IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 15, Issue 11 Ser. II (November 2022), PP 48-55
www.iosrjournals.org

The effect of PGPR (*Plant Growth Promoting Rhizobacteria*) the Roots of the Shy Princess (*Mimosa pudica* L.) on the Growth and Yield of Okra (*Abelmoncus esculentus* L.)

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Abstract
Background*:Okra is a promising fruit vegetable for cultivation, although not many Indonesian people know about the benefits of okra itself. One of the ways to increase okra production is by spurring its growth which will affect crop yields. One of the organic materials that can be used as a booster in plant growth is Plant Growth Promoting Rhizobacteria. PGPR is a beneficial bacteria that lives in plant roots, one of the benefits of PGPR is that it can stimulate plant growth and increase crop yields. PGPR can be made using roots from plants such as bamboo roots, banana roots, elephant grass roots, embarrassed daughter roots and other types. Shy daughter plants are still not widely used by farmers in agricultural activities, therefore it is necessary to do research on the effect of PGPR root of shy princess on the growth and yield of okra plants.* ***Materials and Methods****:This research was carried out from December 2021 - March 2022. Located in the Experimental Field of the Faculty of Agriculture, University of Lambung Mangkurat, Banjarbaru. The research method used a one-factor Randomized Block Design (RBD) with five treatments and five replications to obtain 25 experimental units. The treatments to be applied are as follows: P_0 (Control): 0 ml.l^{-1} water; P_1: 20 ml.l^{-1} water; P_2: 40 ml.l^{-1} water; P_3: 60 ml.l^{-1} water; P_4: 80 ml.l^{-1}.* ***Result****:The results showed that the administration of PGPR root of shy princesst a dose of 40 ml.l^{-1} had an effect on the growth of okra plants at plant height parameters of 7 DAP with an average of 19.88 cm and 14 DAP with an average of 21.72 cm. As well as the paremeter of the yield of okra plants at the number of flowers dose 60 ml.$^{-1}$ with an average of 16.80 flowers and the number of fruits dose 40 ml.$^{-1}$ with an average of 13.20 pieces. The best dose of PGPR for daughter roots is 40 ml.l^{-1}.*

Keywords : *Okra, PGPR, Roots of shy princess .*

Date of Submission: 15-11-2022 Date of Acceptance: 28-11-2022

I. Introduction

Okra is a fruit vegetable that is quite promising to be cultivated, although many Indonesians do not know the benefits of okra itself. Okra pretty much contains vitamins, minerals, as well as complete fiber. However, the lack of information obtained by the public has made many okra production products exported abroad. According to Christy *et al*. (2020), the total production of okra in Indonesia is approximately 70% or around 1,500 t.tahun^{-1} sent to several countries including Australia and Japan. Although the demand in the country is quite low, the demand from abroad is quite high, which allows farmers to cultivate okra. To meet the demand for the export market, it is necessary to increase production. One of the ways to increase okra production is by spurring its growth which will later affect crop yields. Farmers usually use plant growth stimulants from chemicals that if the dose is too high, it will cause the plant to not grow normally. One of the organic materials that can be used as a spur in plant growth is PGPR (*Plant Growth Promoting Rhizobacteria*). According to Christy *et al*. (2020), the use of chemicals in soil with excessive doses can provide considerable problems for the soil, such as reduced soil quality, soil pH to organic matter in the soil. PGPR is a beneficial bacterium that lives in plants, one of the benefits of PGPR is that it can stimulate plant growth and increase crop yields. According to Rohmawati *et al*. (2017), the application of PGPR at a concentration of 30 ml.$^{-1}$ to eggplant plants is able to provide different results against flowering, the time of the first harvest, the harvest period and the weight of the planting fruit. PGPR can be made using roots from plants such as bamboo root, banana root, elephant grass root, and root the shy princess. The shy princess plant is still not widely used by farmers in agricultural activities, this is because the shy princess plant is only considered a weed. The roots of the shy

princess contain bacteria that can fix nitrogen on the roots of plants. This can be seen from the root nodules found in the roots of the princess of shame. According to Sharifah (2016), the nodules on the roots of the princess malu are colonies of microbes such as *Pseudomonas*, *Actinomycetes*, *Rhizobium*, and *Bacillus* sp. The large number of microbes contained in root the shy princess makes its potential to be used as material for making PGPR, therefore it is necessary to conduct research on the effect of PGPR root the shy princess on the growth and yield of okra plants.

II. Materials and Methods

The materials used in this study were okra seeds, shy princess root, granulated sugar, shrimp paste, whiting, bran, manure. The tools used in this study were pots, stoves, buckets, hoes, drills, scales, scissors, knives, tape meters, stationery, cameras. This research was carried out for three months, namely from December 2021 – March 2022. Located in the Experimental Land of the Faculty of Agriculture, University of Lambung Mangkurat Banjarbaru. The study used a one-factor Randomized Group Design (RGD) with five treatments and five tests so that 25 experimental units were obtained. The treatment to be applied is as follows: P_0 (Control) : 0 $ml.l^{-1}$ water, P_1: 20 $ml.l^{-1}$ water, P_2: 40 $ml.l^{-1}$ water, P_3: 60 $ml.l^{-1}$ water and P_4: 80 $ml.l^{-1}$ water.

The implementation of this study is as follows:

Creation of PGPR. The roots of the daughter of shame that had been obtained by 100 g were then reduced in size. Other ingredients that must be prepared are 400 g of granulated sugar, 200 g of shrimp paste, 1 kg of fine bran, whiting 1 tsp and 10 L of water. Heat the water to a boil and put the fine bran to mix thoroughly, then add the paste and granulated sugar. After all the ingredients are mixed and boiling then turn off the stove. The PGPR solution is then cooled, after the cold solution then enter the roots of the shy princess whose size has been reduced. The solution is then incubated for one to two weeks in a tightly closed bucket.

Land processing. The land is cleared of growing weeds, then measures the land with a land area of 10 m x 10 m. Next, make beds with a size of 150 cm x 150 cm as many as 25 beds with a distance between beds of 50 cm and a bed height of 30 cm. The beds that have been processed are then added chicken manure as much as 2.25 $kg.bed^{-1}$, then the land is incubated for 14 days and watering is carried out.

Planting. Before planting seeds are first sown using small polybags, the seeds are first poured into water for ±6 hours. After the seedlings are 14 days old the seedlings are transferred to the field with a row spacing of 50 cm x 50 cm, the seedlings are planted in each hole of one plant.

PGPR application. Application is carried out at 14 and 28 days after planting, namely with the dosage according to treatment. Each dose of treatment is added with water as much as 1 L and then applied to the plant by leaking it to the root. Each bed is casted with ± 3 L of solution water for 9 plants.

Maintenance and Care. Maintenance and care are carried out by watering the plant twice a day in the morning and evening. Then clean up weeds on the field if there are weeds growing.

Harvest. Okra plants can be harvested at the age of 50-90 DAP, Harvesting is carried out after the fruit is ready for harvest with the criterion of fruit length between 7-13 cm or ±3 days after the flowers bloom. Harvesting is carried out by cutting the fruit stalks with the use of a knife.

Observation. Observations were made since the plant was 7 DAP, the observation parameters include plant height, number of leaves, the beginning of the appearance of flowers, the number of flowers, the number of fruits and the total weight of the fruit.

III. Results and Discussion

The results of the analysis of the variety of anova given PGPR roots of shy princess affect the height of okra plants at the age of 7, 14 and 35 DAP while at the age of 21 and 28 DAP PGPR applied to okra plants does not have an effect on plant height.

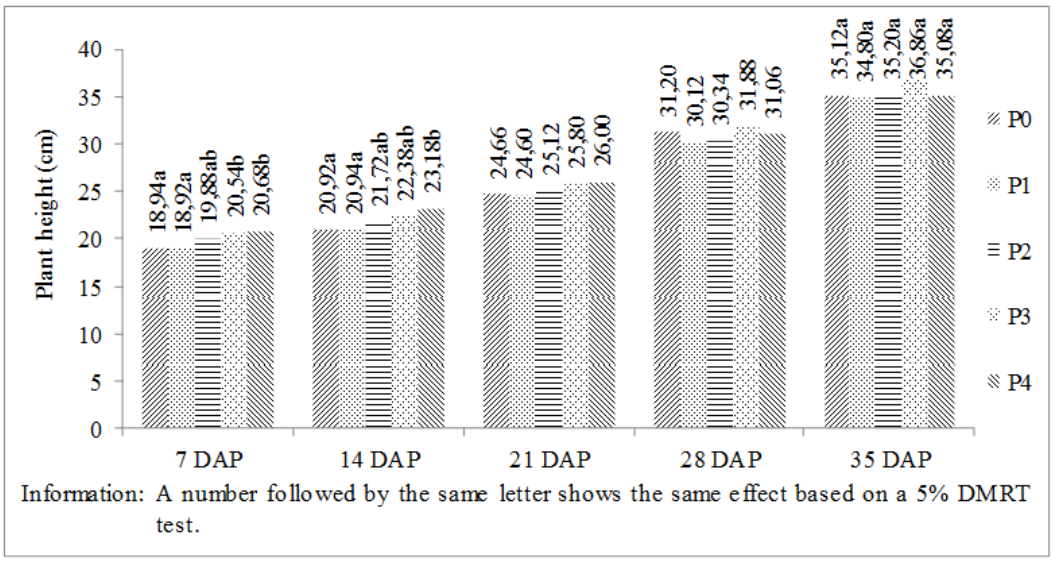

Fig. 1. The average height of the okra plant

Based on (figure 1) on observation of 7 DAP treatments P_4 (80 ml.$^{-1}$), P_3 (60 ml.l^{-1}) and P_2 (40 ml.l^{-1}) showed the same influence but had a different influence on the treatment of P_1 (20 ml.l^{-1}) and P_0 (0 ml.l^{-1}), the application of PGPR for P_4 (80 ml.l^{-1}) was the highest average plant height with an average of 20.68 cm. On observation of 14 DAP treatments P_4 (80 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_2 (40 ml.l^{-1}) showed the same influence but showed different influences on the treatment of P_0 (0 ml.l^{-1}) and P_1 (20 ml.l^{-1}), the application of PGPR treatment P_4 (80 ml.l^{-1}) gave the highest average of 23.18 cm. Then on the observation of 35 DAP treatments P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}), P_2 (40 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_4 (80 ml.l^{-1}) showed the same influence, the highest average on P_3 treatment (60 ml.l^{-1}) which was 36.86 cm.

Okra Plant Height.

Based on the results of the study, the administration of PGPR roots of shy princess has an influence on the height growth of okra plants at the age of 7, 14 and 35 DAP while at the age of 21 and 28 DAP the administration of PGPR does not have an effect on the height of okra plants. The application of PGPR is estimated to increase the N element in the soil that can be absorbed by plants in the growth process, especially the vegetative phase. Suryati *et al*. (2015) suggest that the element that stimulates growth in the vegetative phase as a whole, especially at stem height, is the element N. Cummings (2009) also explained that PGPR can help in providing N elements for plants by fixing N so that it is available to plants. Plants need N elements, especially in the vegetative phase such as plant root growth, stems, leaves and also chlorophyll content.

The dose of PGPR of roots shy princess as much as 80 ml.l^{-1} of water provides the highest growth of average plant height which can be seen in observations 7 and 14 DAP this is in line with Iswati's statement (2012) which states that the more doses of PGPR applied, the more influence it will have an influence that is directly proportional to the growth of height and length of the roots so as to increase production yields. The mechanism of PGPR in increasing yields occurs in various kinds, including by fixing free nitrigens that can be utilized by plants, producing siderophores that are able to iron (Fe) and making them available to plant roots and dissolving minerals such as phosphorus and phytohormone synthesis (Dewi, 2007).

The results of the analysis of the variety of anova that the administration of PGPR roots of shy princess affects the number of leaves of okra plants at the age of 14, 21, 28 and 35 DAP while at the age of 7 DAP PGPR applied to okra plants has no effect on the number of leaves.

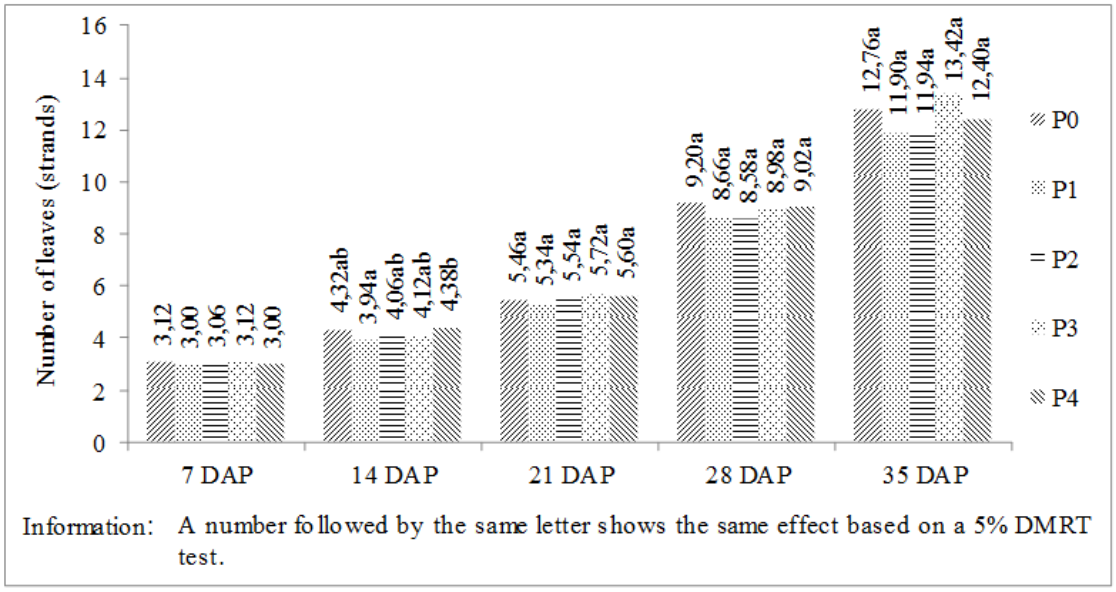

Fig. 2. The average number of leaves of the okra plant.

Based on (figure 2) on the observation of 14 DAP that the treatments of P_4 (80 ml.l^{-1}), P_0 (0 ml.l^{-1}), P_2 (40 ml.l^{-1}) and P_3 (60 ml.l^{-1}) showed the same influence but showed different influences on the treatment of P_1 (20 ml.l^{-1}), the treatment of P_4 (80 ml.l^{-1}) was the highest average with an average of 4.38 strands. On observation of 21 DAP treatments P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}), P_2 (40 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_4 (80 ml.l^{-1}) showed the same influence, the highest average was found in the P_3 treatment (60 ml.l^{-1}) was the highest average with an average of 5.72 strands. On observation of 28 DAP treatments of P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}), P_2 (40 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_4 (80 ml.l^{-1}) showed the same influence, the treatment of P_0 (0 ml.l^{-1}) was the highest average with an average of 9.20 strands. In the treatment of 35 DAP treatments P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}), P_2 (40 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_4 (80 ml.l^{-1}) showed the same influence, the highest average was found in P_3 (60 ml.l^{-1}) which was 13.42 strands.

Number of Leaves of Okra Plant

Based on the results of the study, the PGPR treatment of the daughter of malu roots affects the number of leaves of the okra plant at the age of 14, 21, 28 and 35 DAP. Plants that have been applied with PGPR at the right dosage are able to spur the growth of a more optimal number of plant leaves. The effect of growth on the number of leaves and roots will be apparent to a certain extent after administration of PGPR. According to Shofiah (2018) mentioned that, a sufficient supply of N for plants will form wider leaves with a large amount of chlorophyll so that the resulting assimilate is sufficient to support growth in the vegetative phase. The provision of PGPR is not only good for plant growth that is able to provide nutrients and hormones, PGPR is also able to fight bacteria that can harm plants (Parjono, 2008).

The administration of PGPR with a dose treatment of 80 ml.l^{-1} shows a different influence from other dose treatments, this is because the application of PGPR with higher doses is able to make plant growth better (Rahni, 2012). According to Yasmin *et al*., (2012) the application of PGPR with a certain dose is able to increase the growth of corn plants in the vegetative phase compared to the control treatment.

The results of the analysis of the variety of anova that the administration of PGPR roots of shy princess affects the initial emergence of okra plant flowers.

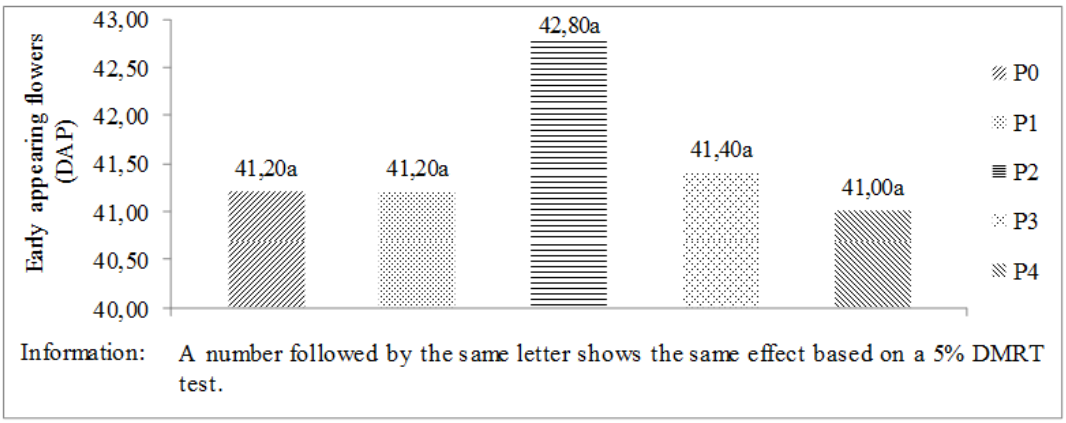

Fig. 3. Average early appearing flowers

Based on preliminary observations of emerging flowers (figure 3) that the treatments of P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}), P_2 (40 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_4 (80 ml.l^{-1}) showed the same influence, the highest average was found in the P_2 treatment (40 ml.l^{-1}) with an average of 42.80 flower emergence time.

Early Appearing Flowers of Okra Plant

Based on the results of the study that the application of PGPR roots of shy princess had an influence on the initial emergence of okra plant flowers but all treatments had the same influence, there was the highest average of early flower emergence in P_2 treatment (40 ml.l^{-1}). The application of PGPR to the beginning of flower emergence does not differ markedly because the content in the PGPR of the daughter root shames more N elements that play a role in the vegetative phase while the flowering process or ripening of plant fruits requires P elements according to the statement of Marvelia *et al*. (2006) revealed that N nutrients have a small role in the flowering process, unlike P elements which have a large role in the flowering process.

N, P and K nutrients have a very important role in plant growth in the vegetative and generative phases. In order for the element N to form in plants, such components must first be converted into carbohydrates, protein fats as well as organic compounds. Based on research that has been carried out, it is stated that the Rhizobium bacteria in PGPR roots of shy princess are able to bind free nitrogen contained in the air and converted into ammonia (NH_3), then converted into amino acids and then into nitrogen that plants need to grow and develop. Meanwhile, Rhizobuim obtains carbohydrates from the host plant as its energy source (Ramdana & Retno, 2015).

The results of the analysis of the variety of anova given PGPR roots of shy princess affect the number of flowers of the okra plant.

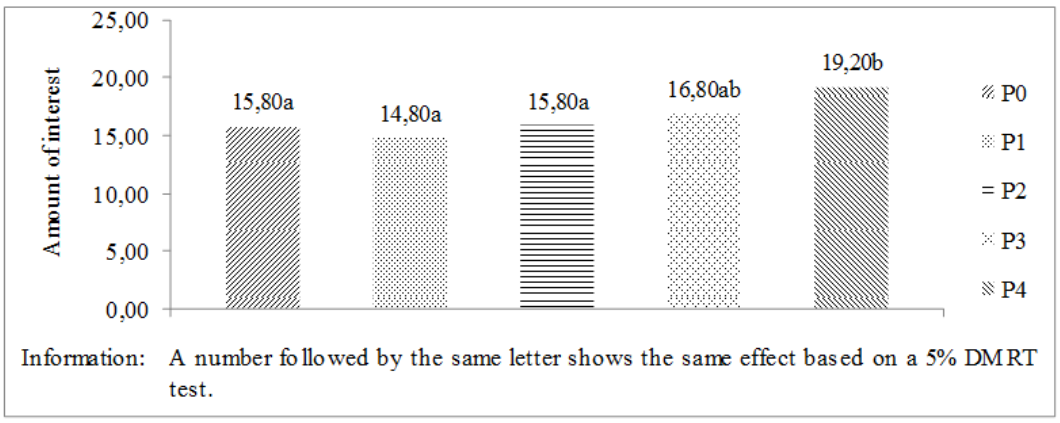

Fig. 4. The average number of flowers of the okra plant

Based on the observation of the number of flowers (figure 4) that the P_4 treatment (80 ml.l^{-1}) had the same effect on the P_3 treatment (60 ml.l^{-1}) but had a different influence on the treatment of P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}) and P_2 (40 ml.l^{-1}), the highest average number of flowers in the P_4 treatment (80 ml.l^{-1}) was 19.20 okra flowers.

Number of Flowers Okra Plant

Based on the results of the study that the application of PGPR roots of shy princess has an influence on the number of fruits of the okra plant, there is a difference between the treatment of giving PGPR roots of shy princess where the administration with the highest dose of 80 ml.l^{-1} gives the highest average number of fruits of the okra plant. According to Rohmawati *et al*. (2017), PGPR administration can have a significant effect on the period of flowering, fruiting, first harvest and fruit weight when compared to without PGPR.

According to Marom *et al*. (2017), microorganisms found in PGPR can break down P elements and make them more available in planting, P elements help in the development of flowers and fruits and PGPR bacteria are also able to supply phosphates bound to dissolved phosphates so that plants can absorb them. Naikofi & Rusae (2017) suggest that PGPR is a group of bacteria that colonize plant roots and is essential for increasing plant development and plant yields and improving soil fertility.

The results of the analysis of the variety of anova given PGPR roots of shy princess affect the number of fruits of the okra plant.

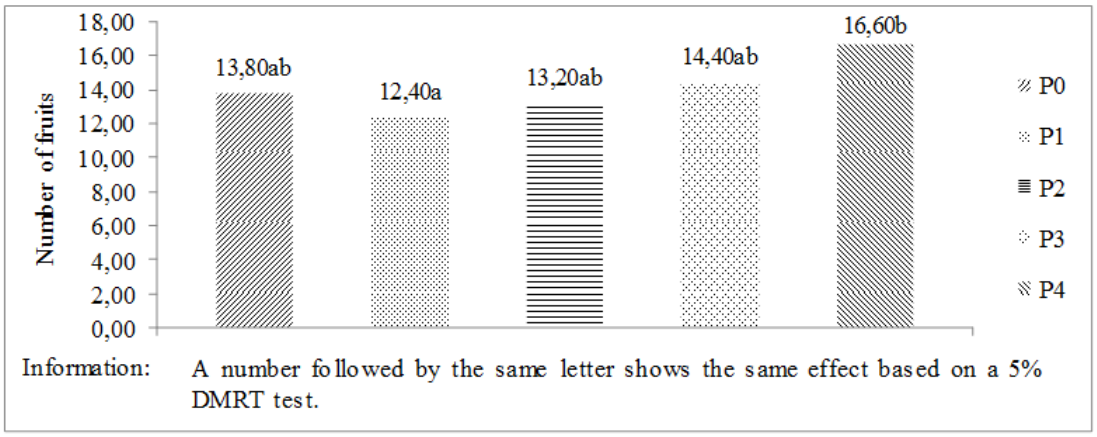

Fig.. 5. The average number of fruits of the okra plant.

Based on the observation of the number of fruits (figure 5) that the P_4 treatment (80 ml.l^{-1}) showed the same effect on the treatment of P_0 (0 ml.l^{-1}), P_2 (40 ml.l^{-1}) and P_3 (60 ml.l^{-1}) but showed a different influence on the treatment of P_1 (20 ml.$^{-1}$), the highest average number of fruits was found in the P_4 treatment (80 ml.l^{-1}) of 16.60 okra fruits.

Number of Fruits of Okra Plant

Based on the results of the study, the administration of PGPR roots of shy princess affects the number of fruits of the okra plant. Dosing 80 ml.l^{-1} showed the highest average yield of the number of fruits and compared to other treatment doses. The administration of PGPR with a dose of 80 ml.l^{-1} water affects the number of fruits, according to Rahni's (2012) statement that the more doses of PGPR given, the better the plant growth.

According to Yuliani (2015) that a large amount of nitrogen emberian at some limit is able to give the production of red chili peppers to be higher. The combination of the application of rabbit urine and PGPR akar putri malu has a positive influence by increasing the yield of the red chili plant fruit (*Capsicum annum* L.).

The results of the analysis of the variety of anova that the administration of PGPR roots of shy princess affects the total weight of okra fruit.

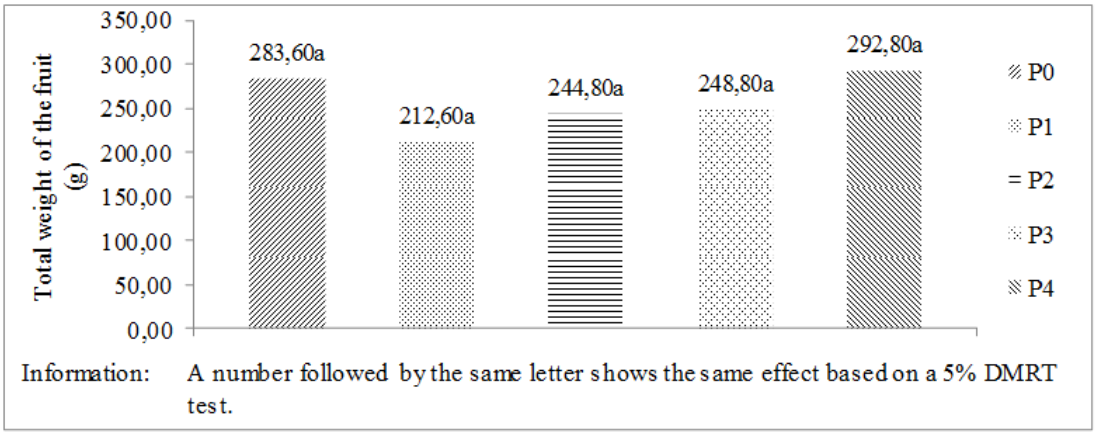

Fig. 6. The average total weight of okra fruits

Based on observations of the total weight of okra fruits (figure 6) that the treatment of P_0 (0 ml.l^{-1}), P_1 (20 ml.l^{-1}), P_2 (40 ml.l^{-1}), P_3 (60 ml.l^{-1}) and P_4 (80 ml.l^{-1}) showed the same influence, the highest average was found in the P_4 treatment (80 ml.l^{-1}) of 292.80 weight of okra fruits.

Total Weight of Okra Fruit

Based on the results of the study that the administration of PGPR roots of shy princess had an effect on the average weight of the total yield of okra plants but all treatments showed the same influence, and there was the highest average total weight of okra plants in the P4 treatment at a dose of 80 ml.l^{-1}. This is in accordance with Rahni's statement (2012) showing that PGPR is able to produce phytohormones such as IAA which are commonly found in plants that have a role in improving quality and yield. This is in line with the increasing number of PGPR applied can provide better results than control.

According to Prasetya (2014), as the plant grows older and matures, its root system also matures. As a result, plants are better able to absorb various kinds of nutrients from the soil, which has an effect on plant growth and development. IAA and gibberellin can be induced by PGPR, which is beneficial for plants as growth promoters, according to Wahyuningsih *et al*. (2017). Auxin hormone has a significant impact on growth, stem length, root differentiation, root branching, and fruit development. According to Febriyanti *et al*. (2015), PGPR treatment has a very different impact on the wet weight of peanut plant pods, which is higher than without PGPR treatment.

IV. Conclusion

Based on the research conducted, it was concluded that the administration of PGPR roots of shy princess was able to influence the average growth of okra 7 and 14 DAP plants at a dose of 40 ml.$^{-1}$, namely 19.88 cm and 21.72 cm. The administration of PGPR roots shy princess affects the average yield of okra plants in the number of flowers at a dose of 60 ml.$^{-1}$ which is 16.88 okra flowers and the number of fruits with a dose of 40 ml.$^{-1}$ which is 13.20 okra fruits. There is the best dose of PGPR for the daughter root of shame on the growth and yield of the okra plant, which is 40 ml.$^{-1}$.

Acknowledgements

Thank you to Dr. Ir. Yusriadi Marsuni, M.Si., Mrs. Ir. Hj. Tuti Heiriyani, M. P., as the first supervisor and second supervisor and friends from Agroecotechnology 2017 who have provided direction, support, enthusiasm, and always patiently faced me in completing this thesis.

References

[1]. Christy, M.D.W.S., Kartika, Y. & Kurniawan, P.W. (2020) Pengaruh Konsentrasi *Plant Growth Promoting Rhizobacteria* (PGPR) dan Pupuk Kandang Ayam pada Pertumbuhan dan Hasil Tanaman Okra Merah (*Abelmoschus esculentus* L. Moench) Di Musim Hujan. *Jurnal Produksi Tanaman*, *8(1)*, 49-57.

[2]. Rohmawati, F.A., Soelistyono R., Koesriharti. (2017). Pengaruh Pemberian PGPR (*Plant Growth Promoting Rhizobacteria*) dan Kompos Kotoran Kelinci pada Pertumbuhan dan Hasil Tanaman Terung (*Solanum melongena* L.). *Jurnal Produksi Tanaman*, *5(8)*, 1294-1300.

[3]. Syarifah, R.N.K. (2016). Pemanfaatan Gulma *Mimosa invisa* sebagai Pengendali Organisme Pengganggu Tanaman. *Jurnal Ilmiah Pertanian*, *16(2)*, 59-67.

[4]. Suryati, D., Sampurno, & E. Anom. (2015). Uji beberapa konsentrasi pupuk azolla (*Azolla pinnata*) pada pertumbuhan bibit kelapa sawit (*Elaeis guineensis* Jacq.) di pembibitan utama. *JOM faperta*, *2(1)*, 1-13.

[5]. Cummings P.S. (2009). The application of plant growth promoting rhizobacteria (PGPR) in low input and organic cultivation of graminaceous crops; potential and problems. *Environmental Biotechnology*, *5(2)*, 43-50.

[6]. Iswati, R. (2012). Pengaruh Dosis Formula PGPR Asal Perakaran Bambu terhadap Pertumbuhan Tanaman Tomat (*Solanum lycopersicum* s.). *Jurnal Agroteknotropika*, *1(1)*, 9-12.
[7]. Dewi, P.I. (2007). Rhizobacteria Pendukung Pertumbuhan Tanaman *Plant Growth Promoting Rhizobacteria*. Fakultas Pertanian. Universitas Padjajaran. Jatinangor.
[8]. Shofiah, D.K.R. & S. Y. Tyasmoro. (2018). Aplikasi PGPR (*Plant Growth Promoting Rhizobacteria*) dan pupuk kotoran kambing pada pertumbuhan dan hasil bawang merah varietas manjung. *J. Protan*, *6(1)*, 78-82.
[9]. Parjono. (2008). *Pseudomonas sp*. Sebagai Pemacu Pertumbuhan dan Pengendali Hayati Fungsi Pathogen Akar Tanaman Kedelai. Institut Pertanian Bogor. Bogor.
[10]. Rahni, N. M. (2012). Efek Fitohormon PGPR Terhadap Pertumbuhan Tanaman Jagung (*Zea mays*). *Jurnal Agribisnis dan Pengembangan Wilayah*, *3(2)*, 27-35.
[11]. Yasmin, H, A. Bano, Samiullah, R. Naz, U. Farooq, A. Nosheen & S. Fahad. 2012. Growth Promotion By P - Solubilizing, Siderophore And Bacteriocin Producing Rhizobacteria In *Zea mays* L. *Journal of Medicinal Plants Research*, *6(3)*, 553-559.
[12]. Marvelia, A., S. Darmanti, & S. Parman. (2006). Produksi Tanaman Jagung Manis (*Zea mays* L. Saccharata) yang Diperlakukan Dengan kompos Kascing Dengan Dosis yang Berbeda. *Buletin Anatomi dan Fisiologi*, *16(2)*, 7-18.
[13]. Ramdana, S. & Retno, P. (2015). *Rhizobium*: Pemanfaatannya Sebagai Bakteri Penambat Nitrogen. Balai Penelitian Kehutanan Makassar. Makassar.
[14]. Marom, N., Rizal, M. Bintoro. 2017. Uji Efektivitas Waktu Pemberian dan Konsentrasi PGPR (Plant Growth Promoting Rhizobacteria) terhadap Produksi dan Mutu Benih Kacang Tanah (*Arachis hypogaea* L.). Agriprima. *Journal of Applied Agricultural Sciences, 1(2)*,174-184.
[15]. Naikofi, Y.M. & A. Rusae. 2017. Pengaruh Aplikasi PGPR dan Jenis Pestisida terhadap Pertumbuhan dan Hasil Tanaman Selada (*Lactuca sativa* L.). *Jurnal Pertanian Konservasi Lahan Kering*, *2(4)*, 71-73.
[16]. Yuliani. (2015). Pemanfaatan Urine Kelinci Dan PGPR (*Plant Growth Promoting Rhizobacteri*a) Dari Akar Tanaman Tauge Untuk Peningkatan Pertumbuhan Dan Hasil Tanaman Cabai (*Capsicum Annum* L.). *Jurnal Agroscience*, *5(1)*, 40-45.
[17]. Prasetya, M. E. (2014). Pengaruh Pupuk NPK Mutiara dan Pupuk Kandang Sapi Terhadap Pertumbuhan dan Hasil Tanaman Cabai Merah Keriting Varietas Arimbi (*Capsicum annuum* L.). *Jurnal Agrifor*, 13(2), 191–198.
[18]. Wahyuningsih, E., Herlina, N., & Tyasmoro, Y. (2017). Pemberian PGPR (*Plant Growth Promoting Rizhobacteria*) dan Pupuk Kotoran Kelinci Terhadap Pertumbuhan dan Hasil Tanaman Bawang Merah (*Allium ascalonicum* L.). *Jurnal Produksi Tanaman*, *5(4)*, 591-599.
[19]. Febriyanti, L.E., M. Martosudiro, & T. Hadiastono. (2015). Pengaruh *Plant Growth Promoting Rhizobacteria* (PGPR) terhadap Infeksi Peanut Stripe Virus (PStV), Pertumbuhan dan Produksi Tanaman Kacang Tanah (*Arachis hypogaea* L.) Varietas Gajah. *Jurnal Hama dan Penyakit Tumbuhan*. *3(1)*, 84-91.

Yusriadi Marsuni, et. al. "The effect of PGPR (Plant Growth Promoting Rhizobacteria) the Roots of the Shy Princess (Mimosa pudica L.) on the Growth and Yield of Okra (Abelmoncus esculentus L.)." *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 15(11), 2022, pp. 48-55.