. Not only genetic factors, but environmental factors such as lighting conditions can also have an effect. to process growth leaf plant red onion. The more big intensity light which accepted so will the more Lots amount leaf resulting (Buntoro *et al.* , 2014).

4.4. Contents Chlorophyll Total

The results of the analysis of variance show that there is no interaction between the provision of concentration PGPR And fertilizer pen to content chlorophyll total leaves. The administration of PGPR and manure concentrations did not have an effect in a way real to content chlorophyll total leaf onion red. The results of the analysis of variance on the provision of PGPR and manure concentrations on the parameters content chlorophyll total plant onion red served on Table 7.

Table 7. Contents Chlorophyll Total Plant Onion Red Effect of PGPR Concentration and Type of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------|-----------------|-----------------|---------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | mg/g | | | |
| A0 (0 ml/l) | 1,214 | 1,044 | 1,069 | 1,109 |
| A1 (15 ml/l) | 1,056 | 1,128 | 0,985 | 1,057 |
| A2 (30 ml/l) | 0,991 | 1,148 | 1,323 | 1,154 |
| A3 (45 ml/l) | 1,000 | 1,284 | 1,103 | 1,129 |
| Rata-rata | 1,065 | 1,151 | 1,120 | |

Chlorophyll content is one indicator for analyzing plant growth and health. An abundant chlorophyll content indicates that the plant can photosynthesize effectively. The higher the chlorophyll content, the better. process photosynthesis will the more optimal (Yama And Kartiko, 2020). Results

Research shows that administering PGPR concentrations at various treatment levels has not significantly affected the total chlorophyll content of shallots. This is thought to be because the plants were entering the generative phase when the chlorophyll test was conducted, so nutrient administration would be more focused on the formation and development of shallot bulbs. The addition of PGPR can accelerate the plants' entry into the generative phase because it can increase rhizobacterial activity in the soil, which will affect the availability of nutrient absorption. The combination of PGPR and fertilizer NPK can speed up occurrence phase generative. Because sufficient important nutrients in the generative phase, especially in the formation and development of tubers (Alfarisi and Tyasmoro, 2024).

Plant onion red Which has entering the generative phase resulting in no significant. And tend low results testing content chlorophyll total leaves. In general, chlorophyll content is influenced by plant age, chlorophyll levels will increase on phase vegetative. And will decrease moment enter aging phase (Husnina, 2025). Factor other Which influence content chlorophyll is the availability of nutrients for plants. The N nutrient content in manure tends to be lower than P_2O_5 and K_2O . This is supported with very low amount colony bacteria mooring N on PGPR, so that its role as a *biofertilizer* is not optimal for increasing availability element N. Role nitrogen. Not only for synthesis protein, but It is also important for the formation of leaf chlorophyll, and can increase vegetative growth and make the leaf color greener (Syifa *et al.* , 2020).

The total chlorophyll content of leaves is influenced by environmental factors, such as sunlight, which plays a crucial role in plant chlorophyll content. Observations show that in the late afternoon, sunlight is not fully available. caught on all part rack vertical farming, so that matter the can be one of the causes that affect the production of chlorophyll in plants. Sunlight has an effect For increase onion chlorophyll red, with Sufficient light will ensure optimal photosynthesis so that chlorophyll and plant growth are optimal (Susilawati *et al .*, 2024).

4.5. Density Stomata

The results of the analysis of variance show that there is no interaction between the provision of concentration PGPR And fertilizer pen to density stomata leaves. The application of PGPR and manure concentrations did not significantly affect leaf stomatal density. The results of the analysis of variance for the application of PGPR and manure concentrations on the stomatal density parameters of shallot leaves are presented in Table 8.

Table 8. Density Stomata Plant Onion Red Consequence PGPR Concentration and Type of Manure

| Concentrati on PGPR | Manure | | | Rata-rata |
|------------------------|-------------------------------------|-----------------|-----------------|-----------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | ----- stomata/mm ² ----- | | | |
| A0 (0 ml/l) | 12,12 | 11,91 | 14,26 | 12,77 |
| A1 (15 ml/l) | 13,10 | 13,36 | 12,51 | 12,99 |
| A2 (30 ml/l) | 11,83 | 13,97 | 11,89 | 12,56 |
| A3 (45 ml/l) | 13,21 | 12,60 | 19,08 | 14,96 |
| Rata-rata | 12,56 | 12,96 | 14,44 | |

Stomatal density in shallot leaves was calculated with the aim of understanding the physiological aspects of plants and the influence of the environment on plant growth, in line with the statement of Khoiroh *et al.* (2014) that stomatal density is related to physiological processes or plant metabolism such as transpiration and photosynthesis. The results of the study showed that the addition of PGPR and manure concentrations as a whole did not significantly affect the parameters of leaf stomatal density. Shallots are C3 plants with stomatal openings occurring in the morning, however, stomatal density can be influenced by other factors such as plant genetic conditions such as stomata and leaf size. Stomata can show different shapes, sizes, and numbers in various species. plant (Bertolino *et al.* , 2019). Density stomata can influenced by the size and number of stomata found on plant leaves. Stomatal density value influenced by big small size stomata, as well as distribution amount

stomata, the more stomata there are, the denser the stomata produced (Eipepa *et al* ., 2023).

The size of the leaves of the red onion plant tends to be small, which can be a mistake. One reason low level density stomata leaf. Size leaf can affect the number of stomata, with a low number resulting in a low distribution of stomata, so that the density of stomata will also be low (Oktaviani And Daningsih, 2021). Level density stomata may differ on every type plant, but If condition environment grow relatively The same, Therefore, the resulting stomatal density value may be insignificant. This is in line with Utami's (2019) statement, which states that similar stomatal densities may be caused by accessions being of the same species and planted in the same environment.

4.6. Long Root

The results of the analysis of variance showed that there was no interaction effect between the administration of PGPR concentration and manure on the root length of shallots. The administration of PGPR concentration and manure gave influence in a way real ($P < 0.05$) to long root plant. The results of further testing using *the Duncan Multiple Range Test* on the administration of PGPR and manure concentrations on the root length parameters of shallot plants are presented in Table 9.

Table 9. Long Root Plant Onion Red Consequence Concentration PGPR and Types of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------------|---------------------|--------------------|--------------------|
| | B1 (Cow) | B2 (Goat) cm | B3 (Rabbit) | |
| A0 (0 ml/l) | 11,17 | 11,42 | 13,92 | 12,17 ^c |
| A1 (15 ml/l) | 13,77 | 14,92 | 15,58 | 14,76 ^b |
| A2 (30 ml/l) | 13,33 | 14,38 | 15,62 | 14,44 ^b |
| A3 (45 ml/l) | 16,25 | 16,83 | 18,00 | 17,03 ^a |
| Rata-rata | 13,63 ^b | 14,39 ^{ab} | 15,78 ^a | |

* Superscript different on line And column Which The same show different real according to Test *Duncan Multiple Range Test* ($P < 0.05$)

The results of root length parameters with different concentrations of PGPR and manure showed significantly different results. PGPR concentration 45 ml/L that is 17.03 cm different real with giving concentration PGPR at 30 ml/L, 15 ml/L, and 0 ml/L was 14.44 cm, 14.76 cm, and 12.17 cm, respectively. This indicates that PGPR affects root growth. This is in line with research by Prasetya and Maghfoer (2021), which found that PGPR application affects plant root height and length by increasing the population of microorganisms that help. provision and absorption of nutrients. Increasing the number of beneficial microorganisms to improve soil fertility can make the soil looser, thus influencing plant growth. root plant. Bacteria PGPR Which active in *rhizosphere* extending plant roots, because it acts as a *biofertilizer* that improves soil structure to make it more crumbly so that the roots spread more widely and become longer (Husnihuda *et al* ., 2017).

The results of the analysis of the number of PGPR bacterial colonies show that the microorganisms which there is on PGPR is bacteria solvent phosphate (1.33×10^8). P-solubilizing bacteria can be useful for dissolving the P content in the growing medium so that it can be absorbed by plants. The nutrient P plays a role in the formation of plant cell membranes, enzymes, and protein synthesis, especially in green tissue, carbohydrate synthesis, and stimulates vegetative and generative growth. (Nuryani *et al.* , 2019). Based on statement the existence The P nutrient in the planting medium can affect root length parameters. According to the research results of Damanik and Suryanto (2018), the application of PGPR... contain *Azospirillum* sp. can influential real to long Plant roots because *Azospirillum* sp. plays a role in increasing root length in shallots. Research shows that plants with the longest and densest roots were found at a PGPR concentration of 45 ml/L. Another role of PGPR is as biostimulan Which can produce hormone growth like auxin so that influence development root plant. Hormone IAA growth produced by PGPR bacteria is useful for stimulating hair growth root Which can increase volume absorption water And element Hara which is dissolved in the soil (Sintawati *et al.* , 2022).

The addition of rabbit manure to shallot plants showed results of 15.78 cm and was not significantly different from the provision of goat manure, namely 14.39 cm, but was significantly different from the provision of goat manure. pen cow that is 13.63 cm. Fertilizer pen rabbit own benefit to increase quality fertility land Which will influence development

Plant roots. In line with research by Rachman *et al.* (2021), organic rabbit manure fertilizer makes the soil looser, increases microbial growth, oxygen levels, and water absorption. With optimal soil structure, roots will develop well, increasing the nutrient absorption area.

The analysis results of rabbit manure showed that the P₂O₅ content (1.42%) tended to be higher than cow manure (0.94%), although not significantly different from goat manure (1.11%). The high P content in soil and manure is thought to accelerate the availability of these nutrients to plants, thereby influencing the condition of the planting medium to become more fertile and will affect the growth of longer and thicker roots. Phosphorus nutrients for plants play a role in forming and stimulating the development of the root system and are related to the function of P in plant metabolism (Fauzi and Puspita, 2017).

4.7. Amount tubers

The results of the analysis of variance showed that there was no interaction between the concentration of PGPR and manure on the average number of bulbs. The concentration of PGPR and manure did not significantly affect the average number of shallot bulbs. The results of the analysis of variance on giving concentration PGPR And fertilizer pen on parameter The average number of shallot bulbs is presented in Table 10.

Table 10. Average Amount tubers Onion Red Effects of Concentration PGPR and Types of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------|-----------------|-----------------|---------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | umbi/rumpun | | | |
| A0 (0 ml/l) | 7,33 | 6,83 | 7,00 | 7,06 |
| A1 (15 ml/l) | 7,83 | 9,67 | 8,67 | 8,72 |
| A2 (30 ml/l) | 8,33 | 8,83 | 8,17 | 8,44 |
| A3 (45 ml/l) | 9,67 | 8,33 | 6,17 | 8,06 |
| Rata-rata | 8,29 | 8,42 | 7,50 | |

The provision of PGPR and manure concentrations has not been able to have a significant effect real to average parameter amount tubers onion red per clump. Results analysis amount colony bacteria PGPR shows there are 1.33×10^8 Phosphate-solubilizing bacteria. However, the N-fixing bacteria content in PGPR is very low or undetectable, which can affect tuber growth. Because Also influenced by availability element Hara N. Growth number of tubers influenced by various factor Wrong the only one influenced by The growth of the number of plant leaves. The results of the statistical analysis showed that the concentration of PGPR did not significantly affect the number of leaves on shallot plants. This is in line with the statement of Sagala and Aini (2023), namely that observations showed that the concentration of PGPR did not significantly affect the number of bulbs per plant because the number of bulbs is influenced by the number of leaves on shallot plants. The results of the correlation analysis showed a positive relationship. between amount tubers And amount leaf per clump, so that the more The more leaves there are, the more tubers will be formed (Kurniasari and Arditya, 2024).

The addition of manure has not significantly affected the number of tubers because the absorption of nutrients, especially N, is not optimal. The N content is lower than P_2O_5 and K_2O in manure. Pen can influence availability element N For growth Bulbs. Nitrogen plays a role in the growth and development of all plant tissues, including the growth of bulbs (Pakpahan *et al.* , 2020). Manure is a *slow-release organic fertilizer* , making it a contributing factor to suboptimal nutrient content for the growth of shallot bulbs. Organic fertilizers are *slow-release*, meaning decompose in a way slow with mechanism element Which contained in organic fertilizer will released in a way slowly And in a way Keep going continuously in term longer time, but the probability of nutrients being lost due to water leaching is smaller (Danial *et al.* , 2020).

Another factor that influences the number of bulbs is the size of the shallot bulb. Larger bulbs will produce fewer bulbs. And on the contrary. Improvement amount tubers can influence decreasing diameter tubers even so on the contrary, because of the correlation between diameter tubers and number of tubers (Susanti *et al.* , 2017). PGPR at a dose of 30 ml/plant was unable to increase the number of tubers, presumably because the tuber diameter increased with a decreased number of tubers, because the K element used for tuber enlargement was more fulfilled (Mahdiannoor *et al.* , 2019). Tuber size and genetic factors such as variety selection can also affect the number of plant tubers. onion red. Election varieties influence ability plant

in distributing the results of photosynthesis, thus affecting the number of bulbs produced (Harahap *et al.* , 2022). Based on the description of onion varieties red Mayan hot springs known that amount offspring Which can The number of shoots produced per clump ranges from 6 to 12. The more shoots there are, the more tubers will be produced (Rihadi *et al.* , 2021).

4.8. Tuber Diameter

The results of the analysis of variance showed that there was no interaction effect between the application of PGPR concentration and manure on bulb diameter. The application of PGPR concentration had a significant effect ($P < 0.05$) on the diameter of shallot bulbs. The results of further testing using *the Duncan Multiple Range Test* on the application of PGPR concentration and manure on the parameter of shallot bulb diameter are presented in Table 11.

Table 11. Diameter tubers Plant Onion Red Consequence PGPR Concentration and Type of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------|-----------------|-----------------|-------------------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | cm | | | |
| A0 (0 ml/l) | 1,69 | 1,58 | 1,49 | 1,59 ^b |
| A1 (15 ml/l) | 1,72 | 1,77 | 1,73 | 1,74 ^b |
| A2 (30 ml/l) | 1,98 | 2,06 | 2,01 | 2,02 ^a |
| A3 (45 ml/l) | 1,76 | 1,94 | 2,23 | 1,98 ^a |
| Rata-rata | 1,79 | 1,84 | 1,87 | |

*Superscript different on column Which The same show different real according to Test *Duncan Multiple Range Test* ($P < 0.05$)

Parameter diameter tubers with giving concentration PGPR showed significantly different results. The PGPR concentration of 30 ml/L with a tuber diameter of 2.02 cm did not differ significantly. real with PGPR 45 ml/L which is 1.98 cm, but significantly different from PGPR 15 ml/L, and 0 ml/L, which are 1.74 cm, and 1.59 cm. This shows that the administration of PGPR has an effect on the growth of the diameter of the stem. tubers. In line with study Sagala And Aini (2023) that is PGPR concentration 30 ml/L capable give influence to observation diameter onion bulbs red Which more big. Element Hara like P And K play a role important for the formation and tuber development. Results quantity analysis colony bacteria PGPR indicates phosphorus-solubilizing bacteria (1.33×10^8) which are thought to play a role in dissolving P nutrients in the planting medium, thereby affecting tuber diameter. Because element Hara phosphorus Which absorbed useful For trigger new cell growth in the bud eyes so that it can increase cell division and diameter on tubers onion red (Ultimate *et al* ., 2020). The height The P and K content in soil and manure can optimize the performance of PGPR as a *biofertilizer* to dissolve P so that its availability increases and will affect the development of shallot bulbs.

Addition fertilizer pen Not yet can give influence in a way However, the addition of goat manure (1.84 cm) can provide results that are not much different from rabbit manure (1.87 cm). The results of the analysis of the nutrient content of N, P, and K in rabbit manure are 1.03%, 1.42%, and 2.26%, respectively. fertilizer pen goat that is 1.24%, 1.11%, 2.49%. Contents P And K on both fertilizer play a role For help development tubers, so that can

affect the diameter tubers. Fertilizer pen goat has content High levels of K are beneficial for improving the quality of shallot bulbs (Shofiah and Tyasmoro, 2018). Rabbit manure can retain water and nutrients around the plant's root area, making macronutrients available for plant cell division (Tamot and Suryani, 2019). Based on soil analysis, it was found that the P and K content was high, which can help accelerate the availability of these elements, thus influencing plant growth. tubers onion red in a way more optimal. Element Hara potassium plays a very important role in the process of formation and development of shallot bulbs (Arjuna *et al .*, 2017).

The results of the shallot bulbs show a variety of shapes and diameters. The diameter of the shallot bulbs can be grouped to determine *the grade* of the bulbs. *Grading* aims to classify agricultural products. according to standardization Which desired based on quality, size, and product integrity (Asminar *et al .*, 2023). *Grading* of shallot plants can be determined based on the diameter of the shallot bulbs, which are divided into *Grade A* (3–4 cm), *Grade B* (2–3 cm), *Grade C* (1.5–2 cm), and *Grade D* (<1.5 cm) (Tarjiyo, 2023). Based on the research results, the diameter of shallot bulbs consists of *Grade B* (A3B3, A2B2, and A2B3), *Grade C* (A0B2, A0B1, A1B1, A1B3, A3B1, A1B2, A3B2, A2B1), And *Grade D* (A0B3). Diameter

The larger the red onion bulbs, the smaller the number of bulbs. Based on the results of the correlation analysis, a negative correlation was found. significant between diameter tubers And amount tubers per clump, matter the

shows that the greater the number of bulbs formed, the smaller the diameter of the resulting bulbs (Kurniasari and Arditya, 2024). Based on observations, the shape of the shallot bulbs in the cow manure treatment tends to be less uniform, while those in goat and rabbit manure tend to be more uniform. Differences in bulb shape and size between treatments can be caused by the seeds used; in this study, the seed source used came from bulbs. The diversity of shallot harvests using seed seeds resulted in relatively more uniform bulb shapes and sizes, while those using bulb seeds resulted in more diverse bulb shapes and sizes (Ulfa *et al.* , 2023).

4.9. Weight Wet Plant

The results of the analysis of variance showed that there was no interaction effect between the administration of PGPR concentration and manure on the wet weight of the plants. The administration of PGPR concentration had a significant effect ($P < 0.05$) on the wet weight of the plants. The results of further testing using *the Duncan Multiple Range Test* on the administration of PGPR concentration on the wet weight parameter of shallot plants are presented in Table 12.

Table 12. Wet Weight of Shallot Plants Due to PGPR Concentration and Type of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------|-----------------|-----------------|--------------------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | g/rumpun | | | |
| A0 (0 ml/l) | 30,76 | 29,67 | 34,84 | 31,76 ^b |
| A1 (15 ml/l) | 39,88 | 50,60 | 45,46 | 45,31 ^a |
| A2 (30 ml/l) | 45,35 | 53,95 | 50,80 | 50,03 ^a |
| A3 (45 ml/l) | 49,65 | 58,30 | 47,60 | 51,85 ^a |
| Rata-rata | 41,41 | 48,13 | 44,68 | |

*Superscript different on column Which The same show different real according to Test *Duncan Multiple Range Test* ($P < 0.05$)

The PGPR concentrations showed significantly different results on the wet weight of the plants. The PGPR concentration of 45 ml/L gave an average yield of 51.85 g/clump, which was not significantly different from the PGPR concentration of 30 ml/L, which was 50.03 g/clump, and the PGPR concentration of 15 ml/L, which was 45.31 g/clump, but was significantly different from the PGPR concentration of 45 ml/L. PGPR 0 ml/L that is 31.76 g/clump. Giving PGPR as *Biofertilizers* significantly impact plant fresh weight due to their ability to increase the fertility of the growing medium and aid optimal plant organ development. Beneficial bacteria in PGPR act as *biofertilizers* by dissolving phosphate, fixing nitrogen, elongating plant roots, and acting as biostimulants that aid nutrient distribution in plants, thus optimizing their growth and development (Kania and Maghfoer, 2018).

The results of the analysis of the number of PGPR bacterial colonies showed that there were solvent bacteria. phosphate (1.33×10^8). Role from bacteria solvent P is For optimize

availability of phosphorus in the planting medium. Increasing the availability of P in the planting medium can affect plant growth. the roots become more optimal, so that field absorption water And nutrition even become more wide. Availability nutrients will help cell division and development in shallot plants. will influence weight wet plant. Availability element Hara Which can be absorbed by plants is one of the factors that influences cell enlargement and will affect the fresh weight of the plant (Hattalaibessy *et al .*, 2020). In line with the statement (Abad *et al .*, 2022), namely increasing nutrient absorption P can support process photosynthesis, so that plant can produces optimal assimilation that will be transported to the bulbs of the plant to increase the fresh weight of shallots. Increasing the concentration of PGPR applied to shallots will yield better results than without PGPR. This is in line with research by Novatriana and Hariyono (2019), where 30 ml of PGR and a 30-minute soaking treatment resulted in the highest total fresh weight and number of shallot bulbs.

Addition fertilizer pen Not yet can influential in a way real on the wet weight of shallot plants. The provision of goat manure shows results average 48.13 g/clump, fertilizer pen rabbit as big as 44.68 g/clump, and cow manure 41.41 g/clump. Goat manure allegedly can help growth And development plant as seen in the wet weight parameters of the plants but not yet optimally. In line with the research results of Manik *et al .*, (2022), namely the dose of goat manure with treatment 45 tons/ha provides donation element Hara highest

compared to other levels, but has not been able to provide optimal growth results with parameter the whole thing Still linear. Contents mark ratio The C/N in goat manure is also known to be lower, namely (14.8), which is not much different from the C/N ratio value of soil of (14.0), and lower than cow manure (15.4) and rabbit manure (19.0), so that it can show that the nutrient content in goat manure can be faster. available and absorbed by plants. Organic materials that have become compost or fertilizer can be used for plants if the C/N ratio is <20 (Yuniwati *et al.* , 2012).

The increase in nutrient content in the growing medium after being given PGPR and manure indicates nutrient absorption that influences the growth and development of plant organs. Increased nutrient absorption will affect the photosynthesis process that occurs optimally, so that plant growth and development run optimally, and photosynthate yields will also increase (Rambe *et al.* , 2019). Optimal photosynthesis will produce good photosynthate yields and water content in the tissue to increase the wet weight of the plant. The amount of nutrient absorption water And hoarding results photosynthesis on leaf For translocated affects the wet weight of the tubers produced (Murni, 2018).

4.10. Weight Wet tubers

The results of the analysis of variance show that there is no interaction effect between giving concentration PGPR And fertilizer pen to weight wet tubers

Shallots. PGPR concentration significantly affected ($P < 0.05$) the wet weight of shallot bulbs. Further testing results using *Duncan's Multiple Range Test* against giving concentration PGPR on The wet weight parameters of shallot bulbs are presented in Table 13.

Table 13. Weight Wet tubers Plant Onion Red Consequence PGPR Concentration and Type of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------|-----------------|-----------------|---------------------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | g/rumpun | | | |
| A0 (0 ml/l) | 21,99 | 18,77 | 19,67 | 20,15 ^c |
| A1 (15 ml/l) | 25,49 | 33,67 | 30,17 | 29,78 ^b |
| A2 (30 ml/l) | 30,95 | 40,88 | 35,81 | 35,88 ^a |
| A3 (45 ml/l) | 33,71 | 36,39 | 34,13 | 34,74 ^{ab} |
| Rata-rata | 28,04 | 32,43 | 29,95 | |

*Superscript different on column Which The same show different real according to Test *Duncan Multiple Range Test* ($P < 0.05$)

The results of the wet weight parameters of shallot bulbs with the given concentration PGPR show results influential real. Concentration PGPR 30 ml/L gave results of 35.88 g/clump which was not significantly different from PGPR 45 ml/L which was 34.74 g/clump, but significantly different from PGPR 15 ml/L which was 29.78 g/clump and PGPR 0 ml/L which was 20.15 g/clump. This shows that the concentration of PGPR 30 ml/L which was not significantly different from PGPR 45 ml/L can have an effect because it is more effective and efficient for the wet weight parameter of the bulbs. The average fresh weight of shallot bulbs given PGPR 30 ml/L was 35.88 g/clump, which is the same as 11.96 tons/ha of production. tubers fresh equivalent with 8, 97 tons/ha tubers dry, so that production

tubers dry on study This Still Not yet in accordance with the description varieties (10.9 tons/ha). The production of fresh shallot bulbs was lower than several other studies, namely 26.73 tons/ha (Firmansyah, 2018) and 14.07 tons/ha (Octavia *et al* ., 2019). Matter This can caused by Because differences in methods and treatments provided in the research conducted.

Plants can basically measure their nutrient needs so that based on that results study concentration PGPR 30 ml/l is concentration sufficient to affect the wet weight of shallot bulbs. In line with research by Novatriana and Hariyono (2019), watering 30 ml of PGPR on shallot plants can affect the height, number of leaves, leaf area, and weight of shallots. fresh And dry, amount tubers, And diameter tubers onion red. Supported by research by Mursyid *et al* . (2023) namely PGPR concentration of 30 ml/L and without treatment Catfish wastewater with a watering frequency of once every 6 days showed heavier shallot bulbs.

The development of the wet weight of shallot bulbs is also supported by the content of P-solubilizing bacteria (1.33×10^8) in PGPR which can help with the availability of element Hara phosphorus through improvement enzyme phosphomonoesterase which then plays a role in providing P nutrients. In line with the statement of Firmansyah *et al* . (2015), namely the presence of available P in the soil can increase the yield of shallot bulbs. Phosphorus functions for the development and enlargement cell on organ plant, so that help in increases the growth and development of shallot bulbs (Noor *et al* ., 2022). Giving PGPR on root plant also allegedly can increase process

photosynthesis on plant so that weight wet tubers even experience improvement. Things the caused by Because existence activity bacteria in body plant which acts as a phytohormone, especially auxin, which is thought to increase plant photosynthesis (Tuhuteru *et al.* , 2019).

Type fertilizer pen Which added on plant onion red has not been able to significantly influence the wet weight of shallot bulbs. The treatment level fertilizer pen goat give results that is 32.43 g/clump, rabbit manure is 29.95 g/clump, and cow manure is 28.04 g/clump. The manure used has a different nutrient content. so that response to the plants even will different. Difference The manure used will also show different responses in plants (Idris *et al.* , 2018). The addition of goat manure provides nutrients that are absorbed more quickly by plants than other types of manure. This is because goat manure has a more optimal nutrient content, such as a C/N ratio of 14.8, which is not much different from the soil C/N ratio of 14.0. If organic material has a C/N content close to or equal to the C/N value land then the material it can be used or absorbed by plants (Dewanti *et al.* , 2020). In line with research Manik *et al.* . (2022) namely fertilizer goat pen with The 45 ton/ha treatment provided the highest nutrient contribution compared to other levels, however Not yet can give results optimal to growth with the overall parameters still linear.

The results of the statistical analysis show that there is still an increase in the wet weight of the tubers. on treatment fertilizer pen goat, although in a way overall manure has not produced significant results. Based on the results of the analysis of the content element Hara K fertilizer pen goat known that content The K content (2.49%) is more optimal than that of cattle (1.08%) and rabbits (2.26%). This is in line with the statement of Shofiah and Tyasmoro (2018), namely that goat manure contains higher K than other nutrients, so it is useful for improving the quality of shallot bulbs. Potassium plays a very important role in the process of formation and development of shallot bulbs. Adequate availability of K can support growth. onion red Which more optimal, Because potassium very have a real impact to weight wet per clump And play a role in process photosynthesis and can increase tuber weight (Baka *et al* ., 2020).

4.11. Weight Dry tubers (Oven)

The results of the analysis of variance showed that there was no interaction effect between the administration of PGPR concentration and manure on the dry weight of tubers. (oven). Giving concentration PGPR give influence in a way real ($P < 0.05$) to weight dry tubers (oven). Results test carry on with *Duncan Multiple Range Test* on the provision of PGPR and manure concentrations on the dry weight parameters of shallot bulbs (oven) is presented in Table 14.

Table 14. Weight Dry tubers (Oven) Plant Onion Red Effect of PGPR Concentration and Type of Manure

| PGPR concentration | Manure | | | Average |
|-----------------------|--------------|-----------------|-----------------|--------------------|
| | B1 (Sapi) | B2 (Kambing) | B3 (Kelinci) | |
| | g/rumpun | | | |
| A0 (0 ml/l) | 3,16 | 2,91 | 2,49 | 2,85 ^c |
| A1 (15 ml/l) | 3,25 | 4,30 | 3,85 | 3,80 ^b |
| A2 (30 ml/l) | 4,76 | 5,04 | 4,62 | 4,81 ^a |
| A3 (45 ml/l) | 4,23 | 4,34 | 3,75 | 4,11 ^{ab} |
| Rata-rata | 3,85 | 4,15 | 3,68 | |

*Superscript different on column Which The same show different real according to Test *Duncan Multiple Range Test* ($P < 0.05$)

Parameter results dry weight tuber (oven) onion red with The administration of PGPR concentration showed significantly different results at PPGR concentrations of 30 ml/L with PGPR 15 ml/L and PGPR 0 ml/L. The PGPR concentration of 30 ml/L gave an average result of 4.81 g/clump which was not significantly different from PGPR 45 ml/L, namely 4.11 g/clump, but significantly different from PGPR 15 ml/L, namely 3.80 g/clump And PGPR 0 ml/L that is 2.85 g/clump. Concentration PGPR 30 ml/L affects the dry weight of tubers (oven), because at this concentration, PGPR works more optimally and efficiently as a *biofertilizer*. Certain PGPR concentrations can increase nutrient availability, thus plant can absorb it in a way optimal And produce tubers which are more Lots (Daughter And Hidrawati, 2024). Matter This Also influenced by P-solubilizing bacteria content in PGPR (1.33×10^8) which supports the availability of nutrients, especially P become more optimal. Phosphorus can help the plant's metabolic processes so that with composition nutrition Which optimal will help

increase weight dry network plant Because biomass Which formed more (Triyono *et al.* , 2025). The availability of nutrients can help the photosynthesis process, so that the photosynthate results are more optimal and affect the dry weight. tubers. Mark weight dry tubers influenced by ability plant in distributing results photosynthesis become photosynthate, the more tall the result then the dry weight of the tubers will also increase (Miftakhurrohmah *et al.* , 2017).

The addition of manure to shallot plants did not significantly affect the dry weight of the bulbs (oven). The addition of goat manure give results that is 4.15 grams/clump, fertilizer pen cow manure, namely 3.85 grams/clump, and rabbit manure, namely 3.68 g/clump. The results of the analysis show improvement weight dry tubers (oven) on treatment manure goat, although in a way general fertilizer pen Not yet give significant results. Based on the analysis results, the %K content (2.49%) in goat manure has a higher value compared to cow and rabbit manure. The K element plays a role in assisting the photosynthesis process, the results of photosynthate will trigger the formation of larger tubers so that it can increase dry weight (Herlina and Elsie, 2016). The K nutrient plays a role in plant physiological processes such as photosynthesis, accumulation, translocation, and carbohydrate transport. Optimal plant physiological processes will influence weight dry tubers. Photosynthesis Which optimal can stimulates the formation of larger tubers, and increases dry weight because the results of photosynthesis are channeled to the tubers (Fatirahma and Kastono, 2020).

CHAPTER V

CONCLUSION AND SUGGESTION

5.1. Conclusion

Based on the research conducted, it was concluded that a PGPR concentration of 30 ml/L provided the highest and most efficient results for shallot growth and yield. Applying goat manure was more efficient, given in smaller amounts, with results comparable to rabbit manure.

5.2. Suggestion

Suggestion Which can given is need done analysis content PGPR bacteria more specifically so that the main function of PGPR can be known, and analysis of N, P, K content is available to determine the role of PGPR bacteria in optimizing growth, as well as use model rack vertical farming other in order to compare its efficiency and effectiveness.

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ATTACHMENT

Attachment 1. *Layout Test*

| KI | KIII | KII |
|------|------|------|
| A0B1 | A1B1 | A2B1 |
| A3B1 | A3B2 | A0B2 |
| A2B2 | A2B1 | A1B3 |
| A3B3 | A0B1 | A3B2 |
| A1B1 | A1B2 | A0B3 |
| A0B2 | A3B1 | A3B1 |
| A3B2 | A2B2 | A1B1 |
| A0B3 | A0B3 | A0B1 |
| A1B3 | A3B3 | A3B3 |
| A2B3 | A1B3 | A1B2 |
| A2B1 | A0B2 | A2B3 |
| A1B2 | A2B3 | A2B2 |



Information :

Factor First that is Concentration PGPR (A) consists of from 4 level : A0 = 0 ml/L

A1 = 15 ml/L

A2 = 30 ml/L

A3 = 45 ml/L

Factor Second that is Type Fertilizer Pen (B) consists of from 3

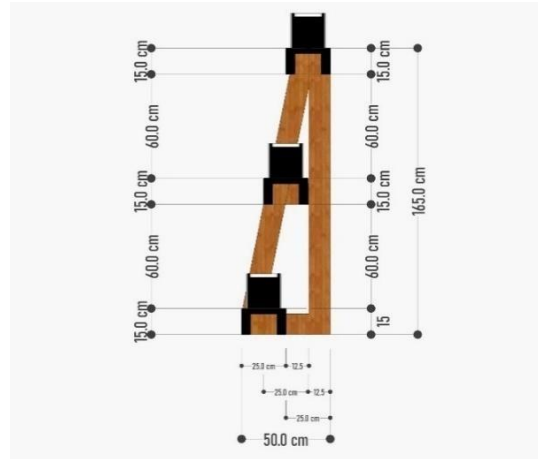
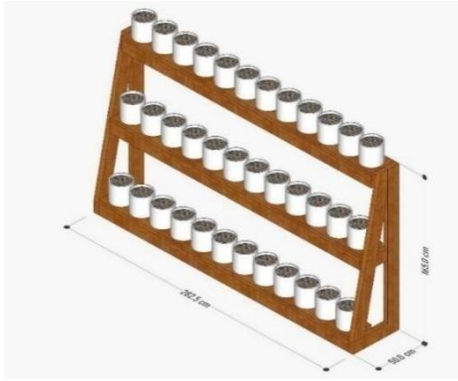
level : B1 = Cow Manure

B2 = Fertilizer Pen Goat B3 =

Rabbit Manure

K = Group

Attachment 2. Shelf Model Vertical farming



Attachment 3. Plant Description Onion Red Variety Maja Cipanas

ATTACHMENT LETTER DECISION MINISTER AGRICULTURE

NUMBER : 597/Kpts/TP.240/8/1984 DATE : 11 August 1984

DESCRIPTION ONION RED VARIETY MAJA Cipanas

| | | |
|--------------------------------|---------|---|
| Origin | : | local Cipanas |
| Age | : | - start flowering 50 day - harvest (60 % of stems (weak) 60 days |
| Plant height | : | 34.1 cm (24.3–43.7 cm) |
| Flowering ability (natural) | : | quite easy |
| Lots offspring | : | 6–12 per clump |
| Form leaves | : | cylindrical, perforated |
| Color leaves | : | green |
| Lots leaves | : | 16–49 leaves |
| Form flowers | : | like umbrella |
| Color flowers | : | white |
| Lots fruit/stalk | : | 60 – 100 (81) |
| Number of flowers/stems | : | 100 – 130 (128) |
| Number of flower stalks/clumps | : | 2 – 7 |
| Seed | shape : | round, flat, wrinkled |
| Color seeds | : | black |
| Bulb | shape : | round |

| | |
|-----------------------------|--|
| Color tubers | : red old |
| Tuber production | : 10.9 tons/ha tubers Dry |
| tuber weight loss (wet-dry) | : 24.9% |
| Resilience to disease | : sufficient stand to rotten tubers (<i>Botrytis (allii)</i>) |
| Sensitivity to disease | : sensitive to rotten end leaf (<i>Phytophthora (porri)</i>) |
| Description | : good for plains low and tall |
| Researcher | : Hendro Sunardjono, Prasodjo, Darliah and Nasran Horizon Arbain |

Attachment 4. Calculation Need Fertilizer NPK Plant Red onion

Fertilizer NPK Standard Onion Red according to Sumarni *et al* . (2012) :

$$N = 190 \text{ kg/ha}$$

$$P_2O_5 = 92$$

$$\text{kg/ha } K_2O =$$

$$120 \text{ kg/ha}$$

Contents nutrients N, P, K on each type fertilizer based on laboratory analysis results:

1. Fertilizer Cowshed

- N = 0.82%
- $P_2O_5 = 0.94\%$
- $K_2O = 1.08\%$

2. Fertilizer Pen Goat

- N = 1.24%
- $P_2O_5 = 1.11\%$
- $K_2O = 2.49\%$

3. Fertilizer Pen Rabbit

- N = 1.03%
- $P_2O_5 = 1.42\%$
- $K_2O = 2.26\%$

Population Plant

$$\text{Land area} = 1 \text{ ha} = 10,000 \text{ m}^2$$

$$\text{Plant distance} = 15 \times 20 \text{ cm} = 300 \text{ cm}^2 = 0.03 \text{ m}^2$$

$$\text{Population Plants} = \frac{10,000}{0.03} = 333.333 \text{ plant}$$

Fertilizer Dirt Cow

$$\text{Nitrogen (N)} = \frac{100}{0.82} \times 190 = 23,170.7 \text{ kg/ha}$$

$$\begin{aligned} \text{Dose per plants} &= \frac{23,170.7}{333,333} = 0.0695 \text{ kg/plant} \\ &= 0.07 \text{ kg/plant} \\ &= 70 \text{ g/plant} \end{aligned}$$

Fertilizer Dirt Goat

$$\begin{aligned} \text{Nitrogen (N)} &= \frac{100}{1.24} \times 190 = 15,322.6 \text{ kg/ha} \\ \text{Dose per plants} &= \frac{15,322.6}{333,333} = 0.046 \text{ kg/plant} \\ &= 0.05 \text{ kg/plant} \\ &= 50 \text{ g/plant} \end{aligned}$$

Fertilizer Dirt Rabbit

$$\begin{aligned} \text{Nitrogen (N)} &= \frac{100}{1.03} \times 190 = 18,446.6 \text{ kg/ha} \\ \text{Dose per plants} &= \frac{18,446.6}{333,333} = 0.0553 \text{ kg/plant} \\ &= 0.06 \text{ kg/plant} \\ &= 60 \text{ g/plant} \end{aligned}$$

Recapitulation Contents Hara Each Type Fertilizer Cages based on Nutrient Equivalence N

| | N | P ₂ O ₅ | K ₂ O |
|--------------------------------------|-------------|--|----------------------------|
| B1 (Fertilizer) Pen Cow) | 190 kg N/ha | 219 kg P ₂ O ₅ /ha | 252 kg K ₂ O/ha |
| B2 (Fertilizer) Pen Goat) | 190 kg N/ha | 185 kg P ₂ O ₅ /ha | 415 kg K ₂ O/ha |
| B3 (Fertilizer) Pen Rabbit) | 190 kg N/ha | 284 kg P ₂ O ₅ /ha | 452 kg K ₂ O/ha |

Attachment 5. Results Analysis Land Pre- Treatment

Lampiran Hasil Pemeriksaan Tanah
No. Contoh: 0026.TN.LKA.07.2024

| No. | Parameter | Satuan | Hasil Pengujian | Kriteria Penilaian | Metode/Alat Pengujian |
|-----|---------------------------------------|---------|-----------------|--------------------|-----------------------|
| 1. | Kadar Air | % | 13.56 | - | Gravimetri |
| 2. | C Organik | | 4.89 | Tinggi | Spektrofotometri |
| 3. | N Total | | 0.35 | Sedang | Kjeldahl |
| 4. | C/N | - | 14.0 | Sedang | - |
| 5. | P ₂ O ₅ HCl 25% | mg/100g | 281 | Sangat Tinggi | Spektrofotometri |
| 6. | K ₂ O HCl 25% | | 74 | Sangat Tinggi | AAS |

Lembang, 2 Agustus 2024

Koordinator Satuan Pelayanan
Laboratorium Kimia Agro


Geise Arisandi, S.Si., M.P.
Pembina Tingkat I
NIP. 19781211 200501 2 001

Attachment 6. Recapitulation Results Analysis Contents Hara Fertilizer Pen


| Parameters | * | Fertilizer Pen | | | | | |
|-----------------------------------|----------------------------------|----------------|------------------|----------|-----------|----------|-----|
| | | Cow** | Goat Criteria | Criteria | ** Rabbit | Criteria | ** |
| N _{total} (%) | (N+P ₂ O ₅ | 0.82 | | 1.24 | | 1.03 | |
| P ₂ O ₅ (%) | +K ₂ O): | 0.94 | (M) | 1.11 | (M) | 1.42 | (M) |
| K ₂ O (%) | Min. 2% | 1.08 | | 2.49 | | 2.26 | |
| C _{organic} (%) | Min. 15% | 12.60 | (M) | 18.29 | (M) | 19.55 | (M) |
| C/N | Max.25 | 15.4 | (M) | 14.8 | (M) | 19.0 | (M) |
| Level Water (%) | 8- 25% | 4.86 | (R) | 5.52 | (R) | 4.81 | (R) |
| pH | 4- 9 | 8.46 | (M) | 8.58 | (M) | 8.34 | (M) |

Information : *) Decision Minister Agriculture Republic Indonesia No. 261/KPTS/SR.310/M/4/2019/

**) Results of Nutrient Content Analysis of Manure from the Agro Chemistry Laboratory, 2024. M = Meets. R = Low.


Attachment 6. (Advanced)

Certificate Results Analysis Fertilizer Pen Cow



UPTD BALAI PERLINDUNGAN TANAMAN PANGAN DAN HORTIKULTURA
SATUAN PELAYANAN LABORATORIUM KIMIA AGRO

Jalan Raya Tangkuban Parahu KM. 22 Cikole, Lembang - Bandung 40391
 Telepon / Fax.: (022) 2784949, Email: lab_agro@yahoo.co.id; labkimiaagro@gmail.com



No. Seri: 90.LHP-PO.LKA.08.2024

LAPORAN HASIL PENGUJIAN
TEST REPORT


1. **Nama dan Alamat Pemohon** : Nurul Aulia Khoerunnisa
Name and Address of Applicant
2. **Nama Contoh** : Sampel Pukan Sapi
Name and Sample
3. **Nomor Contoh** : 0103.PO.07.2024
Sample ID
4. **Banyaknya Contoh** : 1 Kg
Number of Sample
5. **Keadaan Contoh** : Lembab
Description of Sample
6. **Tanggal Terima** : 25 Juli 2024
Date of Received
7. **Tanggal Pengujian** : 29 Juli s.d. 08 Agustus 2024
Date of Testing
8. **Hasil Pengujian** : Terlampir
Test Result

| No. | Parameter | Satuan | Hasil Pengujian | Metode/Alat Pengujian |
|-----|--|--------|-----------------|-----------------------|
| 1. | pH | - | 8.46 | SNI 7763:2018 |
| 2. | C Organik | % | 12.60 | |
| 3. | N Total (N Organik + NH ₄) | | 0.82 | |
| 4. | Kadar Air | | 4.86 | |
| 5. | C/N | - | 15.4 | - |
| 6. | P ₂ O ₅ | % | 0.94 | Spektrofotometri |
| 7. | K ₂ O | | 1.08 | AAS |

Keterangan: Hasil pengujian di atas, kecuali kadar air, dihitung atas dasar berat kering (adbk).


Attachment 6. (Advanced)

Certificate Results Analysis Fertilizer Pen Goat



UPTD BALAI PERLINDUNGAN TANAMAN PANGAN DAN HORTIKULTURA
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Jalan Raya Tangkuban Parahu KM. 22 Cikole, Lembang - Bandung 40391
 Telepon / Fax.: (022) 2784949, Email: lab_agro@yahoo.co.id; labkimiaagro@gmail.com



No. Seri: 92.LHP-PO.LKA.08.2024

LAPORAN HASIL PENGUJIAN
TEST REPORT


1. Nama dan Alamat Pemohon : Nurul Aulia Khoerunnisa
Name and Address of Applicant
2. Nama Contoh : Sampel Pukan Kambing
Name and Sample
3. Nomor Contoh : 0105.PO.07.2024
Sample ID
4. Banyaknya Contoh : 1 Kg
Number of Sample
5. Kedaaan Contoh : Lembab
Description of Sample
6. Tanggal Terima : 25 Juli 2024
Date of Received
7. Tanggal Pengujian : 29 Juli s.d. 08 Agustus 2024
Date of Testing
8. Hasil Pengujian : Terlampir
Test Result

| No. | Parameter | Satuan | Hasil Pengujian | Metode/Alat Pengujian |
|-----|--|--------|-----------------|-----------------------|
| 1. | pH | - | 8.58 | SNI 7763:2018 |
| 2. | C Organik | % | 18.29 | |
| 3. | N Total (N Organik + NH ₄) | | 1.24 | |
| 4. | Kadar Air | | 5.52 | |
| 5. | C/N | - | 14.8 | - |
| 6. | P ₂ O ₅ | % | 1.11 | Spektrofotometri |
| 7. | K ₂ O | | 2.49 | AAS |

Keterangan: Hasil pengujian di atas, kecuali Kadar air, dihitung atas dasar berat kering (adbk)


Attachment 6. (Advanced)

Certificate Results Analysis Fertilizer Pen Goat



UPTD BALAI PERLINDUNGAN TANAMAN PANGAN DAN HORTIKULTURA
SATUAN PELAYANAN LABORATORIUM KIMIA AGRO

Jalan Raya Tangkuban Parahu KM. 22 Cikole, Lembang - Bandung 40391
 Telepon / Fax.: (022) 2784949, Email: lab_agro@yahoo.co.id; labkimiaagro@gmail.com



No. Seri: 91.LHP-PO.LKA.08.2024

LAPORAN HASIL PENGUJIAN
TEST REPORT

1. **Nama dan Alamat Pemohon** : Nurul Aulia Khoerunnisa
Name and Address of Applicant
2. **Nama Contoh** : Sampel Pukan Kelinci
Name and Sample
3. **Nomor Contoh** : 0104.PO.07.2024
Sample ID
4. **Banyaknya Contoh** : 1 Kg
Number of Sample
5. **Keadaan Contoh** : Lembab
Description of Sample
6. **Tanggal Terima** : 25 Juli 2024
Date of Received
7. **Tanggal Pengujian** : 29 Juli s.d. 08 Agustus 2024
Date of Testing
8. **Hasil Pengujian** : Terlampir
Test Result

| No. | Parameter | Satuan | Hasil Pengujian | Metode/Alat Pengujian |
|-----|--|--------|-----------------|-----------------------|
| 1. | pH | - | 8.34 | SNI 7763:2018 |
| 2. | C Organik | % | 19.55 | |
| 3. | N Total (N Organik + NH ₄) | | 1.03 | |
| 4. | Kadar Air | | 4.81 | |
| 5. | C/N | - | 19.0 | - |
| 6. | P ₂ O ₅ | % | 1.42 | Spektrofotometri |
| 7. | K ₂ O | | 2.26 | AAS |

Keterangan: Hasil pengujian di atas, kecuali kadar air, dihitung atas dasar berat kering (adbk).

Attachment 7. Standard Quality Fertilizer Biological Liquid And Certificate of Analysis Results PGPR

| No | Standard Parameters | Quality |
|----|--|--------------------------------------|
| | Number of living cells per genus | |
| | A. Microbial consortium consisting of 2 genera, one of which meets the technical requirements: | |
| | 1. Bacteria* | $\geq 1 \times 10^7$ cfu/ml |
| | 2. Actinomycetes* | $\geq 1 \times 10^4$ cfu/ml |
| | 3. Fungi* | $\geq 1 \times 10^4$ cfu/ml |
| | Genus both are appropriate condition technical: | $\geq 1 \times 10^6$ cfu/ml |
| 1. | 1. Bacteria* | $\geq 1 \times 10^4$ cfu/ml |
| | 2. Actinomycetes* | $\geq 1 \times 10^5$ cfu/ml |
| | 3. Fungi* | |
| | B. Consortium microbes Which consists of on more than 2 genus, Wrong One genus in accordance technical requirements : | |
| | 1. Bacteria* | $\geq 1 \times 10^6$ cfu/ml |
| | 2. Actinomycetes* | $\geq 1 \times 10^4$ cfu/ml |
| | 3. Fungi* | $\geq 1 \times 10^5$ cfu/ml |
| | Genus others as appropriate condition technical: | $\geq 1 \times 10^3$ cfu/ml |
| | 1. Bacteria* | Positive |
| | 2. Actinomycetes* | Positive |
| | 3. Fungi* | Positive |
| | Test functional* | Positive |
| 2. | a. mooring N | |
| | b. Solvent P | |
| | c. Elemental solvent Hara other (K, Si, Zn, etc.) | |
| | d. Renovator material organic | |
| | e. Former nodule root | |
| 3. | Pathogenicity on Negative plants | |
| 4. | <i>E. coli</i> | $< 1 \times 10^3$ cfu or MPN/g or ml |
| | <i>Salmonella</i> sp | $< 1 \times 10^3$ cfu or MPN/g or ml |
| | . | $< 1 \times 10^3$ cfu or MPN/g or ml |

Information: (Decision Minister Agriculture Republic Indonesia No. 261/KPTS/SR.310/M/4/2019)

Attachment 7. (Advanced)



LABORATORIUM ICBB
PT BIODIVERSITAS BIOTEKNOLOGI INDONESIA
 ICBB-Complex Jl. Cilubang Nagrak No. 62 Kel. Situgede Kec. Bogor Barat
 Kota Bogor 16115 - Jawa Barat - INDONESIA
 Ph. 62-251-8423 005 / 8423 003 Fax: 62-251-8423 004
<http://www.icbb.or.id>

No. : 28.1/FP/ICBB
 Revisi : 8

LAPORAN HASIL PENGUJIAN
No.: 1337/LHP/PTBBI.Mark/IX/2024

| No. | Parameter | Metode | Satuan | No. Identifikasi |
|-----|---------------------|--|--------|---------------------|
| | | | | Pupuk Hayati Cair |
| | | | | 2408.06434 |
| 1 | Mikrob Pelarut P | ICBB/MU/12.001.13 (Plate Count, Pour Plate) | CFU/mL | $1,33 \times 10^8$ |
| 2 | Mikrob Pelarut K # | Plate Count, Pour Plate | CFU/mL | $< 1 \times 10^1$ * |
| 3 | Mikrob Penambat N # | Plate Count, Pour Plate | CFU/mL | $< 1 \times 10^1$ * |

Keterangan :


#) Parameter tidak terakreditasi

*) Jumlah koloni kurang dari satu kali pengenceran terendah (tidak ada pertumbuhan pada pengenceran terendah)


Attachment 8. Results Analysis Land Post Treatment

| Treatment | Parameter | | | | |
|-----------|-----------|-----------------------------------|----------------------|--------------------------|-----|
| | N (%) | P ₂ O ₅ (%) | K ₂ O (%) | C _{organic} (%) | C/N |
| A0B1 | 0,60 | 0,33198 | 0,37776 | 7,30 | 12 |
| A1B1 | 0,56 | 0,28936 | 0,44201 | 7,13 | 13 |
| A2B1 | 0,55 | 0,30427 | 0,36693 | 7,21 | 13 |
| A3B1 | 0,58 | 0,31531 | 0,38852 | 7,41 | 13 |
| A0B2 | 0,69 | 0,36001 | 0,65122 | 8,53 | 12 |
| A1B2 | 0,65 | 0,29715 | 0,44331 | 8,03 | 12 |
| A2B2 | 0,60 | 0,31859 | 0,50242 | 8,07 | 13 |
| A3B2 | 0,68 | 0,31449 | 0,40297 | 8,17 | 12 |
| A0B3 | 0,62 | 0,31374 | 0,48429 | 7,79 | 13 |
| A1B3 | 0,68 | 0,37825 | 0,47274 | 8,25 | 12 |
| A2B3 | 0,71 | 0,28489 | 0,50981 | 8,21 | 12 |
| A3B3 | 0,67 | 0,38424 | 0,41745 | 8,03 | 12 |

Attachment 9. (Advanced)



Laboratorium Penguji
BADAN STANDARDISASI INSTRUMEN PERTANIAN
PUSAT STANDARDISASI INSTRUMEN HORTIKULTURA
 Laboratorium Kimia BALAI PENGUJIAN STANDAR INSTRUMEN TANAMAN SAYURAN
 Jl. Tangkuban Parahu No. 517 Lembang – Bandung Barat 40391
 Telp. (022) 2786245 Fax. (022) 278228; e-mail: Labpenguji_balitsa@yahoo.com



SCIENCE . INNOVATION . NETWORKS


SERTIFIKAT HASIL PENGUJIAN TANAH/KESUBURAN - 1
LABORATORIUM KIMIA


Form K.05.a.

Nomor Surat Permintaan : K.200/Koord. Adm./11/2024
 Nama Peminta Pengujian : Nurul Aulia Khoerunnisa
 Alamat Peminta Pengujian : Jl. Ahmad Yani No.74, RT/RW 15/05, Cipaisan, Kec. Purwakarta, Kab. Purwakarta, Jawa Barat
 Jenis Sampel : Media Tanam Tanah
 Asal Sampel : Ds. Cipaisan, Kec. Purwakarta, Kab. Purwakarta, Prov. Jawa Barat

Tanggal Terima Sampel : 11 November 2024
 Tanggal Pengujian : 11 November - 20 Desember 2024

| No. | KODE LAPANG | NO. LAB | TEKSTUR | | | Eks. 1-5 | | | | Terhadap bahan kering 105°C | | | | | | | | | | | | KB | | | |
|-----|-------------|---------|------------|------|------|-------------------------------|-----|----------------|----------|-----------------------------|-------------------------------|------------------|-----------|------------|------------|-------------------------------|---|-----------------------------|------------|-----|---|----|---|---|---|
| | | | Pasir | Debu | Liat | pH | | C-org. Kummies | N | C/N | Bray 1 | Olsen | M. Venema | HCl 25 % | | KCl 1 N | | Eks. Amonium Acetat 1M pH 7 | | | | | | | |
| | | | | | | P ₂ O ₅ | K | | | | P ₂ O ₅ | K ₂ O | Al.dd | H.dd | Ca | Mg | K | Na | Jml | KTK | | | | | |
| | | | Gravimetri | | | Elektrometri | | Spektro FM | Kjeldahl | Spektro FM | Flame FM | Spektro FM | Flame FM | Titrimetri | | Spektrofotometri Serspan Atom | | | Titrimetri | | | | | | |
| % | | | | | % | | | | ppm | | mg/100g | | | | cmol(+)/kg | | | | | % | | | | | |
| 1 | A0B1K1.2.3 | NV 36 | - | - | - | 7,7 | 6,8 | 7,30 | 0,60 | 12 | - | - | - | 331,98 | 377,76 | - | - | - | - | - | - | - | - | - | - |
| 2 | A1B1K1.2.3 | NV 37 | - | - | - | 7,8 | 6,9 | 7,13 | 0,56 | 13 | - | - | - | 289,36 | 442,01 | - | - | - | - | - | - | - | - | - | - |
| 3 | A2B1K1.2.3 | NV 38 | - | - | - | 7,8 | 6,9 | 7,21 | 0,55 | 13 | - | - | - | 304,27 | 366,93 | - | - | - | - | - | - | - | - | - | - |
| 4 | A3B1K1.2.3 | NV 39 | - | - | - | 7,8 | 7,0 | 7,41 | 0,58 | 13 | - | - | - | 315,31 | 388,52 | - | - | - | - | - | - | - | - | - | - |
| 5 | A0B2K1.2.3 | NV 40 | - | - | - | 7,7 | 6,8 | 8,53 | 0,69 | 12 | - | - | - | 360,01 | 651,22 | - | - | - | - | - | - | - | - | - | - |
| 6 | A1B2K1.2.3 | NV 41 | - | - | - | 7,3 | 6,4 | 8,03 | 0,65 | 12 | - | - | - | 297,15 | 443,31 | - | - | - | - | - | - | - | - | - | - |
| 7 | A2B2K1.2.3 | NV 42 | - | - | - | 7,1 | 6,4 | 8,07 | 0,60 | 13 | - | - | - | 318,59 | 502,42 | - | - | - | - | - | - | - | - | - | - |
| 8 | A3B2K1.2.3 | NV 43 | - | - | - | 6,7 | 5,9 | 8,17 | 0,68 | 12 | - | - | - | 314,49 | 402,97 | - | - | - | - | - | - | - | - | - | - |
| 9 | A0B3K1.2.3 | NV 44 | - | - | - | 6,9 | 6,2 | 7,79 | 0,62 | 13 | - | - | - | 313,74 | 484,29 | - | - | - | - | - | - | - | - | - | - |
| 10 | A1B3K1.2.3 | NV 45 | - | - | - | 6,8 | 5,9 | 8,25 | 0,68 | 12 | - | - | - | 378,25 | 472,74 | - | - | - | - | - | - | - | - | - | - |
| 11 | A2B3K1.2.3 | NV 46 | - | - | - | 6,4 | 5,7 | 8,21 | 0,71 | 12 | - | - | - | 284,89 | 509,81 | - | - | - | - | - | - | - | - | - | - |
| 12 | A3B3K1.2.3 | NV 47 | - | - | - | 7,0 | 6,0 | 8,03 | 0,67 | 12 | - | - | - | 384,24 | 417,45 | - | - | - | - | - | - | - | - | - | - |

Koordinator Laboratorium,

 Tri Harfan, S.T
 NIP.199303122022031002

Lembang, 20 Desember 2024
 Penyelia Lab. Kimia,

 Fahmi Apranto, S.Si, M. Agr
 NIP.198704192011011010

Sertifikat ini hanya berlaku untuk sampel yang diuji dan tidak dapat diperbanyak tanpa izin dari Balai Pengujian Standar Instrumen Tanaman Sayuran
 This certificate is related to the sample/s submitted only and shall not be copied without written permission from Indonesian Vegetables Instrument Standard Testing Institute

Attachment 10. Data Temperature And Humidity During the Research

Data Average Temperature And Humidity Daily in Subdistrict Capaisan

| Month | Temperature | humidity |
|--------------|--------------------|-----------------|
| July | ±27°C | ±80% |
| August | ±28°C | ±70% |
| September | ±28°C | ±70% |

Source : Meteoblue Weather, 2024.

Attachment 11. Processing Data Tall Plant Height

Data at 6 Months After Planting

| Treatment | Group | | | Total | Average |
|-----------|------------------|--------|--------|--------|---------|
| | 1 | 2 | 3 | | |
| | ----- (cm) ----- | | | | |
| A0B1 | 21.50 | 25.40 | 24.50 | 71.40 | 23.80 |
| A1B1 | 25.40 | 22.35 | 20.50 | 68.25 | 22.75 |
| A2B1 | 29.00 | 27.75 | 22.25 | 79.00 | 26.33 |
| A3B1 | 26.00 | 28.50 | 21.30 | 75.80 | 25.27 |
| A0B2 | 24.90 | 20.00 | 22.50 | 67.40 | 22.47 |
| A1B2 | 35.50 | 30.70 | 29.70 | 95.90 | 31.97 |
| A2B2 | 38.00 | 32.75 | 37.75 | 108.50 | 36.17 |
| A3B2 | 31.75 | 31.00 | 40.00 | 102.75 | 34.25 |
| A0B3 | 22.25 | 33.75 | 23.75 | 79.75 | 26.58 |
| A1B3 | 32.00 | 32.50 | 36.25 | 100.75 | 33.58 |
| A2B3 | 37.50 | 35.75 | 30.75 | 104.00 | 34.67 |
| A3B3 | 34.75 | 31.00 | 41.25 | 107.00 | 35.67 |
| Total | 358.55 | 351.45 | 350.50 | 40.08 | |
| Average | 29.88 | 29.29 | 29.21 | | 29.46 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|---------|---------|
| | B1 | B2 | B3 | | |
| A0 | 71.40 | 67.40 | 79.75 | 218.55 | 24.28 |
| A1 | 68.25 | 95.90 | 100.75 | 264.90 | 29.43 |
| A2 | 79.00 | 108.50 | 104.00 | 291.50 | 32.39 |
| A3 | 75.80 | 102.75 | 107.00 | 285.55 | 31.73 |
| Total | 294.45 | 374.55 | 391.50 | 1060.50 | |
| Average | 24.54 | 31.21 | 32.63 | | 29.46 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - 1 \\
\text{1 db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(1060.50)^2}{3.4.3} = 31240.56$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(21.50)^2 + (25.40)^2 + (24.50)^2 + \dots + (41.25)^2] - 31240.56 \\
&= 32534.94 - 31240.56 \\
&= 1294.37
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(358.55)^2 + (351.45)^2 + (350.50)^2]}{4.3} - 31240.56 \\
&= 3.23
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(71.40)^2 + (67.40)^2 + (79.75)^2 + \dots + (107.00)^2]}{3} - 31240.56 \\
&= 955.33
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{KB} - \text{FK} \\
&= \frac{[(218.55)^2 + (264.90)^2 + (291.50)^2 + (285.55)^2]}{3.3} - 31240.56
\end{aligned}$$

$$\begin{aligned}
 &= 364.68 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(294.45)^2 + (374.55)^2 + (391.50)^2]}{3.4} - 31240.56 \\
 &= 447.83 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 955.33 - 364.68 - 447.83 \\
 &= 142.82 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 1294.37 - 3.23 - 364.68 - 447.83 - 142.82 \\
 &= 335.82
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{3.23}{2} = 1.61 \\
 \text{KT Treatment} &= \frac{\text{JK Treatment}}{\text{db Treatment}} = \frac{955.33}{11} = 86.85 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{364.68}{3} = 121.56 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{447.83}{2} = 223.92 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{142.82}{6} = 23.80 \\
 \text{KT Error} &= \frac{\text{JK}}{\text{db error Error}} = \frac{335.82}{22} = 15.26
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{1.61}{15.26} = 0.11 \\
 \text{KT Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{86.85}{15.26} = 5.69
 \end{aligned}$$

$$\begin{aligned}
 \text{KT A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{121.56}{15.26} = 7.96 \\
 \text{KT B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{223.92}{15.26} = 14.67 \\
 \text{KT A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{23.80}{15.26} = 1.56
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|---------|--------|---------|--------------|------|
| Group | 2 | 3.23 | 1.61 | 0.11 | 3.44 | ns |
| Treatment | 11 | 955.33 | 86.85 | 5.69 | 2.26 | * |
| A | 3 | 364.68 | 121.56 | 7.96 | 3.05 | * |
| B | 2 | 447.83 | 223.92 | 14.67 | 3.44 | * |
| AxB | 6 | 142.82 | 23.80 | 1.56 | 2.55 | ns |
| Error | 22 | 335.82 | 15.26 | | | |
| Total | 35 | 1294.37 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{15.26}}{29.461} \times 100\% \\
 &= 13.26\%
 \end{aligned}$$

8. Test Carry on *Duncan Multiple Range Test*

(DMRT) DMRT Test Treatment A (PGPR

Concentration)

$$\text{sd} = \sqrt{\frac{\text{KT rB}}{\text{error}}} = \sqrt{\frac{15.26}{3.3}} = 1.302$$

Table Comparator Duncan

| | 2 | 3 | 4 |
|----------|-------|-------|-------|
| sd | 1,302 | 1,302 | 1,302 |
| r (p,db) | 2,933 | 3,080 | 3,173 |
| RP | 3.81 | 4.01 | 4.13 |

Table Matrix Plant Height Onion Red

| Average Treatment | | Average | | | | |
|-------------------|-------|--------------------|--------------------|-------------------|-----------------|---|
| Notation | | A2 | A3 | A1 | A0 | |
| A2 | 32.39 | 0 ^{ns} | | | | a |
| A3 | 31.73 | 0.66 ^{ns} | 0 ^{ns} | | | a |
| A1 | 29,43 | 2,96 ^{ns} | 2,30 ^{ns} | 0 ^{ns} | | a |
| A0 | 24,28 | 8,11 [*] | 7,45 [*] | 5,15 [*] | 0 ^{ns} | b |

Description : A0 = PGPR concentration 0 ml/L, A1 = PGPR concentration 15 ml/L, A2 = PGPR concentration 30 ml/L, A3 = PGPR concentration 45 ml/L.

Test DMRT Treatment B (Type Fertilizer Pen)

$$sd = \sqrt{\frac{KT rA}{\text{error}}} = \sqrt{\frac{15.26}{3.4}} = 1.128$$

Table Comparator Duncan

| | 2 | 3 |
|----------|-------|-------|
| sd | 1,128 | 1,128 |
| r (p,db) | 2,933 | 3,080 |
| RP | 3.31 | 3.47 |

Table Matrix Plant Height Onion Red

| Average Treatment | | Average Notation | | | |
|-------------------|-------|--------------------|-----------------|-----------------|---|
| | | B3 | B2 | B1 | |
| B3 | 32.63 | 0 ^{ns} | - | | a |
| B2 | 31.21 | 1.42 ^{ns} | 0 ^{ns} | | a |
| B1 | 24.54 | 8.09 [*] | 6.67 | 0 ^{ns} | b |

Information : B1 = Fertilizer Pen Cow, B2 = Fertilizer Pen Goat, B3 = Rabbit Manure.

Tests of Between-Subjects Effects

Dependent Variable: Tinggi_Tanaman

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|----------------------------------|-------------------------|----|-------------|----------|-------|
| Corrected Model | 958,553 ^a | 13 | 73,735 | 4,830 | <,001 |
| Intercept | 31240,562 | 1 | 31240,562 | 2046,612 | <,001 |
| Konsentrasi_PGPR | 364,678 | 3 | 121,559 | 7,964 | <,001 |
| Pupuk_Kandang | 447,834 | 2 | 223,917 | 14,669 | <,001 |
| Kelompok | 3,225 | 2 | 1,613 | ,106 | ,900 |
| Konsentrasi_PGPR * Pupuk_Kandang | 142,816 | 6 | 23,803 | 1,559 | ,206 |
| Error | 335,820 | 22 | 15,265 | | |
| Total | 32534,935 | 36 | | | |
| Corrected Total | 1294,373 | 35 | | | |

a. R Squared = ,741 (Adjusted R Squared = ,587)

Tinggi_Tanaman

Duncan^{a,b}

| A | N | Subset | |
|------|---|---------|---------|
| | | 1 | 2 |
| A0 | 9 | 24,2833 | |
| A1 | 9 | | 29,4333 |
| A3 | 9 | | 31,7278 |
| A2 | 9 | | 32,3889 |
| Sig. | | 1,000 | ,143 |

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 15,265.

a. Uses Harmonic Mean Sample Size = 9,000.

b. Alpha = 0,05.

Tinggi_Tanaman

Duncan^{a,b}

| B | N | Subset | |
|------|----|---------|---------|
| | | 1 | 2 |
| B1 | 12 | 24,5375 | |
| B2 | 12 | | 31,2125 |
| B3 | 12 | | 32,6250 |
| Sig. | | 1,000 | ,385 |

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 15,265.

a. Uses Harmonic Mean Sample Size = 12,000.

b. Alpha = 0,05.

Attachment 12. Processing Data Amount Leaf Plant Data

Number of Plant Leaves at 6 Months After Planting

| Treatment | Group | | | Total | Average |
|-----------|---------------------|--------|--------|--------|---------|
| | 1 | 2 | 3 | | |
| | ------(strand)----- | | | | |
| A0B1 | 17.50 | 20.50 | 29.00 | 67.00 | 22.33 |
| A1B1 | 23.50 | 24.50 | 15.00 | 63.00 | 21.00 |
| A2B1 | 28.50 | 17.00 | 26.50 | 72.00 | 24.00 |
| A3B1 | 26.00 | 34.00 | 30.00 | 90.00 | 30.00 |
| A0B2 | 25.50 | 14.00 | 25.50 | 65.00 | 21.67 |
| A1B2 | 35.00 | 31.50 | 36.00 | 102.50 | 34.17 |
| A2B2 | 33.50 | 29.50 | 29.50 | 92.50 | 30.83 |
| A3B2 | 38.00 | 26.00 | 25.50 | 89.50 | 29.83 |
| A0B3 | 16.00 | 29.00 | 19.50 | 64.50 | 21.50 |
| A1B3 | 24.00 | 34.50 | 29.50 | 88.00 | 29.33 |
| A2B3 | 31.50 | 33.00 | 25.00 | 89.50 | 29.83 |
| A3B3 | 21.00 | 20.00 | 22.50 | 63.50 | 21.17 |
| Total | 320.00 | 313.50 | 313.50 | 40.08 | |
| Average | 26.67 | 26.13 | 26.13 | | 26.31 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 67.00 | 65.00 | 64.50 | 196.50 | 21.83 |
| A1 | 63.00 | 102.50 | 88.00 | 253.50 | 28.17 |
| A2 | 72.00 | 92.50 | 89.50 | 254.00 | 28.22 |
| A3 | 90.00 | 89.50 | 63.50 | 243.00 | 27.00 |
| Total | 292.00 | 349.50 | 305.50 | 947.00 | |
| Average | 24.33 | 29.13 | 25.46 | | 26.31 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(947.00)^2}{3.4.3} = 24911.36$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(17.50)^2 + (20.50)^2 + (29.00)^2 + \dots + (22.50)^2] - 24911.36 \\
&= 26290.50 - 24911.36 \\
&= 1379.14
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(320.00)^2 + (313.50)^2 + (313.50)^2]}{4.3} - 24911.36 \\
&= 2.35
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(67.00)^2 + (65.00)^2 + (64.50)^2 + \dots + (63.50)^2]}{3} - 24911.36 \\
&= 750.81
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(196.50)^2 + (253.50)^2 + (254.00)^2 + (243.00)^2]}{3.3} - 24911.36
\end{aligned}$$

$$\begin{aligned}
 &= 248.58 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(292.00)^2 + (349.50)^2 + (305.50)^2]}{3.4} - 24911.36 \\
 &= 150.68 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 750.81 - 248.58 - 150.68 \\
 &= 351.55 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 1379.14 - 2.35 - 248.58 - 150.68 - 351.55 \\
 &= 625.98
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{2.35}{2} = 1.17 \\
 \text{KT Treatment} &= \frac{\text{JK Treatment}}{\text{db Treatment}} = \frac{750.81}{11} = 68.26 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{248.58}{3} = 82.86 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{150.68}{2} = 75.34 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{351.55}{6} = 58.59 \\
 \text{KT Error} &= \frac{\text{JK error}}{\text{db Error}} = \frac{625.98}{22} = 28.45
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{1.17}{28.45} = 0.04 \\
 \text{KT Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{68.26}{28.45} = 2.40
 \end{aligned}$$

$$\begin{aligned}
 \text{KT A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{82.86}{28.45} = 2.91 \\
 \text{KT B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{75.34}{28.45} = 2.65 \\
 \text{KT A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{58.59}{28.45} = 2.06
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|---------|-------|---------|--------------|------|
| Group | 2 | 2.35 | 1.17 | 0.04 | 3.44 | ns |
| Treatment | 11 | 750.81 | 68.26 | 2.40 | 2.26 | * |
| A | 3 | 248.58 | 82.86 | 2.91 | 3.05 | ns |
| B | 2 | 150.68 | 75.34 | 2.65 | 3.44 | ns |
| AxB | 6 | 351.55 | 58.59 | 2.06 | 2.55 | ns |
| Error | 22 | 625.98 | 28.45 | | | |
| Total | 35 | 1379.14 | 1.17 | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{28.45}}{26.31} \times 100\% \\
 &= 20.28\%
 \end{aligned}$$

Attachment 11. (Advanced)Transformation Root Two Square ($\sqrt[2]{x}$) Data Amount Leaf Age 6 MST

| Treatment | Group | | | Total | Average |
|-----------|---------------------|-------|-------|-------|---------|
| | 1 | 2 | 3 | | |
| | ------(strand)----- | | | | |
| A0B1 | 4.18 | 4.53 | 5.39 | 14.10 | 4.70 |
| A1B1 | 4.85 | 4.95 | 3.87 | 13.67 | 4.56 |
| A2B1 | 5.34 | 4.12 | 5.15 | 14.61 | 4.87 |
| A3B1 | 5.10 | 5.83 | 5.48 | 16.41 | 5.47 |
| A0B2 | 5.05 | 3.74 | 5.05 | 13.84 | 4.61 |
| A1B2 | 5.92 | 5.61 | 6.00 | 17.53 | 5.84 |
| A2B2 | 5.79 | 5.43 | 5.43 | 16.65 | 5.55 |
| A3B2 | 6.16 | 5.10 | 5.05 | 16.31 | 5.44 |
| A0B3 | 4.00 | 5.39 | 4.42 | 13.81 | 4.60 |
| A1B3 | 4.90 | 5.87 | 5.43 | 16.20 | 5.40 |
| A2B3 | 5.61 | 5.74 | 5.00 | 16.35 | 5.45 |
| A3B3 | 4.58 | 4.47 | 4.74 | 13.79 | 4.60 |
| Total | 61.48 | 60.78 | 61.01 | | |
| Average | 5.12 | 5.07 | 5.08 | | 5.09 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|-------|-------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 14.10 | 13.84 | 13.81 | 41.75 | 4.64 |
| A1 | 13.67 | 17.53 | 16.20 | 47.40 | 5.27 |
| A2 | 14.61 | 16.65 | 16.35 | 47.61 | 5.29 |
| A3 | 16.41 | 16.31 | 13.79 | 46.51 | 5.17 |
| Total | 58.79 | 64.33 | 60.15 | 183.27 | |
| Average | 4.90 | 5.36 | 5.01 | | 5.09 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

Group = $(k - 1) = 3 - 1$

db Group = 2

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(183.27)^2}{3.4.3} = 933.00$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(4.18)^2 + (4.53)^2 + (5.39)^2 + \dots + (4.74)^2] - 933.00 \\
&= 946.94 - 933.00 \\
&= 13.92
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(61.48)^2 + (60.78)^2 + (61.01)^2]}{4.3} - 933.00 \\
&= 0.02
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(14.10)^2 + (13.84)^2 + (13.81)^2 + \dots + (13.79)^2]}{3} - 933.00 \\
&= 7.39
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)}{K.B} - \text{FK} \\
&= \frac{[(41.75)^2 + (47.40)^2 + (47.61)^2 + (46.51)^2]}{3.3} - 933.00
\end{aligned}$$

$$\begin{aligned}
 &= 2.53 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(58.79)^2 + (64.33)^2 + (60.15)^2]}{3.4} - 933.00 \\
 &= 1.39 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 7.39 - 2.53 - 1.39 \\
 &= 3.47 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 13.94 - 0.02 - 2.53 - 1.39 - 3.47 \\
 &= 6.53
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{0.02}{2} = 0.01 \\
 \text{KT Treatment} &= \frac{\text{JK Treatment}}{\text{db Treatment}} = \frac{7.39}{11} = 0.67 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{2.53}{3} = 0.84 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{1.39}{2} = 0.69 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{3.47}{6} = 0.58 \\
 \text{KT Error} &= \frac{\text{JK Error}}{\text{db Error}} = \frac{6.53}{22} = 0.30
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{0.01}{0.30} = 0.04 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{0.67}{0.30} = 2.26
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{0.84}{0.30} = 2.84 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{0.70}{0.30} = 2.34 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{0.58}{0.30} = 1.95
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|-------|------|---------|--------------|------|
| Group | 2 | 0.02 | 0.01 | 0.04 | 3.44 | ns |
| Treatment | 11 | 7.39 | 0.67 | 2.26 | 2.26 | * |
| A | 3 | 2.53 | 0.84 | 2.84 | 3.05 | ns |
| B | 2 | 1.39 | 0.69 | 2.34 | 3.44 | ns |
| AxB | 6 | 3.47 | 0.58 | 1.95 | 2.55 | ns |
| Error | 22 | 6.53 | 0.30 | | | |
| Total | 35 | 13.94 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Total average}} \times 100\% \\
 &= \frac{\sqrt{0.30}}{5.09} \times 100\% \\
 &= 10.70\%
 \end{aligned}$$

Attachment 13. Processing Data Contents Chlorophyll Total Leaf

Total Chlorophyll Content Data

| Treatment | Group | | | Total | Average |
|-----------|--------------------|--------|--------|--------|---------|
| | 1 | 2 | 3 | | |
| | ----- (mg/g) ----- | | | | |
| A0B1 | 1,145 | 1,246 | 1,251 | 3,642 | 1,214 |
| A1B1 | 0.997 | 1,026 | 1,146 | 3,169 | 1,056 |
| A2B1 | 0.950 | 1,022 | 1,001 | 2,973 | 0.991 |
| A3B1 | 0.838 | 1,093 | 1,068 | 2,999 | 1,000 |
| A0B2 | 1,068 | 0.963 | 1,100 | 3,131 | 1,044 |
| A1B2 | 0.965 | 1,142 | 1,278 | 3,385 | 1,128 |
| A2B2 | 1,078 | 1,171 | 1,194 | 3,443 | 1,148 |
| A3B2 | 1,078 | 1,657 | 1,116 | 3,851 | 1,284 |
| A0B3 | 1,120 | 0.975 | 1,113 | 3,208 | 1,069 |
| A1B3 | 0.821 | 0.943 | 1,192 | 2,956 | 0.985 |
| A2B3 | 1,098 | 1,159 | 1,711 | 3,968 | 1,323 |
| A3B3 | 1,146 | 0.937 | 1,227 | 3,310 | 1,103 |
| Total | 12,304 | 13,334 | 14,397 | 40,085 | |
| Average | 1,025 | 1,111 | 1,200 | | 1,112 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 3,642 | 3,131 | 3,208 | 9,981 | 1,109 |
| A1 | 3,169 | 3,385 | 2,956 | 9,510 | 1,057 |
| A2 | 2,973 | 3,443 | 3,968 | 10,384 | 1,154 |
| A3 | 2,999 | 3,851 | 3,310 | 10,160 | 1,129 |
| Total | 12,783 | 13,810 | 13,442 | 40,035 | |
| Average | 1,065 | 1,151 | 1,120 | | 1,112 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(40,035)^2}{3.4.3} = 44,522$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(1,145)^2 + (1,246)^2 + (1,251)^2 + \dots + (1,227)^2] - 44,636 \\
&= 45,635 - 44,522
\end{aligned}$$

$$= 1.113$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(12,304)^2 + (13,334)^2 + (14,397)^2]}{4.3} - 44,522
\end{aligned}$$

$$= 0.183$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(3,642)^2 + (3,131)^2 + (3,208)^2 + \dots + (3,310)^2]}{3} - 44,522
\end{aligned}$$

$$= 0.416$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(9,981)^2 + (9,510)^2 + (10,384)^2 + (10,160)^2]}{3.3} - 44,522
\end{aligned}$$

$$\begin{aligned}
&= 0.046 \\
\text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
&= \frac{[(12,783)^2 + (13,810)^2 + (13,442)^2]}{3.4} - 44,522 \\
&= 0.045 \\
\text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
&= 0.404 - 0.040 - 0.046 \\
&= 0.325 \\
\text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
&= 1.113 - 0.183 - 0.046 - 0.045 - 0.325 \\
&= 0.514
\end{aligned}$$

4. Square Middle

$$\begin{aligned}
\text{KT Group} &= \frac{\text{JK}_{\text{group}}}{\text{db}_{\text{Group}}} = \frac{0.183}{2} = 0.091 \\
\text{Treatment KT} &= \frac{\text{JK}_{\text{treatment}}}{\text{db}_{\text{Treatment}}} = \frac{0.416}{11} = 0.038 \\
\text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{0.046}{3} = 0.015 \\
\text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{0.045}{2} = 0.023 \\
\text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{0.325}{6} = 0.054 \\
\text{KT Error} &= \frac{\text{JK}_{\text{error}}}{\text{db}_{\text{Error}}} = \frac{0.514}{22} = 0.024
\end{aligned}$$

5. F Count

$$\begin{aligned}
\text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{0.091}{0.023} = 3,907 \\
\text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{0.038}{0.023} = 1,620
\end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{0.015}{0.023} = 0.655 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{0.023}{0.023} = 0.966 \\
 \text{F Calculate A}\times\text{B} &= \frac{\text{KT A}\times\text{B}}{\text{KT Error}} = \frac{0.054}{0.023} = 2,320
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|-------|-------|---------|--------------|------|
| Group | 2 | 1,113 | 0.091 | 3,907 | 3.44 | * |
| Treatment | 11 | 0.183 | 0.038 | 1,620 | 2.26 | ns |
| A | 3 | 0.416 | 0.015 | 0.655 | 3.05 | ns |
| B | 2 | 0.046 | 0.023 | 0.966 | 3.44 | ns |
| AxB | 6 | 0.045 | 0.054 | 2,320 | 2.55 | ns |
| Error | 22 | 0.325 | 0.023 | | | |
| Total | 35 | 0.514 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Total average}} \times 100\% \\
 &= \frac{\sqrt{0.023}}{40,035} \times 100\% \\
 &= 13.74\%
 \end{aligned}$$

Attachment 14. Processing Data Density Stomata Leaf

Stomata Density Data

| Treatment | Group | | | Total | Average |
|-----------|--------|--------|--------|-------|---------|
| | 1 | 2 | 3 | | |
| A0B1 | 16,17 | 9.46 | 10.74 | 36.37 | 12.12 |
| A1B1 | 17.26 | 11.53 | 10.50 | 39.29 | 13.10 |
| A2B1 | 12.60 | 11.55 | 11.33 | 35.48 | 11.83 |
| A3B1 | 17.00 | 11.91 | 10.71 | 39.62 | 13.21 |
| A0B2 | 9.68 | 14.99 | 11.07 | 35.74 | 11.91 |
| A1B2 | 10.69 | 16.01 | 13.39 | 40.09 | 13.36 |
| A2B2 | 11.13 | 15.97 | 14.82 | 41.92 | 13.97 |
| A3B2 | 11.78 | 11.33 | 14.68 | 37.79 | 12.60 |
| A0B3 | 14.46 | 16.11 | 12.21 | 42.78 | 14.26 |
| A1B3 | 10.06 | 12.00 | 15.48 | 37.54 | 12.51 |
| A2B3 | 7.94 | 12.87 | 14.87 | 35.68 | 11.89 |
| A3B3 | 22.82 | 17.06 | 17.35 | 57.23 | 19.08 |
| Total | 161.59 | 160.79 | 157.15 | | |
| Average | 13.47 | 13.40 | 13.10 | | 13.32 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 36.37 | 35.74 | 42.78 | 114.89 | 12.77 |
| A1 | 39.29 | 40.09 | 37.54 | 116.92 | 12.99 |
| A2 | 35.48 | 41.92 | 35.68 | 113.08 | 12.56 |
| A3 | 39.62 | 37.79 | 57.23 | 134.64 | 14.96 |
| Total | 150.76 | 155.54 | 173.23 | 479.53 | |
| Average | 12.56 | 12.96 | 14.44 | | 13.32 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

Group = $(k - 1) = 3 - 1$

db Group = 2

Treatment = $(p - 1) = 12 - 1$

$$\begin{aligned}
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - 1 \\
&= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1) (B - 1) = (4 - 1) (3 - 1) = 6 \\
\text{db Error} &= (AB - 1) (K - 1) = (12 - 1) (3 - 1) = 22 \\
\text{Total} &= (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(479.53)^2}{3.4.3} = 6387.47$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(16.17)^2 + (9.46)^2 + (10.74)^2 + \dots + (17.35)^2] - 6387.47 \\
&= 6710.67 - 6387.47 \\
&= 323.20
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(161.59)^2 + (160.79)^2 + (157.15)^2]}{4.3} - 6387.47 \\
&= 0.93
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(36.37)^2 + (35.74)^2 + (42.78)^2 + \dots + (57.23)^2]}{3} - 6387.47 \\
&= 130.09
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(114.89)^2 + (116.92)^2 + (113.08)^2 + (134.64)^2]}{3.3} - 6387.47 \\
&= 33.08
\end{aligned}$$

$$\begin{aligned}
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(150.76)^2 + (155.54)^2 + (173.23)^2]}{3.4} - 6387.47 \\
 &= 23.35 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 130.09 - 33.08 - 23.35 \\
 &= 73.66 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 323.20 - 0.93 - 33.08 - 23.35 - 73.66 \\
 &= 192.17
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{0.93}{2} = 0.47 \\
 \text{Treatment KT} &= \frac{\text{JK}_{\text{treatment}}}{\text{Treatment}} = \frac{130.09}{11} = 11.83 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{33.08}{3} = 11.03 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{23.35}{2} = 11.68 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{73.66}{6} = 12.28 \\
 \text{KT Error} &= \frac{\text{JK}_{\text{error}}}{\text{Error}} = \frac{192.17}{22} = 8.74
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{0.47}{8.74} = 0.05 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{11.83}{8.74} = 1.35 \\
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{11.03}{8.74} = 1.26
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{11.68}{8.74} = 1.34 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{12.28}{8.74} = 1.41
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|--------|-------|---------|--------------|------|
| Group | 2 | 0.93 | 0.47 | 0.05 | 3.44 | ns |
| Treatment | 11 | 130.09 | 11.83 | 1.35 | 2.26 | ns |
| A | 3 | 33.08 | 11.03 | 1.26 | 3.05 | ns |
| B | 2 | 23.35 | 11.68 | 1.34 | 3.44 | ns |
| AxB | 6 | 73.66 | 12.28 | 1.41 | 2.55 | ns |
| Error | 22 | 192.17 | 8.74 | | | |
| Total | 35 | 323.20 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{8.73}}{13.32} \times 100\% \\
 &= 22.19\%
 \end{aligned}$$

Attachment 13. (advanced)Transformation Root Two Square ($\sqrt[2]{x}$) Data Density Stomata Leaf

| Treatment | Group | | | Total | Average |
|-----------|---------------------|-------|-------|-------|---------|
| | 1 | 2 | 3 | | |
| | ------(strand)----- | | | | |
| A0B1 | 4.02 | 3.08 | 3.28 | 10.38 | 3.46 |
| A1B1 | 4.15 | 3.40 | 3.24 | 10.79 | 3.60 |
| A2B1 | 3.55 | 3.40 | 3.37 | 10.32 | 3.44 |
| A3B1 | 4.12 | 3.45 | 3.27 | 10.84 | 3.61 |
| A0B2 | 3.11 | 3.87 | 3.33 | 10.31 | 3.44 |
| A1B2 | 3.27 | 4.00 | 3.66 | 10.93 | 3.64 |
| A2B2 | 3.34 | 4.00 | 3.85 | 11.19 | 3.73 |
| A3B2 | 3.43 | 3.37 | 3.83 | 10.63 | 3.54 |
| A0B3 | 3.80 | 4.01 | 3.49 | 11.30 | 3.77 |
| A1B3 | 3.17 | 3.46 | 3.93 | 10.56 | 3.52 |
| A2B3 | 2.82 | 3.59 | 3.86 | 10.27 | 3.42 |
| A3B3 | 4.78 | 4.13 | 4.17 | 13.08 | 4.36 |
| Total | 43.56 | 43.76 | 43.28 | | |
| Average | 3.63 | 3.65 | 3.61 | | 3.63 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|-------|-------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 10.38 | 10.31 | 11.30 | 31.99 | 3.55 |
| A1 | 10.79 | 10.93 | 10.56 | 32.28 | 3.59 |
| A2 | 10.32 | 11.19 | 10.27 | 31.78 | 3.53 |
| A3 | 10.84 | 10.63 | 13.08 | 34.55 | 3.84 |
| Total | 42.33 | 43.06 | 45.21 | 130.60 | |
| Average | 3.53 | 3.59 | 3.77 | | 3.63 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

Group = $(k - 1) = 3 - 1$

db Group = 2

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(130.60)^2}{3.4.3} = 473.79$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(4.02)^2 + (3.08)^2 + (3.28)^2 + \dots + (4.17)^2] - 473.79 \\
&= 479.57 - 473.79 \\
&= 5.78
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(43.56)^2 + (43.76)^2 + (43.28)^2]}{4.3} - 473.79 \\
&= 0.01
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(10.38)^2 + (10.31)^2 + (11.30)^2 + \dots + (13.08)^2]}{3} - 473.79 \\
&= 2.18
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)}{K.B} - \text{FK} \\
&= \frac{[(31.99)^2 + (32.28)^2 + (31.78)^2 + (34.55)^2]}{3.3} - 473.79
\end{aligned}$$

$$\begin{aligned}
 &= 0.55 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(42.33)^2 + (43.06)^2 + (45.21)^2]}{3.4} - 473.79 \\
 &= 0.37 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 2.18 - 0.55 - 0.37 \\
 &= 1.26 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 5.78 - 0.01 - 0.55 - 0.37 - 1.26 \\
 &= 3.59
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK}_{\text{group}}}{\text{db}_{\text{Group}}} = \frac{0.01}{2} = 0.005 \\
 \text{Treatment KT} &= \frac{\text{JK}_{\text{treatment}}}{\text{db}_{\text{Treatment}}} = \frac{2.18}{11} = 0.198 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{0.55}{3} = 0.183 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{0.37}{2} = 0.187 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{1.26}{6} = 0.210 \\
 \text{KT Error} &= \frac{\text{JK}_{\text{error}}}{\text{db}_{\text{Error}}} = \frac{3.59}{22} = 0.163
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{0.005}{0.163} = 0.03 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{0.198}{0.163} = 1.22
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{0.183}{0.163} = 1.12 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{0.187}{0.163} = 1.15 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{0.210}{0.163} = 1.29
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|------|-------|---------|--------------|------|
| Group | 2 | 0.01 | 0.005 | 0.03 | 3.44 | ns |
| Treatment | 11 | 2.18 | 0.198 | 1.22 | 2.26 | ns |
| A | 3 | 0.55 | 0.183 | 1.12 | 3.05 | ns |
| B | 2 | 0.37 | 0.187 | 1.15 | 3.44 | ns |
| AxB | 6 | 1.26 | 0.210 | 1.29 | 2.55 | ns |
| Error | 22 | 3.59 | 0.163 | | | |
| Total | 35 | 5.78 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{0.163}}{3.63} \times 100\% \\
 &= 11.03\%
 \end{aligned}$$

Attachment 15. Processing Data Long Root Plant Root

Length Data

| Treatment | Group | | | Total | Average |
|-----------|------------------|--------|--------|-------|---------|
| | 1 | 2 | 3 | | |
| | ----- (cm) ----- | | | | |
| A0B1 | 11.00 | 8.75 | 13.75 | 33.50 | 11.17 |
| A1B1 | 12.25 | 15.65 | 13.40 | 41.30 | 13.77 |
| A2B1 | 13.00 | 14.25 | 12.75 | 40.00 | 13.33 |
| A3B1 | 17.75 | 16.25 | 14.75 | 48.75 | 16.25 |
| A0B2 | 12.00 | 10.25 | 12.00 | 34.25 | 11.42 |
| A1B2 | 15.25 | 13.50 | 16.00 | 44.75 | 14.92 |
| A2B2 | 14.00 | 12.40 | 16.75 | 43.15 | 14.38 |
| A3B2 | 15.00 | 18.00 | 17.50 | 50.50 | 16.83 |
| A0B3 | 13.75 | 14.50 | 13.50 | 41.75 | 13.92 |
| A1B3 | 19.25 | 11.25 | 16.25 | 46.75 | 15.58 |
| A2B3 | 14.35 | 13.50 | 19.00 | 46.85 | 15.62 |
| A3B3 | 18.25 | 15.50 | 20.25 | 54.00 | 18.00 |
| Total | 175.85 | 163.80 | 185.90 | 40.08 | |
| Average | 14.65 | 13.65 | 15.49 | | 14.60 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 33.50 | 34.25 | 41.75 | 109.50 | 12.17 |
| A1 | 41.30 | 44.75 | 46.75 | 132.80 | 14.76 |
| A2 | 40.00 | 43.15 | 46.85 | 130.00 | 14.44 |
| A3 | 48.75 | 50.50 | 54.00 | 153.25 | 17.03 |
| Total | 163.55 | 172.65 | 189.35 | 525.55 | |
| Average | 13.63 | 14.39 | 15.78 | | 14.60 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(525.55)^2}{3.4.3} = 7672.30$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(11.00)^2 + (8.75)^2 + (13.75)^2 + \dots + (20.25)^2] - 7672.30 \\
&= 7917.23 - 7672.30 \\
&= 244.93
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(175.85)^2 + (163.80)^2 + (185.90)^2]}{4.3} - 7672.30 \\
&= 20.41
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(33.50)^2 + (34.25)^2 + (41.75)^2 + \dots + (54.00)^2]}{3} - 7672.30 \\
&= 138.32
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(109.50)^2 + (132.80)^2 + (130.00)^2 + (153.25)^2]}{3.3} - 7672.30
\end{aligned}$$

$$\begin{aligned}
 &= 106.77 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(163.55)^2 + (172.65)^2 + (189.35)^2]}{3.4} - 7672.30 \\
 &= 28.54 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 138.32 - 106.77 - 28.54 \\
 &= 3.01 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 244.93 - 20.41 - 106.77 - 28.54 - 3.01 \\
 &= 86.21
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{20.41}{2} = 10.20 \\
 \text{Treatment KT} &= \frac{\text{JK treatment}}{\text{DB Treatment}} = \frac{138.32}{11} = 12.57 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{106.77}{3} = 35.59 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{28.54}{2} = 14.27 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{3.01}{6} = 0.50 \\
 \text{KT Error} &= \frac{\text{JK error}}{\text{db Error}} = \frac{86.21}{22} = 3.92
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{10.20}{3.92} = 2.60 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{12.57}{3.92} = 3.21
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{35.59}{3.92} = 9.08 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{14.27}{3.92} = 3.64 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{0.50}{3.92} = 0.13
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|--------|-------|---------|--------------|------|
| Group | 2 | 20.41 | 10.20 | 2.60 | 3.44 | ns |
| Treatment | 11 | 138.32 | 12.57 | 3.21 | 2.26 | * |
| A | 3 | 106.77 | 35.59 | 9.08 | 3.05 | * |
| B | 2 | 28.54 | 14.27 | 3.64 | 3.44 | * |
| AxB | 6 | 3.01 | 0.50 | 0.13 | 2.55 | ns |
| Error | 22 | 86.21 | 3.92 | | | |
| Total | 35 | 244.93 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{3.92}}{14.60} \times 100\% \\
 &= 13.56\%
 \end{aligned}$$

8. Test Carry on *Duncan Multiple Range Test*

(DMRT) DMRT Test Treatment A (PGPR

Concentration)

$$sd = \sqrt{\frac{KT \text{ rB}}{\text{error}}} = \sqrt{\frac{3.92}{3.3}} = 0.660$$

Table Comparator Duncan

| | 2 | 3 | 4 |
|----------|-------|-------|-------|
| sd | 0.660 | 0.660 | 0.660 |
| r (p,db) | 2,933 | 3,080 | 3,173 |
| RP | 1.94 | 2.03 | 2.09 |

Table Matrix Long Plant Roots Red onion

| Average Treatment | | Average | | | | |
|-------------------|-------|-------------------|--------------------|-------------------|-----------------|---|
| Notation | | A3 | A1 | A2 | A0 | |
| A3 | 17.03 | 0 ^{ns} | | | | a |
| A1 | 14.76 | 2.27 [*] | 0 ^{ns} | | | b |
| A2 | 14,44 | 2,58 [*] | 0,31 ^{ns} | 0 ^{ns} | | b |
| A0 | 12,17 | 4,86 [*] | 2,59 [*] | 2.28 [*] | 0 ^{ns} | c |

Description : A0 = Concentration PGPR 0 ml/L, A1 = Concentration PGPR 15 ml/L, A2 = PGPR concentration 30 ml/L, A3 = PGPR concentration 45 ml/L.

Test DMRT Treatment B (Type Manure)

$$sd = \sqrt{\frac{KT \text{ rA}}{\text{error}}} = \sqrt{\frac{3.92}{3.4}} = 0.571$$

Table Comparator Duncan

| | 2 | 3 |
|----------|-------|-------|
| sd | 0.571 | 0.571 |
| r (p,db) | 2,933 | 3,080 |
| RP | 1.68 | 1.76 |

Table Matrix Long Plant Roots Red onion

| Average Treatment | | Average Notation | | | |
|-------------------|-------|--------------------|--------------------|-----------------|----|
| | | B3 | B2 | B1 | |
| B3 | 15.78 | 0 ^{ns} | - | | a |
| B2 | 14,39 | 1,39 ^{ns} | 0 ^{ns} | | ab |
| B1 | 13,63 | 2,15 [*] | 0,76 ^{ns} | 0 ^{ns} | b |

Information : B1 = Fertilizer Pen Cow, B2 = Fertilizer Pen Goat, B3 = Rabbit Manure.

Attachment 16. Processing Data Amount tubers Onion Red Data

Average Number of Red Onion Bulbs

| Treatment | Group | | | Total | Average |
|-----------|---------------------------|-------|--------|--------|---------|
| | 1 | 2 | 3 | | |
| | ----- (tuber/clump) ----- | | | | |
| A0B1 | 6.00 | 7.00 | 9.00 | 22.00 | 7.33 |
| A1B1 | 5.50 | 9.50 | 8.50 | 23.50 | 7.83 |
| A2B1 | 8.00 | 6.00 | 11.00 | 25.00 | 8.33 |
| A3B1 | 8.00 | 10.00 | 11.00 | 29.00 | 9.67 |
| A0B2 | 6.00 | 5.50 | 9.00 | 20.50 | 6.83 |
| A1B2 | 10.00 | 9.50 | 9.50 | 29.00 | 9.67 |
| A2B2 | 6.50 | 10.00 | 10.00 | 26.50 | 8.83 |
| A3B2 | 9.00 | 8.00 | 8.00 | 25.00 | 8.33 |
| A0B3 | 5.50 | 7.50 | 8.00 | 21.00 | 7.00 |
| A1B3 | 9.00 | 9.00 | 8.00 | 26.00 | 8.67 |
| A2B3 | 9.00 | 8.50 | 7.00 | 24.50 | 8.17 |
| A3B3 | 7.00 | 5.50 | 6.00 | 18.50 | 6.17 |
| Total | 89.50 | 96.00 | 105.00 | 290.50 | |
| Average | 7.46 | 8.00 | 8.75 | | 8.07 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|-------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 22.00 | 20.50 | 21.00 | 63.50 | 7.06 |
| A1 | 23.50 | 29.00 | 26.00 | 78.50 | 8.72 |
| A2 | 25.00 | 26.50 | 24.50 | 76.00 | 8.44 |
| A3 | 29.00 | 25.00 | 18.50 | 72.50 | 8.06 |
| Total | 99.50 | 101.00 | 90.00 | 290.50 | |
| Average | 8.29 | 8.42 | 7.50 | | 8.07 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(290.50)^2}{3.4.3} = 2344.17$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(6.00)^2 + (7.00)^2 + (9.00)^2 + \dots + (6.00)^2] - 2344.17 \\
&= 2437.75 - 2344.17 \\
&= 93.58
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(89.50)^2 + (96.00)^2 + (105.00)^2]}{4.3} - 2344.17 \\
&= 10.10
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(22.00)^2 + (20.50)^2 + (21.00)^2 + \dots + (18.50)^2]}{3} - 2344.17 \\
&= 39.24
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(63.50)^2 + (78.50)^2 + (76.00)^2 + (72.50)^2]}{3.3} - 2344.17
\end{aligned}$$

$$\begin{aligned}
 &= 14.35 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(99.50)^2 + (101.00)^2 + (90.00)^2]}{3.4} - 2344.17 \\
 &= 5.93 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 39.24 - 14.35 - 5.93 \\
 &= 18.96 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 93.58 - 10.10 - 14.35 - 5.93 \\
 &= 44.23
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{10.10}{2} = 5.05 \\
 \text{Treatment KT} &= \frac{\text{JK treatment}}{\text{DB Treatment}} = \frac{39.24}{11} = 3.57 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{14.35}{3} = 4.78 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{5.93}{2} = 2.97 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{18.96}{6} = 3.16 \\
 \text{KT Error} &= \frac{\text{JK error}}{\text{db Error}} = \frac{44.24}{22} = 2.01
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{5.05}{2.01} = 2.51 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{3.57}{2.01} = 1.77
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{4.78}{2.01} = 2.38 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{2.97}{2.01} = 1.47 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{3.16}{2.01} = 1.57
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|-------|------|---------|--------------|------|
| Group | 2 | 10.10 | 5.05 | 2.51 | 3.44 | ns |
| Treatment | 11 | 39.24 | 3.57 | 1.77 | 2.26 | ns |
| A | 3 | 14.35 | 4.78 | 2.38 | 3.05 | ns |
| B | 2 | 5.93 | 2.97 | 1.47 | 3.44 | ns |
| AxB | 6 | 18.96 | 3.16 | 1.57 | 2.55 | ns |
| Error | 22 | 44.24 | 2.01 | | | |
| Total | 35 | 93.58 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{2.01}}{8.07} \times 100\% \\
 &= 17.57\%
 \end{aligned}$$

Attachment 17. Processing Data Diameter Tubers

Data Tubers Diameter (cm)

| Treatment | Group | | | Total | Average |
|-----------|------------------|-------|-------|-------|---------|
| | 1 | 2 | 3 | | |
| | ----- (cm) ----- | | | | |
| A0B1 | 1.89 | 1.42 | 1.76 | 5.06 | 1.69 |
| A1B1 | 2.19 | 1.56 | 1.41 | 5.16 | 1.72 |
| A2B1 | 2.37 | 1.83 | 1.72 | 5.93 | 1.98 |
| A3B1 | 2.21 | 1.45 | 1.62 | 5.28 | 1.76 |
| A0B2 | 1.63 | 1.55 | 1.57 | 4.75 | 1.58 |
| A1B2 | 1.90 | 1.70 | 1.72 | 5.32 | 1.77 |
| A2B2 | 2.60 | 1.70 | 1.89 | 6.19 | 2.06 |
| A3B2 | 2.15 | 1.83 | 1.84 | 5.82 | 1.94 |
| A0B3 | 1.35 | 1.55 | 1.57 | 4.47 | 1.49 |
| A1B3 | 1.86 | 1.72 | 1.61 | 5.19 | 1.73 |
| A2B3 | 1.90 | 1.88 | 2.25 | 6.04 | 2.01 |
| A3B3 | 2.16 | 2.29 | 2.26 | 6.70 | 2.23 |
| Total | 24.22 | 20.46 | 21,22 | | |
| Average | 2.02 | 1.71 | 1.77 | | 1.83 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|-------|-------|-------|---------|
| | B1 | B2 | B3 | | |
| A0 | 5.06 | 4.75 | 4.47 | 14.28 | 1.59 |
| A1 | 5.16 | 5.32 | 5.19 | 15.66 | 1.74 |
| A2 | 5.93 | 6.19 | 6.04 | 18.16 | 2.02 |
| A3 | 5.28 | 5.82 | 6.70 | 17.80 | 1.98 |
| Total | 21.43 | 22.08 | 22.40 | 65.90 | |
| Average | 1.79 | 1.84 | 1.87 | | 1.83 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - 1 \\
\text{1 db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(65.90)^2}{3.4.3} = 120.65$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(1.89)^2 + (1.42)^2 + (1.76)^2 + \dots + (2.26)^2] - 120.65 \\
&= 123.91 - 120.65 \\
&= 3.26
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(24,22)^2 + (20,46)^2 + (21,22)^2]}{4.3} - 120.65 \\
&= 0.66
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(5.06)^2 + (4.75)^2 + (4.47)^2 + \dots + (6.70)^2]}{3} - 120.65 \\
&= 1.54
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)}{K.B} - \text{FK} \\
&= \frac{[(14.28)^2 + (15.66)^2 + (18,16)^2 + (17.80)^2]}{3.3} - 120.65
\end{aligned}$$

$$\begin{aligned}
 &= 1.12 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(21.43)^2 + (22.08)^2 + (22.40)^2]}{3.4} - 120.65 \\
 &= 0.04 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 1.45 - 1.12 - 0.04 \\
 &= 0.38 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 3.26 - 0.66 - 1.12 - 0.04 - 0.38 \\
 &= 1.08
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{0.66}{2} = 0.33 \\
 \text{KT Treatment} &= \frac{\text{JK Treatment}}{\text{db Treatment}} = \frac{1.54}{11} = 0.14 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{1.12}{3} = 0.37 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{0.04}{2} = 0.02 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{0.38}{6} = 0.06 \\
 \text{KT Error} &= \frac{\text{JK Error}}{\text{db Error}} = \frac{1.06}{22} = 0.05
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{0.33}{0.05} = 6.81 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{0.14}{0.05} = 2.90
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{0.37}{0.05} = 7.72 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{0.02}{0.05} = 0.42 \\
 \text{F Calculate A}\times\text{B} &= \frac{\text{KT A}\times\text{B}}{\text{KT Error}} = \frac{0.06}{0.05} = 1.32
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|------|------|---------|--------------|------|
| Group | 2 | 0.66 | 0.33 | 6.81 | 3.44 | * |
| Treatment | 11 | 1.54 | 0.14 | 2.90 | 2.26 | * |
| A | 3 | 1.12 | 0.37 | 7.72 | 3.05 | * |
| B | 2 | 0.04 | 0.02 | 0.42 | 3.44 | ns |
| AxB | 6 | 0.38 | 0.06 | 1.32 | 2.55 | ns |
| Error | 22 | 1.06 | 0.05 | | | |
| Total | 35 | 3.26 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{0.05}}{1.83} \times 100\% \\
 &= 12.01\%
 \end{aligned}$$

8. Test Carry on *Duncan Multiple Range Test*

(DMRT) DMRT Test Treatment A (PGPR

Concentration)

$$\text{sd} = \sqrt{\frac{\text{KT rB}}{\text{error}}} = \sqrt{\frac{0.05}{3.3}} = 0.073$$

Table Comparator Duncan

| | 2 | 3 | 4 |
|----------|-------|-------|-------|
| sd | 0.073 | 0.073 | 0.073 |
| r (p,db) | 2,933 | 3,080 | 3,173 |
| RP | 0.21 | 0.23 | 0.23 |

Table Matrix Diameter tubers Onion Red

| Average Treatment | | Average | | | | |
|-------------------|------|--------------------|-----------------|-----------------|-----------------|---|
| Notation | | A2 | A3 | A1 | A0 | |
| A2 | 2.02 | 0 ^{ns} | | | | a |
| A3 | 1.98 | 0.04 ^{ns} | 0 ^{ns} | | | |
| A1 | 1,74 | 0,28* | 0,24* | 0 ^{ns} | | a |
| A0 | 1,59 | 0,43* | 0,39* | 0,15 | | b |
| | | | | | 0 ^{ns} | b |

Description : A0 = Concentration PGPR 0 ml/L, A1 = Concentration PGPR 15 ml/L, A2 = PGPR concentration 30 ml/L, A3 = PGPR concentration 45 ml/L.

Attachment 18. Processing Data Weight Wet Plant Wet

Weight Data

| Treatment | Group | | | Total | Average |
|-----------|-----------------------|--------|--------|---------|---------|
| | 1 | 2 | 3 | | |
| | ----- (g/clump) ----- | | | | |
| A0B1 | 30.80 | 22.29 | 39.20 | 92.29 | 30.76 |
| A1B1 | 41.61 | 50.02 | 28.01 | 119.64 | 39.88 |
| A2B1 | 52.86 | 40.05 | 43.13 | 136.04 | 45.35 |
| A3B1 | 52.31 | 49.26 | 47.39 | 148.96 | 49.65 |
| A0B2 | 31.28 | 23.80 | 33.92 | 89.00 | 29.67 |
| A1B2 | 63.06 | 43.10 | 45.63 | 151.79 | 50.60 |
| A2B2 | 58.29 | 43.22 | 60.35 | 161.86 | 53.95 |
| A3B2 | 63.73 | 54.47 | 56.69 | 174.89 | 58.30 |
| A0B3 | 25.25 | 46.84 | 32.44 | 104.53 | 34.84 |
| A1B3 | 43.32 | 42.67 | 50.38 | 136.37 | 45.46 |
| A2B3 | 55.03 | 38.48 | 58.90 | 152.41 | 50.80 |
| A3B3 | 54.38 | 37.95 | 50.46 | 142.79 | 47.60 |
| Total | 571.92 | 492.15 | 546.50 | 1610.57 | |
| Average | 47.66 | 41.01 | 45.54 | | 44.74 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|---------|---------|
| | B1 | B2 | B3 | | |
| A0 | 92.29 | 89.00 | 104.53 | 285.82 | 31.76 |
| A1 | 119.64 | 151.79 | 136.37 | 407.80 | 45.31 |
| A2 | 136.04 | 161.86 | 152.41 | 450.31 | 50.03 |
| A3 | 148.96 | 174.89 | 142.79 | 466.64 | 51.85 |
| Total | 496.93 | 577.54 | 536.10 | 1610.57 | |
| Average | 41.41 | 48.13 | 44.68 | | 44.74 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

Group = $(k - 1) = 3 - 1$

db Group = 2

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(1610.57)^2}{3.4.3} = 72053.77$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(30.80)^2 + (22.29)^2 + (39.20)^2 + \dots + (50.46)^2] - 72053.77 \\
&= 76470.15 - 72053.77
\end{aligned}$$

$$\begin{aligned}
&= 4416.38 \\
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(571.92)^2 + (492.15)^2 + (546.50)^2]}{4.3} - 72053.77 \\
&= 276.76
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(92.29)^2 + (89.00)^2 + (104.53)^2 + \dots + (142.79)^2]}{3} - 72053.77 \\
&= 2751.10
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(285.82)^2 + (407.80)^2 + (450.31)^2 + (466.64)^2]}{3.3} - 72053.77
\end{aligned}$$

$$\begin{aligned}
 &= 2226.89 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(496.93)^2 + (577.54)^2 + (536.10)^2]}{3.4} - 72053.77 \\
 &= 270.82 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 2751.10 - 2226.89 - 270.82 \\
 &= 253.39 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 4416.38 - 276.76 - 2226.89 - 270.82 - 253.39 \\
 &= 1388.52
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{276.76}{2} = 138.38 \\
 \text{KT Treatment} &= \frac{\text{JK Treatment}}{\text{db Treatment}} = \frac{2751.10}{11} = 250.10 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{2226.89}{3} = 742.30 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{270.82}{2} = 135.41 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{253.39}{6} = 42.23 \\
 \text{KT Error} &= \frac{\text{JK Error}}{\text{db Error}} = \frac{1388.52}{22} = 63.11
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{138.38}{63.11} = 2.19 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{250.10}{63.11} = 3.96
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\overline{\text{KT A}}}{\text{KT Error}} = \frac{742.30}{63.11} = 11.76 \\
 \text{F Calculate B} &= \frac{\overline{\text{KT B}}}{\text{KT Error}} = \frac{135.41}{63.11} = 2.15 \\
 \text{F Calculate A}\times\text{B} &= \frac{\overline{\text{KT A}\times\text{B}}}{\text{KT Error}} = \frac{42.23}{63.11} = 0.67
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|---------|--------|---------|--------------|------|
| Group | 2 | 276.76 | 138.38 | 2.19 | 3.44 | ns |
| Treatment | 11 | 2751.10 | 250.10 | 3.96 | 2.26 | * |
| A | 3 | 2226.89 | 742.30 | 11.76 | 3.05 | * |
| B | 2 | 270.82 | 135.41 | 2.15 | 3.44 | ns |
| AxB | 6 | 253.39 | 42.23 | 0.67 | 2.55 | ns |
| Error | 22 | 1388.52 | 63.11 | | | |
| Total | 35 | 4416.38 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Total average}} \times 100\% \\
 &= \frac{\sqrt{63.11}}{44.74} \times 100\% \\
 &= 17.76\%
 \end{aligned}$$

8. Test Carry on *Duncan Multiple Range Test*

(DMRT) DMRT Test Treatment A (PGPR

Concentration)

$$\text{sd} = \sqrt{\frac{\text{KT rB}}{\text{error}}} = \sqrt{\frac{63.11}{3.3}} = 2,648$$

Table Comparator Duncan

| | 2 | 3 | 4 |
|----------|-------|-------|-------|
| sd | 2,648 | 2,648 | 2,648 |
| r (p,db) | 2,933 | 3,080 | 3,173 |
| RP | 7.77 | 8.16 | 8.40 |

Table Matrix Wet Weight Plant Onion Red

| Average Treatment | | Average | | | | |
|-------------------|-------|--------------------|--------------------|-----------------|-----------------|---|
| Notation | | A3 | A2 | A1 | A0 | |
| A3 | 51.85 | 0 ^{ns} | | | | a |
| A2 | 50.03 | 1,81 ^{ns} | 0 ^{ns} | | | a |
| A1 | 45.31 | 6,54 ^{ns} | 4,72 ^{ns} | 0 ^{ns} | | a |
| A0 | 31.76 | 20.09 * | 18.27 * | 13.55 * | 0 ^{ns} | b |

Information: A0 = Concentration PGPR 0 ml/L, A1 = Concentration PGPR 15 ml/L, A2 = PGPR concentration 30 ml/L, A3 = PGPR concentration 45 ml/L.

Attachment 19. Processing Data Weight Wet tubers Onion Red Wet

Weight Data for Shallot Bulbs

| Treatment | Group | | | Total | Average |
|-----------|-----------------------|--------|--------|--------|---------|
| | 1 | 2 | 3 | | |
| | ----- (g/clump) ----- | | | | |
| A0B1 | 21.67 | 14.72 | 29.59 | 65.98 | 21.99 |
| A1B1 | 29.28 | 26.97 | 20.22 | 76.47 | 25.49 |
| A2B1 | 35.71 | 24.17 | 32.97 | 92.85 | 30.95 |
| A3B1 | 43.03 | 25.74 | 32.36 | 101.13 | 33.71 |
| A0B2 | 17.84 | 13.81 | 24.67 | 56.32 | 18.77 |
| A1B2 | 40.35 | 29.71 | 30.95 | 101.01 | 33.67 |
| A2B2 | 45.21 | 33.86 | 43.58 | 122.65 | 40.88 |
| A3B2 | 43.28 | 31.87 | 34.03 | 109.18 | 36.39 |
| A0B3 | 11.89 | 22.19 | 24.94 | 59.02 | 19.67 |
| A1B3 | 33.68 | 29.90 | 26.93 | 90.51 | 30.17 |
| A2B3 | 36.78 | 27.38 | 43.27 | 107.43 | 35.81 |
| A3B3 | 38.02 | 27.23 | 37.13 | 102.38 | 34.13 |
| Total | 396.74 | 307.55 | 380.64 | | |
| Average | 33.06 | 25.63 | 31.72 | | 30.14 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|--------|--------|---------|---------|
| | B1 | B2 | B3 | | |
| A0 | 65.98 | 56.32 | 59.02 | 181.32 | 20.15 |
| A1 | 76.47 | 101.01 | 90.51 | 267.99 | 29.78 |
| A2 | 92.85 | 122.65 | 107.43 | 322.93 | 35.88 |
| A3 | 101.13 | 109.18 | 102.38 | 312.69 | 34.74 |
| Total | 336.43 | 389.16 | 359.34 | 1084.93 | |
| Average | 28.04 | 32.43 | 29.95 | | 30.14 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(1084.93)^2}{3.4.3} = 32696.48$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(21.67)^2 + (14.72)^2 + (29.59)^2 + \dots + (37.13)^2] - 32696.48 \\
&= 35335.66 - 32696.48
\end{aligned}$$

$$\begin{aligned}
&= 2639.18 \\
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(396.74)^2 + (307.55)^2 + (380.64)^2]}{4.3} - 32696.48 \\
&= 376.56
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(65.98)^2 + (56.32)^2 + (59.02)^2 + \dots + (102.38)^2]}{3} - 32696.48 \\
&= 1665.51
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(181.32)^2 + (267.99)^2 + (322.93)^2 + (312.69)^2]}{3.3} - 32696.48
\end{aligned}$$

$$\begin{aligned}
 &= 1387.35 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(336.43)^2 + (389.16)^2 + (359.34)^2]}{3.4} - 32696.48 \\
 &= 116.52 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 1665.51 - 1387.35 - 116.52 \\
 &= 161.65 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 2639.18 - 376.56 - 1387.35 - 116.52 - 161.65 \\
 &= 597.10
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{376.56}{2} = 188.28 \\
 \text{KT Treatment} &= \frac{\text{JK Treatment}}{\text{db Treatment}} = \frac{1665.51}{11} = 151.41 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{1387.35}{3} = 462.45 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{116.52}{2} = 58.26 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{161.65}{6} = 26.94 \\
 \text{KT Error} &= \frac{\text{JK Error}}{\text{db Error}} = \frac{597.10}{22} = 27.14
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{188.28}{27.14} = 6.94 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{151.41}{27.14} = 5.58
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{462.45}{27.14} = 17.04 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{58.26}{27.14} = 2.15 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{26.94}{27.14} = 0.99
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|---------|--------|---------|--------------|------|
| Group | 2 | 376.56 | 188.28 | 6.94 | 3.44 | * |
| Treatment | 11 | 1665.51 | 151.41 | 5.58 | 2.26 | * |
| A | 3 | 1387.35 | 462.45 | 17.04 | 3.05 | * |
| B | 2 | 116.52 | 58.26 | 2.15 | 3.44 | ns |
| AxB | 6 | 161.65 | 26.94 | 0.99 | 2.55 | ns |
| Error | 22 | 597.10 | 27.14 | | | |
| Total | 35 | 2639.18 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{27.14}}{30.14} \times 100\% \\
 &= 17.29\%
 \end{aligned}$$

8. Test Carry on *Duncan Multiple Range Test*

(DMRT) DMRT Test Treatment A

$$\text{sd} = \sqrt{\frac{\text{KT rB}}{\text{error}}} = \sqrt{\frac{27.14}{3.3}} = 1,737$$

Table Comparator Duncan

| | 2 | 3 | 4 |
|----------|-------|-------|-------|
| sd | 1,737 | 1,737 | 1,737 |
| r (p,db) | 2,933 | 3,080 | 3,173 |
| RP | 5.09 | 5.35 | 5.51 |

Table Matrix Wet Weight tuber per Clump

| Treatment | Average | Average | | | | |
|-----------|---------|--------------------|--------------------|-------------------|-----------------|---|
| | | Notation A2 | | A3 | A1 | |
| | | A0 | | | | |
| A2 | 35.88 | 0 ^{ns} | | | a | |
| A3 | 34.74 | 1,14 ^{ns} | 0 ^{ns} | | ab | |
| A1 | 29.78 | 6.10 [*] | 4.96 ^{ns} | 0 ^{ns} | b | |
| A0 | 20.15 | 15.73 [*] | 14.59 [*] | 9.63 [*] | 0 ^{ns} | c |

Information: A0 = Concentration PGPR 0 ml/L, A1 = Concentration PGPR 15 ml/L, A2 = PGPR concentration 30 ml/L, A3 = PGPR concentration 45 ml/L.

Attachment 19. Processing Data Weight Dry tubers (Oven) Onion Red Onion**Bulb Dry Weight (Oven)**

| Treatment | Group | | | Total | Average |
|-----------|-----------------------|-------|-------|-------|---------|
| | 1 | 2 | 3 | | |
| | ----- (g/clump) ----- | | | | |
| A0B1 | 3.26 | 1.80 | 4.41 | 9.47 | 3.16 |
| A1B1 | 4.00 | 3.61 | 2.14 | 9.75 | 3.25 |
| A2B1 | 5.78 | 3.42 | 5.09 | 14.29 | 4.76 |
| A3B1 | 5.67 | 2.93 | 4.08 | 12.68 | 4.23 |
| A0B2 | 3.19 | 2.01 | 3.53 | 8.73 | 2.91 |
| A1B2 | 6.38 | 3.28 | 3.25 | 12.91 | 4.30 |
| A2B2 | 6.10 | 4.35 | 4.68 | 15.13 | 5.04 |
| A3B2 | 5.46 | 3.16 | 4.41 | 13.03 | 4.34 |
| A0B3 | 2.00 | 2.25 | 3.23 | 7.48 | 2.49 |
| A1B3 | 4.99 | 3.19 | 3.36 | 11.54 | 3.85 |
| A2B3 | 3.88 | 5.49 | 4.50 | 13.87 | 4.62 |
| A3B3 | 4.01 | 2.84 | 4.40 | 11.25 | 3.75 |
| Total | 54.72 | 38.33 | 47.08 | | |
| Average | 4.56 | 3.19 | 3.92 | | 3.89 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|-------|-------|--------|---------|
| | B1 | B2 | B3 | | |
| A0 | 9.47 | 8.73 | 7.48 | 25.68 | 2.85 |
| A1 | 9.75 | 12.91 | 11.54 | 34.20 | 3.80 |
| A2 | 14.29 | 15.13 | 13.87 | 43.29 | 4.81 |
| A3 | 12.68 | 13.03 | 11.25 | 36.96 | 4.11 |
| Total | 46.19 | 49.80 | 44.14 | 140.13 | |
| Average | 3.85 | 4.15 | 3.68 | | 3.89 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of Freedom

$$\text{Group} = (k - 1) = 3 - 1$$

$$\text{db Group} = 2$$

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(140.13)^2}{3.4.3} = 545.46$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(3.26)^2 + (1.80)^2 + (4.41)^2 + \dots + (4.40)^2] - 545.46 \\
&= 596.12 - 545.46 \\
&= 50.66
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(54.72)^2 + (38.33)^2 + (47.08)^2]}{4.3} - 545.46 \\
&= 11.21
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(9.47)^2 + (8.73)^2 + (7.48)^2 + \dots + (11.25)^2]}{3} - 545.46 \\
&= 21.00
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)^2}{K.B} - \text{FK} \\
&= \frac{[(25.68)^2 + (34.20)^2 + (43.29)^2 + (36.96)^2]}{3.3} - 545.46
\end{aligned}$$

$$\begin{aligned}
 &= 17.78 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(46.19)^2 + (49.80)^2 + (44.14)^2]}{3.4} - 545.46 \\
 &= 1.37 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 21.00 - 17.78 - 1.37 \\
 &= 1.85 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 50.66 - 11.21 - 17.78 - 1.37 - 1.85 \\
 &= 18.45
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK}_{\text{group}}}{\text{db}_{\text{Group}}} = \frac{11.21}{2} = 5.61 \\
 \text{Treatment KT} &= \frac{\text{JK}_{\text{treatment}}}{\text{db}_{\text{Treatment}}} = \frac{21.00}{11} = 1.91 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{17.78}{3} = 5.93 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{1.37}{2} = 0.68 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{1.85}{6} = 0.31 \\
 \text{KT Error} &= \frac{\text{JK}_{\text{error}}}{\text{db}_{\text{Error}}} = \frac{18.45}{22} = 0.84
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{5.61}{0.84} = 6.68 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{1.91}{0.84} = 2.28
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\text{KT A}}{\text{KT Error}} = \frac{5.93}{0.84} = 7.07 \\
 \text{F Calculate B} &= \frac{\text{KT B}}{\text{KT Error}} = \frac{0.68}{0.84} = 0.82 \\
 \text{F Calculate A} \times \text{B} &= \frac{\text{KT A} \times \text{B}}{\text{KT Error}} = \frac{0.31}{0.84} = 0.37
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|-------|------|---------|--------------|------|
| Group | 2 | 11.21 | 5.61 | 6.68 | 3.44 | * |
| Treatment | 11 | 21.00 | 1.91 | 2.28 | 2.26 | * |
| A | 3 | 17.78 | 5.93 | 7.07 | 3.05 | * |
| B | 2 | 1.37 | 0.68 | 0.82 | 3.44 | ns |
| AxB | 6 | 1.85 | 0.31 | 0.37 | 2.55 | ns |
| Error | 22 | 18.45 | 0.84 | | | |
| Total | 35 | 50.66 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 \text{KK} &= \frac{\sqrt{\text{KT Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{0.84}}{3.93} \times 100\% \\
 &= 23.53\%
 \end{aligned}$$

Attachment 19. (advanced)Data Transformation Root Square (\sqrt{x}) Weight Dry tubers (Oven) per clump

| Treatment | Group | | | Total | Average |
|-----------|-----------------------|-------|-------|-------|---------|
| | 1 | 2 | 3 | | |
| | ----- (g/clump) ----- | | | | |
| A0B1 | 1.81 | 1.34 | 2.10 | 5.25 | 1.75 |
| A1B1 | 2.00 | 1.90 | 1.46 | 5.36 | 1.79 |
| A2B1 | 2.40 | 1.85 | 2.26 | 6.51 | 2.17 |
| A3B1 | 2.38 | 1.71 | 2.02 | 6.11 | 2.04 |
| A0B2 | 1.79 | 1.42 | 1.88 | 5.09 | 1.70 |
| A1B2 | 2.53 | 1.81 | 1.80 | 6.14 | 2.05 |
| A2B2 | 2.47 | 2.09 | 2.16 | 6.72 | 2.24 |
| A3B2 | 2.34 | 1.78 | 2.10 | 6.22 | 2.07 |
| A0B3 | 1.41 | 1.50 | 1.80 | 4.71 | 1.57 |
| A1B3 | 2.23 | 1.79 | 1.83 | 5.85 | 1.95 |
| A2B3 | 1.97 | 2.34 | 2.12 | 6.43 | 2.14 |
| A3B3 | 2.00 | 1.69 | 2.10 | 5.79 | 1.93 |
| Total | 25.33 | 21.22 | 23.63 | | |
| Average | 2.11 | 1.77 | 1.97 | | 1.95 |

| Factor A | Factor B | | | Total | Average |
|----------|----------|-------|-------|-------|---------|
| | B1 | B2 | B3 | | |
| A0 | 5.25 | 5.09 | 4.71 | 15.05 | 1.67 |
| A1 | 5.36 | 6.14 | 5.85 | 17.35 | 1.93 |
| A2 | 6.51 | 6.72 | 6.43 | 19.66 | 2.18 |
| A3 | 6.11 | 6.22 | 5.79 | 18.12 | 2.01 |
| Total | 23.23 | 24.17 | 22.78 | 70.18 | |
| Average | 1.94 | 2.01 | 1.90 | | 1.95 |

Description: A0 = PGPR Concentration 0 ml/L, A1 = PGPR Concentration 15 ml/L, A2 = PGPR Concentration 30 ml/L, A3 = PGPR Concentration 45 ml/L. B1 = Cow Manure, B2 = Goat Manure, B3 = Rabbit Manure.

1. Degrees of FreedomGroup = $(k - 1) = 3 - 1$

db Group = 2

$$\begin{aligned}
\text{Treatment} &= (p - 1) = 12 - 1 \\
\text{db Treatment} &= 11 \\
\text{A (Concentration PGPR)} &= (A - 1) = 4 - \\
1 \text{ db A} &= 3 \\
\text{B (Type Fertilizer Pen)} &= (B - 1) = 3 - 1 \\
\text{db B} &= 2 \\
\text{db A} \times \text{B} &= (A - 1)(B - 1) = (4 - 1)(3 - 1) = 6 \\
\text{db Error} &= (AB - 1)(K - 1) = (12 - 1)(3 - 1) = 22 \\
\text{Total} &\text{ db} = (KAB) - 1 = (3.4.3) - 1 = 35
\end{aligned}$$

2. Factor Correct (FK)

$$\text{FK} = \frac{(\sum Y_{ijk})^2}{KAB} = \frac{(70.18)^2}{3.4.3} = 136.81$$

3. Amount Square (JK)

$$\begin{aligned}
\text{JK Total} &= (\sum Y_{ijk})^2 - \text{FK} \\
&= [(1.81)^2 + (1.34)^2 + (2,10)^2 + \dots + (2,10)^2] - 136.81 \\
&= 140.16 - 136.81 \\
&= 3.35
\end{aligned}$$

$$\begin{aligned}
\text{JK Group} &= \frac{\sum (\sum Y_{ijk})^2}{AB} - \text{FK} \\
&= \frac{[(25.33)^2 + (21.22)^2 + (23.63)^2]}{4.3} - 136.81 \\
&= 0.71
\end{aligned}$$

$$\begin{aligned}
\text{JK Treatment} &= \frac{\sum (\sum Y_{ij})^2}{K} - \text{FK} \\
&= \frac{[(5.25)^2 + (5.09)^2 + (4.71)^2 + \dots + (5.79)^2]}{3} - 136.81 \\
&= 1.43
\end{aligned}$$

$$\begin{aligned}
\text{JK A} &= \frac{\sum (A_i)}{K.B} - \text{FK} \\
&= \frac{[(15.05)^2 + (17.35)^2 + (19.66)^2 + (18.12)^2]}{3.3} - 136.81
\end{aligned}$$

$$\begin{aligned}
 &= 1.23 \\
 \text{JK B} &= \frac{\sum (B_j)^2}{K.A} - \mathbf{FK} \\
 &= \frac{[(23,23)^2 + (24.17)^2 + (22.78)^2]}{3.4} - 136.81 \\
 &= 0.08 \\
 \text{JK A} \times \text{B} &= \text{JK Treatment} - \text{JK A} - \text{JK B} \\
 &= 1.43 - 1.23 - 0.08 \\
 &= 0.12 \\
 \text{JK Error} &= \text{JKT} - \text{JKK} - \text{JK A} - \text{JK B} - \text{JK AB} \\
 &= 3.35 - 0.71 - 1.23 - 0.08 - 0.12 \\
 &= 1.21
 \end{aligned}$$

4. Square Middle

$$\begin{aligned}
 \text{KT Group} &= \frac{\text{JK Group}}{\text{db Group}} = \frac{0.71}{2} = 0.36 \\
 \text{Treatment KT} &= \frac{\text{JK treatment}}{\text{DB Treatment}} = \frac{1.43}{11} = 0.13 \\
 \text{KT A} &= \frac{\text{JK A}}{\text{db A}} = \frac{1.23}{3} = 0.41 \\
 \text{KT B} &= \frac{\text{JK B}}{\text{db B}} = \frac{0.08}{2} = 0.04 \\
 \text{KT A} \times \text{B} &= \frac{\text{JK A} \times \text{B}}{\text{db A} \times \text{B}} = \frac{0.12}{6} = 0.02 \\
 \text{KT Error} &= \frac{\text{JK error}}{\text{db Error}} = \frac{1.21}{22} = 0.05
 \end{aligned}$$

5. F Count

$$\begin{aligned}
 \text{F Count Group} &= \frac{\text{KT Group}}{\text{KT Error}} = \frac{0.36}{0.05} = 6.48 \\
 \text{F Calculate Treatment} &= \frac{\text{KT Treatment}}{\text{KT Error}} = \frac{0.13}{0.05} = 2.37
 \end{aligned}$$

$$\begin{aligned}
 \text{F Calculate A} &= \frac{\overline{KT A}}{KT \text{ Error}} = \frac{0.41}{0.05} = 7.46 \\
 \text{F Calculate B} &= \frac{\overline{KT B}}{KT \text{ Error}} = \frac{0.04}{0.05} = 0.76 \\
 \text{F Calculate A} \times \text{B} &= \frac{\overline{KT A \times B}}{KT \text{ Error}} = \frac{0.02}{0.05} = 0.36
 \end{aligned}$$

6. Table ANOVA

| SK | Db | JK | KT | F count | Ftable 5% | Note |
|-----------|----|------|------|---------|--------------|------|
| Group | 2 | 0.71 | 0.36 | 6.48 | 3.44 | * |
| Treatment | 11 | 1.44 | 0.13 | 2.37 | 2.26 | * |
| A | 3 | 1.23 | 0.41 | 7.46 | 3.05 | * |
| B | 2 | 0.08 | 0.04 | 0.76 | 3.44 | ns |
| AxB | 6 | 0.13 | 0.02 | 0.36 | 2.55 | ns |
| Error | 22 | 1.20 | 0.05 | | | |
| Total | 35 | 3.35 | | | | |

Information: * = significant (F Count > F Table 5%), ns = non significant (F Count < F Table 5%).

7. Coefficient Diversity

$$\begin{aligned}
 KK &= \frac{\sqrt{KT \text{ Error}}}{\text{Average total l}} \times 100\% \\
 &= \frac{\sqrt{0.05}}{1.95} \times 100\% \\
 &= 12.02\%
 \end{aligned}$$

8. Test Carry on Duncan Multiple Range Test

(DMRT) DMRT Test Treatment A

$$\text{sd} = \sqrt{\frac{KT \text{ Error}}{rB}} = \sqrt{\frac{0.05}{3.3}} = 0.078$$

Table Comparator Duncan

| | 2 | 3 | 4 |
|----------|-------|-------|-------|
| sd | 0.078 | 0.078 | 0.078 |
| r (p,db) | 2,933 | 3,080 | 3,173 |
| RP | 0.23 | 0.24 | 0.25 |

Matrix Table Dry Weight tubers (Oven) per clump

| Treatment | Average | Average | | | A3 | |
|-----------|---------|--------------------|--------------------|-------------------|-----------------|---|
| | | Notation A1 | A2 | A0 | | |
| A2 | 2.18 | 0 ^{ns} | | | a | |
| A3 | 2.01 | 0,17 ^{ns} | 0 ^{ns} | | ab | |
| A1 | 1.93 | 0.25 [*] | 0.08 ^{ns} | 0 ^{ns} | b | |
| A0 | 1.67 | 0.51 [*] | 0.34 [*] | 0.26 [*] | 0 ^{ns} | c |

Information: A0 = Concentration PGPR 0 ml/L, A1 = Concentration PGPR 15 ml/L, A2 = PGPR concentration 30 ml/L, A3 = PGPR concentration 45 ml/L.

Attachment 20. Research Documentation



Digital



scale ruler



Vernier caliper



Glass bottle meter



measurement



Tarpaulin



Container Sprinkler



Gallon Jar



Knife



scissors



tray



tools mixer



Pan



Polybag



Label Marker



Mortar and Sieve



Paper



Pestle Filter



Erlenmeyer



Cuvette



Spectrophotometer



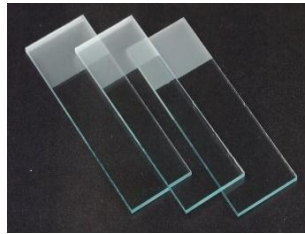
Envelope Oven



Rubber Bracelet



Bran



Glass Preparation



Microscope



Red onion seeds var. Maja Cipanas



Husk burn and EM Land



4 Agriculture



Sugar, Rice



Bran,



Shrimp Paste



dung , Goats, and Rabbit



Fertilizer Pen

Manure Cows



Pen Goat



Fertilizer **Biang Rabbit**



Cage **PGPR Root Bamboo**



The culprit **PGPR Green Bean Root**



The culprit **PGPR Root Mimosa**



Rack **Ethanol vertical farming 80%**



Nail polish **Clear**



Media propagation **biang PGPR**



PGPR



Solution **Fermentator**



Mixing ingredients **For making manure**



Fermentation **manure**



Opening fertilizer every 2 days



Stirring fertilizer every 2 days very



Sample Land and Manure



Seeding seeds shallot bulbs



Onion bulb seeds red



care seeds shallot bulbs



Preparation growing media



Move planting tuber seeds red



onion PGPR



Maintenance shallot plants



Observation shallot plants



Measurement plant height



Harvesting shallot plants



Measurement weight wet plants



Measurement root length



Diameter measurement



Analytical balance



Sample chlorophyll testing



Chlorophyll test



Stomata testing



Onion Seed Certification Red var. Maja Cipanas

Attachment 21. Documentation Research result

A1B1



A1B2



A1B3



A2B1



A2B2



A2B3



A3B1



A3B2



A3B3



A0B1

A0B2

A0B3



A1B1

A1B2

A1B3





A2B1

A2B2

A2B3



A3B1

A3B2

A3B3

HISTORY LIFE



Writer named Nurul Aulia Khoerunnisa, born in Bandung, West Java on January 14, 2002. The author is the second of two children of Mr. Dagri Meifardo and Mrs. Ine Hartati. The author completed her elementary school education at SDN 1 Rangkasbitung Barat, Banten in 2014, her education School Intermediate First in Junior High School 1

Painan, West Sumatra on year 2017, and High School education at SMAN 2 Painan, West Sumatra in 2020. The author continued his education at Diponegoro University Semarang in 2020 in the Agroecotechnology S-1 study program, Department of Agriculture, Faculty of Animal Husbandry and Agriculture, and is still active as a student to date.

During college, the author actively participated in organizational activities at KM An-Nahl. on period 2021-2023 as staff And head department Economy Business, and *International Association of Students in Agricultural and Related Science* He served on the *Undip Local Committee (IAAS LC)* for the 2022-2023 period as a staff member of the Science and Technology Department. He was a teaching assistant for the Basics of Plant Protection course. He was awarded a top 10 position in the 2021 National Essay Competition (LENSA) organized by the Student Executive Board of STIE Surakarta. Writer has carry out Practice Work Field (street vendor) with title "Broccoli Cultivation Techniques (*Brassica oleraceae* L.) at Puspa Agrofarm Hydroponics Sukabumi, West Java".