Vol. 14, No. 1 (2025): 194 - 201 http://dx.doi.org/10.23960/jtep-l.v14i1.194-201

JURNAL TEKNIK PERTANIAN LAMPUNG

ISSN 2302-559X (print) / 2549-0818 (online)
Journal homepage : https://jurnal.fp.unila.ac.id/index.php/JTP

Effect of NPK Phonska Fertilizer Dose and Silica Fertilizer Concentration on Garlic (*Allium sativum* L.)

Choirina Kamilia Rohani[1], Makhziah Makhziah[1,✉], Djarwatiningsih[1]

[1] Universitas Pembangunan Nasional "Veteran", East Java, INDONESIA.

Article History:

Received : 03 June 2024
Revised : 09 September 2024
Accepted : 11 September 2024

Keywords:

Harvest,
Nutrient,
Potassium,
Tuber size.

Corresponding Author:
✉ makhziah.agro.@upnjatim.ac.id
(Makhziah Makhziah)

ABSTRACT

Garlic is widely recognized for its culinary, industrial, and medicinal applications, attributed to its sulfur compounds and allicin, which contribute to its pungent taste and distinctive aroma. This study, conducted in Sajen Village, Pacet District, Mojokerto, from January to May 2024, aimed to evaluate the effects of Phonska NPK and silica fertilizers on garlic production. A factorial experimental design with two factors was employed using a Split-Plot Design within a Randomized Complete Block Design (RCBD). The main plots were treated with silica fertilizer at concentrations of 0 g/L, 5 g/L, 10 g/L, and 15 g/L, while the subplots received Phonska NPK fertilizer at rates of 0 kg/ha (control), 400 kg/ha, 600 kg/ha, and 800 kg/ha. Data were analyzed using analysis of variance (ANOVA) and the HSD test at a 5% significance level. Results indicated that the combination of 0 g/L silica fertilizer and 800 kg/ha Phonska NPK fertilizer yielded the highest garlic production. Although the individual application of Phonska NPK fertilizer did not have a significant effect, the absence of silica fertilizer (0 g/L) significantly influenced leaf width and the development of generative structures.

1. INTRODUCTION

Garlic (*Allium sativum* L.) are included in the horticultural crops, a type of vegetable that has various benefits, ranging from cooking spices, basic ingredients for the food industry, and medicinal ingredients. Garlic has sulfur compounds that contain a chemical called allicin. Allicin causes garlic to have a bitter taste and distinctive aroma (Borlinghaus *et al*., 2021). Garlic has special flavonoid compounds in the flavones found in onions which have been proven to have high antioxidant, antimicrobial and anti-inflammatory properties (Kothari *et al*., 2020). Traditionally, garlic bulbs have been widely used as a medicinal component to increase immunity, treat hypertension, and prevent stroke.

Indonesia population is increasing and the decline in garlic production is causing unbalanced market trade (Handoko, 2020). According to data from the Central Statistics Agency (BPS, 2022), the land area used for planting garlic in Indonesia in 2023 is 26,000 hectares, with a total harvest of 39,254 tonnes/ha, still sufficient for market needs. Garlic production has decreased every year, causing an increase in garlic imports in Indonesia. This shows that garlic is an important crop commodity.

The problem in planting local garlic is the limited varieties available. Garlic production in Indonesia can be increased by selecting garlic seeds with superior varieties and according to the conditions in which the plants are planted. Local garlic varieties include Sangga Sembalun, Lumbu Hijau, Tawangmangu Baru, Lumbu Putih, and

Lumbu Kuning. The varieties Lumbu Hijau, Sangga Sembalun, Tawangmangu Baru, and Lumbu Kuning are varieties that can be planted in the highlands. Meanwhile, the Lumbu Putih variety can only be planted in the lowlands (Kurniaty *et al*., 2022).

The small size of the bulbs is a problematic factor in local garlic cultivation in increasing garlic production due to the lack of nutrients in tuber formation. According to research by Metuah *et al*. (2021) giving 400 kg/ha NPK fertilizer has an impact on plant length at 30 DAP (22.82 cm), number of cloves per plant (3.44), tuber diameter (19.07 mm), and tuber weight per plot (48.79 g). It is suspected that the nutritional needs of garlic plants are met. Garlic bulbs can grow and form more quickly due to the adequate nutrition provided by NPK fertilizer (Hamdani *et al*., 2023). The use of Phonska NPK fertilizer is effective in providing nutrients, especially the macro nutrients that plants need. (Nainggolan *et al*., 2020). NPK fertilizer can stimulate root growth, leaf formation, strengthen stems, reduce the risk of lodging, larger fruit and seed size and shorten the harvest period (Lafina & Napitupulu, 2018).

Apart from providing NPK fertilizer which can increase the production of local garlic plants, silica fertilizer can be applied. Providing sufficient silica fertilizer can prevent plants from falling over easily, moler disease, and being attacked by diseases and pests. According to research by Moeljani *et al*., (2021) the application of 12 g/L of silica fertilizer had a real effect on seed growth capacity of 95.11%, the number of seeds that grew 4 tubers, fresh weight 29.55 g, dry weight 27.35 g, and The tuber diameter was 3.8 cm, but the application of silica fertilizer at a dose of 12 g/L was not significantly different from the application of 14 g/L silica fertilizer. Silica is a micro nutrient that provides plant tolerance to biotic and abiotic stress. Silica is found in large quantities in the earth's crust and is considered the most abundant element after oxygen (Siddiqui *et al*., 2020).

This research aims to determine how the concentration of silica fertilizer and the application of NPK Phonska fertilizer affect the development and increase the production of Lumbu Kuning garlic varieties in the highland region.

2. MATERIALS AND METHODS

The experiment was carried out in the Sajen Pacet area, Mojokerto in January-May 2024. The research was a two factorial experiment, namely the dose of NPK Phonska fertilizer and the concentration of silica fertilizer arranged in a Split Plot Design and repeated 3 times. The soil in Sajen Pacet is Andosol with N-total value of 0.07 ± 0.01%, P-available 94.71 ± 7.34 ppm, and K-exchangeable 0.60. The main plot was the concentration of silica fertilizer: 0 g/L (S0), 5 g/L (S1), 10 g/L (S2), 15 g/L (S3) and the sub plot was the Phonska NPK fertilizer dose: 0 kg/ ha (N0), 400 kg/ha(N1), 600 kg/ha (N2), 800 kg/ha (N3).

Plots were mounded with 4 m long, 1 m wide, 0.35 m high, and 0.5 m spacing with a planting distance of 20 x 20 cm. The garlic seeds of the Lumbu Kuning variety was used and the fertilizer included NPK Phonska fertilizer, ZA fertilizer, ZK fertilizer, SP-36, and silica gold fertilizer. Phonska NPK fertilizer was applied three times at the ages of 3, 6 and 9 WAP according to each treatment dose. ZA fertilizer is given as much as 200 kg/ha at 3 and 6 WAP respectively. The final fertilization is ZK fertilizer of 100 kg/ha which is given at 12 WAP. Pest and disease control uses Marshal insecticide, Score 250 EC fungicide and Dithane M-45 80 WP. Silica fertilizer is applied by spraying it on garlic plants at the ages of 14, 28, 42 and 56 HST according to the concentration of each treatment.

Data were collected by measuring plant length, leaf width, number of leaves, fresh weight, dry weight, tuber weight per plant, tuber diameter, tuber weight per plot (g), tuber weight per hectare (kg), number of cloves, and clove weight (g). Data were analyzed using analysis of variance and Honest Significant Difference (BNJ) 5%.

3. RESULTS AND DISCUSSION

3.1. Vegetative Growth

The study and data processing showed that there was no real interaction between silica fertilizer and Phonska NPK fertilizer on plant height, leaf area and number of local garlic leaves. Phonska NPK fertilizer had no significant effect on vegetative parameters, while the single factor silica fertilizer concentration had a significant effect on leaf width. Phonska NPK treatment was not significant on vegetative parameters. The application dosage of silica fertilizer had no

Table 1. Effect of phonska silica and NPK fertilizer treatment on vegetative growth

Silica Fertilizer (g/L)	Observation of Vegetative Parameters		
	PT 63 HST (cm)	JD 63 HST (strands)	LD (cm)
0	47.73	6.17	1.50 b
5	45.17	6.00	1.38 ab
10	46.01	6.06	1.32 a
15	45.32	6.06	1.34 a
BNJ 5%	tn	tn	0.14
Phonska NPK Fertilizer (kg/ha)			
0	46.11	6.04	1.41
400	45.89	6.06	1.36
600	45.80	6.06	1.37
800	46.43	6.13	1.40
BNJ 5%	tn	tn	tn

Note: The average results with the same letter in the treatment column are not significantly different from the 5% BNJ test, tn = not significantly different, PJ = Plant Length, LT = Leaf Width, JD = Number of Leaves.

significant effect on the parameters of plant length, number of leaves and leaf width (Table 1). This is in line with Goswami *et al*. (2022) where the application of silica had no real effect on the development and growth of garlic, meanwhile the application of silica will have a visible impact when the plants experience drought stress. According to Rastogi *et al*. (2019) explained that silica can be used as an insecticide and prevent drought. Meanwhile, when in the field, water requirements are sufficient so that the application of silica has no effect on the growth of local garlic.

The application of silica has a significant effect on the width of garlic leaves, where increasing the concentration of silica fertilizer causes a decrease in leaf width (Table 1). The largest leaf width was achieved in the treatment without silica fertilizer (0 g/L), while a silica fertilizer concentration of 15 g/L produced the smallest leaf width. Excessive application of silica fertilizer will inhibit plants from absorbing the nutrients nitrogen, phosphorus and potassium (Oklima *et al*., 2024). Apart from that, giving too much silica fertilizer causes the cell walls to become hard, thereby inhibiting the growth of leaf cells and causing the leaves to become narrower.

Giving Phonska NPK had no significant effect on vegetative growth. According to Ndiwa *et al*. (2022), sufficient nutrition can speed up plant metabolic processes, increase cell division, and strengthen plant structures. This is because 800 kg/ha NPK fertilizer contains essential nutrients needed for garlic growth. The results of soil analysis before planting N-Total garlic were classified as low. Before planting garlic, this land was cleared for 7 months and planted with rice. So that the remains of the rice plant become organic material that can support the growth of garlic. The addition of 400 kg/ha of ZA fertilizer is thought to have met the nitrogen needs of garlic plants. According to the research results of Saptorini *et al*. (2019) the application of 400 kg/ha of ZA fertilizer is sufficient for the nutrients needed by shallots so that it has an effect on the growth and yield of shallot plants.

3.2. Generative Growth

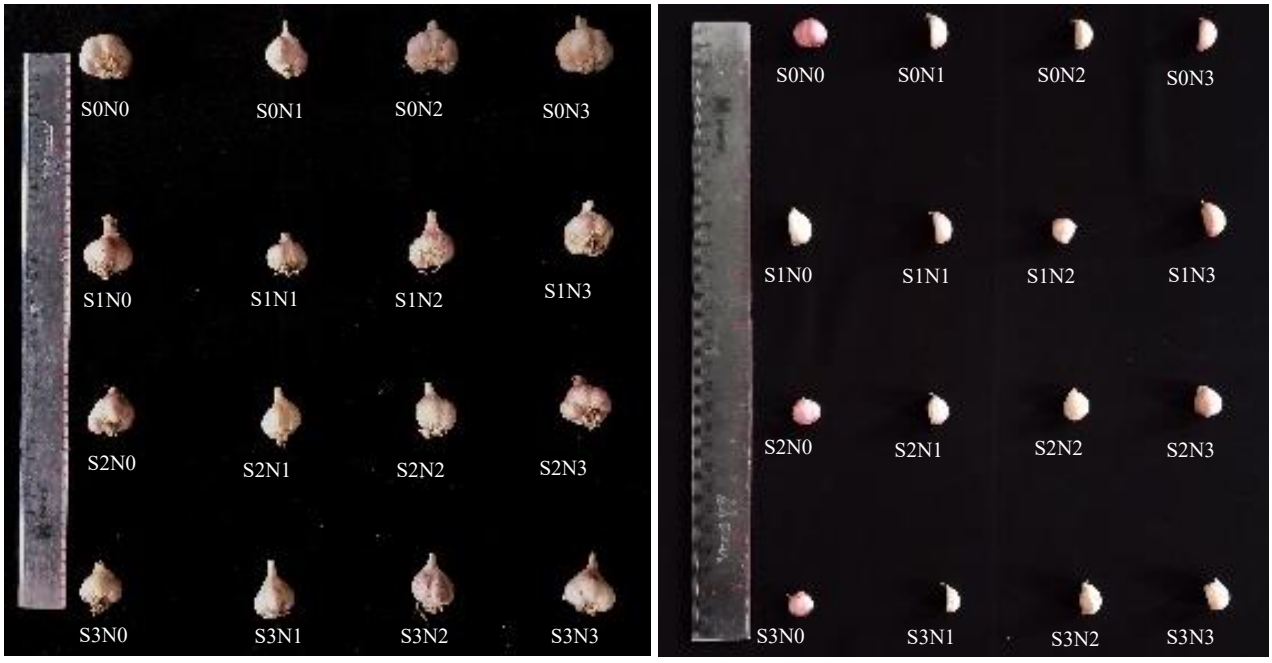
The results of research and data analysis show that there is no relationship between silica fertilizer and Phonska NPK fertilizer on generative parameters. Meanwhile, Phonska NPK did not have a significant effect on the generative parameters, but the silica fertilizer concentration treatment had a significant effect on the results of the generative parameters. Table 2 shows that silica fertilizer has significantly different generative parameters. The fresh weight in the treatment with a silica fertilizer concentration of 0 g/L produced the best average wet weight of the safe, namely 227.00 g and was not significantly different from the 5 g/L and 10 g/L treatments. Meanwhile, the smallest average fresh weight value in the 15 g/L treatment was 135.00 g. Followed by dry weight, the 0 g/L silica fertilizer treatment produced the best average dry weight value of 132.92 g and was not significantly different from the 5 g/L silica fertilizer treatment. Meanwhile, the smallest average dry weight result in the 15 g/L treatment was 84.17 g. The parameters of fresh weight of the safe and dry weight are interrelated. According to Akbar *et al*. (2023) applying excessive amounts of silica can cause stress to the plants which ultimately reduces the yield of local garlic plants.

Based on Table 2 at a silica fertilizer concentration of 0 g/L, the highest tuber weight per plant was obtained (6.06 g). On the other hand, the smallest tuber weight (4.06 g/plant) was found at a concentration of 15 g/L. The silica content content in the soil is thought to be sufficient and adding more silica can reduce the quality of local garlic plants. According to Apriliyanto (2020), applying silica fertilizer does not contribute to plant development and yield, as evidenced by parameters such as fresh weight, dry weight and tuber weight per plant. In fact, the use of silica actually reduces the yield of local garlic plants. Even though the dose of NPK Phonska fertilizer does not have a relevant impact on fresh weight, dry weight and tuber weight per plant, there is a tendency for optimal generative growth when applying a dose of NPK Phonska fertilizer of 800 kg/ha. This is because the application of 400 kg/ha ZA fertilizer met the nutrient needs of garlic. In addition, the condition of the land based on soil analysis shows that the levels of phosphorus and potassium are relatively high, so it is thought to be able to support plant growth and development.

Table 2. Effect of silica fertilizer treatment and phonska NPK fertilizer on generati growth

Silica Fertilizer (g/L)	Generative Parameter Observation		
	BS (g)	BK (g)	BU (g)
0	227.00 b	132.92 c	6.06 b
5	194.17 b	114.58 bc	5.69 b
10	182.92 b	107.08 b	4.69 a
15	135.00 a	84.17 a	4.06 a
BNJ 5%	34.44	18.83	0.91
Phonska NPK Fertilizer (kg/ha)			
0	187.92	112.92	5.08
400	182.08	106.67	5.06
600	176.25	105.83	5.02
800	192.83	113.33	5.33
BNJ 5%	tn	tn	tn

Note: Average results with the same letter in the treatment column are not significantly different from the 5% BNJ test, tn = not significantly different, BS= Fresh Weight, BK= Dry Weight, BUT= Tuber Weight Per Plant.



(a) (b)

Figure 2. Garlic bulbs (a), and cloves (b) resulted from different treatments. (Silica Fertilizer (S): S0 = 0 g/L; S1 = 5 g/L; S2 = 10 g/L; S3 = 15 g/L. Phonska NPK Fertilizer (N): N0 = 0 kg/ha; N1 = 400 kg/ha; N2 = 600 kg/ha; N3 = 800 kg/ha)

3.3. Tuber Diameter (cm)

Figure 2 shows effect of treatment combinations on the bulb and cloves of the garlic resulted from this research. Research and data analysis show that tuber diameter is significantly influenced by the combination of silica fertilizer concentration and Phonska NPK fertilizer dosage. Silica fertilizer will reduce the diameter of the bulbs if NPK Phonska fertilizer is not applied (0 kg/ha) while the application of silica fertilizer combined with NPK Phonska fertilizer (400, 600, 800 kg/ha) does not reduce the diameter of the garlic bulbs (Table 3). The silica element absorbed in the form of SiO_2 can increase cell wall thickness and act as disease protection so that garlic plants are not easily attacked by moler disease (Wibowo *et al*., 2020). The diameter of the bulb is greatly influenced by the number of leaves, the increase in the number of leaves is caused by sufficient potassium nutrients so that the photosynthesis process can run directly, because the greater number of leaves produced can help increase the size of large garlic bulbs (Haryanto *et al*., 2022).

Table 3. Effect of the combination of silica fertilizer and Phonska NPK fertilizer on tuber diameter

Silica Fertilizer Concentration (g/L)	Tuber Diameter (cm)			
	Phonska NPK Fertilizer (kg/ha)			
	0 (N0)	400 (N1)	600 (N2)	800 (N3)
0 (S0)	2.75 b	2.71 b	2.72 b	2.86 b
5 (S1)	2.75 b	2.64 b	2.67 b	2.58 b
10 (S2)	2.63 b	2.60 b	2.50 ab	2.47 ab
15 (S3)	2.21 a	2.36 ab	2.31 ab	2.50 ab
BNJ 5%	0.31			

Note: The average results with the same letter in the treatment column are not significantly different from the 5% BNJ test.

Table 4. Effect of the combination of silica fertilizer and Phonska NPK fertilizer on tuber weight per plot

Silica Fertilizer Concentration (g/L)	Tuber Weight Per Plot (g)			
	Phonska NPK Fertilizer Dosage (kg/ha)			
	0 (N0)	400 (N1)	600 (N2)	800 (N3)
0 (S0)	71.00 ab	75.00 ab	79.33 ab	88.33 b
5 (S1)	86.00 b	68.00 ab	65.67 ab	68.00 ab
10 (S2)	73.33 ab	73.00 ab	73.00 ab	61.67 ab
15 (S3)	49.33 a	50.67 a	49.67 a	66.67 ab
BNJ 5%	30.15			

Note: The average results followed by the same letter in the treatment column are not significantly different from the 5% BNJ test.

3.4. Tuber Weight Per Plot (grams)

Research and data processing show that the weight of tubers per plot is significantly influenced by the combination of silica fertilizer concentration and Phonska NPK fertilizer dosage. The results show in Table 4. The effect on the weight of garlic bulbs per plot was very significantly different from the interaction of silica fertilizer and Phonska NPK fertilizer. The highest tuber weight was in the interaction of 0 g/L silica fertilizer and Phonska NPK fertilizer dose of 800 kg/ha. Garlic obtained the best average value of 88.33 g, not significantly different from the treatment with 5 g/L silica fertilizer and 0 kg/ha Phonska NPK fertilizer. Meanwhile, the smallest result in tuber weight per plot in the treatment of 15 g/L silica fertilizer and 0 kg Phonska NPK fertilizer/plant was 49.33. Sufficient nutrients can increase the size of local garlic bulbs, one of which is potassium which can support the yield of local garlic plants (Fitri & Kesumawati, 2021).

3.5. Tuber Weight

Based on research and data analysis, it shows that the real interaction between silica fertilizer and Phonska NPK fertilizer has a significant impact on tuber weight per hectare. Garlic planting was carried out during the rainy season so that its growth was disrupted due to high rainfall, which affected data variability (Table 5). Tuber weight of 883.33

Table 5. Effect of the combination of silica fertilizer and Phonska NPK fertilizer on tuber weight (kg/ha)

Silika Fertilizer Dose (g/L)	Phonska NPK Fertilizer Dose (kg/ha)			
	0 (N0)	400 (N1)	600 (N2)	800 (N3)
0 (S0)	710.00 ab	750.00 ab	793.33 ab	883.33 b
5 (S1)	860.00 b	680.00 ab	656.67 ab	680.00 ab
10 (S2)	733.33 ab	730.00 ab	730.00 ab	616.67 ab
15 (S3)	493.33 a	506.67 a	496.67 a	666.67 ab
BNJ 5%	301.48			

Note: The average results followed by the same letter in the treatment column are not significantly different from the 5% BNJ test.

kg/ha was achieved by using a silica fertilizer concentration of 0 g/L plus 800 kg/ha of Phonska NPK fertilizer. However, it was not significantly different from the treatment with a concentration of silica fertilizer of 5 g/L and NPK fertilizer of 0 kg/ha. On the other hand, the lowest average value appeared in the combination treatment with a silica fertilizer concentration of 15 g/L and a Phonska NPK fertilizer dose of 0 g/L, resulting in a tuber weight per hectare of 493.33 kg. The results obtained in this research are still below the average from calculating the amount of garlic in Indonesia divided by the area of land used by garlic plants. This shows that giving a dose of Phonska NPK fertilizer of 800 kg/ha is sufficient for the nutrition of garlic plants, because the nutrients in it have been broken down so that bulb formation can be optimal. The elements contained in Phonska NPK fertilizer can have an influence on increasing tuber size, one of which is potassium. Amir *et al*. (2021) explained that an ideal proportion of the nutrient potassium plays a role in large tuber size, and a lack of potassium cause small tuber size so that garlic crop yields are less than optimal.

Giving 0 g/L silica had an effect on the weight of tubers per hectare when compared with giving 15 g/L silica to garlic plants. This is because silica concentrations that are too high can disrupt the balance of nutrients in the soil which affects plants. Excessive silica application can also have a negative impact on receiving the nutrients that garlic needs during bulb formation. In addition, giving too much silica causes water absorption by plants. If water absorption does not go well, the tuber formation process will be hampered.

3.6. Clove Weight

Based on research and data analysis, there is no single interaction or influence between silica fertilizer and Phonska NPK fertilizer on clove weight parameters. A single treatment of silica fertilizer did not have a significant effect on clove weight, nor did NPK Phonska fertilizer. Table 6 states that the treatment of silica fertilizer and Phonska NPK fertilizer is not significantly different. The 0 g/L silica concentration treatment gave the best average clove weight per tuber, namely 0.74 g. However, there was no significant difference with other treatments. Table 6 indicates that application of 0 kg/ha Phonska NPK fertilizer produced the most optimal clove weight, namely 0.74 g, but this result was not significantly different from other treatments.

3.7. Number of Cloves

The results of the research and data analysis showed that the real interaction between silica fertilizer and Phonska NPK fertilizer showed a significant influence on the number of cloves per tuber. Based on further test research by BNJ, Table 7 shows that the interaction of 0 g/L silica concentration with 800 kg/ha NPK Phonska fertilizer had an effect on the highest number of cloves at 12.42 cloves, while the lowest results were in the interaction treatment of 15

Table 6. Effect of silica fertilizer treatment and Phonska NPK fertilizer dosage on clove weight

Silica Fertilizer Concentration (g/L)	Clove weight (g)
0	0.74
5	0.73
10	0.69
15	0.63
BNJ 5%	tn

Phonska NPK Fertilizer Dose (kg/ha)	Clove weight (g)
0	0.74
400	0.68
600	0.70
800	0.67
BNJ 5%	tn

Note: tn = not significant.

Table 7. Effect of the combination of silica fertilizer and Phonska NPK fertilizer on total cloves

Silica Fertilizer Dose (g/L)	Number of Cloves			
	Phonska NPK Fertilizer Dosage (kg/ha)			
	0	400	600	800
0	8.33 ab	7.58 ab	10.83 b	12.42 b
5	8.42 ab	8.67 ab	8.75 ab	9.92 b
10	8.08 ab	9.08 ab	8.17 ab	8.08 ab
15	7.08 a	9.00 ab	7.50 ab	9.00 ab
BNJ 5%	2.78			

Note: The average results with the same letter in the treatment column are not significantly different from the 5% BNJ test.

g/L concentration silica fertilizer with a dose of Phonska NPK fertilizer. 0 g/L yields a total of 7.08 cloves. Treatment with 800 kg/ha Phonska NPK fertilizer and 0 g/L silica fertilizer produced a higher number of garlic cloves compared to treatment with added silica. This indicates that under these experimental conditions, the macronutrient needs of garlic plants have been met by NPK Phonska fertilizer.

Gade's research (2019) stated that the interaction effect of source and silica content on the availability of nitrogen and potassium in the soil at harvest time was not significant, but that of phosphorus and silica was significant. The availability of NPK and silica in the soil increased significantly with the control treatment. Providing 800 kg/ha of Phonska NPK fertilizer can meet the nutritional needs needed during the formation of the number of cloves. This is because the nutrient potassium can help the process of forming the number of cloves, low potassium availability can inhibit the process of forming the number of cloves (Simanjuntak, *et al*., 2023).

4. CONCLUSION

Using a silica concentration of 0 g/L as a single variable had a significant positive impact on leaf area (1.50 cm), fresh weight (227.00 g), dry weight (132.92 g), and tuber weight per plant (6.06 g). On the other hand, administering NPK fertilizer doses did not have an impact on all of these parameters. The interaction between the 0 g/L silica concentration treatment and the NPK fertilizer dose of 800 kg/ha affected tuber diameter (2.86 cm), tuber weight per plot (88.33 g), tuber weight in hectares (883.33 kg/ha), and number of cloves (12.42). The treatment with a dose of NPK Phonska fertilizer of 0 kg/ha was not significantly different from the treatment of NPK Phonska fertilizer of 800 kg/ha. This was due to the fertile soil conditions due to the presence of organic material, where before planting garlic there were rice plants and no planting was carried out for 7 months.

REFERENCES

Akbar, O.S., & Munandar, D.E. (2023). Pengaruh pemberian silika terhadap pertumbuhan dan produksi tanaman jagung pulut (*Zea mays ceratina* L.) varietas lokal Bojonegoro. *Berkala Ilmiah Pertanian*, ***6***(2), 91-97. http://dx.doi.org/10.19184/bip.v6i2.36861

Amir, N., Paridawati, I., & Mulya, S.A. (2021). Respon pertumbuhan dan produksi tanaman bawang merah (*Allium ascalonicum* L.) dengan pemberian pupuk organik cair dan pupuk kalium. *Klorofil: Jurnal Penelitian Ilmu-Ilmu Pertanian*, ***16***(1), 6-11. https://jurnal.um-palembang.ac.id/klorofil/article/download/4033/2641

Apriliyanto, E. (2020). Pengaruh pemberian silika terhadap hasil tanaman okra. *Jurnal Agrosains dan Teknologi*, ***4***(2), 56-63. https://doi.org/10.24853/jat.4.2.56-63

Borlinghaus, J., Foerster, J., Kappler, U., Antelmann, H., Noll, U., Gruhlke, M.C.H., & Slusarenko, A.J. (2021). Allicin, the odor of freshly crushed garlic: A review of recent progress in understanding allicin's effects on cells. *Molecules*, ***26***(6), 1505. https://doi.org/10.3390/molecules26061505

BPS. (2022). *Produksi Tanaman Bawang Putih 2017-2022*. Badan Pusat Statistik Jakarta.

El-Mesirry, D., & Radi, H. (2019). Effect of clove diameter and plant growth regulators on growth and yield of balady Garlic (*Allium sativum* L.). *Alexandria Science Exchange Journal*, ***40***(October-December), 599-603. https://doi.org/10.21608/asejaiqjsae.2019.62843

Fitri, E., Jumini, J., & Kesumawati, E. (2021). Pengaruh dosis kompos limbah sereh wangi dan pupuk NPK terhadap pertumbuhan dan hasil tanaman bawang putih (*Allium sativum* L.) di Dataran Tinggi Gayo Lues. *JFP Jurnal Ilmiah Mahasiswa Pertanian*, ***6***(4), 847-854.

Gade, P.R., Shete, B.J., & Kshirsagar, D.B. (2019). Effect of sources and levels of silicon on availability of major nutrients and silicon in the experimental field of garlic. *Indian Journal of Pure & Applied Biosciences*, ***7***(6), 284-290. https://doi.org/10.18782/2582-2845.7894

Goswami, P., Mathur, J., & Srivastava, N. (2022). Silica nanoparticles as novel sustainable approach for plant growth and crop protection. *Heliyon*, ***8***(7), 1-12. https://doi.org/10.1016/j.heliyon.2022.e09908

Hamdani, K.K., Susanto, H., Nurawan, A., Rodhian, S., & Rahayu, S.P. (2023). Aplikasi pupuk NPK pada tanaman bawang merah di Kabupaten Cirebon. *Vegetalika*, ***12***(2), 160-172. https://doi.org/10.22146/veg.77700

Haryanto, E.T., Handoyo, G.C., & Ningsih, F.V. (2022). Pengaruh pemulsaan pada beberapa varietas bawang putih (*Allium sativum* L.) di Dataran Rendah. *Prosiding Seminar Nasional Perhimpunan Hortikultura Indonesia,* ***1***(1), 191-199.

Kothari, D., Lee, W-D., & Kim, S-K. (2020). Allium flavonols: Health benefits, molecular targets, and bioavailability. *Antioxidants*, ***9***(9), 888. https://doi.org/10.3390/antiox9090888

Kurniaty, W., Eliyanti, E., & Aryunis, A. (2022). Uji adaptasi beberapa varietas tanaman bawang putih (*Allium sativum* L.) di Dataran Rendah Muaro Jambi. *Jurnal Media Pertanian*, ***7***(2), 79. https://doi.org/10.33087/jagro.v7i2.147

Lafina, S., & Napitupulu, D.M. (2018). Pengaruh pupuk kompos dan Pupuk NPK phonska terhadap pertumbuhan dan hasil tanaman jagung manis (*Zea mays saccharata*) varietas bonanza. *Jurnal Agrifor*, ***17***(2), 331-344.

Metuah, J., Kesumawati, E., & Hayati, R. (2021). Pengaruh jarak tanam dan dosis pupuk NPK terhadap pertumbuhan dan hasil tanaman bawang putih (*Allium sativum* L.) di Dataran Rendah, *JFP Jurnal Ilmiah Mahasiswa Pertanian*, ***6***(4), 881-888. https://doi.org/10.17969/jimfp.v6i4.18345

Moeljani, I.R., Faristiawan, Y., & Sulistyono, A. (2021). Pengaruh konsentrasi pupuk silika dan umur transplanting terhadap pertumbuhan dan hasil bawang merah dari benih true shallot seed (TSS). *Agro Bali : Agricultural Journal*, ***5***(1), 50–56. https://doi.org/10.37637/ab.v5i1.804

Nainggolan, T., Sumbayak, R.J., & Gulo, N.K. (2020). Respons pertumbuhan dan hasil melon (*Cucumis melo* L) terhadap berbagai dosis phonska. *Jurnal Agrotekda*, ***3***(2), 93-102. https://jurnal.darmaagung.ac.id/index.php/agrotekda/article/view/728

Ndiwa, A.S.S., Oematan, S.S., & Laiskodat, I.M.H. (2022). The effect of dosage of cow manual fertilizer and inorganic NPK on the growth and production of mustard plants (*Brassica Juncea* L.). *Jurnal Wana Lestari*, ***4***(01), 229-237. https://doi.org/10.35508/wanalestari.v6i01.8140

Sugiarto., & Handoko, R.N.S. (2020). Increasing the quality of garlic (*Allium sativum* L.) against the provision of foliar fertilizer and long induction of SIPLO. *Jurnal Pembangunan dan Alam Lestari*. ***11***(2).

Oklima, A.M., Kusnayadi, H., Kusumawardani, W., & Supardi, S. (2024). Efektifitas pemberian pupuk silikat cair dan pupuk kandang sapi terhadap pertumbuhan dan hasil tanaman jagung manis (*Zea mays Saccharata*) di lahan kering. *Jurnal Agroteknologi dan Kehutanan*, ***4***(1), 35-49.

Rastogi, A., Tripathi, D.K., Yadav, S., Chauhan, D.K., Zivcak, M., Ghorbanpour, M., El-Sheery, N.I., & Brestic, M. (2019). Application of silicon nanoparticles in agriculture. *3 Biotech*, ***9***(90). https://doi.org/10.1007/s13205-019-1626-7

Saptorini, S., Supandji, S., & Taufik, T. (2019). Pengujian pemberian pupuk ZA terhadap pertumbuhan dan produksi tanaman bawang merah varietas bauji. *Jurnal Agrinika: Jurnal Agroteknologi dan Agribisnis*, ***3***(2), 134-148. https://doi.org/10.30737/agrinika.v3i2.731

Siddiqui, H., Ahmed, K.B.M., Sami, F., & Hayat, S. (2020). Silicon nanoparticles and plants: Current knowledge and future perspectives. *Sustainable Agriculutre Reviews 41*, 129–142. https://doi.org/10.1007/978-3-030-33996-8_7

Simanjuntak, P., Panataria, L.R., Saragih, M.K., Manurung, A.I., & Siagian, S. (2023). Respon pertumbuhan dan produksi tanaman bawang merah (*Allium ascalonicum* L.) terhadap pemberian pupuk KCL dan pupuk kandang ayam. *Jurnal Methodagro – Jurnal Penelitian Ilmu Pertanian*, ***9***(2), 21-29.

Wibowo, A.S., Septianti, S.D., & Widodo, L.U. (2020). Pembuatan pupuk cair kalium silika berbahan baku abu daun bambu. *ChemPro*, ***1***(01), 29-35. https://doi.org/10.33005/chempro.v1i01.30