# A comparative study of *Jholmol* and Vermiwash as liquid fertilizers

***Rajendra Dhakal[1], Shankhar Neupane[2] and Sunayana Basnet[1]**

*[1]International Centre for Integrated Mountain Development (ICIMOD), Lalitpur, Nepal*

*[2]Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED), Surkhet, Nepal*

**Corresponding Author's Email: radhakal@icimod.org*

**ABSTRACT**

This study investigates the effects of *Jholmol*, Vermiwash, and their combination on the growth and soil nutrition of onion crops in the rural regions of Nepal. Employing a randomized complete block design (RCBD), each treatment was applied to quadruplicate plots of 100 square meters tailored to the specific needs of onion cultivation. The organic liquid fertilizers *Jholmol* and Vermiwash were tested both individually and in combination, with applications made bi-weekly at a rate of 500 ml per square meter. Growth parameters, including plant height, leaf area, biomass, and yield, along with soil nutrient contents (nitrogen, phosphorus, potassium, and organic matter), were systematically measured and analysed using ANOVA and post hoc Tukey's HSD tests. Results indicated that Vermiwash led to the highest improvements in all measured growth parameters, suggesting its superior efficacy as a standalone treatment. However, the combination of *Jholmol* and Vermiwash showed significantly enhanced soil nutrition, particularly in nitrogen, potassium, and organic matter contents, pointing to potential long-term benefits for soil health and sustainability. These findings underscore the importance of integrating organic liquid fertilizers in agricultural practices to attain both immediate growth benefits and long-term soil fertility, contributing to sustainable agricultural development in Nepal. This study highlights the synergistic effects of using combined organic fertilizers, which could inform future agricultural strategies, particularly in regions facing similar ecological and economic conditions.

**Key words:** Jholmol; Vermiwash; Organic liquid fertilizers; soil nutrition

**Received:** 6 May, 2024 **Accepted:** 18 August, 2024

## Introduction

In the evolving landscape of modern agriculture, the role of liquid fertilizers is paramount, particularly for their efficacy in delivering essential nutrients to crops (Allouzi et al., 2022). Liquid fertilizers are especially relevant in countries like Nepal, where agriculture is a major source of livelihood, particularly in rural areas (IFRI, 2014). The diverse topography and climate of Nepal make it a unique environment for agricultural practices, but it also presents challenges in terms of soil fertility and pest management (Tripathi, 2019; Pilbeam et al.,2005).

Among the plethora of options, *Jholmol* and vermiwash, two organic liquid fertilizers, have emerged as sustainable solutions that not only support plant growth but also enhance soil health (Patnaik et al.,2022; Varshini & Jayanthi 2020). These fertilizers are particularly beneficial in Nepal's rural agriculture, where the need for sustainable and cost-effective farming practices is paramount (ICIMOD 2016).

*Jholmol*, a unique blend of plant extracts, animal waste, and microbial cultures, offers a nutrient-rich composition that fosters vigorous plant growth and bolsters soil fertility (Neupane et al., 2019). It is a bio-liquid manure that is rich in nitrogen, phosphorus, and potassium, the three primary nutrients required for plant growth. Additionally, it contains trace elements and hormones that stimulate plant growth (Varshini & Jayanthi, 2020; ICIMOD, 2016). The organic matter in *Jholmol* improves soil structure, enhancing its capacity to retain water and nutrients. Furthermore, *Jholmol* has been found to have pest-repellent properties, reducing the reliance on chemical pesticides, and contributing to a healthier plant ecosystem (Koirala et al., 2020; Dhakal et al., 2019).

Vermiwash, on the other hand, is a byproduct of vermicomposting that harnesses the activity of earthworms to produce liquid rich in organic matter and beneficial microbes (Mohite et al., 2024). These microbes play a crucial role in nutrient cycling, enhancing soil structure and nutrient availability. Vermiwash is also rich in plant growth hormones and enzymes, which stimulate plant growth and yield (Mohite et al., 2024; Blouin et al., 2019). Moreover, the microbial activity in vermiwash has been associated with disease suppression in plants, providing an added advantage over conventional fertilizers (Bhavya et al., 2021; Yatoo et al., 2021).

The shift towards sustainable agricultural practices has been gaining momentum, with an increasing demand for organic and eco-friendly farming methods (Chandran, 2019). *Jholmol* and vermiwash align with this trend, providing a green alternative to conventional fertilizers. Despite their merits, the comparative effectiveness of these fertilizers, as well as the potential benefits of their combined use, has yet to be thoroughly investigated (ICIMOD, 2016; Manyuchi et al., 2013; Joshi et al., 2015).

This study, conducted in the Karnali province of Nepal, aims to fill this knowledge gap by conducting a comparative analysis of *Jholmol*, vermiwash, and their combination. It focuses on their impact on plant growth and soil fertility. The goal is to uncover any synergistic effects that may arise from using *Jholmol* and vermiwash together, with the intention of developing integrated fertilization strategies that can optimize crop yields while reducing environmental impact.

The outcomes of this research are expected to have profound implications for the advancement of sustainable agricultural practices and the pursuit of food security amidst growing environmental concerns. By elucidating the benefits of these organic fertilizers, this study aims to contribute to the development of sustainable farming practices that are not only productive but also environmentally friendly, particularly in the context of rural Nepal.

## Methodology

### Experimental site:

The experiment was conducted in Bheriganga municipality, Ward No. 11, Surkhet, Nepal on Onion crop (Variety Red creole) . The geographical coordinates of the experimental field were approximately 28.45°N latitude and 81.61°E longitude. The field is situated at an altitude of 1400 meters above sea level. (Bheriganga Municipality, 2024).

### Experimental Design

The experimental design was a randomized complete block design (RCBD) with four treatments: control (without fertilizer), *Jholmol*, Vermiwash, and a combination of both. Each treatment was replicated four times across different plots to ensure the reliability of the results.

#### *Plot Size*

Considering the specific needs of onion cultivation, each plot was sized at approximately 10 meters by 10 meters (100 square meters). This plot size is adequate to minimize edge effects and ensure sufficient space for the onion plants to grow without significant competition from plants in adjacent plots.

### Treatment Application

1. Control: No fertilizer is used in the crop.
2. *Jholmol*: This organic liquid fertilizer was prepared using local resources, such as cow urine, cow dung, water, and commercially available microorganisms (*Jeevatu*), mixed in a 1:16:16:17 proposition and fermented for a week before application (ICIMOD formulation).
3. Vermiwash: This liquid by-product of vermicomposting was collected from earthworm beds containing nutrient-rich leachate and diluted with water in a 1:10 ratio for application.
4. Combination: Both *Jholmol* and Vermiwash were mixed in equal proportions and applied to the plots designated for the combination treatment.

### Application Procedure

Each treatment was applied at a rate of 500 ml per square meter every two weeks. The applications were made early in the morning to minimize evaporation and maximize absorption by the plants.

### Data Collection

Growth parameters such as plant height, leaf area, biomass, and yield were measured bi-weekly. Soil samples were collected before the initiation of the treatment and after the harvest to analyze changes in soil nutrition, including levels of nitrogen, phosphorus, potassium, and organic matter.

### Statistical Analysis

Data were analysed using Analysis of the variance(ANOVA) to determine the significance of the differences between the treatments. The F-statistic and p-values were calculated to assess the statistical significance of the growth and soil nutrition parameters. Following the results from the ANOVA tests for nitrogen, phosphorus, potassium, and organic matter content, post hoc comparisons were conducted to identify which treatments differed. The Tukey's Honest Significant Difference (HSD) test was used for these comparisons due to its robustness in controlling the Type I error rate across multiple comparisons. All statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) software.

### Ethical Considerations

The study considered environmental sustainability and ethical treatment of the land. All experimental treatments were designed to be environmentally safe, promoting organic farming practices that contribute to sustainable agricultural development in the region.

This methodology ensures a comprehensive evaluation of the effects of *Jholmol*, Vermiwash, and their combination on both crop growth and soil health, providing valuable insights into sustainable agricultural practices suitable for the ecological conditions of Karnali Province.

## Results

### Growth Parameters

The study conducted ANOVA to assess the impact of different treatments on the growth parameters of onion crops. The treatments included a control group, *Jholmol*, Vermiwash, and a combination of *Jholmol* and Vermiwash. The growth

parameters analysed were plant height, leaf area, biomass, and yield.

**Table 1: Comparative analysis of *Jholmol*, Vermiwash, and combination treatments**

| Treatment | Mean Height (cm) | Mean Leaf Area ($cm^2$) | Mean Biomass (g) | Mean Yield (kg/ha) |
|---|---|---|---|---|
| *Jholmol* | 25 | 100 | 150 | 2000 |
| Vermiwash | 28 | 120 | 180 | 2200 |
| Combination | 27 | 115 | 170 | 2150 |

*Note: The values in the table represent the mean measurements for each treatment.*

**Table 2: ANOVA Results for the Comparative Analysis of *Jholmol*, Vermiwash, and Combination Treatments**

| Parameter | DF | SS | MS | F-value | p-value |
|---|---|---|---|---|---|
| Plant Height | 3 | 182.67 | 60.89 | 9.15 | 0.001 |
| Leaf Area | 3 | 1140 | 380 | 19.23 | <0.001 |
| Biomass | 3 | 3375 | 1125 | 37.5 | <0.001 |
| Yield | 3 | 90000 | 30000 | 6 | 0.011 |

*Note: DF represents degrees of freedom, SS represents sum of squares, MS represents mean squares, F-value represents the F-statistic, and p-value represents the significance level.*

The ANOVA revealed significant effects of the treatments on all measured growth parameters. Vermiwash consistently led to the highest mean values in plant height, leaf area, biomass, and yield, indicating its superior effectiveness in promoting growth. The combination treatment also improved growth parameters but did not surpass Vermiwash alone. These results suggest that Vermiwash could be a valuable growth enhancer for onion crops and potentially benefit agricultural productivity.

## Soil Nutrition Status

### Nutrient Content Analysis

The nutrient content of *Jholmol*, Vermiwash, and their combination was analyzed to determine the percentage of nitrogen (N), phosphorus (P), potassium (K), and organic matter. The results are presented in Table 3.

**Table 3: Comparison of nutrient composition (%) in different treatments**

| Treatment | Nitrogen (%) | Phosphorus (%) | Potassium (%) | Organic Matter (%) |
|---|---|---|---|---|
| *Jholmol* | 0.35 | 0.18 | 0.25 | 5 |
| Vermiwash | 0.4 | 0.2 | 0.3 | 5.5 |
| Combination | 0.42 | 0.22 | 0.32 | 6 |

### Nitrogen Content

For nitrogen content, there was a significant effect of treatment type at the $p < 0.01$ level for the three conditions [$F(2, 87) = 9.5$, $p < 0.01$]. The mean square (MS) was calculated as 0.006 for the treatment effect.

### Phosphorus Content

Similarly, phosphorus content differed significantly between treatments [$F(2, 87) = 8$, $p < 0.05$], with a mean square of 0.004 for the treatment effect.

### Potassium Content

The potassium content also showed significant differences with treatment [$F(2, 87) = 10$, $p < 0.01$], and the mean square for the treatment effect was 0.0049.

### Organic Matter Content

The organic matter content analysis revealed the most substantial differences between treatments [$F(2, 87) = 12.5$, $p < 0.001$], with a treatment mean square of 0.025.

The detailed ANOVA results for each nutrient content are presented in Tables 4.

**Table 4: ANOVA results for nutrient content**

| Source of Variation | DF | SS | MS | F-value | p-value |
|---|---|---|---|---|---|
| Treatment | 2 | 0.012 | 0.006 | 9.5 | < 0.01 |
| Phosphorus Content | | | | | |
| Treatment | 2 | 0.008 | 0.004 | 8 | < 0.05 |
| Potassium Content | | | | | |
| Treatment | 2 | 0.0098 | 0.0049 | 10 | < 0.01 |
| Organic Matter Content | | | | | |
| Treatment | 2 | 0.05 | 0.025 | 12.5 | < 0.001 |

*Note: DF represents degrees of freedom, SS represents sum of squares, MS represents mean squares, F-value represents the F-statistic, and p-value represents the significance level.*

### Post hoc comparison

**Table 5: Post hoc comparison among different treatment**

| Comparison | Mean Difference | 95% Confidence Interval | p-Value | Significant at α = 0.05 |
|---|---|---|---|---|
| Vermiwash vs Control | 0.06 | 0.03 to 0.09 | <0.001 | Yes |
| *Jholmol* vs Control | 0.03 | 0.01 to 0.05 | 0.01 | Yes |
| Combination vs Control | 0.08 | 0.05 to 0.11 | <0.001 | Yes |
| Combination vs Vermiwash | 0.02 | 0.00 to 0.04 | 0.045 | Yes |
| Combination vs *Jholmol* | 0.05 | 0.02 to 0.08 | 0.002 | Yes |
| Vermiwash vs *Jholmol* | 0.03 | 0.01 to 0.05 | 0.015 | Yes |

The study investigated the comparative effectiveness of Vermiwash *Jholmol* and their combination in enhancing soil nutrient levels relative to an untreated control group. Results indicated significant improvements in soil nutrient content

across all treatments compared to the control.

The application of Vermiwash substantially enhanced soil nutrient levels, highlighting its efficacy as a soil conditioner. Similarly, *Jholmol* demonstrated a significant positive impact on soil nutrient content, though to a lesser extent than Vermiwash.

The combined application of Vermiwash and *Jholmol* exhibited the most significant improvement over the control group, showcasing a synergistic effect between the two fertilizers. This combined approach resulted in a notable enhancement in soil nutrient content, surpassing the effects observed with Vermiwash or *Jholmol* alone.

Furthermore, compared to individual applications, the combination treatment provided a statistically significant additional benefit over Vermiwash alone, emphasizing *Jholmol*'s complementary nature. Similarly, compared to *Jholmol* alone, the combination treatment exhibited a considerable improvement, indicating the superiority of the combined approach over the sole application of *Jholmol*.

While both Vermiwash and *Jholmol* contribute to soil nutrient enhancement, their combination elicits a synergistic effect, resulting in a more substantial improvement in soil quality than fertilizer alone. These findings underscore the potential of combined fertilizer approaches in optimizing soil nutrient levels and enhancing overall soil health.

**Discussion**

The current study's exploration into the effects of *Jholmol*, Vermiwash, and their combination on onion crop growth and soil nutrition provides valuable insights into sustainable agricultural practices. The results demonstrate that Vermiwash has a pronounced effect on the growth parameters of onion crops. This finding is consistent with the findings of Mujeera et al. (2024), who reported similar enhancements in crop performance with Vermiwash application. The high nutrient content, particularly macro-nutrients like nitrogen, phosphorus, and potassium in Vermiwash, is likely responsible for increased plant height, leaf area, biomass, and yield. The statistical significance of these results, as indicated by the F-statistics and p-values, confirms the reliability of Vermiwash as a growth stimulant.

However, the study also brings to light the importance of considering long-term soil health in addition to immediate crop yield. While Vermiwash excels in promoting growth, the combination of *Jholmol* and Vermiwash shows a superior impact on soil nutrition, which is evident by the significant improvements in soil nitrogen, phosphorus, potassium, and organic matter content. The combination treatment's effectiveness could be attributed to the synergistic effects of the nutrient rich Vermiwash and the microbial action of *Jholmol*, which is known to enhance soil microbial activity and thus improve soil structure and function. The improved soil structure can increase water retention, aeration, and nutrient availability, which are critical for sustainable crop production (Acevedo et al., 2022; Sullivan, 1999).

The implications of these findings extend beyond the immediate agricultural benefits. For instance, the improved soil health associated with the combination treatment could lead to reduced dependency on chemical fertilizers, which is a significant concern in sustainable agriculture due to their environmental impact, including soil degradation and water pollution (Pahalvi et al., 2021). By enhancing the natural fertility of the soil, the combination treatment aligns with the principles of organic farming, which emphasize the maintenance of ecological balance and biodiversity.

Moreover, the study's results suggest that the combination treatment could be particularly beneficial in the context of climate change. Healthy soils with high organic matter content are more resilient to extreme weather events, such as droughts and heavy rains. They can sequester carbon, thus contributing to climate change mitigation (Baveye et al., 2020). Therefore, the combination treatment not only improves crop yield and soil health but also potentially offers environmental benefits.

Future research should aim to understand the long-term impacts of these treatments on soil health and their effects on subsequent crop cycles. It would be beneficial to investigate the specific microbial populations influenced by *Jholmol* and how they interact with the nutrients provided by Vermiwash. Additionally, studies could explore the scalability of these treatments for larger agricultural systems and their economic viability for farmers.

**Conclusion**

This study conclusively demonstrates that while Vermiwash alone significantly enhances onion crop growth parameters, the combined application of *Jholmol* and Vermiwash provides a superior benefit in improving soil nutrition in essence, while Vermiwash may be the preferred choice for farmers aiming for immediate crop yield increases, the combination treatment offers a sustainable approach for maintaining soil health and ensuring agricultural productivity in the long run. This study advocates for an integrated crop management strategy that balances short-term yield objectives with the long-term sustainability of the soil ecosystem, potentially contributing to the resilience of agricultural practices in the face of environmental challenges.

**Acknowledgements**

This research was conducted as a part of the action under the GRAPE project (Green Resilient Agricultural Productive Ecosystems), and we are deeply thankful to the GRAPE FA 2 project for their generous financial support and pivotal role in facilitating and guiding this research. Our special gratitude goes to Bheriganga Rural Municipality of Bajura district for their collaboration and technical support during trial setup and data collection. We appreciate Kamal Aryal, Abid Hussain, and Sunil Dhungel for their meticulous review of the methodologies and the report.

## References

grilinks, 2020. Native technical knowledge: Organic package insect pest management in Nepal. Available at: https://agrilinks.org/post/native-technical-knowledge-organic-package-insect-pest-management-nepal [Accessed 3 May 2024].

Baveye, P.C., Schnee, L.S., Boivin, P., Laba, M. and Radulovich, R., 2020. Soil organic matter research and climate change: merely re-storing carbon versus restoring soil functions. Frontiers in Environmental Science, 8, p.579904.

Bhavya, K., Sumalatha, N., Archana, T. and Vijaya Lakshmi, K., 2021. A review vermiwash: a plant growth booster and a disease suppressor. Pharma Inno. J, 10(11), pp.2959-2962.

Blouin, M., Barrere, J., Meyer, N., Lartigue, S., Barot, S. and Mathieu, J., 2019. Vermicompost significantly affects plant growth. A meta-analysis. Agronomy for Sustainable Development, 39, pp.1-15.

Chandran, C.S., Thomas, S. and Unni, M.R. eds., 2019. Organic Farming: New Advances Towards Sustainable Agricultural Systems. Springer.

Dhakal, R., Ghimire, R., Sapkota, M., Thapa, S., Bhatta, A.K. and Regmi, R., 2019. Bioefficacy of different insecticides on cowpea aphid (Aphis craccivora Koch). International Journal of Entomological Research, 7(1), pp.01-07.

International Centre for Integrated Mountain Development (ICIMOD), 2016. Jholmal for small-scale farmlands. Available at: https://www.icimod.org/rms/jholmal-for-small-scale-farmlands/ [Accessed 6 May 2024].

Joshi, R., Singh, J. and Vig, A.P., 2015. Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth, yield and quality of plants. Reviews in Environmental Science and Bio/Technology, 14, pp.137-159.

Koirala, S., Yadav, A., Duwadi, D.C.S. and Kumar, S., 2021. Efficiency of different insecticides against major insect pest of summer squash (Cucurbita pepo) in Mandhana-Kanpur, UP, India.

Manyuchi, M., Chitambwe, T., Phiri, A., Muredzi, P. and Kanhukamwe, Q., 2013. Effect of vermicompost, vermiwash and application time on soil physicochemical properties.

Manyuchi, M.M., Phiri, A., Muredzi, P. and Chitambwe, T., 2013. Comparison of vermicompost and vermiwash bio-fertilizers from vermicomposting waste corn pulp.

Mohite, D.D., Chavan, S.S., Jadhav, V.S., Kanase, T., Kadam, M.A. and Singh, A.S., 2024. Vermicomposting: a holistic approach for sustainable crop production, nutrient-rich bio fertilizer, and environmental restoration. Discover Sustainability, 5(1), p.60.

Pahalvi, H.N., Rafiya, L., Rashid, S., Nisar, B. and Kamili, A.N., 2021. Chemical fertilizers and their impact on soil health. In: Microbiota and Biofertilizers, Vol 2: Ecofriendly tools for reclamation of degraded soil environs, 1-20.

Patnaik, P., Chyne, E., Abbasi, T. and Abbasi, S.A., 2022. Vermiwash: An Organic Fertilizer of Great Potential. In: Advances in Sustainable Development: Proceedings of HSFEA 2020, Springer Singapore, pp.15-27.

Pilbeam, C.J., Mathema, S.B., Gregory, P.J. and Shakya, P.B., 2005. Soil fertility management in the mid-hills of Nepal: Practices and perceptions. Agriculture and Human Values, 22, pp.243-258.

Sullivan, P., 1999. Sustainable soil management. Appropriate Technology Transfer for Rural Areas.

Tripathi, B.P., 2019. Sustainable soil fertility management practices in Nepal. Acta Scientific Agriculture, 3(4), pp.112-113.

Varshini, S.V. and Jayanthi, C., 2020. Organic liquid manures and bio-fertilizers: A tool for soil and crop productivity. Agricultural Reviews, 41(4), pp.387-392.

Yatoo, A.M., Ali, M.N., Baba, Z.A. and Hassan, B., 2021. Sustainable management of diseases and pests in crops by vermicompost and vermicompost tea. A review. Agronomy for Sustainable Development, 41(1), p.7.