



EFFECT OF CATTLE MANURE AND LOF DERIVED FROM CHICKEN EGGSHHELLS ON THE GROWTH AND YIELD OF SHALLOT (*Allium cepa* L.)

PENGARUH PUPUK KANDANG SAPI DAN POC CANGKANG TELUR AYAM TERHADAP PERTUMBUHAN DAN HASIL BAWANG MERAH (*Allium cepa* L.)

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Abstract

Shallots (*Allium cepa* L.) are a horticultural commodity with high economic value and widespread consumption. This study aimed to evaluate the effect of cow manure and liquid organic fertilizer (LOF) made from chicken eggshells on the growth and yield of shallots. The study was conducted at the experimental garden and Plant Physiology Laboratory, Faculty of Agriculture, Malikussaleh University, from November 2024 to February 2025. The experiment was arranged using a two-factorial Randomized Block Design (RBD) with three replications. The first factor was the dose of cow manure (0, 40, and 80 g polybag⁻¹), while the second factor was the concentration of chicken eggshell POC (0, 50, and 100 mL L⁻¹ water). The results showed that cow manure significantly affected plant height at 2 weeks after planting (WAP), root weight and volume, fresh and dry tuber weight per clump, and yield, with the best response at a dose of 40 g polybag⁻¹. Chicken eggshell LOF significantly affected plant height at 4 weeks post-plant growth (WAP), root length and volume, root weight, fresh and dry tuber weight, and yield, with the highest value at a concentration of 100 mL L⁻¹ of water. The interaction of the two treatments significantly affected root weight and volume, with the best combination at a dose of 80 g cow manure per polybag⁻¹. The combination of cow manure and chicken eggshell POC has been shown to increase shallot growth and yield.

Keywords: *cattle manure, chicken eggshells, LOF, shallot, yield*

Abstrak

Bawang merah (*Allium cepa* L.) merupakan komoditas hortikultura bernilai ekonomi tinggi dengan tingkat konsumsi yang luas. Penelitian ini bertujuan untuk mengevaluasi pengaruh pupuk kandang sapi dan pupuk organik cair (POC) berbahan cangkang telur ayam terhadap pertumbuhan dan hasil bawang merah. Penelitian dilaksanakan di kebun percobaan dan Laboratorium Fisiologi Tumbuhan, Fakultas Pertanian, Universitas Malikussaleh, pada November 2024–Februari 2025. Percobaan disusun menggunakan Rancangan Acak Kelompok (RAK) faktorial dua faktor dengan tiga ulangan. Faktor pertama adalah dosis pupuk kandang sapi (0, 40, dan 80 g polybag⁻¹), sedangkan faktor kedua adalah konsentrasi POC cangkang telur ayam (0, 50, dan 100 mL L⁻¹ air). Hasil penelitian menunjukkan bahwa pupuk kandang sapi berpengaruh nyata terhadap tinggi tanaman umur 2 MST, bobot dan volume akar, bobot segar dan kering umbi per rumpun, serta hasil, dengan respons terbaik pada dosis 40 g polybag⁻¹. POC cangkang



telur ayam berpengaruh nyata terhadap tinggi tanaman umur 4 MST, panjang dan volume akar, bobot akar, bobot segar dan kering umbi, serta hasil, dengan nilai tertinggi pada konsentrasi 100 mL L⁻¹ air. Interaksi kedua perlakuan berpengaruh nyata terhadap bobot dan volume akar, dengan kombinasi terbaik pada dosis pupuk kandang sapi 80 g polybag⁻¹. Kombinasi pupuk kandang sapi dan POC cangkang telur ayam terbukti mampu meningkatkan pertumbuhan dan hasil tanaman bawang merah.

Kata kunci: bawang merah, cangkang telur ayam, hasil, pupuk kandang sapi, POC

INTRODUCTION

Shallots (*Allium cepa* L.) are a horticultural commodity with high economic value that plays a crucial role in food security and increasing farmers' incomes. Demand for shallots continues to grow, but production stability remains hampered by fluctuations in land productivity and declining soil fertility (Cahyani, 2022; BPS, 2023). In the long term, intensive use of inorganic fertilizers degrades soil, reducing nutrient uptake efficiency and tuber yield.

The use of organic fertilizer is one strategy for sustainably improving soil fertility. Cow manure has been shown to improve soil physical, chemical, and biological properties and to support shallot growth and yield at specific doses (Sakti & Sugito, 2017; Septania *et al.*, 2022).

Furthermore, liquid organic fertilizer (LOF) based on chicken eggshells has the potential to serve as a source of calcium, which plays a role in plant tissue formation and in improving soil pH, and it also facilitates nutrient uptake (Fatmawati *et al.*, 2021; Suhastyo & Raditya, 2021). However, studies on the combination of cow manure and chicken eggshell LOF in shallot cultivation, particularly in polybag systems, are still limited. Therefore, this study aims to examine the effects of combining these two organic fertilizers on shallot growth and yield.

RESEARCH METHODS

The research was conducted at the experimental garden and Plant Physiology Laboratory of the Faculty of Agriculture at Universitas Malikussaleh from November 2024 to February 2025. The tools used included polybags, hoes, analytical scales, scissors, buckets, watering cans, sacks, calculators, label paper, markers, and writing utensils. The research materials consisted of Bima Brebes variety shallot bulbs, cow manure, LOF made from chicken eggshells, topsoil, and botanical pesticides.

The study was designed using a two-factor Randomized Block Design (RBD). The first factor was the dose of cow manure (P) consisting of three levels, namely P₀ = 0 ton ha⁻¹ (0 g/p.bag), P₁ = 20 ton ha⁻¹ (40 g/p.bag), and P₂ = 40 ton ha⁻¹ (80 g/p.bag). The second factor was the concentration of LOF made from chicken eggshells (C), with three levels: C₀ = 0% (0 ml L⁻¹ water), C₁ = 5% (50 ml L⁻¹ water), and C₂ = 10% (100 ml L⁻¹ water). There were 9 treatment combinations, each replicated 3 times, for a total of 27 experimental units. Each experimental unit consisted of 5 plants, for a total of 135.



RESULTS AND DISCUSSION

Plant Height (PH)

The ANOVA showed that applying cow manure had a significant effect on PH at 2 WAP, while LOF from chicken eggshells had a very significant effect at 4 WAP. The average plant height resulting from the application of cow manure and LOF from chicken egg shells is presented in Table 1.

Table 1. Average height of shallot plants due to cow manure (P) and chicken eggshell LOF (C) treatment

Treatment	Tall Plant (cm)			
	2 WAP	4 WAP	6 WAP	8 WAP
Cow Manure				
P ₀ (0 g/p.bag)	20.00b	29.50a	38.70a	38.50a
P ₁ (40 g/p.bag)	21.71a	31.98a	38.48a	37.93a
P ₂ (80 g/ p.bag)	19.39b	29.20a	36.57a	37.67a
LOF Shell egg				
C ₀ (0 ml/L of water)	19.68a	28.72b	37.94a	37.72a
C ₁ (50 ml/L of water)	20.04a	28.83b	36.78a	37.63a
C ₂ (100 ml/L of water)	21.41a	31.13a	39.04a	38.74a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.

Based on Table 1, the application of cow manure and LOF made from chicken eggshells tended to increase the height of shallot plants. However, the highest average PH was achieved in treatment C₂ (100 mL L⁻¹ water).

Number of Leaves (NL)

The ANOVA results showed that applying cow manure and LOF from chicken eggshells had no significant effect on NL. The average NL per treatment is presented in Table 2.

Table 2. Average NL of shallot plants due to cow manure (P) and chicken eggshell LOF (C) treatments.

Treatment	Amount Leaf (strand)			
	2 WAP	4 WAP	6 WAP	8 WAP
Cow Manure				
P ₀ (0 g/p.bag)	20.55a	31.81a	43.11a	40.55a
P ₁ (40 g/ p.bag)	21.56a	32.11a	45.81a	41.81a
P ₂ (80 g/ p.bag)	18.37a	27.63a	41.11a	40.15a
LOF Shell egg				
C ₀ (0 ml/L water)	20.15a	32.74a	45.56a	40.22a
C ₁ (50 ml/L water)	20.41a	29.49a	42.52a	39.18a
C ₂ (100 ml/L water)	19.93a	29.34a	41.96a	43.11a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.



Based on Table 2, the treatment of cow manure and LOF from chicken eggshells did not have a significant effect on NL.

Number of Offspring

The results of the ANOVA showed that the application of cow manure and LOF made from chicken eggshells had no significant effect on the number of offspring. The average number of offspring per treatment is presented in Table 3.

Table 3. Average number of shallot seedlings due to cow manure treatment (P) and chicken egg shell LOF (C)

Treatment	Amount of Offspring Per Plant			
	2 WAP	4 WAP	6 WAP	8 WAP
Cow Manure				
P ₀ (0 g/p.bag)	5.26a	7.37a	9.00a	10.93a
P ₁ (40 g/ p.bag)	5.81a	7.48a	10.22a	12.04a
P ₂ (80 g/ p.bag)	4.96a	6.62a	9.22a	10.26a
LOF Shell egg				
C ₀ (0 ml/L of water)	5.78a	7.59a	10.52a	11.74a
C ₁ (50 ml/L water)	5.07a	7.22a	9.11a	10.50a
C ₂ (100 ml/L water)	5.15a	6.55a	8.81a	10.81a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.

Based on Table 3, the treatment of cow manure and LOF from chicken egg shells did not have a significant effect on the number of offspring.

Root Length (cm)

The ANOVA showed that cow manure had no significant effect on shallot root length, whereas liquid organic fertilizer made from chicken eggshells did. The average root length for each treatment is presented in Table 4.

Table 4. Average length of shallot plant roots due to cow manure (P) and chicken eggshell LOF

Treatment	Long Root (cm)
Cow Manure	
P ₀ (0 g/p.bag)	21.69a
P ₁ (40 g/ p.bag)	20,20a
P ₂ (80 g/p.bag)	22.76a
LOF Shell egg	
C ₀ (0 ml/L water)	20.04b
C ₁ (50 ml/ L water)	21.13b
C ₂ (100 ml/L of water)	23.46a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.



Based on Table 4, the cow manure treatment had no significant effect on the length of shallot roots. Conversely, the single application of liquid organic fertilizer from chicken eggshells increased root length, with the highest value at a concentration of 23.46 cm per 100 mL of water (C₂), which was significantly different from C₁ and C₀.

Heavy Root (g)

The results of the ANOVA showed that cow manure and LOF from chicken egg shells had a highly significant effect on shallot root weight. The average root weight for each treatment is presented in Table 5.

Table 5. Average heavy root plant onion red consequence treatment fertilizerpen cow (P) and LOF shell chicken eggs (C)

Treatment	Heavy Root (g)
Cow Manure	
P ₀ (0 g/p.bag)	2.54b
P ₁ (40 g/ p.bag)	2.41b
P ₂ (80 g/ p.bag)	3.66a
LOF Shell egg	
C ₀ (0 ml/L water)	2.47b
C ₁ (50 ml/L water)	2.68b
C ₂ (100 ml/L water)	3.45a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.

Based on Table 5, a single application of cow manure increased shallot root weight, with the highest value at 80 g polybag⁻¹ (P₂; 3.66 g), which was significantly higher than P₀ and P₁. The application of LOF from chicken eggshells also increased root weight, with the best results at a concentration of 100 mL L⁻¹ in water (C₂; 3.45 g), which was significantly different from C₁ and C₀. In addition, the combination of cow manure and liquid organic fertilizer of chicken eggshells had a significant effect on the weight of shallot roots. The results of the 5% DMRT follow-up tests are presented in Table 6.

Table 6. Average Root Weight of Shallot Plants Due to the Combination of Cow Manure (P) and Chicken Eggshell LOF (C) Treatments

Treatment	Heavy Root (g)
P0C0	2.03 d
P0C1	2.49 CDs
P0C2	3.10 bc
P1C0	2.73 cd
P1C1	1.91 d
P1C2	2.58 cd
P2C0	2.65 cd
P2C1	3.65 b
P2C2	4.67 a



Description: Means followed by identical letters in the same column indicate no significant difference based on the DMRT ($\alpha = 0.05$).

Based on Table 6, the combination of cow manure (P) and LOF from chicken eggshells (C) affects the root weight variable per sample. This indicates an interaction. from the second factor treatment. Mark the highest value from the variable heavy. The roots per sample were highest in the P2C2 treatment (4.67 g) and lowest in the P1C1 treatment (1.91 g).

Volume Root (ml)

The ANOVA showed that cow manure and LOF containing chicken eggshells had significant effects on shallot root volume. The average root volume for each treatment is presented in Table 7.

Table 7. Average root volume of shallot plants due to cow manure (P) and chicken eggshell LOF (C) treatment.

Treatment	Volume Root (ml)
Cow Manure	
P ₀ (0 g/p.bag)	2.67b
P ₁ (40 g/ p.bag)	2.63b
P ₂ (80 g/ p.bag)	3.74a
LOF Shell egg	
C ₀ (0 ml/L water)	2.74b
C ₁ (50 ml/ L water)	2.85b
C ₂ (100 ml/L water)	3.44a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.

Based on Table 7, a single application of cow manure increased shallot root volume, with the highest value at 80 g polybag⁻¹ (P₂; 3.74), which was significantly higher than P₀ and P₁. The application of LOF from chicken eggshells also increased root volume, with the best result at a concentration of 100 mL L⁻¹ in water (C₂; 3.44), which was significantly different from C₁ and C₀. In addition, the interaction between cow manure and the LOF of chicken eggshells significantly affected the root volume of shallots. The results of the further DMRT test at the 5% level are presented in Table 8.

Based on Table 8, the combination of cow manure and LOF made from chicken eggshells significantly affected root volume per sample, indicating an interaction between the two treatments. The highest value was obtained with the P2C2 combination at 4.67 mL, while the lowest value was found with P1C1 at 2.11 mL.



Table 8. Average root volume of shallot plants combined with cow manure (P) & chicken eggshell LOF (C) treatments

Treatment	Volume Root (ml)
P0C0	2.33 c
P0C1	2.66 c
P0C2	3.00 bc
P1C0	3.11 bc
P1C1	2.11 c
P1C2	2.67 c
P2C0	2.78 c
P2C1	3.78 ab
P2C2	4.67 a

Description: Means followed by identical letters in the same column indicate no significant difference based on the DMRT ($\alpha = 0.05$).

Amount of tubers Per Clump

The ANOVA showed that providing cow manure and LOF from chicken egg shells had no significant effect on the number of shallot bulbs. The average number of tubers resulting from the two treatments is presented in Table 9.

Table 9. Average number of tubers per clump, consequence treatment, fertilizer pen cow (P), and LOF shell egg chicken (C)

Treatment	Amount of tubers Per Clump
Cow Manure	
P ₀ (0 g/p.bag)	11.00a
P ₁ (40 g/ p.bag)	13.26a
P ₂ (80 g/ p.bag)	11.56a
LOF Shell egg	
C ₀ (0 ml/L water)	12.19a
C ₁ (50 ml/ L water)	12.67a
C ₂ (100 ml/ L water)	10.96a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.

Based on Table 9, the treatment of cow manure and LOF from chicken egg shells did not have a significant effect on the number of shallot bulbs.

Heavy Wet tubers Per Clump, Heavy Dry tubers Per Clump, and Production Per Ha

The results of the ANOVA showed that cow manure had a very significant effect on the fresh weight of tubers per clump, as well as a significant effect on the dry weight of air per clump and production per hectare. LOF from chicken eggshells had a very significant effect on tuber fresh weight per clump, tuber dry weight per clump, and production per hectare. A summary of the analysis of variance results for these parameters is presented in Table 10.



Table 10. Average Wet Weight of Bulbs per Clump, Dry Weight of Bulbs per Clump, and Production per Ha of Shallot Plants Due to Cow Pen (P) and Chicken Eggshell LOF (C) Treatments.

Treatment	Heavy Wet Bulbs Per Clump (g)	Heavy Dry Bulbs Per Clump (g)	Production per ha (ton)
Cow Manure			
P ₀ (0 g/p.bag)	61.95b	55.95b	4.48b
P ₁ (40 g/ p.bag)	76.39a	69.87a	5.59a
P ₂ (80 g/ p.bag)	68.94ab	61.67ab	4.94ab
LOF Shell egg			
C ₀ (0 ml/L water)	62.87b	55.84b	4.48b
C ₁ (50 ml/L water)	67.16b	59.97b	4.80b
C ₂ (100 ml/L water)	77.25a	71.69a	5.73a

Note: Values followed by the same letter within a column are not significantly different according to the DMRT at the 5% significance level.

Based on Table 10, cow manure affected the wet weight of shallot bulbs. A dose of 40 g/polybag (P₁) produced the highest wet weight and was significantly different from no fertilizer (P₀), but not significantly different from the other doses. LOF from chicken egg shells also affected tuber wet weight, with a concentration of 100 ml/liter of water (C₂) yielding the highest results and being significantly different from C₁ and C₀.

Cow manure affected tuber dry weight per clump. The highest value was obtained at a dose of 40 g/polybag (P₁), which was significantly different from P₀ but not significantly different from 80 g/polybag. LOF made from chicken eggshells at a concentration of 100 ml/liter of water (C₂) produced the highest tuber dry weight and was significantly different from the other treatments.

Shallot production per hectare increased by providing cow manure and LOF from chicken egg shells. A dose of 40 g/polybag (P₁) and a concentration of 100 ml/liter of water (C₂) produced the highest yield and were significantly higher than the control.

Discussion

Cow manure application affected shallot pH at two WAP, root weight and volume, wet- and dry-bulb weight, and production (tons/ha). The best treatment was obtained at a dose of 40 g/p.bag (equivalent to 20 tons/ha), which is thought to provide balanced and optimal nutrient supply for plants (Minangsih, 2022). Cow manure increases nutrient availability, improves soil fertility and structure, and stimulates microbial activity, thereby supporting root development and nutrient uptake.

Manure application also had no significant effect on PH at 4–8 WAP, leaf number (LN), tiller number (TN), tuber number, and root length. This is thought to be due to the slow decomposition of organic matter and the dominant influence of plant genetic factors on these characteristics (Meriati, 2018; Putra *et al.*, 2015).

Meanwhile, the provision of 40 g/polybag of cow manure resulted in the highest weight and production of bulbs because this dose was most effective in supporting the activity of soil



microorganisms and the availability of nutrients, especially phosphorus and potassium, which play a role in bulb enlargement and increasing shallot production (Manik *et al.*, 2019; Alfian *et al.*, 2015).

The study found that applying LOF from chicken eggshells alone affected shallot growth and yield. The chicken eggshell LOF significantly affected root length and volume, and had a very significant effect on root weight, bulb wet & dry weight, and production (tons/ha). The best treatment was obtained at a concentration of 100 ml/L in water (C₂), which is thought to optimally meet plant nutrient needs during the generative phase (Prasetyo, 2015).

Chicken eggshells contain high levels of calcium carbonate, as well as P, Mg, K, and micronutrients, which play a role in the formation and development of root systems and increase nutrient absorption efficiency (Nurjanah *et al.*, 2017; Maduwu, 2023). P supports root development and photosynthesis, while Ca strengthens cell walls and stimulates root formation (Rahma, 2016).

Chicken eggshell LOF had no significant effect on PH, LN, TN, or bulb number, which are thought to be more influenced by plant genetic factors (Ambarwati & Yudono, 2012; Yuliana, 2023). Increased bulb yield and production are also associated with potassium's role in bulb enlargement and in improving shallot yield quality (Tarigan & Sembiring, 2017; Azmi *et al.*, 2017).

The study showed an interaction between cow manure and chicken eggshell LOF on shallot root weight and volume. However, the interaction between the two treatments had no significant effect on PH, LN, tiller number, root length, wet- and dry-bulb weight, or yield (tons/ha). This difference in response is likely due to variations in manure dosage and LOF concentration, which influence soil nutrient availability.

The right combination of solid and LOF can increase nutrient availability and improve soil physical, chemical, and biological properties, thereby supporting the development of plant root systems (Musnamar, 2005). Soil with a high organic content has better aeration and is less prone to compaction, thus optimizing root growth.

The best response to root weight and volume variables was observed at the highest dose-concentration combination, indicating that treatment interactions are influenced by plant ability, genetic factors, and environmental conditions in the plant's response to the treatment (Suciantini, 2015; Santi *et al.*, 2023).

CONCLUSION

Cow manure and LOF made from chicken eggshells significantly affected shallot growth and yield, with the optimum dose of 40 g of cow manure per polybag and 100 mL of LOF per L of water. The interaction between the two treatments only affected root weight and volume, with the best combination being 80 g of cow manure per polybag.



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