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Pb Heavy Metal Content, Growth and Yield of Four Kale Varieties (*Ipomea reptans* Poir.) due to Dosage of Chicken Manure with Sediment Media of Sewers

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Abstract: Food insecurity is a condition in an area, community or household where the level of security and availability does not meet the standards needed for the growth and health of the majority of the population. Kangkung is a heavy metal-absorbing weed plant that many people like as a vegetable. Food security in urban communities is limited by existing land and growing media, so using media from sewer sediment is an alternative. The experiment used a factorial Randomized Block Design (RAK), consisting of two factors, namely the dose of chicken manure (A) with 4 levels as follows: a_0 : 0 t ha^{-1} (control), a_1 : 10 t ha^{-1}, a_2 : 20 t ha^{-1} and a_3 : 30 t ha^{-1} and Kangkung Variety (K) with 4 levels as follows: k_0 : Serimpi Variety, k_1 : Amanda Variety, k_2 : Bangkok LP-1 Variety and k_3 : Bika Variety, so there are 16 treatment combinations repeated 2 times. The research findings indicated that there was no significant correlation between the dosage of chicken manure and the plant type in terms of plant growth, yield, and absorption of PB heavy metals, with the exception of leaf count. The optimum dose of chicken manure is 5.05 t ha^{-1} in the Serimpi variety with a maximum number of leaves of 11.30 plants^{-1}, 5.27 t ha^{-1} in the Amanda variety produces a maximum number of leaves of 16.68 plants^{-1} , 9.20 t ha^{-1} in the Bangkok LP-1 variety produces a maximum number of leaves of 16.77 plants^{-1} and 3.83 t ha^{-1} in the Bika variety produces a maximum number of leaves of 18.66 plants^{-1}.

Keywords: Chicken Manure, Heavy Metal Content, Kale Varieties, Sewer Sediment Media.

Abstrak: *Kerawanan pangan adalah suatu kondisi di suatu daerah, komunitas atau rumah tangga dimana tingkat keamanan dan ketersediaan pangan tidak memenuhi standar yang dibutuhkan untuk pertumbuhan dan kesehatan sebagian besar penduduk. Kangkung merupakan tanaman gulma penyerap logam berat yang banyak disukai masyarakat sebagai sayuran. Ketahanan pangan pada masyarakat perkotaan dibatasi oleh lahan dan media tanam yang ada, sehingga penggunaan media dari endapan selokan menjadi salah satu alternatif. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK) faktorial, yang terdiri dari dua faktor, yaitu*

dosis pupuk kandang ayam (A) dengan 4 taraf sebagai berikut: a0 : 0 t ha-1 (kontrol), a1 : 10 t ha-1 , a2 : 20 t ha-1 dan a3 : 30 t ha-1 dan Varietas Kangkung (K) dengan 4 taraf sebagai berikut: k0 : Varietas Serimpi, k1 : Varietas Amanda, k2 : Varietas Bangkok LP-1 dan k3 : Varietas Bika, sehingga terdapat 16 kombinasi perlakuan yang diulang sebanyak 2 kali. Hasil penelitian menunjukkan bahwa tidak ada korelasi yang signifikan antara dosis pupuk kandang ayam dan jenis tanaman dalam hal pertumbuhan tanaman, hasil, dan serapan logam berat PB, kecuali jumlah daun. Dosis pupuk kandang ayam yang optimum adalah 5,05 t ha-1 pada varietas Serimpi dengan jumlah daun maksimum 11,30 tanaman-1, 5,27 t ha-1 pada varietas Amanda menghasilkan jumlah daun maksimum 16,68 tanaman-1 , 9,20 t ha-1 pada varietas Bangkok LP-1 menghasilkan jumlah daun maksimum 16,77 tanaman-1 dan 3,83 t ha-1 pada varietas Bika menghasilkan jumlah daun maksimum 18,66 tanaman-1.

Kata Kunci: *Kotoran Ayam, Kandungan Logam Berat, Varietas Kangkung, Media Endapan Selokan.*

INTRODUCTION

Food insecurity is a condition that is not expected. Steps that can be used to overcome this include utilizing local resources and land that provides agricultural services to carry out gardening activities, including yards, school/office gardens, public spaces and idle land. Handling food insecure areas is an effort to address household food and nutritional insufficiency due to difficulties in obtaining food or because they do not have the purchasing power to obtain that food. Cultivation and crop production can be done with soil media and organic matter. Land in urban areas is difficult to find, the use of sewer sludge can be an alternative, but whether the media is safe for consumption needs to be done by planting land kale (Ipomea reptans Poir.) as a plant that absorbs heavy metals in various varieties. Water spinach is a weed (Jeanine Arana et al, 2022) which can be used as a vegetable plant, containing vitamins A, B, C, protein, calcium, phosphorus, sitosterol and minerals, especially iron. This plant is classified as an annual and has a brief lifespan. It does not require a significant amount of space for cultivation (Gaso et al., 2022). Water spinach cultivation certainly cannot be separated from technology to produce water spinach with good quality and optimal results. One very important technology is fertilization. Fertilization aims to add nutrients to plants so that plants can grow and develop well (Ramdhan and Swardana, 2021).

According to Maisarah and Fitria (2022), kale cultivation currently uses a lot of chemical fertilizers. Continuous use of chemical fertilizers can cause losses because they pollute the environment and create residues in the soil. The use of chemical fertilizers affects the microorganisms in the soil; Therefore, it is necessary to use organic fertilizer to maintain nutrients. Organic fertilizers have many advantages, including containing more complete microorganisms and nutrients, which can improve the physical, biological and chemical properties of the soil (Suartini and Anggia, 2021). In recent decades, livestock agriculture has undergone an industrial revolution, leading to the generation of animal dung as a kind of organic fertilizer (Andong Wang, et al., 2021). One of the organic fertilizers is chicken manure, which is one of the main sources of heavy metals in agricultural soil which causes bioaccumulation due to its non-degradable nature (Shihang Wu, et al., 2023; Xiaomeng Chen et al., 2022; Wenwen Deng, 2020 ; Luqman Riaz et al., 2020; Ying Zhang et al., 2021). Besides heavy metals, chicken manure contains many pathogens, toxic substances that will pose a major threat to human health and environmental sustainable development (Hailong Mao, et al., 2020).

The content of Nitrogen, Phosphorus and Potassium in chicken manure is higher than other manures, namely Nitrogen 1.30%, Phosphorus 1.21% and Potassium 1.39% (Aprilia et al., 2020).

So chicken fertilizer can be an alternative to increase the availability, adequacy and efficiency of nutrients for plants, so as to reduce the use of inorganic fertilizers and increase plant yields (Nafia'ah and Swardana, 2021).

Apart from chicken manure, one of the factors that can influence the productivity of kale plants is the selection of superior varieties of kale plants which aims to optimize the growth and yield of cultivated plants. Variety selection needs to be considered to meet agronomic targets, namely to achieve maximum production (Susilowati and Suprapto, 2017). Differences in varieties cause differences in genes that regulate plant growth and development. This is because each variety has its own characteristics (Rokhmah and Sastro, 2020).

METHODS

The experiment was carried out in the field in Langen Sari Village, Lembang District, West Bandung Regency, at an altitude of 1200 m above sea level, carried out in August-October 2022.

The materials used were water spinach varieties Serimpi, Amanda, Bangkok LP-1 and Bika, chicken manure, sewer sediment media, polybags. The tools used are hoes, scales, gloves, masks, buckets, emrats, stationery, hand sprayers and digital scales.

The experimental approach included a factorial randomized block design (RBD). The treatment design in this experiment consisted of two factors, namely: Chicken manure dose (A) with 4 factor levels, namely a0 : 0 t ha^{-1} (control), a1 : 10 t ha^{-1}, a2 : 20 t ha^{-1} and a3 : 30 t ha^{-1} and Kangkung Variety (K) with 4 factor levels, namely k_0 : Serimpi Variety, k_1 : Amanda Variety, k_2 : Bangkok LP-1 Variety and k_3 : Bika Variety. There were 16 treatment combinations which were repeated 2 times. Each treatment combination consisted of 10 plants placed in 1 row, so that the total number of kale plants consisted of 320 plants.

The data were subjected to statistical analysis using analysis of variance. If there is a notable disparity between the treatments, proceed with Duncan's test at the 5% significance level. To test the optimum dose of chicken manure for each kale variety that gave the highest number of leaves, a quadratic regression test was carried out.

RESULTS AND DISCUSSION

From the results of the Agro Chemistry Laboratory test (2022), the ditch sediment soil planting medium used in this research had a soil pH (H2O) of 8.4 (slightly alkaline), C-organic 2.15% (medium), N-total 0, 25% (medium), CN ratio 9 (low), total P_2O_5 content 279 mg (very high), available P/P2O5 Olsen content 118 mg (very high), K2O content 31 mg (medium), Fe 5.83 mg kg^{-1}, Zn 2.40 mg kg^{-1}, Cu 0.77 mg, heavy metal Pb 27.13 kg^{-1} , Cd 1.08 mg kg^{-1} . Texture: 37% sand, 16% dust and clay (47%). The results of the chicken manure analysis were soil pH (H2O) 8.4 (slightly alkaline), C-organic 33.12% (high), N-total 2.96%, water content 21.12% (high), CN ratio 11.2 (moderate), P2O5 content 6.13% (moderate), K2O content 7.42% (moderate), Ca 8.78% (moderate), Mg (1.27%), Fe 702 .6 mg kg^{-1}, Cu 365.23 mg kg^{-1}, Zn 126.12 mg kg^{-1}, heavy metal Pb 24.37 mg kg^{-1}, Cd 2.29 mg kg^{-1}. From the results of laboratory tests on planting media in ditch sediment soil and analysis of chicken manure, it can be seen that the most dominant heavy metal is the heavy metal Pb, so research needs to be carried out.

The results observed and analyzed in this research are:

1. Plant Height (cm)

Findings from the examination and evaluation of plant height measurements taken at 15 DAP, 20 DAP, 25 DAP, and 30 DAP. The research findings indicated that there was no significant interaction between the treatment dose of chicken manure and the variety of plants in terms of plant height. In terms of independent effects, the results of the analysis are in Table 1.

Table 1. Effect of Chicken Manure Dosage and varieties on Plant Height at 15 DAP, 20 DAP, 25 DAP and 30 DAP

Treatment	Plant Height (cm)			
	15 DAP	20 DAP	25 DAP	30 DAP
Chicken Manure				
a_0 = 0 t ha^{-1} (controll)	1,87 a	3,72 a	6,81 a	11,36 ab
a_1 = 10 t ha^{-1}	1,98 a	3,53 a	6,14 a	10,56 a
a_2 = 20 t ha^{-1}	2,08 a	3,89 a	6,89 a	12,28 b
a_3 = 30 t ha^{-1}	1,83 a	3,40 a	5,99 a	10,28 a
Varietas				
k_0 = Serimpi	1,95 a	3,81 a	6,29 a	10,43 a
k_1 = Amanda	1,86 a	3,43 a	6,24 a	11,33 a
k_2 = Bangkok	2,05 a	3,70 a	6,63 a	11,34 a
LP-1	1,90 a	3,58 a	6,68 a	11,38 a
K_3 = Bika				

Note: Based on the Duncan's Multiple Range Test with a significance threshold of 5% ,there is no statistically significant difference in the average number that is immediately following the same letter in the same column.

According to the data in Table 1, the amount of chicken manure applied at 30 days after planting (DAP) had a notable impact on the height of the plants. The treatment with 20 tons per hectare (t ha-1) resulted in the tallest plants, except for the treatment with no chicken manure. However, the type of variety used did not have a significant effect on plant height at any of the observed time points.
The augmentation in plant height growth is attributed to the utilization of chicken manure, which enhances the accessibility of both macro and micro nutrients. The chicken manure used is known to contain macro and micro nutrients needed by plants such as N 2.9%, P 6.13%, K 7.42%, Ca 8.78%, Mg 1.27% and micronutrients such as Fe 702.60 mg kg^{-1}, Cu 365.23 mg kg^{-1} and Zn 126.12 mg kg^{-1}. The availability of these nutrients can cause increased height growth of kale plants. This is as stated by Gunawan (2020), that fertilizers that contain various nutrients, both macro and micro, when given in optimal quantities, will be able to increase plant growth.

2. Number of Leaves (strands)

The investigation revealed a significant interaction between the dosages of chicken manure and the variety in relation to the number of leaves at the age of 30 DAP, as indicated in Table 2.
Table 2. Effect of chicken manure dosage and variety on number of leaves at 30 DAP.

Treatment	Leaf Number 30 DAP (strands)			
	k_0 = Serimpi	k_1 = Amanda	k_2 = Bangkok LP-1	k_3 = Bika
a_0 = 0 t ha^{-1}	11,67 a B	10,84 a A	15,00 a D	12,50 a C
a_1 = 10 t ha^{-1}	13,50 b A	15,00 bc B	18,50 c C	19,67 c D
a_2 = 20 t ha^{-1}	18,50 d C	14,84 b A	24,17 d D	16,33 b B
a_3 = 30 t ha^{-1}	16,00 c A	20,00 c C	16,50 b B	24,67 d D

Note: A common lowercase letter (in the vertical direction) and capital letters (in the horizontal direction) denote the average values, There is no evidence of significant changes based on the results of Duncan's Multiple Range Test at a 5% significance level.

Based on Table 2, it shows that the dose of chicken manure 30 t ha^{-1} on the Bika variety (a_3k_3) gave the highest number of leaves compared to other treatments.

3. Plant biomass, plant dry weight, and root loss ratio

No correlation was seen between the different dosages of chicken manure and the variety in terms of fresh weight per plant, dry weight per plant, and root decay ratio. The outcomes of the analysis may be observed in Table 3, regardless of any external factors.

Table 3. Effect of Dosage of Chicken Manure and Varieties on Fresh and Dry Weight per Plant and Root Fertilizer Ratio

Treatment	Fresh Weight per Plant (g)	Dry Weight per Plant (g)	Shoot Root Ratio
Chicken Manure			
a_0 = 0 t ha^{-1} (kontrol)	21,78 a	1,33 a	2,46 a
a_1 = 10 t ha^{-1}	25,20 a	1,65 b	2,51 a
a_2 = 20 t ha^{-1}	23,94 a	1,33 a	2,63 a
a_3 = 30 t ha^{-1}	20,32 a	1,11 a	2,38 a
Varietas			
k_0 = Serimpi	30,77 c	1,70 b	2,82 a
k_1 = Amanda	19,97 ab	1,28 a	2,44 a

k_2 = Bangkok LP-1	15,83 a	1,05 a	2,21 a
k_3 = Bika	24,66 b	1,38 ab	2,50 a

Note: Based on the findings of Duncan's Multiple Range Test at a significance level of 5%, there is no observable distinction in the mean number that succeeds the identical letter inside the identical column.

Dosage of chicken manure showed the same effect on fresh weight per plant and root shoot ratio, but there were different effects on plant dry weight. The dose of chicken manure 10 t ha-1 had a better effect than other treatments. Varietal treatment had a different effect on fresh weight and dry weight of plants, but showed the same effect on the character of root decay ratio. Serimpi variety gave the highest plant fresh weight and dry weight compared to other varieties. Plant dry weight is influenced by plant photosynthesis rate and plant growth rate. This is in line with the statement of Bhoki and Beja (2021), dry weight shows the ability of plants to take in nutrients to support growth and metabolic activity. The greater the dry weight, the more efficient the photosynthetic process takes place, resulting in better plant growth.

4. Uptake of the Heavy Metal Pb

The analytical findings indicated that there was no correlation between the dosage of chicken manure and the variety in terms of the absorption of the heavy metal Pb. The independent effects of the analysis results are in Table 4.

Table 4. Effect of Chicken Manure Dosage and varieties on the Uptake of the Heavy Metal Pb

Treatment	Uptake of the heavy metal Pb (mg kg^{-1})
	1
Chicken Manure	
a_0 = 0 t ha^{-1} (kontrol)	0,12 a
a_1 = 10 t ha^{-1}	0,15 a
a_2 = 20 t ha^{-1}	0,12 a
a_3 = 30 t ha^{-1}	0,13 a
Varietas	
k_0 = Serimpi	0,15 a
k_1 = Amanda	0,13 a
k_2 = Bangkok LP-1	0,12 a
k_3 = Bika	0,13 a

Note: Based on the findings of Duncan's Multiple Range Test at a significance level of 5%, there is no observable distinction in the mean number that succeeds the identical letter in the identical column.

Based on Table 4, the doses of chicken manure and varieties showed no significant effect on the uptake of heavy metal Pb in all treatments.

Of all the treatments, it showed that the kale plants accumulated the heavy metal Pb in small amounts (<0.3 mg kg $^{-1}$) so that the kale plants grown on the media of sewer sediment soil could be consumed, according to the regulation book of the minister of agriculture concerning the safety and quality of fresh food of plant origin lead (Pb) content can be consumed up to a limit of 0.3 mg kg $^{-1}$ (Ministry of Agriculture, 2018).

Heavy metals in the soil in a free state can be toxic and absorbed by plants. Under these conditions, apart from affecting the availability of plant nutrients, heavy metals can also contaminate crop yields. If heavy metals enter the soil environment, there will be a balance in the soil, then they will be absorbed by plants through the roots, and then they will be distributed to other plant parts. Suppliers of heavy metals in agricultural land are agrochemicals (fertilizers and pesticides), motor vehicle exhaust, fuel oil, organic fertilizers (Suhaeni and Wardi, 2016).

There was no significantly different effect on the growth and yield of kale in all treatments on the Pb heavy metal uptake parameter. This could be due to the fact that kale is a plant that has high adaptability to its environment and it could also be due to the accumulation of metals in plants not only depending on the content of heavy metals in water and soil, but also on the chemical elements of the soil, the type of metal, soil pH, and types of plants as stated by Juhri (2017) that the accumulation of heavy metals can be caused by several factors not only depending on soil and water.

5. Optimum Dosage of Chicken Manure for Each Kale Variety That Provides the Highest Number of Leaves.

From all the observations, the interaction occurred in the observation of the number of leaves. Based on the regression analysis, the R^2 value for each variety was obtained, namely k_0 = serimpi of 0.42, k_1 = amanda of 0.02, k_2 = Bangkok LP-1 of 0.55 and k_3 = bika of 0.50. R^2 values range from 0 to 1, where the smaller the R^2 value indicates the weaker the relationship between the two variables and vice versa (Table 5).

Table 5. Optimum Dosage of Chicken Manure in Various Varieties to Produce Maximum Number of Kale Leaves

Varietas	Regression equation	X optimum	Y maksimum
Serimpi	$\hat{Y}$ =3,792-0,04 x+0,00 x^2	5,05	11,30
Amanda	$\hat{Y}$ =3,688-0,056 x+0,02 x^2	5,27	16,68
Bangkok LP-1	$\hat{Y}$ = 3,732-0,045 x.0,00 x^2	9,20	16,77
Bika	$\hat{Y}$ = 3,745 + 0,02 x + 0,00 x^2	3,83	18,66

The varietal response curve to the dose of chicken manure can be seen in Figure 1.

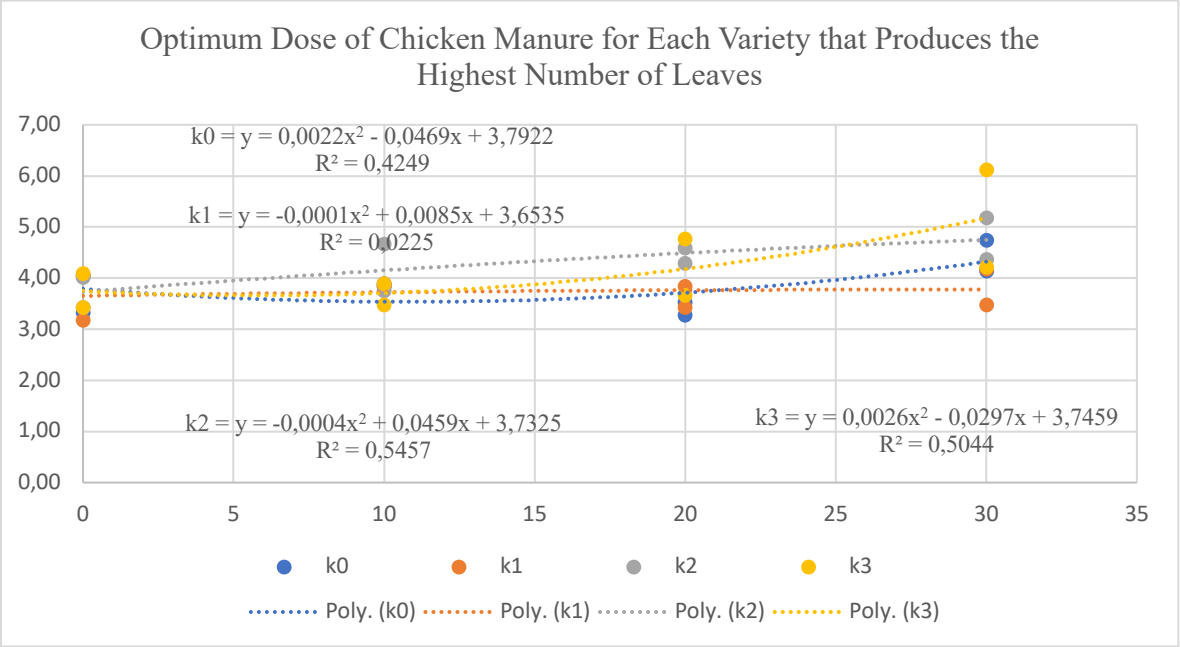

Figure 1. Optimum Chicken Manure Dosage Response Curve for Each Kale Variety Giving Maximum Number of Leaves

Based on the results of the regression analysis to test the optimum dose of chicken manure for each variety of kale that gave the highest number of leaves in treatment k_0 (sempire variety), which was 5.05 t ha^{-1}, it was able to increase the highest number of leaves by 11.30 plant^{-1} which indicated by the regression equation $\hat{Y}$ = 3.792+-0.04x+0.00 x2 and R^2 = 0.42, which means that 42% of chicken manure affected the number of leaves, whereas in treatment k_1 (amanda variety) it was equal to 5.27 t ha $^{-1}$ was able to increase the highest number of leaves by 16.68 plant^{-1} as shown by the regression equation $\hat{Y}$ = 3.688-0.056x+0.02 x^2 and R^2 = 0.02 which means that 2% dose of chicken manure affects the number of leaves, The optimum dose for k2 (Bangkok LP-1 variety) is 9.20 t ha^{-1} which can increase the highest number of leaves by 16.77 plant^{-1} as shown by the regression equation $\hat{Y}$ = 3.732-0.045x+0.00x^2 and R^2 = 0.55, which means that 55% dose of chicken manure affects the number of leaves and the optimum dose for k_3 of the bika variety) is 3.83 t ha^{-1} capable of increasing the highest number of leaves by 18.66 plant^{-1} which is shown by the equation regression $\hat{Y}$ = 3.745 + 0.02x + 0.00 x^2 and R^2 = 0.50 which means that 50% dose of chicken manure affects the maximum number of leaves.

CONCLUSION

From the empirical findings and subsequent analysis, the following deductions may be made:

1) The relationship between the dosage of chicken manure and the variety affected the number of leaves that were 30 DAP.
2) The optimum dose of chicken manure is 5.05 t ha^{-1} for the Serimpi variety with a maximum number of leaves of 11.30 plants^{-1}; 5.27 t ha^{-1} in the Amanda variety produces a maximum number of leaves of 16.68 plants^{-1}; 9.20 t ha^{-1} in the Bangkok LP-1 variety produces a maximum number of leaves of 16.77 plants^{-1} and a chicken manure dose of 3.83 t ha^{-1} in the Bika variety produces a maximum number of leaves of 18.66 plants $^{-1}$.

The use of ditch sediment media is safe for use in plant cultivation so it can reduce soil deposition in ditches (environmentally friendly). Further research on administering the same dose of chicken manure and varieties but in different places and seasons needs to be carried out for more accurate information.

REFERENCES

AndongWang, Dongsheng Zou, Xinyi Zeng, Bin Chen, Xiaochen Zheng, Longcheng Li, Liqing Zhang, Zhihua Xiao and Hua Wang. 2021. Speciation and environmental risk of heavy metals in biochars produced by pyrolysis of chicken manure and water-washed swine manure. Scientific Reports | (2021) 11:11994:1-14. www.nature.com/scientificreports/. | https://doi.org/10.1038/s41598-021-91440-8.

Anggia, E. V. and Hamidah, I. 2019. Morphological Sanitation Level of Ipomoea sp. (Kangkung) as an ingredient for consumption by the people of Indramayu. Proceedings of the National Mathematics and Science Seminar, (September): 98–101. https://prosiding.biounwir.ac.id/article/view/17. DOI: https://doi.org/10.5281/zenodo.3648332

Aprilia, E. et al. 2020. Growth and Yield of Pakchoy Plants on Sandy Soil Using Biochar and Chicken Manure. Growth and Yield of Pakchoy on Sandy Soil by Using Biochar and Cow Manure Fertilizer, 22(2): 72–78. doi: http://dx.doi.org/10.20961/agsjpa.v22i2.42093.

Bhoki, M., Jeksen, J. and Beja, H. D. 2021. The Effect of Providing Chicken Manure on the Growth and Yield of Green Mustard Plants (*Brassica juncea* L.). Journal of Agro Wiralodra (4)2: 64-68. https://agrowiralodra.unwir.ac.id/index.php/agrowiralodra/article/view/67. https://doi.org/10.31943/agrowiralodra.v4i2.67.

Elawati, Kandowangko, N. Y. and Lamondo, D. 2018. Efficiency of absorption of the heavy metal copper (Cu) by water spinach plants (*Ipomoae aquatica* forks) with different contact times. Radial – Journal of Science, Engineering and Technology Civilization, 6(2):162–166. https://stitek-binataruna.e-journal.id/radial/article/view/175. DOI: https://doi.org/10.37971/radial.v6i2.175

Gaso, M.T. et al. (2022) 'Growth Response of Ground Water Spinach (*Ipomea reptans* Poir) after Giving Rice Husk Charcoal', Journal of Biology and Biology Education. doi: http://dx.doi.org/10.55241/spibio.v3i2.59.

Jeanine Arana, Stephen L. Meyers, Wenjing Guan and William G. Johnson. 2022. Interference of morningglories (*Ipomoea* spp.) with triploid watermelon 'Fascination'. Published online by Cambridge University Press. https://www.cambridge.org/core/journals/weed-science/article/interference-of-morningglories-ipomoea-spp-with-fascination-triploid-watermelon/F37CD36E0A5FFACCEB5D858B324E93D6. DOI: https://doi.org/10.1017/wsc.2022.35

Hailong Mao, Ke Wang, Zhe Wang, Jing Peng, Nanqi Ren. 2020. Metabolic function, trophic mode, organics degradation ability and influence factors of bacterial and fungal communities in chicken manure composting. Bioresour. Technol. 122883. National Library of Medicine. National Center for Biotechnology Information. https://pubmed.ncbi.nlm.nih.gov/32006923/ doi: 10.1016/j.biortech.2020.122883.

Juhri, D. A. 2017. The Effect of Heavy Metals (Cadmium, Chromium, and Lead) on Reducing the Wet Weight of Water Spinach (*Ipomoea aquatica* Forsk) as Extension Material for Vegetable Farmers. Journal of Education Lantern Research Center Lppm Um Metro (2) 2: 219-229

https://ojs.ummetro.ac.id/index.php/lentera/article/view/708. DOI: http://dx.doi.org/10.24127/jlpp.v2i2.708

Ministry of Agriculture. 2018. Regulation of the Minister of Agriculture of the Republic of Indonesia Number 53/PERMENTAN/KR.040/12/2018 concerning Safety and Quality of Fresh Food of Plant Origin. https://peraturan.bpk.go.id> download

Luqman Riaz, Qianqian Wang, Qingxiang Yang, Xunan Li, Wei Yuan. 2020. Potential of industrial composting and anaerobic digestion for the removal of antibiotics, antibiotic resistance genes and heavy metals from chicken manure. Science of The Total Environment (718), 137414. Elsevier. https://www.sciencedirect.com/science/article/abs/pii/S0048969720309244?via%3Dihub. https://doi.org/10.1016/j.scitotenv.2020.137414

Maisarah and Fitria, D. 2022. The Effect of Dosing Guano Fertilizer on the Growth and Yield of Several Varieties of Water Spinach (*Ipomea aquatica*). Journal of Sustainable Agriculture, 10(1): 137-146. https://e-journal.my.id/perbal/article/view/1611/1287. DOI: https://doi.org/10.30605/perbal.v10i1.1611. ISSN 2302-6944, e-ISSN 2581-1649.

Andi Nadila, Gamar B.N. Shamdas, Lestari, M.P. Alibasyah and Masrianih. 2021. Effect of Chicken Manure Dosage on the Growth and Yield of Ground Water Spinach Plants (*Ipomoea reptans* Poir.) and Its Use as a Learning Media, Journal of Biology Science and Education (JBSE), 9(2): 814–819.

https://www.scribd.com/document/635942641/Untitled#. doi: http://jurnal.fkip.untad.ac.id.

Ramdhan, M., Nafiaah, H.H. and Swardana, A. 2021. Effect of Chicken Manure Dosage and Trichoderma sp. on the Growth and Yield of Ground Water Spinach (*Ipomoea reptans* Poir.). Journal of Agrotechnology and Science (Journal of Agrotechnology Science). JAGROS (6)1 : 52-64. https://journal.uniga.ac.id/index.php/JPP/article/view/1619

Rokhmah, N. A., Rahman, M. and Sastro, Y. (2020) 'Ammonia Reduction by Land Water Spinach (*Ipomea reptans*) in Fish Cultivation Using Vertiminaponic Technology', AGROPROSS (4): 8-9, https://proceedings.polije.ac.id/index.php/agropross/article/view/9. doi: 10.25047/agropross.2020.9.

Rompegading, A. B. , Muhlis, N.F, Arfadilla, R., et.al. .2021. Initial Detection of Copper Metal (Cu) Content in Land Water Spinach Plants (*Ipomoea reptans*). BIOEDUSAINS: Journal of Biology and Science Education (4) \: 246–250. https://journal.ipm2kpe.or.id/index.php/BIOEDUSAINS/article/view/2790. doi: https://doi.org/10.31539/bioedusains.v4i2.2790.

Sajuri S, Mawaripta, H.D., Supriyanto, E.A, and Jazilah S. 2022. Growth Response of Water Spinach Plants (*Ipomoea reptans* Poir) to the Treatment of Number of Seeds and Nutrients with the Axis Hydroponic System in Coastal Areas. Agrotek : Scientific Journal of Agricultural Sciences 6(1) : 83–89. https://jurnal.fp.umi.ac.id/index.php/agrotek/article/view/178 DOI: https://doi.org/10.33096/agrotek.v6i1.178

Shihang Wu, Dina Tursenjan, Yuebing Sun. 2023. Impact of compost methods on humification and heavy metal passivation during chicken manure composting. Journal of Environmental Management (325) Part B, 116573 Elsevier. Science Direct. https://www.sciencedirect.com/science/article/abs/pii/S0301479722021466?via%3Dihub. https://doi.org/10.1016/j.jenvman. 22022.116573

Suwartini, N.K.S. and Anggia. 2021. The Effect of Application of Different Doses of Goat Manure on the Growth and Production of Curly Chili Plants. Effect of Different Doses of Goat Manure on Growth and Production of Curly Chili (*Capcisum annum* L.), Agriyan Journal: Unidayan Agrotechnology Journal 7(2):8-15. eISSN 2808 - 8077 pISSN 2407 - 1099 . https://ejournal.lppmunidayan.ac.id>download.

Suhaeni and Wardi, R. Y. 2016. Analysis of Heavy Metal Cadmium (Cd) Levels in Ground Water Spinach Plants (*Ipomoea reptans* Poir), Dynamics, 07(2):1–8. P-ISSN: 2087 – 7889 E-ISSN: 2503 – 4863. https://journal.uncp.ac.id>article>view

Wenwen Deng, Anyun Zhang, Shujuan Chen, Xueping He, Lei Jin, Xiumei Yu, Shengzhi Yang, Bei Li, Liangqian Fan, Lin Ji, Xin Pan, Likou Zou. 2020. Heavy metals, antibiotics and nutrients affect the bacterial community and resistance genes in chicken manure composting and fertilized soil. Journal of Environmental Management (257), 109980. Elsevier. https://www.sciencedirect.com/science/article/abs/pii/S0301479719316986?via%3Dihub. https://doi.org/10.1016/j.jenvman.2019.109980

Xiaomeng Chen, Zhuang Du, Tong Guo, Junqiu Wu, Bo Wang, Zimin Wei, Limimg Jia, Kejia Kang. 2022. Effects of heavy metals stress on chicken manure composting via the perspective of microbial community feedback. Environmental Pollution (294), 118621. https://www.sciencedirect.com/science/article/abs/pii/S0269749121022065?via%3Dihub. https://doi.org/10.1016/j.envpol.2021.118624.

Ying Zhang, Qinghong Sun, Jianmin Wang, Yuexuan Ma, Bo Cao. 2021. Responses of heavy metals mobility and resistant bacteria to adding time of activated carbon during chicken manure composting. Environmental Pollution (290), 118070. Elsevier. https://www.sciencedirect.com/science/article/abs/pii/S0269749121016523?via%3Dihub. https://doi.org/10.1016/j.envpol.2021.118070