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Phosphate solubilization by *Pseudomonas fluorescens* on peanut (*Arachis hypogaeal* L.) growth and production

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Abstract:
Peanuts are plants that are included in the secondary crops. However, the application of inorganic phosphorus fertilizer with continuous use can reduce soil quality, thereby reducing the yield of peanut harvests. The use of *Pseudomonas fluorescens* bacteria can increase phosphate absorption in peanuts so that it can reduce the dose of inorganic P fertilizer. This study was conducted from August to November 2024. Using the non-factorial RBD (randomized block design) method with *Pseudomonas fluorescens* bacterial concentration treatment consisting of control (without concentration), 20 ml/l, 30 ml/l, 40 ml/l, 50 ml/l, and 60 ml/l and a reduction of ¼ dose of SP-36 fertilizer. The parameters observed included plant height, dry biomass weight, fresh pod weight per sample, dry pod weight per sample, dry seed weight per plot, weight of 100 seeds, and number of root nodules. The results will be analyzed using ANOVA analysis of variance and DMRT further test. The administration of *Pseudomonas fluorescens* with a concentration of 50 ml/l + 75 kg/ha can provide a significant difference in the parameters of fresh pod weight per sample of 106.1 g and a concentration of 30 ml/l + 75 kg/ha affects the weight of dry pods weighing 71.60 g, dry seed weight of 648.8 g, weight of 100 seeds with a total of 57.95 g, and the number of root nodules of 24.21. For the parameters of plant height and dry biomass weight showed insignificant results.

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INTRODUCTION

Secondary crops are a type of alternative or second food crop that functions to replace the main food crop other than the rice group (KBBI VI, 2023). One example of secondary crops is peanuts (*Arachis hypogaea* L.), which are included in the leguminosae family and grow well in tropical and subtropical climates (Respati et al., 2014). Along with the growth of Indonesia's population from 261.35 million in 2017 to 272.68 million in 2021 (BPS, 2022). Peanut production has actually decreased every year. Data shows that peanut production decreased from 495,477 tons of dry matter in 2017 to 398,642 tons in 2021 (Directorate General of Food Crops, 2021). According to Tupamahu (2017), Indonesia is still facing a shortage of peanut supply, with a national deficit of 1.88%, so the country is still dependent on imports. On the other hand, excessive and continuous use of inorganic fertilizers, especially phosphorus in the form of P_2O_5 on agricultural land, can have negative impacts, such as disrupting the activity of soil microorganisms and decreasing soil fertility (Schnug & Haneklaus, 2016). The phosphorus provided is at risk of settling in the lower layers of the soil, so that it cannot be absorbed and utilized by plants (Muthia et al., 2023).

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Phosphate is very much needed by peanut plants because of its role in seed formation. However, phosphate fertilization is often inefficient because phosphate is bound in a form that is not available to plants (Pasaribu et al., 2014). It is undeniable that the availability of dissolved phosphorus elements that can be absorbed by plants is very small because it is bound to cations in the soil. One effort to increase available phosphorus in the soil is by utilizing biological agents of Phosphate-Solubilizing Bacteria (PSB). These bacteria can also be called phosphate-solubilizing bacteria (PBC) because they produce phosphatase enzymes and organic acids that can increase phosphate dissolution in the soil (Asih and Wartapa, 2022). With the presence of PBC, it is hoped that plants will be able to absorb P elements given through fertilizers.

One of the bacteria that has this function is *Pseudomonas fluorescens*. *Pseudomonas fluorescens* bacteria are included in PGPR, which can stimulate plant growth by producing siderophores. Siderophores are iron-binding compounds that can be synthesized by Pseudomonas. The main function of siderophores is to change Fe (iron) compounds contained in the soil into a form that can be accepted by plants (Anhar et al., 2014). In addition, the siderophores produced can be used as plant disease control. The administration of *Pseudomonas fluorescens* has a significant effect on increasing the growth of chili and soybeans and inhibiting the growth of the pathogen *Sclerotium rolfsii*. Therefore, it is necessary to conduct a study related to the application of phosphate-solubilizing bacteria to the production and growth of peanuts (*Arachis hypogea* L.).

METHOD

Place and Date

This research will be conducted from August to November 2024, located in agricultural land in Jember Regency, East Java, Indonesia, with a height of 100 meters above sea level.

Research Methods

The research design used was a non-factorial Randomized Block Design (RBD) with one treatment, namely the use of *Pseudomonas fluorescens* concentration. The treatment used a reference concentration of 30 ml/L (LAB PHTPH, 2017). The levels of treatment used are as follows: P0: SP-36 (100 kg/ha) + 0 ml/L *Pseudomonas fluorescens*, P1: SP-36 (75 kg/ha) + 20 ml/L *Pseudomonas fluorescens*, P2: SP-36 (75 kg/ha) + 30 ml/L *Pseudomonas fluorescens*, P3: SP-36 (75 kg/ha) + 40 ml/L *Pseudomonas fluorescens*, P4: SP-36 (75 kg/ha) + 50 ml/L *Pseudomonas fluorescens*, and P5: SP-36 (75 kg/ha) + 60 ml/L *Pseudomonas fluorescens*. Based on the treatment, 6 levels were obtained with 4 repetitions. So that the total number of plots is 24 plots with a size of 2 × 1 m and a planting distance of 30 × 20 cm.

P. fluorescens is tested for spore density; if the spore density reaches 10^7 CFU/ml (colony-forming unit), then the bacteria are ready to be applied. Application of *P. fluorescens* is a week before planting by spraying it onto the soil surface using a knapsack sprayer in the afternoon. Fertilization with chicken manure at a dose of 20 tons/ha (400 g/plot) and leveled with the soil using a hoe (Rozak, 2020). Inorganic fertilizers are applied twice, namely at the age of 14 HST, and the second fertilization is carried out at the age of 30 DAP by dissolving it with water in the afternoon (Kariya et al. 2022). The doses of fertilizers used are Urea fertilizer 100 kg/ha (20 g/plot), KCl 150 kg/ha (30 g/plot), and ¾ dose of SP-36, as much as 75 kg/ha (15 g/plot). Data analysis using variance analysis with DMRT (Duncan Multiple Range Test) for further testing.

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RESULT

Fresh Pod Weight each Sample (g)

Table 1. Advanced test results of the fresh pod weight for each sample

Treatment of *P. fluorescens* + SP-36	Weight (g)	DMRT value 5%
P5 (60 ml/l + 75 kg/ha)	118.4 a	-
P4 (50 ml/l + 75 kg/ha)	106.1 ab	19.54
P0 (0 ml/l + 100 kg/ha)	96.1 bc	20.48
P2 (30 ml/l + 75 kg/ha)	92.5 bc	21.07
P3 (40 ml/l + 75 kg/ha)	88.0 bc	21.47
P1 (20 ml/l + 75 kg/ha)	77.5 c	21.75

Description: Values followed by the same letter indicate that they are not significantly different based on the 5% DMRT test.

It was found that the P5 treatment (60 ml/l + 75 kg/ha SP-36) had the highest weight, reaching 118.4 g, and the results were significantly different from the P1 treatment (20 ml/l + 75 kg/ha SP-36), with a weight of 77.5 g. However, the weight results produced by P4 were efficient with a concentration (50 ml/l + 75 kg/ha with a weight result of 106.1 g. In addition, the P0, P2, P3, and P1 treatments showed no significant difference.

Dry Pod Weight each Sample (g)

Table 2. Advanced test results of dry pod weight for each sample

Treatment of *P. fluorescens* + SP-36	Weight (g)	DMRT value 5%
P5 (60 ml/l + 75 kg/ha)	88.91 a	-
P4 (50 ml/l + 75 kg/ha)	87.08 a	28.63
P0 (0 ml/l + 100 kg/ha)	73.92 ab	29.85
P3 (40 ml/l + 75 kg/ha)	72.04 ab	30.65
P2 (30 ml/l + 75 kg/ha)	71.60 ab	30.92
P1 (20 ml/l + 75 kg/ha)	57.31 b	31.35

Description: Values followed by the same letter indicate that they are not significantly different based on the 5% DMRT test.

The treatment P5 (60 ml/l + 75 kg/ha SP-36) had the highest weight with a value of 88.91 g. The results were significantly different from P1 (20 ml/l + 75 kg/ha SP-36) with a weight of 57.31 g. Treatment P2 (30 ml/l + 75 kg/ha) found efficient results with a result of 71.60 g which was not significantly different from treatments P5 and P4. While the weight produced by P4 and P5 was significantly different from P1.

Dry seeds weight for each plot (g)

Table 3. Advanced test results of dry seed weight for each plot

Treatment of *P. fluorescens* + SP-36	Weight (g)	DMRT value 5%
P4 (50 ml/l + 75 kg/ha)	717.0 a	-
P5 (60 ml/l + 75 kg/ha)	690.0 ab	181.53
P3 (40 ml/l + 75 kg/ha)	661.5 ab	189.29
P2 (30 ml/l + 75 kg/ha)	648.8 ab	194.38
P0 (0 ml/l + 100 kg/ha)	603.5 ab	196.06
P1 (20 ml/l + 75 kg/ha)	506.0 b	198.78

Description: Values followed by the same letter indicate that they are not significantly different based on the 5% DMRT test.

Table 3 explains that treatment P4 (50 ml/l + 75 kg/ha) has the highest weight with a value of 717.0 g. The results are significantly different from treatment P1 (20 ml/l + 75 kg/ha), which found a weight of 506.0 g. Treatment P2 (30 ml/l + 75 kg/ha) is a treatment with an efficient concentration that produces dry seed weight with a result of 648.8 g. The weight results of other treatments, both P4, P5, P3, P2, and P0, are not significantly different. For Treatments P5, P3, P0, P2, and P1, results were also not significantly different.

Weight 100 seeds

Table 4. Advanced test results of 100 seeds

Treatment of *P. fluorescens* + SP-36	Weight (g)	DMRT value 5%
P4 (50 ml/l + 75 kg/ha)	62.73 a	-
P5 (60 ml/l + 75 kg/ha)	60.35 ab	12.01
P2 (30 ml/l + 75 kg/ha)	57.95 ab	12.52
P3 (40 ml/l + 75 kg/ha)	53.75 ab	12.86
P0 (0 ml/l + 100 kg/ha)	49.20 b	12.97
P1 (20 ml/l + 75 kg/ha)	49.03 b	13.15

Description: Values followed by the same letter indicate that they are not significantly different based on the 5% DMRT test

Table 4 explains that the results of P4 (50 ml/l + 75 kg/ha) have the highest weight of 100 seeds, with a value of 62.73 g, and are not significantly different from the P2 treatment (30 ml/l + 75 kg/ha), which is efficient at 57.95 g. For the P1 treatment (20 ml/l + 75 kg/ha), which has the lowest weight of 49.03 g. For Treatments P4, P5, P3, and P2, results were found that were not significantly different from those of treatments P5, P3, P2, P0, and P1.

Number of root nodules (pieces)

Table 5. Advanced test results of the number of root nodules

Treatment of P. fluorescens + SP-36	Weight (g)	DMRT value 5%
P5 (60 ml/l + 75 kg/ha)	26.04 a	-
P4 (50 ml/l + 75 kg/ha)	25.21 ab	6.45
P2 (30 ml/l + 75 kg/ha)	24.21 ab	6.72
P3 (40 ml/l + 75 kg/ha)	24.18 ab	6.90
P0 (0 ml/l + 100 kg/ha)	19.79 ab	6.96
P1 (20 ml/l + 75 kg/ha)	19.07 b	7.06

Description: Values followed by the same letter indicate that they are not significantly different based on the 5% DMRT test

Table 5 explains that the results of P5 (60 ml/l + 75 kg/ha) produced the highest root nodules, with a total of 26.04 pieces, and were significantly different from P1 (0 ml/l + 100 kg/ha), which amounted to 19.07 pieces. While the results of root nodules from the efficient treatment of P2 (30 ml/l + 75 kg/ha) showed a result of 24.21 g. For Treatments P4, P2, P3, P0, and P1 also found the same results that were not significantly different.

DISCUSSION

Based on all observed parameters, the application of *Pseudomonas fluorescens* did not show a significant effect on plant height and dry biomass weight. However, it did result in significant differences in fresh pod weight per sample, dry pod weight per sample, dry seed weight per plot, 100-seed weight, and the number of root nodules. The lack of a significant effect on plant height may be due to insufficient nutrient absorption, indicating that the treatment was not effective in enhancing nutrient uptake. To improve crop yield, it is essential to meet the plant's nutritional requirements, one way of which is through fertilization (Artha, 2017). A reduction in fertilizer use may also contribute to lower plant height. Although the use of inorganic fertilizers is often necessary, excessive application can lead to soil degradation. Therefore, combining inorganic fertilizers with biofertilizers is considered a more sustainable solution (Ikhsan et al., 2018).

Phosphorus is required in large amounts by plant parts with high metabolic activity and rapid cell division, such as shoot tips and root tips, as well as during the stages of flowering, seed, and fruit formation and maturation (Purba et al., 2021). This suggests that during plant growth, phosphorus availability may be insufficient. The availability of phosphate is also affected by environmental conditions, which in turn influence the population of *P. fluorescens* in the soil. According to Lestari and Muryanto (2018), rainfall can leach essential nutrients like nitrogen, phosphorus, and potassium, along with *P. fluorescens* bacteria, reducing their presence in the soil. During the study, rainfall was at a moderate level, recorded at 116.7 mm (Tampubolon & Sihombing, 2017).

The highest fresh pod weight per sample, 118.4 g, was observed in treatment P5 (60 ml/l + 75 kg/ha SP-36), while the most effective treatment was P4 (50 ml/l + 75 kg/ha), with a weight of 106.1 g. This suggests that the nutrient supply, particularly phosphorus, enhanced by the application of *P. fluorescens*, contributed to increased fresh pod weight per sample. The peanut plant's ability to absorb nutrients plays a key role, as the application of phosphorus fertilizer supports pod filling and increases seed weight (Elviani et al., 2022). The phosphate-solubilizing ability of the bacteria helps plants absorb phosphorus more efficiently, which is then used along with photosynthates to fill the pods and support seed development (Yasinta et al., 2017). When phosphorus uptake is optimal, seeds develop more fully, resulting in higher seed weights.

The dry pod weight parameter reflects the extent to which nutrients and photosynthetic products are stored in the seeds. This weight is influenced by the plant's earlier growth stages. Based on Table 3, treatment P2 (30 ml/l + 75 kg/ha) resulted in a dry pod weight of 71.60 g, which was not significantly different from treatment P4 (50 ml/l + 75 kg/ha). This outcome is likely due to adequate potassium availability, which plays a crucial role in enhancing the number of filled pods, dry pod and seed weight per plot, and the dry weight of 100 seeds. Potassium supports the synthesis of proteins and carbohydrates, which are then distributed throughout the plant and contribute to pod and seed development in peanuts (Samosir & Pakpahan, 2019). An increase in carbohydrate production promotes pod and seed formation, as nutrients absorbed by plant tissues are directed to the cells where they are most needed.

Similarly, when pod weight shows significant results, it also influences the observed dry seed weight. In this study, treatment P2 (30 ml/l + 75 kg/ha) yielded a dry seed weight of 648.8 g. This suggests that the concentration used effectively increased peanut seed yield per plot, likely due to the optimal activity of phosphate-solubilizing bacteria. Susanti et al. (2019) stated that the availability of phosphorus significantly influences bacterial effectiveness in promoting plant growth and productivity. A reduction in phosphorus levels can stimulate bacteria to solubilize more phosphate, making it easier for plants to absorb. Moreover, the *P. fluorescens* bacteria are capable of lowering alkaline soil pH by releasing organic acids, which was evident in this study as the soil pH was recorded at 7 post-harvests. Ayesha et al. (2023) support this by noting that *P. fluorescens* can neutralize high pH soils. Additionally, Rachman et al. (2016) found that the application of *P. fluorescens* positively affected chili plant growth by converting insoluble phosphate into forms that are accessible to plants.

If 100 dry seeds produced in the P2 treatment (30 ml/l + 75 kg/ha) have a significant difference with the results obtained of 58.0 g. It can be assumed that when the P. fluorescens bacteria were given, they had colonized optimally with a value of more than 107 cfu, and they could dissolve the phosphorus element so that it could be absorbed by the plants (Fitriawati, 2018). In addition, Hartati et al. (2023) stated that *P. fluorescens*, which is included in the PGPR bacteria, has a role as a producer of hormones that stimulate the weight of seeds per plant. Azman et al. (2014) also said that phosphorus is important during the formation of root development, so that it is better able to absorb nutrients in greater quantities and improve the quality of the weight itself. In addition, the results of laboratory tests stated that the total N content was 0.154%, P2O5 was 0.129%, and K2O with a result of 562.28 ppm. The results showed that the total N and P2O5 content was low, while the K2O results were high (Ain et al. 2022).

The number of root nodules observed also affects the weight variable by increasing the concentration of *P. fluorescens*, which is a good bacterium that will increase soil fertility for other bacterial habitats. Efficient treatment is at P2 (30 ml/l + 75 kg/ha), resulting in 24.21 pieces. The more fertile the plants are, the more colonization by other bacteria will increase (Ilham et al. 2019). According to Hartati et al. (2023), the formation of root nodules in legume plants is also influenced by the availability of nutrients and soil pH. Generally, bacteria that increase the number of root nodules are from the Rhizobium bacteria group, but giving *P. fluorescens* causes good soil conditions and indirectly can increase soil fertility, so that it increases colonization of Rhizobium bacteria (Widawati et al. 2015). Increasing the number of root nodules will indirectly increase fertility, which can affect the CEC, where the CEC of the soil is good, the soil pH condition is optimal (Alfiah et al. 2016).

CONCLUSION

Based on the activities and findings of this research, it can be concluded that the application of *Pseudomonas fluorescens* influenced several yield parameters. The highest results were observed in fresh pod weight (106.1 g), dry pod weight (71.60 g), dry seed weight (648.8 g), 100-seed weight (57.95 g), and the number of root nodules (24.21). However, for plant height and biomass weight, no significant differences were observed with the application of *P. fluorescens*. A concentration of 50 ml/l combined with 75 kg/ha SP-36 significantly increased fresh pod weight. In contrast, the concentrations of 30 ml/l + 75 kg/ha SP-36 had a notable effect on dry pod weight, dry seed weight, 100-seed weight, and root nodule formation.

REFERENCES

Ain, S. N. A. F., M. A. Azis., & S. Dude. (2022). Analisis Unsur Hara Makro (N, P, K) Serta C-organik dan pH pada Lahan Kering di Kecamatan Tabonggo Kabupaten Gorontalo. *Jurnal Agroteknopika, 11*(2), 42-48.

Alfiah, L. N., D. Zul., & N. Nelvia. (2016). Pengaruh Inokulasi Campuran Isolat Bakteri Pelarut Fosfat Indigenus Riau Terhadap Pertumbuhan Dan Produksi Tanaman Kedelai (*Glycine max* L. Merr). *Jurnal Agroteknologi, 7*(1), 7 – 14.

Anhar, A., F. Doni., & L. Advinda. (2014). Respons Pertumbuhan Tanaman Padi (*Oryza sativa* L.) Terhadap Introduksi *Pseudomonad fluoresen*. *EKSAKTA UNP, 1*, 1-11.

Artha, I. N. (2017). Prinsip Dasar Produksi dan Usaha Peningkatan Produktivitas Tanaman. Bahan Ajar Dasar-Dasar Agronomi. Program Studi Agroekoteknologi Fakultas Pertanian Universitas Udayana.

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Asih, P.R. & A. Wartapa. (2022). Aplikasi Bakteri Pelarut Fosfat dan Fungi *Mikoriza arbuskula* dalam Meningkatkan Hasil dan Mutu Benih Kacang Tanah*. Agriland: Jurnal Ilmu Pertanian, 10*(3), 202-207. https://doi.org/10.30743/agr.v10i3.6328

Ayesha, C., L. Advinda., V. Violita., D. Handayani., & D. H. Putri. (2023). Potensi *Pseudomonas fluorescens* Sebagai Bakteri Pemacu Pertumbuhan Tanaman. *Serambi Biologi, 8*(1), 98-103.

Azman, E.A., J. Shamshuddin, C. F. Ishak, & R. Ismail. (2014). Increasing rice production using different lime sources on an acid sulphate soil in Merbok, Malaysia. *Pertanika, 372,* 223-247.

Badan Pusat Statistik. (2022). Laju Pertumbuhan Penduduk Indonesia tahun 2021.

Direktoral Jendral Tanaman Pangan. (2021). Laporan Tahunan 2021 (pp. 1-108). Direktoral Jendral Tanaman Pangan.

Fitriawati, R. (2018). Pengaruh Pupuk Fosfat dan PGPR (*Plant Growth Promoting Rhizobacteria*) terhadap Pertumbuhan dan Hasil Tanaman Kacang Hijau (*Vigna radiata* L.) var. Vima-1. *Undergraduate thesis*. Universitas Siliwangi

Hartati, R. D., M. Suryaman, & A. Saepudin. (2023). Pengaruh Pemberian Bakteri Pelarut Fosfat Pada Berbagai pH Tanah Terhadap Pertumbuhan Dan Hasil Kedelai (*Glycine max* (L.) Merr). *JA-CROPS, 1*(1), 26-34.

Ikhsan, D., R. Hindersah., & D. Herdiyantoro. (2018). Pertumbuhan Tanaman Kacang Tanah (*Arachis hypogea* L. Merril) Setelah Aplikasi *Azotobacter chroococcum* dan Pupuk NPK. *Jurnal Agrologia, 7*(1), 1-8.

Ilham, F., T. B. Prasetyo., & S. Prima. (2019). Pengaruh Pemberian Dolomit Terhadap Beberapa Sifat Anorganik Tanah Gambut Dan Pertumbuhan Serta Hasil Tanaman Bawang Merah (*Allium ascalonicum* L). *Jurnal Solum, 16*(1), 29-39.

Kamus Besar Bahasa Indonesia edisi VI. (2023). Palawija. https://kbbi.kemdikbud.go.id/entri/palawija.

Laboratorium Perlindungan Hama Tanaman Pangan dan Hortikultura. (2017). SOP Perbanyakan Bakteri dan Cendawan menggunakan media cair. Dinas Pertanian Jawa Timur.

Lestari, S. U dan M. Muryanto. 2018. Analisis Beberapa Unsur Anorganik Kompos *Azolla mycrophylla*. *Jurnal Ilmiah Pertanian, 14*(2), 60-66. https://doi.org/10.31849/jip.v14i2.441

Muthiah, A., L. Advinda, A. Anhar, I. L. E. Putri, & S. A. Farma. (2023). *Pseudomonas fluorescens as Plant Growth Promoting Rhizobacteria* (PGPR). *Jurnal Serambi Biologi, 8*(1), 67-73.

Pasaribu, P. K., A. Barus., & Mariati. (2014). Pertumbuhan dan Produksi Kacang Tanah (*Arachis hypogaea* L.) Dengan Pemberian Pupuk Kandang Sapi Dan Pupuk Fosfat. *Jurnal Agroteknologi, 2*(4), 1391 – 1395.

Purba, T., H. Ningsih., P. A. S. Junaedi., B. G. Junairiah., R. Figiyanto., & A. Arsi. (2021). *Tanah dan Nutrisi Tanaman*. Yayasan Kita Menulis.

Rachman R, M. Anshor, & B. Bahrudin. (2015). Aplikasi Bakteri Pelarut Fosfat, Bakteri Penambat Nitrogen dan Mikoriza terhadap Pertumbuhan Tanaman Cabai (*Capsicum annum* L.). *e-J. Agrotekbis, 3*(3), 316–328.

Respati, E, L. Hasanah, S. Wahyuningsih, Sehusman, M. Manurung, Y Supriyati, & Rinawati. (2014). Keragaman Plasma Nutfah Kacang Tanah Berdasarkan Karakter Morfologi, Hasil dan Kadar Minyak. *Buletin Konsumsi Pangan Pusdatin (Pusat Data dan Sistem Informasi Pertanian), 5*(4), 9-19.

Samosir, O. M. & T. W. Pakpahan. (2019). Respon Pertumbuhan Dan Produksi Kacang Tanah (*Arachis hypogaea* L.) Terhadap Pemberian Paclobutrazol Dan Pupuk Kalium. *Jurnal Agrotekda, 3*(1), 28-37

Schnug, E., & H. Haneklaus, S. H. (2016). *The enigma of fertilizer phosphorus utilization. Phosphorus in agriculture* is 100%. Page 7-26.

Susanti, R., A. Afriani, F. S. Harahap, W. Fadhillah, R. Oesman, & H. Walida. (2019). Aplikasi Mikoriza dan Beberapa Varietas Kacang Tanah Dengan Pengolahan Tanah Konservasi terhadap Perubahan sifat Biologi Tanah. *Jurnal Pertanian Tropik, 6*(1), 34- 42.

Tampubolon, K., & F. N. Sihombing. (2017). Pengaruh Curah Hujan Dan Hari Hujan Terhadap Produksi Pertanian Serta Hubungannya Dengan Pdrb Atas Harga Berlaku Di Kota Medan. *Jurnal Pembangunan Perkotaan, 5*(1), 35-42.

Tupamahu, M. Y. (2017). Respon Penawaran Kacang Tanah di Indonesia. *Jurnal Ilmiah agribisnis dan Perikanan (Agrikan UMMU-Ternate), 10*(2), 57-64.

Widawati, S., & S. Saefudin. (2015). Isolasi dan Uji Efektifitas *Plant Growth Promoting Rhizobacteria* di Lahan Marginal pada Pertumbuhan Tanaman Kedelai (*Glycine max* L. Merr.) varietas Wilis. *Prosiding Seminar Nasional Masam Latosol Darmaga Gakuryoku, 1*(1), 59-65.

Yasinta, I., A. Arsyad, & I. Islan. (2017). Respon Tanaman Kacang Tanah (*Arachis hypogea* L.) Terhadap Pemberian Pupuk Fosfor Dan Asam Triiodobenzoat. *Jurnal Online Mahasiswa, 4*(1), 1-13.