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Optimizing Onion Growth on Coastal Land: Evaluating Various Manure Types and Dosages

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ABSTRACT

The demand for onion in Indonesia has been on the rise. However, domestic production to date has not been able to meet all the needs of the people in Indonesia. This research aims to obtain the best type and dose of manure for the growth and production of shallots on coastal land. The design used in this research was a factorial Randomized Complete Block Design (RCBD) with 2 factors. The first factor is the type of manure which consists of 3 levels, namely: chicken manure, goat manure, and cow manure. The second factor is the dose of manure which consists of 4 levels, namely: 5, 10, 15, and 20 tons ha^{-1}. A total of 12 treatment combinations were derived from the two factors, each repeated 3 times to create 36 experimental units. The results showed that the interaction between several types and doses of manure had a significant effect on the variables of plant height and number of leaves at 2 WAP, 3 WAP, 4 WAP, 5 WAP, and 6 WAP. The optimum dose of manure was 20 tons ha^{-1} resulting in the highest average variable weight per plot of 142 g. The application of different types and dosages of manure did not significantly impact plant height, number of leaves, number of tillers, fresh weight of plants, fresh weight of tubers per hill, or weight per tuber.

Keywords : coastal land, manure dosages, manure types, onion

INTRODUCTION

Onion (*Allium ascalonicum* L) are one of the important vegetable commodities for Indonesian people because of their function as the main cooking spice, so the demand for onion is increasing. Domestic production to date has not been able to meet all the needs of onion in Indonesia. The Central Statistics Agency (BPS) reported that Indonesia is expected to produce 1.97 million tons of onion in 2022. This amount is 1.51% lower than the previous year, which saw a production of 2.00 million tons. When we observe the pattern, Indonesia's onion production typically rises, and it was anticipated to hit a record of 2 million tons in 2021. However, this upward trend did not continue last year (DataIndonesia, 2023).

Onion cultivation usually uses fertile land, but fertile land and its numbers continue to decrease. The reduction in fertile land must be overcome by replacing cultivated land with marginal land. One of the marginal lands that can be used for shallow cultivation is coastal land.

The obstacles to plant culture on coastal land are generally rough soil texture, high sand content, and high salt content. Appropriate land management and technology are expected to be able to turn coastal land which is classified as marginal land with a low fertility level into a productive agricultural area. Efforts made to increase plant production on coastal land are by providing manure as a source of organic material which plays a role in improving the physical, chemical, and biological properties of the soil. Physically, manure can improve soil structure, form soil aggregates, and increase moisture retention capacity (Rajiman *et al*., 2008).

Coastal land typically exhibits unstable soil properties, including low soil moisture, high evapotranspiration, elevated salt content, and limited organic matter. It is characterized by very low Cation Exchange Capacity (CEC), organic carbon, and calcium, resulting in a low water binding capacity (Rajiman *et al*., 2008). Additionally, there is a deficiency of nitrogen elements (Sunardi & Sarjono, 2007), coupled with a small surface area and large

pores, leading to reduced water holding capacity. Consequently, the soil rapidly loses water, resulting in a decrease in media humidity.

Manure is an organic fertilizer that comes from animals. Farm animals whose manure can be used include chickens, goats, and cows. Applying chicken manure to sandy soil can increase vegetative growth and the quality of tomato crop yields (Kandil & Gad, 2010). Chicken manure can increase the availability of N and other nutrients (Rengga *et al*., 2022). Composed cow manure of 5-15 tons ha^{-1} can improve the physical, chemical, and biological properties of the soil, thereby increasing the availability of N, P, and K nutrients (Pamungkas, 2013). Apart from chicken manure and cow manure, goat manure is also useful for increasing plant growth (Ekwealor, 2020). It is necessary to add manure to Entisol soil. Entisol soil is soil that has limitations such as physical properties, chemical properties, and biological properties that do not support farming. With these characteristics, the nutrients available to plants in Entisol soil are certainly very small (Olivier, 2014).

MATERIALS AND METHODS

This research was conducted between November 2020 and January 2021 in coastal land located in Lempuing Village, Bengkulu City, at an altitude of approximately 5 meters above sea level. The materials and tools used in this study included Bima variety onion, cow manure fertilizer, chicken manure fertilizer, goat manure fertilizer, and urea fertilizer. The equipment used comprised a hoe, irrigation tools, water hoses, stakes, bamboo, wood, machete, measuring tape, buckets, black and silver plastic mulch, books, and stationery

The research design employed in this study was a Randomized Complete Block Design (RCBD), incorporating two factors organized in a factorial arrangement. The first factor consisted of three types of fertilizers: chicken, goat, and cow manure, while the second factor encompassed the dosage of manure, ranging from 5 to 20 tons ha^{-1}. The research process involved several stages, including soil analysis, land preparation, seed readiness, planting, treatment application, sample selection, and plant maintenance.

The observed variables in this study encompassed plant height (in centimeters), the number of leaves (in strands), the number of tubers per clump, root length (in centimeters), and the weight of fresh produce (in grams). Supporting data, such as soil analysis results, included nitrogen (N), phosphorus (P), potassium (K), organic carbon content (C-organic), and pH levels. Data obtained from the study were analyzed using analysis of variance (ANOVA) with a significance level of 5%. Further comparisons of treatment means were conducted using a Duncan's Multiple Range Test (DMRT) at the 5% significance level.

RESULTS AND DISCUSSION

Initial soil analysis results indicate the following: N content at 0.20% (medium), P at 3.41 ppm (very low), K at 0.21% (low), C-organic at 0.80% (medium), pH at 5.6, Na at 0.07 cmol kg^{-1}, Ca at 5.20 cmol kg^{-1}, and Mg at 0.18 cmol kg^{-1}. The soil composition includes sand at 87.33%, dust at 10.75%, and clay at 1.92%. Based on these results, it can be concluded that the soil used in this research exhibits low soil fertility. Despite the flat terrain, the location is situated in a depression, which allows sunlight to reach the area throughout the day, as it is slightly open on both sides.

Throughout the research conducted from November 2020 to January 2021, we experienced extreme weather conditions, including hot days and heavy rain with wind. The recorded rainfall in November, December, and January was 25.83 mm, 16.74 mm, and 16.31 mm, respectively. The air temperatures were 26.7 °C, 26.9 °C, and 27 °C, while the average air humidity was 85%, 84%, 85%, and 82%, respectively. The average duration of sunlight exposure was 53% and 66%, respectively. Onion plants require maximum sunlight (at least 70% sunlight), an air temperature range of 25-32 °C, and a relative humidity of 50-70% (Khosa, 2018).

Pest and disease attacks began to appear when the soybean plants were at 14 days after planting (DAP). The pests that attacked the onion plants during the research were grasshoppers and leaf caterpillars, causing damage to the plant leaves. As a countermeasure, we conducted weekly spraying using two types of insecticides with the active ingredients Deltamethrin (25 g L^{-1}) and Profenofos (500 g L^{-1}).

The interaction between the type and dose of manure had a significant impact on plant root length. The type of manure significantly affected plant height at 3, 4, 5, and 6 weeks after planting (WAP), the number of leaves at 2, 3, 4, and 6 WAP, root length, and fresh stover weight. The dose of manure had a significant effect on plant height at 2, 4, 5, and 6 WAP, the number of leaves at 2, 3, 5, and 6 WAP, root length, fresh stover weight, and the number of tubers per hill (Table 1).

The application of cow manure at a rate of 20 tons per hectare resulted in the longest average root length of 3.89 cm. When compared to the root lengths of onion plants treated with chicken or goat manure, there were no significant differences (refer

to Table 2). This finding aligns with the results of Idris *et al*. (2018), who observed that the application of 20 tons per hectare of chicken manure led to longer root lengths in Palu Valley variety onion plants compared to lower fertilizer doses. Chicken manure, known for its complete nutrient content, has the ability to increase soil humus levels and promote the activity of soil-decomposing microbes. Its high nitrogen content, three times greater than other manures, contributes to enhanced plant root growth (Sitanggang *et al*., 2015). The nutrient richness of chicken manure can be attributed to the inclusion of both liquid (urine) and solid components (Kartina *et al*., 2017).

Tabel 1. The Effects of fertilizer types, manure dosage, and their interactions on observed variables

Variable	F value			
	Fertilizer types	Dosage of manure	Interaction	CV (%)
Plant height 2 WAP	0.28 ns	12.25 **	0.60 ns	10.98
Plant height 3 WAP	3.65 *	3.00 ns	0.39 ns	17.97
Plant height 4 WAP	26.32 **	6.83 **	1.13 ns	14.42
Plant height 5 WAP	7.03 **	5.33 **	0.74 ns	12.2
Plant height 6 WAP	5.37 *	9.18 **	1.52 ns	6.62
Number of leaves 2 WAP	5.49 *	4.32 *	1.54 ns	16.54
Number of leaves 3 WAP	30.20 **	7.73 **	1.82 ns	15.57
Number of leaves 4 WAP	21.86 **	2.94 ns	0.49 ns	19.77
Number of leaves 5 WAP	0.35 ns	4.76 **	0.65 ns	15.92
Number of leaves 6 WAP	8.41 **	3.29 *	2.05 ns	14.82
Root length	23.95 **	9.64 **	2.09 *	14.42
Weight of fresh produce	5.13 *	72.16 **	1.63 ns	21.68
Number of tubers per clump	2.60 ns	17.07 **	1.81 ns	21.7

Note : * = significant ($p<0.05$); ** = highly significant ($p<0.01$); ns = non-significant ($p\geq0.05$)

The role of cow manure in enhancing root length growth in onion plants can vary depending on factors like the type and quality of the cow manure, the application rate, and specific soil and environmental conditions. Properly composted cow manure is typically preferred to mitigate the risk of pathogens and nutrient imbalances. It is crucial to adhere to recommended application guidelines and consider other variables, such as the onion variety, to optimize root growth (Köninger *et al*., 2021)

Similarly, the influence of goat manure on root length growth in onion plants is contingent on factors such as the type and quality of the manure, application rates, soil characteristics, and environmental conditions. Using properly composted goat manure is important to minimize the introduction of pathogens and achieve balanced nutrient levels. Adhering to recommended application guidelines and accounting for variables like shallot variety and local soil conditions will help maximize root growth in shallot plants. Atmaja's research (2019) suggests that the application of 30 tons ha^{-1} of goat and cow manure fertilizer tends to result in the highest onion yield compared to lower doses. Goat and cow manure are known for their high P content, with phosphorus being the second most crucial nutrient for plants after N. Phosphorus plays a central role in plant growth and development.

Tabel 2. Effect of manure types and dosage on root length in onion

Manure types	Dosage of manure (ton/ha)			
	5	10	15	20
Chicken	2.56 b	2.33 b	2.67 b	3.11 a
	B	B	B	B
Goat	3.00 b	3.11 b	3.56 b	3.67 a
	A	A	A	A
Cow	3.67 b	3.67 b	3.33 b	3.89 a
	A	A	A	A

Note : Number followed the same capital letter in the column (vertically) and the same lowercase letter in the row (horizontally) are the same different is not significant at DMRT 5%

The type of manure has a significant effect on the growth variables of shallot plants. The highest plant height at 6 WAP (29.44 cm) was achieved in the chicken manure manure treatment, and the lowest plant height (26.94 cm) was achieved in the cow manure manure treatment (Table 3). In terms of plant height variables, good manure for growing onion is chicken manure. Chicken manure contains more N, P, and K nutrients than other manure (Utami & Handayani, 2003). Chicken manure can provide the nutrients that plants need for growth and development and can be absorbed by the plants well (Susikawati *et al*., 2018). Chicken manure is the manure with the highest N element. The element N is an essential nutrient that is needed by plants for vegetative growth, including in the formation of leaves, stems, and roots (Ohyama, 2010).

Table 3. Effect of manure type on onion plant height

Manure types	Plant height (cm)				
	2	3	4	5	6
Cow	7.63	14.36 ab	20.19 b	24.55 b	26.94 b
Goat	7.76	12.72 b	16.00 c	23.64 b	28.30 ab
Chicken	7.79	15.52 a	24.66 a	28.13 a	29.44 a

Note : Number followed the same letter in the column (vertically) is not significant at DMRT 5%

Table 4. Effect of manure types on onion number of leaves

Manure types	Number of leaves				
	2	3	4	5	6
Cow	5.22 b	8.75 a	11.25 a	14.66	18.13 a
Goat	5.05 b	5.74 b	7.30 b	13.8	17.02 ab
Chicken	6.19 a	9.47 a	12.66 a	13.47	14.88 b

Note : Number followed the same letter in the column (vertically) is not significant at DMRT 5%

The highest number of leaves on the 6 WAP (an average of 18.13 pieces) was obtained from cow manure treatment, the lowest number of leaves was 14.88 pieces produced by chicken manure (Table 4). This shows that good manure for growing the number of onion plant leaves is chicken manure. The research results of Idris *et al*. (2018) showed that cow manure did not affect the number of leaves and number of tubers per hill. Providing manure can improve plant growth because it can increase the levels of humus and nutrients in the soil. Manure can change all soil fertility factors such as nutrients, increasing humus content, and soil structure (Idris *et al*., 2018). From a physical aspect, manure encourages the process of loosening the soil, so that it can support the growth and development of onion.

Manure, a substance rich in nutrients crucial for crop development, contains approximately 70-80% of N, 60-85% of P, and 80-90% of K from feeds. These nutrients offer a viable alternative to the fertilizers needed for pasture or crop growth, reducing the need to purchase additional fertilizers. Plants are agnostic to the source of nutrients. However, in contrast to commercial fertilizers, manure is distinguished by its organic carbon content, playing a pivotal role in preserving soil health. This encompasses maintaining cation exchange capacity, soil tilth, and water holding capacity (Herbert *et al*., 2008).

It's worth noting that chicken manure contains three times more nitrogen than other types of manure. Research by Duruigbo (2007) application of poultry manure at the rate of 15 tons ha-1 significantly increased soil pH from 4.14±0.9 (control) to 5.80±0.23 (pH in water) and from 3.62±0.13 to 5.78±0.18 (pH in KCl), respectively. Poultry manure rate of 5 tons ha^{-1} did not significantly increase soil pH. In a separate study, the use of 20 tons ha^{-1} of goat manure resulted in shallots with a bulb dry weight of 1.51 kg m^{-1} or 12.11 tons ha^{-1} (Kania & Maghfoer, 2018).

Cow manure exerts a significant impact on the observed variables. The highest yields of fresh and oven-dried tubers were achieved at a manure dose of 20 tons/ha, resulting in 11,763 tons, 2,114 tons, and 1,506 tons, respectively. This represents a substantial yield increase of 51.43% and 40.37% (Uma *et al*., 2022). To enhance crop productivity, coastal onion cultivation requires environmental engineering through the incorporation of drum fertilizer. This aims to optimize the physical, chemical, and biological properties of the soil to facilitate plant growth and development. The application of manure significantly contributes to improving these soil properties (Liu *et al*., 2020).

The average root length was found to be 3.63 cm with chicken manure and 2.66 cm with cow ma-

nure (refer to Table 5). The disparity in nutrient composition among various types of manure is believed to be a leading factor influencing variations in root length following manure application. On average, chicken manure contains higher levels of N, P, K, and organic carbon (C-Organic) compared to other types of manure (Idris *et al*., 2018).

The average weight of fresh stover exhibited significant variation, with the highest weight of 35.07 g observed for cow manure, and the lowest of 26.34 g for goat manure (Table 5). This discrepancy highlights the efficient nutrient absorption by plants, particularly N, known to enhance photosynthesis rates, thereby stimulating vegetative growth. The increased N levels lead to greater protein production within plants, consequently promoting tissue growth and overall plant weight (Idris *et al*., 2018). Velis (2021) affirmed that manure application contributes to the additional weight of cells formed as a result of photosynthesis, characterized by the observed increase in plant stover weight.

Table 5. Effect of manure types on onion yield

Manure types	Variabel		
	Root length	Weight of fresh produce	Number of tubers per clump
Cow	2.66 b	35.07 a	6.75 b
Goat	3.58 a	26.34 b	6.52 a
Chicken	3.63 a	33.52 a	5.55 a

Note : Number followed the same letter in the column (vertically) is not significant at DMRT 5%

In the context of the highest number of tubers per hill, averaging 6.75 tubers, the cow manure treatment outperformed the chicken manure treatment, which had the lowest count of 5.55 tubers (as shown in Table 5). These findings suggest that the independent application of different manure types significantly impacts growth; however, it doesn't exert an effect on shallot plant yield. This discrepancy underscores the suboptimal utilization of nutrients, such as N, P, and K contained in manure, leading to inadequate support for shallot growth and physiological processes within plant tissues. As a result, only a limited portion of photosynthesis results are translocated into the bulbs. The applied manure may not be readily available to plants during their growth and development phases due to the slow decomposition of the manure, leading to delayed nutrient availability for the plants (Du *et al*., 2020).

Manure will gradually decompose, releasing nutrients through a decomposition process that becomes gradually available to plants (Subatra, 2013). This is because the nutrients in the soil remain bound in the form of complex compounds that cannot be directly absorbed by plants (Rachmadhani *et al*., 2014). The slow decomposition of these nutrients from manure significantly impacts the speed at which soybean plant roots can absorb the necessary nutrients, leading to suboptimal plant growth. Additionally, organic material introduced into the soil must undergo multiple breakdowns by microorganisms for the nutrients to become available, with the visible effects typically observed in the 2-3rd planting season (Setyorini *et al*., 2019).

The type of manure has a significant effect on the growth of onion plants. The highest plant height of 6 WAP (29.44 cm) was produced by a manure dose of 20 tons ha^{-1}, and the lowest plant height of 26.18 cm was produced by a manure dose of 5 tons ha^{-1} (Table 6). These results are by research by Idris *et al*. (2018) which shows that a dose of 20 tons ha^{-1} provides the best results for onion plants. Plant growth rates continue to increase along with the application of manure at increasingly higher doses (Dewi, 2018). Manure positively influences the height growth of onion plants by providing essential nutrients, improving soil structure, and creating a conducive environment for overall plant development (Suem *et al*., 2013).

Table 6. Effect of manure dosage on onion plant height

Manure dosage (tonnes/ha)	Plant height				
	2	3	4	5	6
5	6.79 c	12.48	17.81 b	23.26 b	26.18 b
10	7.24 bc	13.96	18.44 b	23.63 b	27.22 b
15	7.99 b	14.29	21.85 a	26.70 a	29.11 a
20	9.07 a	16.07	23.03 a	28.18 a	30.40 a

Note : Number followed the same letter in the column (vertically) is not significant at DMRT 5%

The highest number of onion leaves at 6 WAP, 17.63 pieces, was produced by a manure dose of 15 tons ha^{-1}, while the lowest number of 14.29 pieces was achieved with a manure dose of 5 tons ha^{-1} (Table 7). This increase in the number of leaves at various manure doses indicates efficient absorption of the N nutrient in manure by the plants. Macro nutrients, such as N, play a crucial role in plant growth. Leaves, being a vital part of plants due to their chlorophyll content, facilitate the photosynthesis process. Nitrogen, an essential nutrient (Dewanto *et al*., 2017), supports plant growth and development,

as emphasized by the statement by Fadil & Sutejo (2020), highlighting the importance of N for vegetative growth, especially in stems, branches, and leaves.

The enhanced soil structure resulting from manure application facilitates the absorption of nutrients by onion plants, supporting the leaf formation process. Plants lacking additional N nutrients exhibit stunted growth with smaller, thinner, and fewer leaves. The leaf formation process is intricately linked to nutrients like N and P present in the soil. These nutrients play pivotal roles in new cell formation and are primary components of organic compounds in plants, including amino acids, nucleic acids, chlorophyll, ADP, and ATP. A deficiency in these nutrients can disrupt the plant's metabolism, hindering the leaf formation process (Fathi, 2022).

Table 7. Effect of manure dosage on onion number of leaves

Manure dosage (ton ha^{-1})	Number of leaves				
	2	3	4	5	6
5	4.89 b	6.55 c	8.66	12.07 b	14.29 b
10	5.26 b	7.77 b	10.77	13.88 ab	15.85 ab
15	5.44 b	8.29 ab	10.92	15.47 a	17.63 a
20	6.37 a	9.33 a	11.25	15.29 a	17.59 a

Note : Number followed the same letter in the column (vertically) is not significant at DMRT 5%

The longest root length, measuring 3.88 cm, was observed with a manure dose of 20 tons ha^{-1}, contrasting with the shortest length of 3.03 cm produced by a manure dose of 5 tons ha^{-1} (Table 8). This observation highlights the escalating growth rate in correlation with higher manure doses. Beyond promoting root growth, manure offers a multitude of benefits, providing essential macro and micro nutrients to plants while enhancing the soil's physical properties, thereby creating an environment conducive to robust root development (Amjad *et al*., 2016).

Similarly, the highest fresh stover weight, reaching 59.02 g, was attained with a manure dose of 20 tons ha^{-1}, while the lowest weight, 12.25 g, occurred at a manure dose of 5 tons ha^{-1} (Table 8). This trend underscores the positive correlation between increased manure doses and growth rates. Differing manure doses significantly affect plant stover weight, likely due to the manifold improvements in soil biological, chemical, and physical activity induced by manure application, resulting in fertile soil conducive to plant growth (Park *et al*., 2019) Moreover, manure's ability to augment soil water-holding capacity enhances water absorption by plants, further fostering their growth (Soelistijono *et al*., 2020).

The highest number of tubers per hill, recorded at 8.77 tubers, was associated with a manure dose of 20 tons ha^{-1}, while the lowest count of 4.37 tubers occurred at a manure dose of 5 tons ha^{-1} (Table 8). This continuing trend indicates that the nutrient content, such as N, P, and K, in manure can be optimally utilized by plants. Efficient nutrient absorption, particularly of nitrogen, correlates with elevated photosynthesis rates, contributing to increased tuber growth (Idris *et al*., 2018). Emphasize the role of the element K in aiding the photosynthesis process, crucial for the formation of new organic compounds transported to storage organs like tubers. Idris *et al*.'s (2018) research specifically notes that a manure dose of 20 tons ha^{-1} yields 6.07 tubers, aligning with Mayun's (2007) findings that a cow manure dose of 30 tons ha^{-1} significantly impacts tuber growth and yield per hectare .

Table 8. Effect of manure dosage on onion yield

Manure dosage (ton ha^{-1})	Root length	Weight of fresh produce	Number of tubers per clump
5	3.07 b	12.25 d	4.37 c
10	3.03 b	22.15 c	5.48 bc
15	3.14 b	33.15 b	6.48 b
20	3.88 a	59.02 a	8.77 a

Note : Number followed the same letter in the column (vertically) is not significant at DMRT 5%

Coastal land has various problems such as high salt levels and low organic matter content so it does not support cultivation efforts. Salinity is one of the limiting factors for plant growth and productivity. The adverse effects of salinity on plants are related to reduced N and P uptake (Ullah, 2021). Differences in research results are influenced by environmental factors so the higher the treatment dose given does not ensure higher plant yields. The average daily temperature at the time of the study was 26 °C, while the optimal temperature for shallot plants was 22 °C. At the appropriate air temperature, onion plants will develop maximum vegetative and generative organ growth. On the other hand, at low or high temperatures, inhibition occurs, resulting in low growth and onion yields are low (Khosa, 2018).

CONCLUSION

Drawing from the research findings and analysis, it is evident that an interaction exists between the type of manure and its dosage concerning the observed variable of root length. Specifically, chicken manure emerges as the optimal choice for monitoring plant height during weeks 2, 3, 4, 5, and 6. Moreover, the most favorable manure dosage for enhancing the growth and yield of onion is determined to be 20 tons ha^{-1} .

References

Amjad A.A., Radovich, T.J.K., Nguyen, H.V., Uyeda, J., Arakaki, A., Cadby, J., Paull, R., Sugano, J. & Teves, G. (2016). Use of organic fertilizers to enhance soil fertility, plant growth, and yield in a tropical environment. *In* Organic Fertilizers from Basic Conceptsto Applied Outcomes. DOI: http://dx.doi.org/10.5772/62529.

Atmaja, I. M. D., Wirajaya, A. A. N. M. & Kartini, L. (2019). Effect of goat and cow manure fertilizer on the growth of shallot (*Allium ascalonicum L*). *SEAS (Sustainable Environment Agricultural Science), 3*(1), 19-23. DOI: 10.22225/seas.3.1.1336.19-23.

Bulmer, C.E. & Simpson, D.G. (2005). Soil compaction and water content as factors affecting the growth of lodgepole pine seedlings on sandy clay loam soil. *Can. J. Soil Sci., 85*(5), 667-679. DOI::10.4141/S04-055.

DataIndonesia. (2023). Indonesia Produksi Bawang Merah Sebanyak 1,97 ton tahun 2022. https://dataindonesia.id/industri-perdagangan/detail/indonesia-produksi-bawang-merah-sebanyak-197-juta-ton-pada-2022.

Dewanto, F.G., Londok, J.J.M.R., Tuturoong, R.A.V. & Kaunang, W.B. (2017). Pengaruh pemupukan anorganik dan organik terhadap produksi tanaman jagung sebagai sumber pakan. *Zootec*, 32(5), 1-8. DOI: 10.35792/zot.32.5.2013.982.

Dewi, W.W. (2018). Respon dosis pupuk kandang kambing terhadap pertumbuhan dan hasil tanaman mentimun (*Cucumis sativus* L.) varietas hibrida. VIABEL *J. Ilm. Ilmu-Ilmu Pertan*., 10 (2), 11-29. DOI: 10.35457/viabel.v10i2.140.

Du, Y., Cui, B., Zhang, Q., Wang, Z., Sun, J. & Niu, W. (2020). Effects of manure fertilizer on crop yield and soil properties in China: A meta-analysis. *CATENA*, 193(5), 104617. DOI: 10.1016/j.catena.2020.104617.

Duruigbo, C.I., Obiefuna, J.C. & Onweremadu, E.U. (2007). Effect of poultry manure rates on soil acidity in an Ultisol. *International Journal of Soil Science*, 2(2), 154-158. DOI: 10.3923/ijss.2007.154.158.

Ekwealor, K., Anukwuorji, C., Egboka, T.P., Eze, H. & Anukwuorji, C.A. (2020). Studies on the comparative effects of cow dung, goat dung and poultry manure in the restoration of gully eroded soil using *Amaranthus hybridus* as test plant. *Journal of Soil Science and Plant Nutrition*, 6(2), 10-16. DOI: 10.9734/AJSSPN/2020/v6i230082.

Fadil, M. & Sutejo, H. (2020). Pengaruh jenis dan dosis pupuk organik terhadap pertumbuhan dan hasil tanaman terong (*Solanum melongena* L.) varietas Milano. *Agrifor*, 19(1), 87. DOI: 10.31293/ af.v19i1.4617.

Fathi, A. (2022). Role of nitrogen (N) in plant growth, photosynthesis pigments, and N use efficiency: A review. *Agrisost*, 28, 1-8. DOI: 10.5281/zenodo.7143588.

Herbert, S., Hashemi, M., Chickering-Sears, C. & Weis, S. (2008). Plant Nutrients from Manure. Center for Agriculture, Food, and the Environment. University of Massachusetts Amherst, https://ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/plant-nutrients-from-manure.

Idris, I., Basir, M. & Wahyudi, I. (2018). Pengaruh berbagai jenis dan dosis pupuk kandang terhadap pertumbuhan dan hasil tanaman bawang merah varietas Lembah Palu. *J. Agrotech*, 8 (2), 40–49. DOI: 10.31970/agrotech.v8i2.19.

Kandil, H., N. Gad. 2010. Response of tomato plants to sulphur and organik fertilizer. International Journal of Academic Research, 2(3), 204-210.

Kania, S.R. & Maghfoer, M.D. (2018). Pengaruh dosis pupuk kandang kambing dan waktu aplikasi PGPR terhadap pertumbuhan dan hasil bawang merah (*Allium ascaloniucum* L.). *J. Produksi Tanaman*, 6(3), 407-414.

Khosa, J., Lee, R., Joshi, S., Shaw, M., McCallum, J. & Macknight, R. (2018). A guide for the cultivation of onion under controlled environment conditions. *HORTSCIENCE*, 53(12), 1746–1749. DOI: https://doi.org/10.21273/HORTSCI13515-18.

Köninger, J., Lugato, E., Panagos, P., Kochupillai, M., Orgiazzi, A. & Briones, M. J. I. (2021). Manure management and soil biodiversity: Towards more sustainable food systems in the EU. *Agricultural Systems*, 194, 1-24. DOI :10.1016/j.agsy.2021.103251.

Liu, S., Wang, J., Pu, S., Blagodatskaya, E., Kuzyakov, Y. & Razavi, B.S. (2020). Impact of manure on soil biochemical properties: A global synthesis. Science of The Total Environment, 745. DOI: https://doi.org/10.1016/j.scitotenv.2020.141003.

Mayun, I.A. (2007). Efek mulsa jerami padi dan pupuk kandang sapi terhadap pertumbuhan dan hasil bawang merah di daerah pesisir. J. *AGRITROP*, 26(1), 33-40.

Ohyama, T. (2010). Nitrogen as a major essential element of plants. *In book*: Nitrogen Assimilation in Plants. (pp.1-18) Edition: 1, Chapter: 1, Publisher Research Signpost, Tokyo.

Olivier, R. (2020). Entisol chemical properties on the system organic agriculture. *IJSOC*, 2(3), 177-183. DOI: https://doi.org/10.54783/ijsoc.v2i3.148.

Pamungkas, D.H. (2013). Pengaruh bentuk dan dosis pupuk kandang sapi terhadap pertumbuhan, hasil, kualitas nilam. *Agros*, 15(1), 11–20.

Park, J., Cho, K.H., Ligaray, M. & Choi, M.J. (2019). Organic matter composition of manure and its potential impact on plant growth. *Sustainability*, 11(8), 2346. DOI: 10.3390/su11082346.

Rachmadhani, N.W., Koesriharti, K. & Santoso, M. (2014). Effect of organic and inorganic fertilizer on the growth and yield of kidney bean (*Phaseolus vulgaris* L.). *J. Produksi Tanam*, 2 (6), 443–452.

Rajiman, P. Yudono, Sulistyaningsih, E. & Hanudin, E. (2008). Pengaruh pembenah tanah terhadap sifat fisika tanah dan hasil bawang merah pada lahan pasir pantai Bugel Kabupaten Kulon Progo. *J. Agrin*, 12(1), 67–77.

Rengga, W. D. P., Malikhana, A., Rayditya, R. & Prasetyo, R. (2022). Analysis of chicken manure fertilizer on the growth effectiveness of water spinach (*Ipomoea reptans* Poir.). *Majalah Ilmiah Peternakan*, 25(2),. 114-119. DOI: https://doi.org/10/.24843/MIP.2022.v25.i02.p10.

Setyorini, D., Saraswati, R., Ea, D. & Anwar, K. (2019). Pupuk 2: Pupuk organik dan pupuk hayati. Litbang Pertanian.

Sitanggang, A., Islan, & Saputra, S.I. (2015). Effect giving chicken manure and plant growth. JOM Faperta, 2(1)

Soelistijono, R., Suprapti, E., Aziez, A.F. & N.A. W. (2020). Varietas Devon I : Effect of cow manure dosage and kind of biofertilizer to the Growth of Soybean Devon I Variety. *J. Ilm. AGRINECA,* 6698, 125–134.

Subatra, K. (2013). Pengaruh sisa amelioran, pupuk N dan P terhadap ketersediaan N, pertumbuhan dan hasil tanaman padi di musim tanam kedua pada tanah gambut. *J. Lahan Suboptimal,* 2(2), 159–169.

Suem, M. A., Ali, M., Robbani, M., Bose, S. K. & Rahman, M. S. (2013). Growth and yield of onion as influenced by organic manures. *Journal of Agroforestry and Environment*, 7(2), 175 -178.

Sunardi & Sarjono, Y. (2007). Penentuan kandungan unsur makro pada lahan pasir pantai Samas Bantul dengan metode analisis aktivasi neutron (AAN). Pros. PPI - PDIPTN, 123–129.

Susikawati, D., Yelni, G. & Setiono. (2018). Respon pertumbuhan dan hasil tanaman bawang merah (*Allium ascalonicum*, L) dengan pemberian pupuk kandang ayam di Ultisol. *J. Sains Agro* 03(02), 1–9.

Ullah, A., Bano, A. & Khan, N. (2021). Climate change and salinity effects on crops and chemical communication between plants and plant growth-promoting microorganisms under stress. *Front. Sustain. Food Syst*., 5, 1-16. DOI: https://doi.org/10.3389/fsufs.2021.618092.

Uma, K. I., Kustiani, E. & Junaidi, J. (2022). Pengaruh dosis pupuk kandang sapi dan ukuran benih terhadap pertumbuhan dan hasil tanaman bawang merah (*Allium ascalonicum* L.). *JINTAN: Jurnal Ilmiah Pertanian Nasional*, 2 (2), 167. DOI: 10.30737/jintan.v2i2.2789.

Utami, S. N. H. & Handayani, S. (2003). Sifat kimia Entisol pada sistem pertanian organik. *Ilmu Pertanian*, 10(2), 63-69.

Velis, K.M. (2021). Biological benefits of manure application on agricultural soils. Institute of Agriculture and Natural Resources, UNL WATER. https://water.unl.edu/article/animal-manure-management/biological-benefits-manure-application-agricultural-soils.