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Application of Silica Concentration and Planting Methods on the Growth and Yield of TSS Red Onions (*Allium ascalonicum* L.)

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Abstract

Shallot propagation using seeds or True Shallot Seed (TSS) faces several challenges, including low seedling survival rates and slow seedling development. This study aims to evaluate the effects of silica concentration and planting methods on optimizing the growth and productivity of TSS shallot bulbs. The research was conducted at the UPT Development of Rice and Secondary Crops Seeds in Malang Regency from February to June 2025. The experiment employed a factorial design arranged as a Completely Randomized Design (CRD) with two factors, resulting in eight treatment combinations, each replicated five times. The first factor was silica concentration at four levels: 0 g/L, 12 g/L, 14 g/L, and 16 g/L. The second factor was the planting method, with two levels: direct planting and soil-block seeding. Observed parameters included seedling growth percentage, plant height, number of leaves, number of bulbs, wet weight of stover per clump, dry weight of stover per clump, and dry weight of bulbs. The results indicated no significant interaction between silica concentration and planting method on the growth and yield of TSS shallot bulbs. However, the single treatment at 16 g/L silica concentration (S3) significantly improved seedling growth percentage and plant height, whereas the direct planting method (T1) yielded higher plant height. These findings suggest that applying a 16 g/L silica concentration and direct planting can enhance shallot plant growth when propagated from TSS seeds.

Keywords: Direct Planting, Plant Growth, Seedling Growth Percentage, Soil Block

1. Introduction

Shallots (*Allium ascalonicum* L.) are a horticultural crop that has long been widely cultivated in Indonesia and are commonly grown on a household scale, resulting in high demand. In Indonesia, shallot production fluctuated between 2021 and 2023. In 2021, production was recorded at 2 million tons, decreasing to 1.982 million tons in 2022 and slightly increasing to 1.985 million tons in 2023 (Badan Pusat Statistik, 2024).

In general, farmers continue to use mini bulbs as seeds when cultivating shallots. This preference stems from the advantages of bulbs over botanical seeds or True Shallot Seeds (TSS) (Syam'un et al., 2017). However, propagation using bulbs presents several challenges, including high demand, limited availability, susceptibility to damage, and a short shelf life.

The generative propagation of shallots, or through TSS (True Shallot Seed) seeds, has several advantages, including long shelf life, freedom from disease, lower seed requirements than using bulbs, and improved production efficiency. TSS as planting material has the disadvantage of requiring a longer seeding time than using bulbs. The disadvantages of TSS include the nursery requiring 5-7 weeks, a long harvest time of 90-100 days, low bulb-forming capacity, and disease attacks that cause shallot stems to grow crooked. (Sayaka et al., 2020) .

Applying silica to plants can help increase growth. Research by Moeljani et al. (2021) showed that applying silica to TSS Bauji shallots at 12 g/l and 14 g/l reduced seedling mortality compared to lower treatments. Applying silica to plants can play an important role in maintaining plant resistance to salinity stress and increasing antioxidant enzyme activity under stress (Taufiq et al., 2020). In addition, silica increases photosynthesis rates and improves plant resistance to abiotic stresses, including drought and metal poisoning, as well as to biotic stresses such as pests and diseases (Paramita et al., 2022). The effect of silica on plants is also related to the availability of P in the soil,

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where silica can replace P, thereby suppressing Al and Fe compounds (Puteri et al., 2014).

The direct planting system is a method of plant propagation that avoids sowing seeds, making it more efficient in terms of time and labor. The results of research by Sopha and Basuki (2017) indicate that planting TSS varieties of Tuk-tuk directly in the field without seedlings can increase shallot yield to 15.2 tons per hectare. The results of other research by Sopha et al. (2016) on shallots of the TSS variety of Bima, when seeded in beds, increased seed number and the highest dry weight to 1.52 kg/m^2. This finding can be caused by seeding, which can select for transplanted seeds, helping achieve healthy, uniform plant growth.

The TSS seed sowing technique involves planting seeds until they develop into seedlings before transplanting. One medium suitable for sowing TSS seeds is a soil block. A soil block is a seeding medium composed of a mixture of various planting substrates formed into a box shape with a compact soil structure, designed to produce strong seedlings prior to transplanting. The advantage of using soil blocks is their environmentally friendly sowing system, which eliminates the need for plastic-molded containers (Lasriama & Pangestu, 2022). Based on the description above, applying silica and using different planting methods can enhance the growth of TSS shallots. Therefore, experiments are necessary to determine the optimal silica concentration and planting methods to improve the growth and yield of TSS shallots.

2. Material and Methods

This research was conducted from February to June 2025 at the Technical Implementation Unit for Rice and Secondary Crops Seed Development, Randutelu, Randuagung, Singosari District, Malang Regency, East Java, at coordinates 7º52'10.77" South Latitude and 112º40'49.12" East Longitude. The tools and materials required include *soil block markers*, hoes, plastic cups, measuring cups, sprayers, labels, analytical scales, rulers, meters, stationery, logbooks, cameras, TSS red onion seeds of the Blue Lancor variety, silica, planter bags, boron, Urea fertilizer, SP-36 fertilizer, ZK, soil, compost, goat manure, planter bags, *soil blocks*, antackol fungicide, and furadan and buldok insecticides.

The study used a Completely Randomized Design (CRD), consisting of 2 (two) factors. The first factor is silica concentration, with 4 levels: 0 g/l, 12 g/l, 14 g/l, and 16 g/l; the second factor is planting method, with 2 levels: direct planting and *soil block seeding.* The parameters observed include the percentage of seedling growth, plant length, number of leaves, number of tillers, number of tubers, wet weight of the stover per clump, dry weight of the stover per clump, and dry weight of tubers per clump.

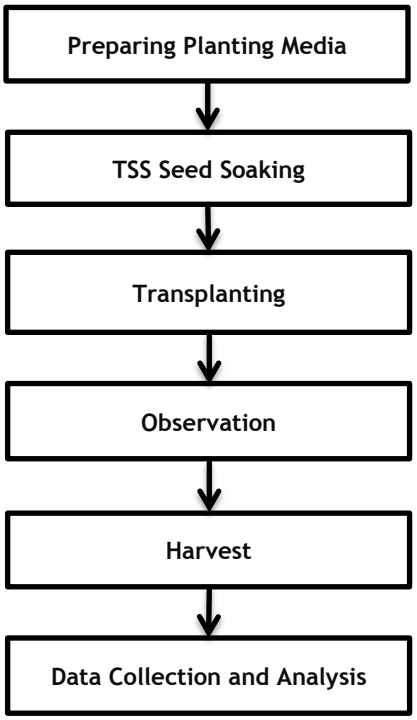

Figure 1. Research Implementation Flowchart

The research data will be analyzed using a Completely Randomized Design (CRD) with a factorial pattern. If the analysis results indicate a significant or very significant effect, a comparison test will be conducted using the Least Significant Difference (LSD) test at the 5% significance level to determine differences between treatments in Microsoft Excel 2010.

3. Results and Discussion

3.1. Seedling Growth Percentage (%)

Table 1 shows that the single treatment of silica concentration had a highly significant effect, whereas the single treatment of planting method had no significant effect on the percentage of TSS in red onion seedling growth. The average percentage of the growth of TSS red onion seedlings under silica concentration treatments and planting methods is shown in Table 1.

From the research results, it is known that the single factor of silica concentration treatment of 12 g/l (S1) of 81.00%, 14 g/l (S2) of 81.60%, and 16 g/l (S3) of 84.20% can increase the percentage value of TSS shallot seed growth compared to the silica concentration treatment of 0 g/l of 73.50%. The silica concentration treatments of 12 g/l, 14 g/l, and 16 g/l have almost the same percentage of seed growth, with the seed body percentage>80% in all three treatments.

The higher the concentration of silica given to plants, the higher the percentage of seedlings that grow, indicating that silica can increase the number of seedlings that grow to or above 80%. This finding is in line with the results of research by Moeljani et al. (2021), which showed that the

administration of silica at 12 g/l and 14 g/l can increase vigor above 80% in TSS Bauji varieties, indicating high growth rates as a result of metabolic activity under optimum conditions and temperatures. The application of silica can increase plant growth by strengthening cell walls through foliar fertilization. The administration of silica can increase resistance to pests and moler diseases because it can induce the formation of lignin and suberin compounds that accumulate in cell walls, resulting in their thickening and making the cell walls strong and difficult for fungi to penetrate (Hersanti et al., 2023). Meanwhile, the treatment of planting methods, both direct planting and through *soil blocks*, did not differ significantly in the percentage of TSS shallot seedlings.

Table 1. Average Percentage of Seedling Growth (%) of Red Onion Seeds, TSS Silica Concentration Treatment, and Planting Method

Treatment	Percentage of TSS Red Onion Seed Growth (%)
Silica Concentration	
Silica 0 g/l (S_0)	73.50 ± 10.50 a
Silica 12 g/l (S_1)	81.00 ± 7.00 b
Silica 14 g/l (S_2)	81.60 ± 5.00b
Silica 16 g/l ($S_{3)}$	84.20 ± 4.00 b
BNT 5%	4.69
How to Plant	
Direct Planting (T_1)	81.40 ± 10.11
Soil Block Seedling (T_2)	78.75 ± 12.89
BNT 5%	tn.

Information: Values accompanied by the same letter in the same column indicate that there is no significant difference based on the BNT test at the 5% level.

3.2. Plant Length

Table 2 shows that the single treatment of silica concentration had a very significant effect on the observation ages of 14 and 21 HST, and the single treatment of planting method had a very significant effect on the observation ages of 7, 14, and 28 HST and had a significant effect on the ages of 21 and 35 HST. The average length of TSS shallot plants, based on silica concentration treatment and planting method, is shown in Table 2. The growth of TSS shallot plants due to silica concentration treatment and planting method can be seen in Figure 2.

Table 2. Average Plant Length (cm) of Red Onion TSS Silica Concentration Treatment and Planting Method

Treatment	Observation Age (HST)				
	7	**14**	**21**	**28**	**35**
Silica Concentration					
Silica 0 g/l (S_0)	11.94 ± 6.04	14.04 ± 8.28 a	22.45 ± 1.20 a	32.43 ± 1.85	42.08 ± 2.84
Silica 12 g/l (S_1)	12.55 ± 4.71	15.03 ± 8.66 ab	23.61 ± 0.71 ab	33.12 ± 4.24	42.21 ± 1.49
Silica 14 g/l (S_2)	12.79 ± 3.95	15.42 ± 7.51 b	24.37 ± 0.29 b	33.74 ± 5.96	42.92 ± 4.49
Silica 16 g/l ($S_{3)}$	13.33 ± 4.58	15.73 ± 6.30 b	24.73 ± 0.58 b	34.00 ± 6.67	43.30 ± 1.29
BNT 5%	tn.	1.00	1.50	tn.	tn.
How to Plant					
Direct Planting (T_1)	13.62 ± 1.14 b	16.59 ± 1.51 b	24.58 ± 2.20 b	34.26 ± 2.83 b	43.13 ± 1.63 b
Soil Block Seedling (T_2)	11.69 ± 1.79 a	13.52 ± 2.24 a	23.54 ± 3.13 a	32.39 ± 0.69 a	42.12 ± 1.63 a
BNT 5%	0.68	0.71	0.99	0.96	0.79

Information: Values accompanied by the same letter in the same column indicate that there is no significant difference based on the BNT test at the 5% level.

Figure 2. Growth of TSS Shallots

S $_0$: Silica 0 g/l, S $_1$: Silica 12 g/l; S $_2$: Silica 14 g/l; S $_3$: Silica 16 g/l; T $_1$: Plant directly; T $_2$: *Soil block*

From the research results, the single treatment of silica concentration on plant length had good results at the age of 14 HST, with an average value in the 16 g/l treatment of 15.73, and at the age of 21 HST, with an average value in the 16 g/l treatment of 24.73 cm compared to the treatment of a smaller silica concentration. The application of silica to shallot plants helps them remain more upright and less likely to fall over. The application of silica to plants can

increase the accumulation of these elements in the leaves, which play a role in maintaining the upright position of the leaves, where this condition supports the efficiency of capturing sunlight during the photosynthesis process and facilitates the translocation of CO $_2$ to plant tissue (Suhaelah et al., 2025). According to Putri et al. (2017), the application of silica fertilizer in nano form to rice plants can provide a more significant increase in plant height compared to without silica application because silica causes the leaves to be upright and stretch well so that the leaf surface can absorb sunlight optimally for the photosynthesis process and the photosynthates produced can be used in the growth process, namely stem elongation.

The single treatment of planting method significantly affected the parameters of shallot plant length and TSS at the ages of 7, 14, and 28, and had a very significant effect at the age of 35 HST. Based on Table 2, good average results for the length of shallot plants and TSS at the ages of 7, 14, 28, and 35 HST in the direct planting method treatment were 13.62 cm, 16.59 cm, 34.26 cm, and 43.13 cm, respectively. Plant height is strongly influenced by competition for available growth space (Aisyah & Herlina, 2018). The planting method and the plant nursery container affect the plant roots' ability to obtain the necessary water and nutrients. The results of Pieter & Sudomo's (2021) research show that the average height of jamblang plants is best when planted in 20 x 30 cm polybags, reaching 33.75 cm, because the larger container size can affect the availability of space for the roots to absorb better nutrients and water, which causes the plant height to increase. Thus, planting directly in planter bags can increase the growth of TSS shallot plants compared to planting in soil blocks, which may be due to inhibited root growth, whereas direct planting allows roots to absorb more nutrients, enabling better development.

3.3. Number of Leaves

Table 3 shows that silica concentration and planting method did not significantly affect the number of shallot leaves with TSS from the beginning to the end of the observation period (7-35 HST). The average number of shallot leaves with TSS, by silica concentration and planting method, is shown in Table 3.

The results of the study showed that the single treatment of silica concentration and planting method did not significantly differ in the number of TSS shallot leaves at any observation age (7-35 HST). This finding aligns with the results of research by Ameliana et al. (2024), which showed that administering silica to Ampenan variety shallot plants did not significantly affect the number of leaves, as environmental conditions could. Silica is an essential nutrient that helps strengthen plants and does not directly affect the formation of new leaves.

Suboptimal environmental conditions during the research can be a contributing factor. TSS nursery is carried out in two ways: direct planting in planter bags and seedlings in soil blocks, where light factors affect leaf formation during photosynthesis. Conditions in a nursery greenhouse, with natural sunlight entering through the side of the building, result in insufficient light for photosynthesis and cause plants to become thin and wilt. According to Rizkiani et al. (2020), solar energy entering *the* greenhouse and reflected by radiation to parts of the building is converted to heat energy, which can cause plant

fluid loss (evapotranspiration).

Table 3. Average Number of Red Onion Leaves, TSS Silica Concentration, Treatment, and Planting Method

Treatment	Observation Age (HST)				
	7	14	21	28	35
Silica Concentration					
Silica 0 g/l (S_0)	2.50 ± 0.00	4.10 ± 0.75	5.80 ± 1.50	7.18 ± 2.38	8.63 ± 2.63
Silica 12 g/l (S_1)	2.45 ± 0.25	4.10 ± 0.75	5.53 ± 0.13	6.88 ± 0.38	8.25 ± 0.50
Silica 14 g/l (S_2)	2.30 ± 0.25	3.95 ± 0.75	5.30 ± 0.75	6.45 ± 0.50	8.23 ± 0.13
Silica 16 g/l ($S_{3)}$	2.55 ± 0.50	4.28 ± 1.38	5.68 ± 0.88	7.13 ± 1.38	8.68 ± 1.63
BNT 5%	tn.	tn.	tn.	tn.	tn.
How to Plant					
Direct Planting (T_1)	2.48 ± 0.41	4.21 ± 0.64	5.74 ± 0.74	7.14 ± 1.22	8.63 ± 1.31
Soil Block Seedling (T_2)	2.43 ± 0.16	4.00 ± 0.47	5.41 ± 0.44	6.68 ± 0.56	8.26 ± 0.30
BNT 5%	tn.	tn.	tn.	tn.	tn.

Information: Values accompanied by the same letter in the same column indicate that there is no significant difference based on the BNT test at the 5% level.

3.4. Yields

Table 4 shows that the silica concentration treatment and planting method did not significantly affect the harvest yield, namely the wet weight of the stover per clump, the dry weight of the stover per clump, the number of bulbs per clump, and the weight of bulbs per clump of TSS shallots. The average TSS shallot harvest yield for the silica concentration treatment and the TSS shallot planting method is shown in Table 4. The harvest yield is shown in Figure 3.

The study results showed that the number of TSS shallot bulbs in the silica concentration treatments and planting methods averaged three bulbs. However, this differed from the findings for wet weight of the stover, dry weight of the stover, and bulb weight, which were higher on average in the 16 g/L silica concentration treatment (S3) compared to lower concentrations, and in the direct planting method (T1) compared to the soil block seedling method (Figure 2). These findings align with the research by Moeljani et al. (2021), which demonstrated that silica concentrations of 12 g/L and 14 g/L produced higher wet and dry weights per plant compared to other treatments. The application of silica to shallot plants increased yields, as reflected in the wet and dry weights of the plants (Ameliana et al., 2024).

Table 4. Average Yield of Red Onion TSS Harvest by Silica Concentration Treatment and Planting Method

Treatment	Yields			
	Wet Weight of Stovetop Per Clump	Dry weight of stover per hill	Number of Bulbs Per Clump	Heavy Bulbs Per Clump
Silica Concentration				
Silica 0 g/l (S_0)	85.88 ± 1.88	17.18 ± 0.38	3.73 ± 1.13	15.68 ± 0.13
Silica 12 g/l (S_1)	86.25 ± 3.75	17.25 ± 0.75	3.38 ± 0.88	14.00 ± 1.00
Silica 14 g/l (S_2)	94.50 ± 15.00	18.83 ± 2.63	3.70 ± 0.25	15.13 ± 1.63
Silica 16 g/l (S_3)	102.88 ± 11.88	20.58 ± 2.38	3.08 ± 0.13	16.65 ± 8.25
BNT 5%	tn.	tn.	tn.	tn.
How to Plant				
Direct Planting (T_1)	94.00 ± 22.72	18.76 ± 4.50	3.55 ± 0.94	15.91 ± 4.30
Soil Block Seedling (T_2)	90.75 ± 17.72	18.15 ± 3.54	3.39 ± 0.74	14.81 ± 1.92
BNT 5%	tn.	tn.	tn.	tn.

Information: Values accompanied by the same letter in the same column indicate that there is no significant difference based on the BNT test at the 5% level.

Figure 3. TSS Red Onion Harvest Results. S_0: Silica 0 g/l, S_1: Silica 12 g/l; S_2: Silica 14 g/l; S_3: Silica 16 g/l; T_1: Plant directly; T_2: *Soil block*

4. Conclusion

Based on the research findings, higher silica concentrations led to improved outcomes, increasing the seedling germination rate to over 80%. Silica treatment also enhanced plant growth, particularly in terms of plant height. Additionally, the direct planting method produced favorable results for TSS shallot plant height at all observation stages. However, neither silica concentration nor planting method significantly affected TSS yields in shallots.

References

Aisyah, Y., & Herlina, N. (2018). Pengaruh jarak tanam tanaman jagung manis (*Zea mays* L. var. *saccharata*) pada tumpangsari dengan tiga varietas tanaman kedelai (*Glycine max* (L.) Merrill). *Jurnal Produksi Tanaman, 6*(1), 66–75.

Badan Pusat Statistik. (2024). *Produksi tanaman sayuran dan buah-buahan semusim menurut provinsi dan jenis tanaman, 2024*. https://www.bps.go.id/id/statistics-table/3/produksi-tanaman-sayuran-dan-buah-buahan-semusim-menurut-provinsi-dan-jenis-tanaman2024.html?year=2024

Ameliana, F., Nikmatullah, A., & Santoso, B. B. (2024). Pengaruh pemberian berbagai konsentrasi pupuk silikat cair terhadap pertumbuhan dan hasil bawang merah (*Allium cepa* L.) pada musim penghujan. *Jurnal Ilmiah Mahasiswa Agrokomplek, 3*(2), 100–109. https://doi.org/10.29303/jima.v3i2.5197

Hersanti, Febrianti, N., & Djaya, L. (2023). Effectiveness of nano chitosan and nano silica to suppress the growth of *Fusarium oxysporum*, the cause of twisting disease on shallot. *Jurnal Fitopatologi Indonesia, 19*(6), 265–275. https://doi.org/10.14692/jfi.19.6.265-275

Lasriama, F., & Pangestu, F. T. H. (2022). Design landscape urbanism pada taman hortikultura tropis Waduk Pluit. *Jurnal Sains, Teknologi, Urban, Perancangan, Arsitektur (Stupa), 3*(2), 2407. https://doi.org/10.24912/stupa.v3i2.12338

Pieter, L. A. G., & Sudomo, A. (2021). Efek ukuran wadah semai terhadap pertumbuhan awal bibit jamblang (*Syzygium cumini* (L.) Skeels) [The effect of container size on growth of Java plum (*Syzygium cumini* (L.) Skeels) seedlings]. *Jurnal Agroforestri Indonesia, 2*, 107–114.

Moeljani, I. R., Faristiawan, Y., & Sulistyono, A. S. (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

Paramita, W. N. (2022). Efektivitas pupuk organik cair dengan penambahan silika sebagai media tanam hidroponik pakcoy [Liquid organic fertilizer effectiveness with addition of silica as a planting media for pakcoy hydroponics]. *LenteraBio, 11*(1), 36–43. https://journal.unesa.ac.id/index.php/lenterabio/index36

Puteri, E. A., Nurmiaty, Y., & Agustiansyah, A. (2014). Pengaruh aplikasi fosfor dan silika terhadap pertumbuhan dan hasil tanaman kedelai (*Glycine max* [L.] Merrill). *Jurnal Agrotek Tropika, 2*(2), 241–245. https://doi.org/10.23960/jat.v2i2.2092

Putri, F. M., Suedy, S. W. A., & Darmanti, S. (2017). Pengaruh pupuk nanosilika terhadap jumlah stomata, kandungan klorofil, dan pertumbuhan padi hitam (*Oryza sativa* L. cv. *japonica*). *Buletin Anatomi dan Fisiologi, 2*(1), 72. https://doi.org/10.14710/baf.2.1.2017.72-79

Rizkiani, D. N., Sumadyo, A., & Marlina, A. (2020). Greenhouse sebagai wadah penelitian hortikultura. *Jurnal Ilmiah Mahasiswa Arsitektur, 3*(2), 461–470. https://jurnal.ft.uns.ac.id/index.php/senthong/index

Sayaka, B., Pasaribu, S. M., & Dermoredjo, S. K. (2020). Prospect for farmers' adoption of true shallot seed. *Forum Penelitian Agro Ekonomi, 38*(1), 53–66. https://doi.org/10.21082/fae.v38n1.2020.53-66

Sopha, G. A., & Basuki, R. S. (2017). Optimasi bahan penutup benih dalam budidaya tanam langsung true shallot seed (TSS). *Jurnal Galung Tropika, 6*(3), 154–161. https://doi.org/10.31850/jgt.v6i3.245

Sopha, G. A., Sumarni, N., Setiawati, W., & Suwandi, S. (2016). Teknik penyemaian benih true shallot seed untuk produksi bibit dan umbi mini bawang merah. *Jurnal Hortikultura, 25*(4), 318–330. https://doi.org/10.21082/jhort.v25n4.2015.p318-330

Suhaelah, E., AM, K., & Millah, Z. (2025). Respons pertumbuhan dan hasil umbi mini bawang merah (*Allium ascalonicum* L.) asal biji terhadap perlakuan densitas tanaman dan tingkat konsentrasi pupuk silika cair. *Jurnal Ilmu Pertanian Tirtayasa, 7*(1), 292–300. https://doi.org/10.33512/jipt.v7i1.33695

Syam'un, E., Yassi, A., Jayadi, M., Sjam, S., Ulfa, F., & Zainal. (2017). Meningkatkan produktivitas bawang merah melalui penggunaan biji sebagai bibit. *Jurnal Dinamika Pengabdian, 2*(2), 188–193. https://journal.unhas.ac.id/index.php/jdp/article/view/2162

Taufiq, F., Kristanto, B. A., & Kusmiyati, F. (2020). Effect of silica fertilizer on the growth and production of soybean in saline soil. *Agrosains: Jurnal Penelitian Agronomi, 22*(2), 88–93.