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Response of Growth and Yield of Samhong King Curly Mustard Greens (*Brassica juncea* L.) to Land Tillage and Differences in Mulch Application

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ABSTRACT

Land processing intensively and over an extended period can lead to a decline in cultivated land quality, resulting in suboptimal plant growth. The utilization of mulch is anticipated to enhance soil quality, enabling mustard plants to thrive and yield effectively. This study investigates the most effective type of mulch in conjunction with land tillage to maximize the growth and productivity of Samhong King curly mustard greens. The experiment was conducted at the Mapena Agricultural and Livestock Polytechnic experimental garden from November 2023 to March 2024. A factorial (3x2) experiment was set up in a randomized complete block design with four blocks. The first factor, mulch type, comprised three levels: straw, silver-black, and no mulch. On the other hand, the second factor, land tillage, consisted of two levels: tillage and no-tillage. Observations encompassed growth parameters, harvest variables, and environmental factors. The data underwent statistical analysis using analysis of variance (ANOVA), with Tukey's statistic calculated at a significance level of 5%. The findings revealed that the combination of tillage with silver-black mulch application facilitated superior growth and yield of curly mustard greens compared to the application of straw mulch or no mulch with tillage and no-tillage.

Keywords: *Curly mustard greens, Factorial experiment, Land Tillage, Silver-black mulch, Straw mulch*

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1. INTRODUCTION

Green mustard, scientifically known as Brassica juncea L., is a leafy vegetable highly valued for its abundant vitamins A and C (Nessley 2022). The consumption of mustard greens per person in Indonesia has shown a consistent increase over the past three years (BPS, 2023). Farmers cultivate various types of mustard greens, including Caisim mustard greens, Pakcoy mustard greens, pagoda mustard greens, bitter mustard greens, kailan mustard greens, and curly mustard greens (Sutarto *et al.,* 2016; Tripama and Yahya, 2018; Nessley, 2022). Green mustard plants thrive in sub-tropical climates but can also adapt well to tropical climates. While they are primarily grown in lowland areas, they can also flourish in highland regions. These plants are known for tolerating high temperatures (Irmawati, 2018). However, long-term intensive land tillage practices can negatively impact soil quality, leading to a decline in its physical properties. To address this issue, it is crucial to implement effective land management strategies, such as combining land tillage with mulching. Mulching is considered a vital component of sustainable agriculture as it enhances plant growth and productivity, suppresses weed growth, reduces evaporation rates, improves air content and soil temperature, prevents soil erosion, and alters the physico-chemical and biological properties of the soil (Thakur & Kumar 2021). There are two main types of mulch: organic mulch and inorganic mulch. Organic mulch is derived from natural sources such as household waste, agricultural waste, rice husks, straw mulch, and wood waste. Rice straw mulch is widely used for various plant types (Ji & Unger 2001). On the other hand, inorganic mulch is commonly represented by black polyethylene film and white transparent film (Gosar *et al.*, 2010; Subrahmaniyan *et al.,* 2006). Interestingly, the application of silver-black mulch has been found to enhance the growth of tomato plants compared to straw or dry leaf mulch (Raksun *et al.,* 2020). Additionally, implementing a tillage system has shown promising results in improving the growth components and yields of shallot plants when compared to no tillage (Mafula and Sugito 2019). Given these findings, the author aims to investigate the optimal combination of mulch types and land tillage techniques to maximize the growth and yields of Samhong King curly mustard greens.

2. MATERIAL AND METHODS

The research was conducted at the Mapena Agricultural and Livestock Polytechnic experimental garden in Lajo Lor, Singgahan District, Tuban Regency (-6,9661402, 111,765878 / 6°57'59.1"S 111°45'57.2" E), from November 2023 to March 2024. This research used a factorial (3x2) randomized complete block design with four blocks. The first factor is the type of mulch, which consists of 3 levels: straw mulch, silver-black mulch, and no mulch. In the meantime, the second factor to consider is land tillage, which encompasses two levels: tillage and no-tillage. As a result, there are six different combinations of treatments, each repeated four times, resulting in 24 experimental units. The chosen planting material is Ta Fung brand Samhong King curly mustard greens. The mustard plants are sown and allowed to grow for two weeks or until they have developed three leaves. The mustard seeds are planted in Guludan, which measures 6 m x 0.5 m, with a planting distance of 20 cm x 20 cm. Before planting, the Guludan is prepared according to the specific treatment. Initially, manure is applied before transplanting, while the primary fertilizer, urea fertilizer, is applied at a rate of 250kg/ha (Rolanda *et al.,* 2021). Additionally, supplementary fertilizer is applied at 21 DAS and 35 DAS using NPK Mutiara 16:16:16 fertilizer at a dose of 250kg/ha. The observations conducted include both non-destructive and destructive measurements. Non-destructive observations involve

recording the length (cm) and number of leaves of the plants. These observations are made 42 days after sowing (DAS). On the other hand, destructive observations involve measuring the plants' fresh weight (g) and calculating the harvest index. These observations are made at the time of harvesting the mustard greens. Furthermore, environmental observations are carried out to monitor soil temperature and soil pH using a soil moisture analyzer. The collected data is subjected to statistical analysis using analysis of variance (ANOVA) and Tukey's statistic at a significance level of 5%.

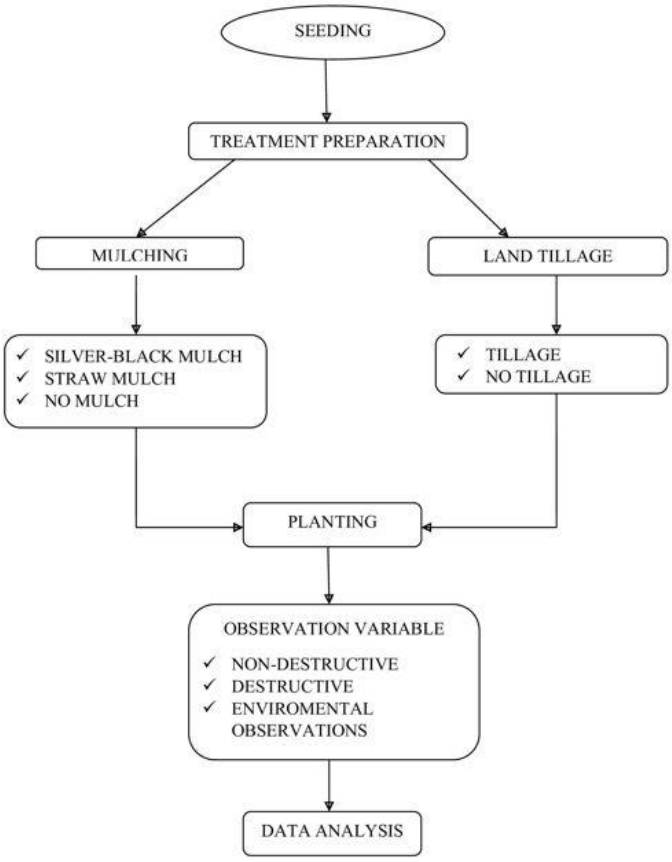

Figure 1. Flow diagram of research implementation

3. RESULTS AND DISCUSSION

Environmental observation

The environmental observations in each treatment yielded varying results. The highest average temperature of 33.3°C was recorded in the Guludan treated with no tillage combined with silver-black mulch. Conversely, the lowest temperature of 30.9°C was observed in the Guludan with tillage treatment and straw mulch (Figure 2). Mustard greens thrive best in highland areas with ample sunlight intensity, soil temperature ranging from 7-28°C, environmental humidity of approximately 75%, and soil moisture levels between 60-80% (wb) (Telaumbanua & Purwantana, 2014). However, research indicates that mustard plants can flourish even at temperatures as high as 33.3°C. This adaptability is attributed to using cultivars that are well-suited for field temperatures. Moreover, soil temperatures ranging from 10°C to 35.6°C provide favorable conditions for the metabolic activity of most soil microorganisms (Davidson & Janssens, 2006). These microorganisms play a

crucial role in the nutrient cycle within the soil, ensuring the availability of nutrients for plants (Onwuka, 2018). Conversely, low soil temperatures can impede nutrient absorption due to the high viscosity of soil water and reduced nutrient transport activity in plant roots. Low soil temperatures reduce tissue nutrient concentrations, reducing root growth (Lahti *et al.,* 2002). The soil pH suitable for mustard cultivation is 6,0-7,0 (Haryanto, 2001). The highest average pH in the observations made was 6,5 in the tillage treatment with no-mulch application, while the lowest pH was 6,0 in the no-tillage treatment combined with no mulch application and the combined tillage treatment with straw mulch (Figure 2). Based on the research, the pH in each treatment is still suitable for mustard greens to grow optimally.

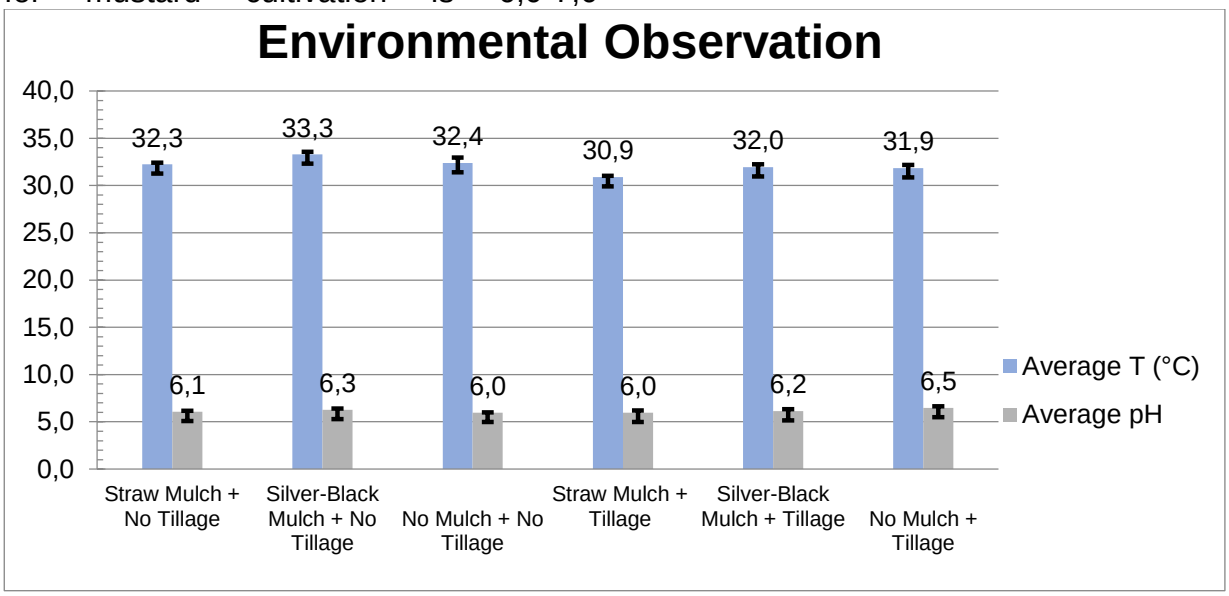

Figure 2. Observations Chart of average temperature (T) and soil pH for each treatment combination

Observation of plant growth

Non-intrusive observations were conducted by monitoring the growth of mustard green plants, specifically by tracking the number of leaves and plant height. The analysis of variance (ANOVA) revealed significant relationships, with a p-value of 0.01 for both the leaf count and plant height variables. The growth characteristics of curly mustard greens showed better outcomes when subjected to tillage and silver-black mulch application compared to other methods. Plant growth results from an increase in cell number and the enlargement of each cell, which is irreversible and can be quantified (Wahyudin, 2009).

Table 1. Number of leaves and length of mustard green plants in tillage and mulching treatments at 42 DAS

Land Tillage	Mulch	Number of leaves (leaves)	Plant length (cm)
Tillage	Silver-black	17,00 ± 1,46	24,89 ± 1,37
Tillage	Straw	8,75 ± 1,46	17,72 ± 1,37
Tillage	No mulch	10,75 ± 1,46	18,41 ± 1,37
No-Tillage	Silver-black	7,50 ± 1,46	17,61 ± 1,37
No-Tillage	Straw	11,75 ± 1,46	20,66 ± 1,37
No-Tillage	No mulch	9,75 ± 1,46	18,06 ± 1,37

Applying a combination of tillage and silver-black mulch gave the highest mean value for the number of leaves variable, with a value of 17,00 leaves, and the highest mean for the plant length variable, with a value of 24,89 cm (Table 1). Applying a combination of tillage and mulching improves the physical properties of the soil, macronutrient content, and the number of fungal populations in the plant rhizosphere (Nugroho, 2019; Permana *et al.,* 2017). The application of silver-black mulch can improve the growth and production of chili plants, for example, in the variables of plant height and the number of secondary branches of chili plants (Zairani *et al.,* 2023). This result also aligns with research that has been carried out, where the application of tillage combined with silver-black mulch can increase the number of leaves and length of curly mustard greens compared to other treatments.

Table 2. Simple effect Test of the variable number of leaves (leaves) on the mulch comparison factor in each land tillage treatment observed at 42 DAS

Land Tillage	Mulching Comparison		Difference	P-value
	X1	X2		
Tillage	Silver-black	Straw	8,25 ± 2,06	**0,01**
Tillage	Silver-black	No mulch	6,25 ± 2,06	0,07
Tillage	Straw	No mulch	-2,00 ± 2,06	0,92
No-Tillage	Silver-black	Straw	-4,25 ± 2,06	0,36
No-Tillage	Silver-black	No mulch	-2,25 ± 2,06	0,88
No-Tillage	Straw	No mulch	2,00 ± 2,06	0,92

Note: Numbers in bold indicate significance based on Tukey's adjustment at alpha=0.05; The difference value is obtained based on the subtraction of the mean from the treatment column X1 to column X2 at each land tillage interval.

The simple effect test analysis of the variable number of leaves at 42 DAS shows that different mulching applications provide significant differences in the tillage treatment. Combining tillage with silver-black mulch can increase the number of leaves by a difference of 8,25 leaves, which is higher than that of straw mulch application. In the no-tillage treatment, using different mulches did not significantly affect the variable number of leaves at 42 DAS (Table 2).

Table 3. Simple effect Test of the variable plant length (cm) on the mulch comparison factor in each land tillage treatment observed at 42 DAS

Land Tillage	Mulching Comparison		Difference	P-value
	X1	X2		
Tillage	Silver-black	Straw	7,17 ± 1,94	**0,02**
Tillage	Silver-black	No mulch	6,48 ± 1,94	**0,04**
Tillage	Straw	No mulch	-0,69 ± 1,94	1,00
No-Tillage	Silver-black	Straw	-3,05 ± 1,94	0,63
No-Tillage	Silver-black	No mulch	-0,46 ± 1,94	1,00
No-Tillage	Straw	No mulch	2,59 ± 1,94	0,76

Note: Numbers in bold indicate significance based on Tukey's adjustment at alpha=0.05; The difference value is obtained based on the subtraction of the mean from the treatment column X1 to column X2 at each land tillage interval.

The analysis of the simple effect test of the plant length variable at 42 DAS showed that in the tillage treatment, different mulching applications provided significant differences. The combination of tillage with silver-black mulch can increase plant length by a difference of 7,17 cm compared to straw mulch and also higher compared with no mulch application, which is a difference of 6,48 cm. Meanwhile, in the no-tillage treatment, different mulches did not

significantly affect the plant length variable at 42 DAS (Table 3). This result is also consistent with previous research that shows that applying black mulch and tillage can improve okra plants' growth and vegetative yield (Mamkagh, 2009).

Observation of harvest

The statistical analysis, ANOVA, reveals noteworthy interactions between tillage and mulching treatments for both the plant fresh weight variable and the harvest index variable. The p-value for the plant fresh weight variable is 0.00, while the p-value for the harvest index variable is 0.02. Among the different combinations of tillage and mulch, applying silver-black mulch in conjunction with tillage yielded the highest average fresh weight of plants and harvest index during the harvest observations. Specifically, the average fresh weight of plants was 403.00 g, and the average harvest index was 0.95 (Table 4).

Table 4. Plant fresh weight variables and harvest index in land tillage and mulching treatments for harvest observations

Land Tillage	Mulch	Fresh weight (g)	Harvest Index
Tillage	Silver-black	403,00 ± 16,05	0,95 ± 0,02
Tillage	Straw	316,00 ± 16,05	0,85 ± 0,02
Tillage	No mulch	326,00 ± 16,05	0,85 ± 0,02
No-Tillage	Silver-black	263,00 ± 16,05	0,84 ± 0,02
No-Tillage	Straw	289,00 ± 16,05	0,88 ± 0,02
No-Tillage	No mulch	262,00 ± 16,05	0,82 ± 0,02

The results of the simple effect test on the variable fresh weight of plants during harvest observations showed that in the tillage treatment, the use of different mulches made a significant difference in the variable fresh weight of plants. The combination of tillage with silver-black mulch can increase the fresh weight of plants by 87,00 g higher than straw mulch and 77,00 g higher than compared to without mulch application (Table 5). Meanwhile, in the no-tillage treatment, the mulch difference did not significantly affect the plant fresh weight variable (Table 5).

Table 5. Simple effect test of the plant fresh weight variable (g) on the mulch comparison factor in each tillage treatment for harvest observation

Land Tillage	Mulching Comparison		Difference	P-value
	X1	X2		
Tillage	Silver-black	Straw	87,00 ± 22,7	**0,02**
Tillage	Silver-black	No mulch	77,00 ± 22,7	**0,04**
Tillage	Straw	No mulch	-10,00 ± 22,7	1,00
No-Tillage	Silver-black	Straw	-26,50 ± 22,7	0,84
No-Tillage	Silver-black	No mulch	1,00 ± 22,7	1,00
No-Tillage	Straw	No mulch	27,50 ± 22,7	0,82

Note: Numbers in bold indicate significance based on Tukey's adjustment at alpha=0.05; The difference value is obtained based on the subtraction of the mean from the treatment column X1 to column X2 at each land tillage interval.

The simple effect test on the harvest index variable shows that in the tillage treatment, differences in the type of mulch significantly influence the harvest index. The combination of tillage with silver-black mulch makes the harvest index higher than straw mulch with a difference of 0,10, and the difference is 0,11 higher if silver-black mulch is used than no mulch. Meanwhile, in the no-tillage treatment, different mulch types did

not significantly affect the harvest index variable (Table 6).

Table 6. Simple effect Test of the harvest index on the mulch comparison factor in each tillage treatment for harvest observation

Land Tillage	Mulching Comparison		Difference	P-value
	X1	X2		
Tillage	Silver-black	Straw	0,10 ± 0,03	**0,03**
Tillage	Silver-black	No mulch	0,11 ± 0,03	**0,03**
Tillage	Straw	No mulch	0,00 ± 0,03	1,00
No-Tillage	Silver-black	Straw	-0,03 ± 0,03	0,87
No-Tillage	Silver-black	No mulch	0,03 ± 0,03	0,95
No-Tillage	Straw	No mulch	0,06 ± 0,03	0,41

Note: Numbers in bold indicate significance based on Tukey's adjustment at alpha=0.05; The difference value is obtained based on the subtraction of the mean from the treatment column X1 to column X2 at each land tillage interval.

According to the research conducted, the optimal condition for cultivating Samhong King curly mustard greens involves the combination of tillage with the application of silver-black mulch. This practice enhances the environmental factors necessary for plant growth. The silver-black mulch consists of a silver top surface and a black inner surface. The silver surface is designed to reflect light, promoting efficient photosynthesis in plants, while the black color helps maintain stable soil temperature by preventing heat release through evaporation. Silver-black mulch has been found to enhance the growth and yield of eggplant crops significantly. The black color of the mulch aids in withstanding high temperatures, while the silver color reflects sunlight, increasing light absorption by the plants. This result, in turn, boosts plant metabolism and influences the formation of yield components in eggplant crops (Muslim & Soelistyono, 2017). Meanwhile, tillage can improve the soil's biological and physico-chemical properties, improving soil aeration so that mustard plants can grow and produce well compared to other treatments. Tillage can improve the growth characteristics of mustard greens, possibly due to the proliferation of roots to a greater depth and extent, which supports the availability of moisture and nutrients, so plant growth characteristics are accumulated better compared to no-tillage (Kumar *et al.,* 2016).

4. CONCLUSION

There was a significant interaction between the tillage treatment and the mulching on the growth variables and yield components of the Samhong King curly mustard greens. Utilizing a blend of tillage and silver-black mulch can substantially enhance the number of leaves, plant length, fresh weight, and the harvest index of Samhong King curly mustard greens. In comparison to alternative treatments, the average number of leaves observed was 17, the plant length measured 24.89 cm, the fresh weight amounted to 403 g, and the harvest index reached 0.95.

REFERENCES

Badan Pusat Statistik (BPS). 2024. Rata-rata Konsumsi Perkapita Seminggu Menurut Kelompok Sayur-Sayuran Per Kabupaten/ Kota (Satuan Komoditas), 2021-2023. [Online]. Available at https:// www.bps. go.id/ id /statistics- table/2/ MjEwMCMy/ rata-rata-konsumsi-perkapita-seminggu-menurut-kelompok-sayur-sayuran-per-kabupaten-kota.html. Verified on 26 Maret 2024.

Davidson, E. A., and I. A. Janssens. 2006. "Temperature Sensitivity of Soil Carbon Decomposition and Feedbacks to Climate Change."

Nature 440(7081): 165–73. doi:10.1038/nature04514.

Gosar, B., A. Tajnšek, A. Udovč, and D. Baričevič. 2010. "Evaluating a New Ridge and Furrow Rainfall Harvesting System with Two Types of Mulches." *Irrigation and Drainage* 59(3): 356–64. doi:10.1002/ird.468.

Irmawati. 2018. "Respon Pertumbuhan Dan Produksi Tanaman Caisin (*Brassica Jencea* L.) Dengan Perlakuan Jarak Tanam." *Journal of Agritech Science* 2(1): 30–36.

Ji, S., and P. W. Unger. 2001. "Soil Water Accumulation under Different Precipitation, Potential Evaporation, and Straw Mulch Conditions." *Soil Science Society of America Journal* 65(2): 442–48. doi:10.2136/sssaj2001.652442x.

Kumar, R., R. S. Singh, D. Singh, and, S. Kumar. 2016. Effect of Tillage and Irrigation Levels on Growth and Yield of Indian Mustard (*Brassica juncea* L.). Environment & Ecology. 34 (4C):2345-2348.

Lahti, M., P. J. Aphalo, L. Finér, T. Lehto, I. Leinonen, H. Mannerkoski, and A. Ryyppö. 2002. "Soil Temperature, Gas Exchange and Nitrogen Status of 5-Year-Old Norway Spruce Seedlings." *Tree Physiology* 22(18): 1311–16. doi:10.1093/treephys/22.18.1311.

Mafula, F. and Y. Sugito. 2019. "Pengaruh Sistem Olah Tanah Terhadap Pertumbuhan Dan Hasil Beberapa Varietas Bawang Merah (*Allium ascalonicum* L.) The Effect of Tillage System on Growth and Yield on Some Varieties of Shallot (*Allium ascalonicum* L.)." *Jurnal Produksi Tanaman* 7(3): 457–63.

Mamkagh, A. M. A. 2009. "Effect of Tillage Time and Plastic Mulch on Growth and Yield of Okra (*Abelmoschus esculentus*) Grown under Rain-Fed Conditions." *International Journal of Agriculture and Biology* 11(4): 453–57.

Telaumbanua, M., B. Purwantana, dan L. Sutiarso. 2014. "Rancangbangun Aktuator Pengendali Iklim Mikro Di Dalam Greenhouse Untuk Pertumbuhan Tanaman Sawi (*Brassica rapa* Var.Parachinensis L.)." *Agritech: Jurnal Fakultas Teknologi Pertanian UGM* 34(2): 213–22.

Muslim, M., and R. Soelistyono. 2017. "The Effect Of Silver Black Plastic Mulch With Various Form And High Of Seedbed On Growth Of Cauliflower (*Brassica oleracea* Var. Botrytis L.)." *PLANTROPICA Journal of Agricultural Science. 2017* 2(2): 85–90.

Nessley, C. H. 2022. "Mustard Greens." *Home Vegetable Gardening*: 172–74. doi:10.36019/9781978812086-041.

Nugroho, P. A. 2019. "Pengolahan Tanah Dalam Penyiapan Lahan Untuk Tanaman Karet Soil Tillage in Land Clearing for Rubber Plantation." *Perspektif* 17(2): 129. doi:10.21082/psp.v17n2.2018.129-138.

Onwuka, B. 2018. "Effects of Soil Temperature on Some Soil Properties and Plant Growth." *Advances in Plants & Agriculture Research* 8(1): 34–37. doi:10.15406/apar.2018.08.00288.

Permana, I. B. P. W., I. W. D. Atmaja, and I. W. Narka. 2017. "Pengaruh Sistem Pengolahan Tanah Dan Penggunaan Mulsa Terhadap Populasi Mikroorganisme Dan Unsur Hara Pada Daerah Rhizosfer Tanaman Kedelai (*Glycine max* L.)." *E-Jurnal Agroekoteknologi Tropika (Journal of Tropical Agroecotechnology)* 6(1): 41–51.

Raksun, A., M. Mahrus, and I G. Mertha. 2020. "Pertumbuhan Vegetatif Tomat (*Solanum lycopersicum* Mill) Pada Keragaman Tipe Mulsa Dan Dosis Pupuk Organik." *Jurnal Biologi Tropis* 20(1): 40–45. doi:10.29303/jbt.v20i1.1420.

Rolanda, I. A., A. Z. Arifin, and

Sulistyawati. 2021. “Pengaruh Pemberian Dosis Pupuk Nitrogen Terhadap Pertumbuhan Dan Hasil Tanaman Sawi Pahit *(Brassica juncea* L.).” *Jurnal Agroteknologi Merdeka Pasuruan* 5(2): 1–6.

Subrahmaniyan, K., P. Kalaiselvan, T. N. Balasubramanian, and W. Zhou. 2006. "Crop Productivity and Soil Properties as Affected by Polyethylene Film Mulch and Land Configurations in Groundnut (*Arachis hypogaea* L.)." *Archives of Agronomy and Soil Science* 52(1): 79–103. doi:10.1080/03650340500421786.

Thakur, M., and R. Kumar. 2021. "Mulching: Boosting Crop Productivity and Improving Soil Environment in Herbal Plants." *Journal of Applied Research on Medicinal and Aromatic Plants* 20: 100287. doi:10.1016/j.jarmap.2020.10028.

Tripama, B., and M. R. Yahya. 2018. “Respon Konsentrasi Nutrisi Hidroponik Terhadap Tiga Jenis Tanaman Sawi (*Brassica juncea* L.) Response Of Hydroponic Nutrition Concentration To Three Types Of Mustard Plant *(Brassica juncea* L.)." *Agritrop* 16(2): 237–49.

Sutarto, U. A., Koesriharti, dan N. Aini. 2016. "Respon Tiga Jenis Sawi (*Brassica* Sp.) Terhadap Aplikasi Macam Mulsa Responses Of Three Types Mustard (*Brassica* Sp.) On Applications Type Of Mulch." *Jurnal Produksi Tanaman* 4(6): 447–53.

Wahyudin, G. Satari dan T. Nurmala dan Aep Wawan Irwan dan Agus. 2009. *Dasar-Dasar Agronomi*.

Zairani, F. Y., B. Hasani, L. Nisfuriah, Dali, R. Kalasari, and G. Abd. Nasser. 2023. "The Effect of Various Kinds of Mulch on the Growth and Production of Chili Plants." *Journal of Global Sustainable Agriculture* 3(2): 7. doi:10.32502/jgsa.v3i2.6072.