



Effect Of Organic And Inorganic Fertilizer Combinations On The Growth And Yield Of Welsh Onion (*Allium Fistulosum* L.) In Highland Areas

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Abstract

*Welsh onion (*Allium fistulosum* L.) is an economically valuable horticultural commodity commonly cultivated in the highland regions of Indonesia. Despite suitable environmental conditions, its productivity remains below its potential, partly due to inefficient fertilizer management practices. This study was conducted to assess the influence of integrated organic and inorganic fertilization on the growth and yield of Welsh onion and to identify the most suitable fertilizer combination for highland cultivation. The experiment was carried out from February to May 2026 in Insil Village, Bolaang Mongondow Regency, North Sulawesi, Indonesia. A non-factorial Randomized Complete Block Design (RCBD) consisting of six fertilizer treatments and three replications was applied. The treatments included P0 (without fertilizer), P1 (1.8 t ha⁻¹ organic fertilizer + 900 kg ha⁻¹ NPK), P2 (2.7 t ha⁻¹ organic fertilizer + 750 kg ha⁻¹ NPK), P3 (3.6 t ha⁻¹ organic fertilizer + 600 kg ha⁻¹ NPK), P4 (4.5 t ha⁻¹ organic fertilizer + 450 kg ha⁻¹ NPK), and P5 (5.4 t ha⁻¹ organic fertilizer + 300 kg ha⁻¹ NPK). Experimental data were subjected to analysis of variance (ANOVA), and treatment means were compared using the Least Significant Difference (LSD) test at the 5% significance level. The findings demonstrated that integrated fertilization significantly influenced plant height, leaf production, tiller formation, and fresh biomass of Welsh onion. Among the tested treatments, P3 exhibited the most favorable overall performance in promoting both plant growth and yield. These results indicate that combining organic and inorganic fertilizers provides a balanced nutrient supply capable of enhancing Welsh onion productivity while contributing to more sustainable nutrient management practices in*





highland agricultural systems.

Keyword: Welsh onion, organic fertilizer, inorganic fertilizer, plant growth, crop yield.

INTRODUCTION

Welsh onion (*Allium fistulosum* L.) is one of the important horticultural commodities cultivated extensively in highland regions due to its considerable economic value and its widespread use as a culinary ingredient. The crop performs well under cool climatic conditions, fertile soils, and sufficient water availability, making high-altitude areas highly suitable for its cultivation. As reported by Cahyono (2009), the optimal elevation for Welsh onion production ranges from 900 to 1,700 meters above sea level.

One of the highland regions with favorable environmental characteristics for Welsh onion cultivation is Insil Village, Passi Timur District, Bolaang Mongondow Regency, North Sulawesi. Situated at approximately 1,055 meters above sea level, the area possesses climatic and soil conditions that support horticultural production. Nevertheless, the productivity of Welsh onion in this location has not yet reached its maximum potential, indicating that several production factors still require improvement, particularly nutrient management in the cultivation system.

Nutrient availability plays a fundamental role in determining plant growth and crop yield. Fertilization is therefore an essential agronomic practice to ensure that plants receive adequate nutrients throughout their growth cycle. Organic fertilizers, especially chicken manure, contribute not only essential nutrients but also improve soil physical, chemical, and biological properties. Previous studies have demonstrated that repeated application of chicken manure increases soil organic matter content, enhances microbial activity, and gradually releases nutrients that support plant development (Lestari et al., 2023; Detuage et al., 2023). However, because nutrient mineralization occurs relatively slowly, organic fertilizer alone may not be sufficient to satisfy crop nutrient requirements during periods of rapid vegetative growth.

In contrast, inorganic fertilizers such as NPK provide nitrogen, phosphorus, and potassium in forms that are readily available for plant uptake. These nutrients are essential for supporting vegetative development, photosynthetic activity, and overall crop productivity (Wibowo, 2021). Despite their effectiveness, excessive reliance on inorganic fertilizers may gradually reduce soil quality and sustainability. Consequently, integrating organic and inorganic nutrient sources has become an alternative fertilization strategy that aims to improve nutrient use efficiency while maintaining long-term soil fertility.

Several previous investigations have reported positive responses of horticultural crops



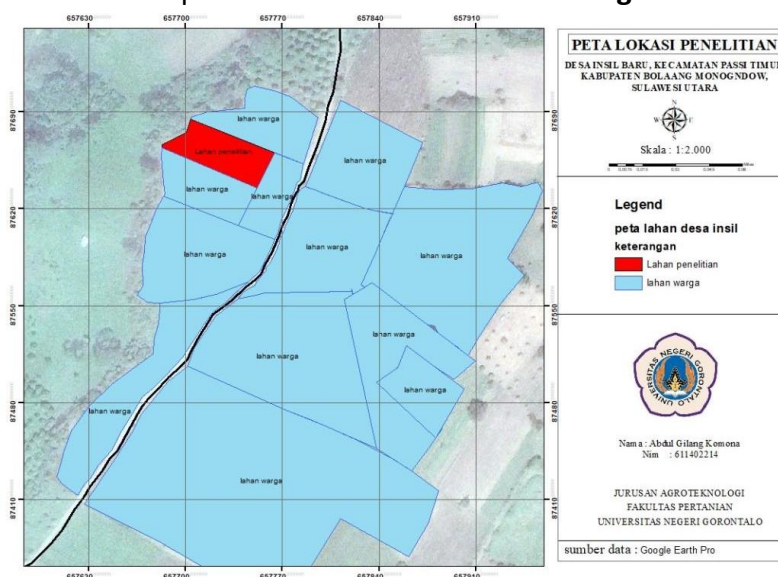
to integrated fertilization practices. Harbing et al. (2023) observed that the combined application of chicken manure and NPK fertilizer enhanced the growth and yield of shallots.

Likewise, Bari et al. (2024) found significant improvements in plant height, leaf production, and fresh biomass of green spinach following the application of the same fertilizer combination. These findings suggest that the complementary functions of organic and inorganic fertilizers create a more favorable growing environment and ensure a more balanced nutrient supply for crop development.

Although the benefits of integrated fertilization have been documented in several horticultural commodities, information regarding the appropriate combination of chicken manure and NPK fertilizer for Welsh onion cultivated under the specific agroecological conditions of Insil Village remains limited. Therefore, this study was designed to evaluate the effects of combined organic and inorganic fertilizer application on the growth and yield of Welsh onion (*Allium fistulosum* L.) and to identify the fertilizer combination that provides the most effective performance under local highland cultivation conditions.

METHOD

This research was conducted from February to May 2026 in Insil Village, Passi Timur District, Bolaang Mongondow Regency, North Sulawesi, Indonesia. The study site is situated at an elevation of approximately 1,055 meters above sea level and possesses environmental characteristics that are suitable for the cultivation of Welsh onion (*Allium fistulosum* L.). The geographical location of the experimental area is illustrated in **Figure 1.c**.



This study utilized a non-factorial Randomized Complete Block Design (RCBD) featuring six fertilizer regimes across three replications. The treatments comprised varying combinations of chicken manure and NPK fertilizer: P0 (control), P1 (1.8 t ha⁻¹ + 900 kg ha⁻¹), P2 (2.7 t ha⁻¹ + 750 kg ha⁻¹), P3 (3.6 t ha⁻¹ + 600 kg ha⁻¹), P4 (4.5 t ha⁻¹ + 450 kg ha⁻¹), and P5 (5.4 t ha⁻¹ + 300 kg ha⁻¹). While the organic manure was incorporated into the substrate during land preparation, the chemical fertilizer was applied sequentially according to the crop's growth stages. Standard crop management practices, such as irrigation and pest control, were uniformly maintained across all plots to isolate the treatment effects.

Growth and yield attributes (plant height, leaf and tiller numbers, and fresh weight) were monitored at 2, 4, 6, and 8 WAP. Destructive sampling at harvest was performed to determine individual fresh biomass using a calibrated digital balance. Statistical differences among treatments were assessed via ANOVA, followed by a post-hoc Least Significant Difference (LSD) test ($\alpha = 5\%$) for mean separation where applicable.

RESULTS AND DISCUSSION

Table 1. Growth Parameters of Welsh Onion at 8 WAP

Treatment	Plant Height (cm)	Number of Leaves	Number of Tillers
P0	46.93a	9.29a	2.34a
P1	54.17b	11.04b	2.88bc
P2	55.14bc	12.34b	2.88bc
P3	54.79bc	12.00b	3.13bc
P4	55.53bc	12.34b	3.04bc
P5	57.58c	12.34b	3.54c
LSD 5%	2.92	1.36	0.35

Source: Primary data processed, 2026.

Note: Means followed by different letters within the same column are significantly different according to the Least Significant Difference (LSD) test at the 5% significance level. WAP = Weeks After Planting. Demonstrates that different combinations of organic and inorganic fertilizers significantly influenced the vegetative growth of Welsh onion at 8 weeks after planting. Significant differences were observed in plant height, leaf number, and tiller production among the evaluated treatments. Treatment P5 produced the tallest plants, reaching 57.58 cm, and also



recorded the highest number of tillers with an average of 3.54 tillers per plant. Meanwhile, the greatest leaf production (12.34 leaves) was obtained in treatments P2, P4, and P5. In comparison, plants grown without fertilizer application (P0) consistently exhibited the lowest values for all observed growth variables, indicating limited vegetative development under nutrient-deficient conditions.

The improved growth performance recorded in fertilized treatments reflects the positive interaction between organic and inorganic nutrient sources. Chicken manure contributes organic matter that enhances soil structure, increases microbial activity, and improves the soil's capacity to retain nutrients and moisture. At the same time, NPK fertilizer provides readily available nitrogen, phosphorus, and potassium that can be immediately utilized by plants to support vegetative growth (Lestari et al., 2023; Wibowo, 2021). The complementary functions of these fertilizer sources create a more favorable environment for plant development than the absence of fertilization.

The superior plant height observed in treatment P5 indicates that increasing the proportion of chicken manure while reducing the NPK dosage was still capable of supplying sufficient nutrients for vigorous vegetative growth. Organic amendments gradually release nutrients while simultaneously improving soil physical and biological properties, allowing plants to maintain continuous growth throughout the cultivation period. Comparable results were reported by Karya et al. (2024), who demonstrated that chicken manure application enhanced the growth performance of Welsh onion through improvements in soil quality. Furthermore, adequate nitrogen availability stimulates cell division and elongation processes, thereby contributing to greater plant height and more extensive leaf formation (Wibowo, 2021).

The higher number of leaves and tillers observed in fertilized treatments also indicates that integrated nutrient management promoted better plant vigor and nutrient utilization efficiency. Organic fertilizer functions as a slow-release nutrient source, whereas inorganic fertilizer supplies nutrients that are immediately available during active growth stages. This balanced nutrient availability supports root development, enhances nutrient absorption, and improves overall plant performance. According to Salman (2024), the incorporation of organic materials into the soil improves aeration and water retention, thereby creating conditions that facilitate root growth and nutrient uptake. Consequently, Welsh onion plants receiving combined fertilizer applications produced more leaves and tillers than those cultivated without fertilizer input.



Table 2. Fresh Weight of Welsh Onion at Harvest

Treatment	Fresh Weight (g plant ⁻¹)
P0	81.21a
P1	222.29b
P2	252.38c
P3	301.42e
P4	275.79d
P5	287.17d
LSD 5%	14.05

Source: Primary data processed, 2026.

Note: Means followed by different letters within the same column are significantly different according to the Least Significant Difference (LSD) test at the 5% significance level.

The results presented in Table 2 indicate that the application of combined organic and inorganic fertilizers significantly influenced the fresh weight of Welsh onion at harvest. Among all treatments, P3 produced the highest fresh weight, reaching 301.42 g plant⁻¹, and differed significantly from the other fertilizer combinations. In contrast, plants grown without fertilizer application (P0) recorded the lowest fresh weight of 81.21 g plant⁻¹, demonstrating the importance of nutrient supplementation in increasing biomass production.

The outstanding performance of treatment P3 suggests that the combination of 3.6 t ha⁻¹ chicken manure and 600 kg ha⁻¹ NPK supplied nutrients in a proportion that effectively supported plant growth and yield formation. A balanced nutrient supply enhances physiological processes such as photosynthesis, assimilate translocation, and cell expansion, all of which contribute to greater biomass accumulation. Wibowo (2021) reported that appropriate nutrient management improves nutrient absorption efficiency and promotes optimal growth and productivity in Welsh onion cultivation.

Interestingly, although treatment P5 resulted in the highest vegetative growth based on plant height and tiller number, the greatest fresh weight was achieved under treatment P3. This finding indicates that vigorous vegetative development is not always directly associated with maximum yield production. Instead, achieving an appropriate balance between organic and inorganic nutrient inputs appears to be more effective in optimizing biomass accumulation and harvest performance.



These findings are consistent with previous studies demonstrating the benefits of integrated fertilization strategies. Mendrofa (2025) reported that combining organic and inorganic fertilizers improves nutrient availability and enhances crop productivity by providing both immediate and sustained nutrient release. Likewise, Murnita and Taher (2021) emphasized that integrated fertilization contributes not only to increased crop yield but also to the maintenance of soil fertility and the sustainability of agricultural production systems over the long term

CONCLUSION

The present study confirms that integrating organic and inorganic fertilizers plays an important role in enhancing the growth and productivity of Welsh onion (*Allium fistulosum* L.) cultivated under highland conditions in Insil Village, Bolaang Mongondow Regency. Compared with the unfertilized control, all fertilizer treatments improved vegetative growth characteristics, including plant height, leaf number, tiller formation, and fresh biomass production, demonstrating the positive contribution of balanced nutrient management to crop performance.

Among the evaluated fertilizer combinations, treatment P5 (5.4 t ha⁻¹ chicken manure + 300 kg ha⁻¹ NPK) exhibited the best vegetative response by producing the tallest plants and the highest number of tillers. However, the greatest fresh weight was achieved under treatment P3 (3.6 t ha⁻¹ chicken manure + 600 kg ha⁻¹ NPK), indicating that this combination supplied nutrients in a proportion that more effectively supported biomass accumulation and harvest yield.

These findings suggest that an appropriate integration of organic and inorganic nutrient sources is capable of improving Welsh onion production while simultaneously promoting more efficient fertilizer utilization and better soil fertility management. Therefore, the application of 3.6 t ha⁻¹ chicken manure combined with 600 kg ha⁻¹ NPK can be considered a suitable fertilization strategy for Welsh onion cultivation in highland agroecosystems with similar environmental conditions.

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