The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
20(2): S2: 614-617, 2025 www.thebioscan.com

# GROWTH RESPONSE OF MUSTARD AND GREEN GRAM PLANTS TO AQUARIUM WASTEWATER IRRIGATION

**Vijay Krishanan[*1], Devasena, B [2], Nafisa Farheen [3], Shobana, S [4] and Geetha, C[5]**

[*1 & 2]Peri college of physiotherapy, Chennai -48

[3] Peri college of Pharmacy, Chennai -48

[4] Peri Institute of Technology, Chennai - 48

[5] Peri college of Nursing, Chennai -48

Corresponding mail id: publications@peri.ac.in

**DOI: 10.63001/tbs.2025.v20.i02.S2.pp614-617**

KEYWORDS
Aquarium wastewater, mustard,
green gram, irrigation, plant growth,
wastewater reuse

Received on:

08-04-2025

Accepted on:

05-05-2025

Published on:

05-06-2025

## ABSTRACT

Aquarium wastewater contains organic matter, beneficial bacteria, and essential nutrients that can potentially improve plant growth. This study investigates the effects of aquarium wastewater on the germination and growth of mustard (Brassica juncea) and green gram (Vigna radiata). Seeds were grown under different treatments involving wastewater concentrations. Morphological parameters such as plant height, leaf size, and germination rate were recorded. Results revealed enhanced growth in mustard compared to green gram, suggesting that non-leguminous crops respond more favorably to aquarium wastewater. The findings support the eco-friendly reuse of fish tank effluent in sustainable agriculture.

## INTRODUCTION

Rapid urbanization and industrialization have led to significant water pollution, affecting freshwater availability for agriculture. Reusing nutrient-rich wastewater, such as aquarium effluents, is gaining attention as a sustainable alternative. Aquarium water contains nitrogen, phosphorus, and beneficial microorganisms that support plant development. However, not all wastewater types are suitable; factors like chemical additives or salt content must be considered. This study aims to evaluate the growth response of leguminous and non-leguminous plants, particularly mustard and green gram, to irrigation with aquarium wastewater.

Although aquarium water may initially emit an unpleasant odor, it typically dissipates within an hour. Despite its nutritional value, not all aquarium water is suitable for plant irrigation. Water from saltwater aquariums should be avoided, particularly for potted or edible plants, due to the harmful effects of excess salinity. Additionally, water treated with chemicals—such as pH adjusters, ammonia neutralizers, or fish medications—should not be reused for edible crops, as residual compounds can be detrimental to plant health and potentially enter the food chain. In aquariums with poor maintenance and heavy sludge buildup, the wastewater should be applied sparingly to avoid over-fertilization. Sludge from outdoor pond filters may also be used, preferably diluted, to enrich soil nutrients. The growing concern over the presence of contaminants in irrigation water such as pesticides, heavy metals, and organic pollutants has made water quality monitoring in agriculture increasingly important. Polluted irrigation water can adversely affect crop physiology and ultimately impact human and animal health via the food chain.

Many developed countries are actively promoting the treatment and reuse of wastewater in agriculture. However, the effectiveness and safety of such practices depend on careful evaluation of water quality and its impact on crops. Certain plant species exhibit high sensitivity to contaminants and can serve as bioindicators in eco-toxicological assessments. Standard phytotoxicity bioassays often utilize germination rate, root elongation, and shoot length as rapid and reliable indicators of water toxicity due to their sensitivity, cost-effectiveness, and ease of measurement.

The objective of this study is to assess the physiological and morphological responses of selected cultivated plants—namely mustard (Brassica juncea), cucumber (Cucumis sativus), barley (Hordeum vulgare), and maize (Zea mays)—to irrigation with different types of water, including aquarium wastewater. The study also aims to identify the most suitable water type (alkaline, acidic, tap, deionized, or distilled) to serve as a control in bioassays.

In addition, advances in inoculum production for arbuscular mycorrhizal (AM) fungi have shifted from traditional pot culture to modern methods such as hydroponics, nutrient film technique, aeroponics, and in vitro root organ culture. Despite these innovations, pot culture remains the most widely used approach. With urbanization contributing to the accumulation of various organic wastes, recent studies have explored their application in enhancing AM fungal growth. Notably, while many substrates have been investigated, the use of mustard seed waste for AM fungal inoculum production remains underexplored. This study also briefly discusses the potential of mustard seed waste as a substrate for mass production of AM fungi, particularly Acaulospora laevis and Glomus mosseae, using wheat and barley as host plants.

## 2. LITERATURE REVIEW

Mangla et al. [1]. Inoculum Production of Endophytic Mycorrhiza Using Mustard Seed Waste as Substrate This study explored a sustainable approach for mass-producing endophytic mycorrhizal inoculum using mustard seed waste. It shows that agro-waste can be repurposed for microbial culture development, which can enhance plant growth and stress tolerance, especially in low-fertility or polluted soils. Ankley et al. [2] .Development and Evaluation of Test Methods for Benthic Invertebrates and Sediments Though focused on benthic invertebrates, this paper contributes to phytotoxicity test methodologies. It is relevant for designing controlled exposure experiments involving wastewater and plant systems under various flow and feeding regimes.Bojovic et al[3]. Effects of NaCl on Seed Germination in Brassicaceae and Solanaceae SpeciesThis study analyzed the inhibitory effects of salt stress (NaCl) on germination across multiple species. Salinity-induced delay or reduction in germination and seedling vigor provides comparative insight into similar responses under wastewater stress conditions containing saline or ionic components.

Gong et al. [4].Continuous Seed Germination and Early Growth Test for Soil Ecotoxicology.This foundational work developed a standardized germination assay for soil ecotoxicology. It underscores the significance of seed germination and root elongation as sensitive indicators of environmental toxicity, supporting wastewater impact assessments. Kanae [5]. VGlobal Warming and the Water Crisis While not experimental, this paper contextualizes environmental stress impacts on water availability and agriculture, especially under climate change. It indirectly supports the argument for alternative water sources like treated wastewater for irrigation. Kungolos et al [6]. Bioassays for Wastewater Evaluation The authors emphasize using plant-based bioassays to assess effluent quality. The paper supports the idea that germination tests and phytotoxicity assessments are essential in evaluating the reusability of wastewater in agriculture. Ling et al[7] Mercury Effects on Seed Germination and Growth This study showed how heavy metals (like Hg) inhibit seed germination and early seedling development in vegetables. It offers toxicological benchmarks useful in comparing the effects of trace contaminants in aquarium or industrial wastewater. Liu et al [8] Heavy Metal Contamination from Sewage Irrigation The paper presents evidence of heavy metal accumulation in soils and crops due to long-term wastewater irrigation. It highlights concerns regarding crop safety and soil degradation, emphasizing the need for monitoring and treatment before wastewater reuse.

Mahmood et al [9]. Copper and Zinc Stress on Maize Germination Focusing on trace metals, the study found that increasing concentrations of Cu and Zn inhibited maize seed germination and root growth. This reinforces the relevance of assessing micronutrient and heavy metal levels in recycled water. Srivastava & Singh [10]. Insecticide Effects on Germination and Genetic Changes in Barley Profenophos exposure caused not only germination inhibition but also chromosomal anomalies and chlorophyll mutations in barley. This suggests that pollutants in wastewater can have genetic and physiological impacts beyond visible growth metrics. Tal [11]. Israel's Water Management Strategy This policy-oriented study discusses the integration of treated wastewater in agriculture. It serves as a real-world case showing how treated effluents, if managed correctly, can support irrigation without compromising crop health.

Wang et al [12]. Phytotoxicity Bioassays Using Cucumber This research validated germination and root elongation in cucumber as reliable endpoints for toxicity testing. It supports the use of simple, rapid bioassays to screen wastewater quality before agricultural application. Ayyasamy et al [13]. This study demonstrates that bioremediated sago effluent improved seed germination in green gram and maize compared to untreated effluent, highlighting the potential of microbial treatment in reducing effluent toxicity and enabling its reuse in agriculture. Begum et al [14]. The research presents how untreated effluents significantly inhibit germination rate, root length, and shoot length. The study emphasizes the phytotoxic nature of industrial discharges and the variability of response based on plant species. Jaiswal [15] The effluent impacted Brassica germination negatively at high concentrations, with visible root toxicity. The results are directly applicable to mustard (as Brassica), and suggest caution in using such effluents without treatment. Rana et al [16]. This study showed dose-dependent inhibition of germination, with higher effluent concentrations delaying germination and reducing seedling biomass. The leafy vegetables studied showed species-specific tolerance levels.

Mizan [17] Industrial effluents inhibited Cicer arietinum germination by interfering with water uptake and enzyme activity. The findings indicate a broader relevance for legumes like green gram and suggest careful analysis of effluent composition before use. Ali et al[18]. Sewage effluent irrigation increased plant biomass but altered soil pH and nutrient levels. This points to a dual effect—plant growth promotion under certain conditions but potential long-term soil quality degradation. Ayyasamy et al [19]. Both terrestrial and aquatic plants experienced decreased chlorophyll content and biomass with untreated effluent. The paper supports using biochemical markers (like chlorophyll) alongside germination data to evaluate wastewater toxicity.

Doke et al[20]. Significant inhibition of seed germination and elongation was observed, especially in legumes such as Vigna. This parallels expected responses in green gram and mustard and confirms sugar effluents' phytotoxicity at untreated levels. Damodharan & Reddy[21]. Treated effluents, when appropriately diluted, enhanced sugarcane growth. The findings suggest that treatment and dilution of effluent are key in reducing toxic effects and potentially offering a nutrient source.Almodares & Sharif [22]. This study reports reduced sugar content and biomass in plants irrigated with saline or low-quality water. It underlines the need for quality screening of irrigation water to ensure crop productivity and biochemical integrity. Abdul & Sirajudeen [23]. The presence of nitrates, heavy metals, and EC (electrical conductivity) beyond permissible limits in groundwater used for irrigation poses long-term risks to crop health. This research is relevant for evaluating aquarium or recycled water use.

### 3. METHODOLOGY

**SAMPLE COLLECTION AND EXPERIMENTAL SETUP**

In controlled laboratory conditions, the effects of two types of water with varying qualities were evaluated on the physiological and morphological parameters of mustard (Brassica juncea) seeds, owing to their high sensitivity in phytotoxicity assays. For each treatment group, 25–30 seeds were placed on pleated filter paper inside plastic germination trays (21 × 15 × 5 cm). The filter paper was pre-moistened with 25 mL of the respective test water.

Each germination tray was sealed using a nested plastic cup and lid system to minimize evaporation and maintain consistent humidity. The trays were then incubated in the dark at a controlled temperature of 20 –25 °C for seven days. At the end of the incubation period, key growth indicators including germination percentage, root length (cm), and shoot length (cm) were recorded. This experimental protocol aligns with national regulations for evaluating seed quality in agricultural crops.

**SOIL SAMPLING METHODOLOGY**

**SAMPLING TOOLS:**

Soil samples were collected using standard agricultural tools, including spades and pick-axes. In cases where manual tools were not required, open furrow techniques were employed to obtain representative soil samples.

**SAMPLE COLLECTION BAGS:**

Samples were stored in clean, dry plastic or cloth bags to prevent contamination during transport and storage.

**SAMPLING PROCEDURE:**

To ensure the accuracy of nutrient analysis, soil samples were collected from the plow layer (approximately 2–6 inches depth), which is considered optimal for representing available nutrient levels in cultivated land. If the collected soil was moist, it was air-dried under shade to preserve its physical and chemical integrity prior to laboratory analysis.

**ESTIMATION OF AVAILABLE NITROGEN, PHOSPHORUS, AND POTASSIUM IN SOIL**

**ESTIMATION OF AVAILABLE NITROGEN**

**REAGENTS:**

- Nitrogen Reagent-1 (N-1)
- Nitrogen Reagent-2 (N-2)
- Decolourizer (D-1)

**PROCEDURE:**

1. Weigh 0.5 grams of air-dried soil into a measuring tube (Tube No. 1) and transfer it into a soil mixing tube (Tube No. 2).
2. Add 5 mL of Nitrogen Reagent-1 (N-1) to the soil sample and shake the mixture for 5–10 minutes.
3. Add a pinch of Decolourizer (D-1) and mix thoroughly. Filter the mixture using filter paper and a funnel into a colour development bottle (Tube No. 3).
4. To the clear filtrate, add 2 drops of Nitrogen Reagent-2 (N-2) and mix well. Allow 1–2 minutes for color development.
5. Compare the resulting colour with the standard nitrogen colour chart and record the level as Low (L1, L2), Medium (M1, M2), or High (H1, H2).
6. Discard the used solution and thoroughly clean all glassware and plasticware.

**ESTIMATION OF AVAILABLE PHOSPHORUS**

**REAGENTS:**

- Phosphorus Reagent-1 (P-1)
- Phosphorus Reagent-2 (P-2)
- Decolourizer (D-1)

**PROCEDURE:**

1. Weigh 0.5 grams of soil into a measuring tube (Tube No. 1) and transfer to a mixing tube (Tube No. 2).
2. Add 5 mL of Phosphorus Reagent-1 (P-1) and mix for 15 minutes.
3. Add a pinch of Decolourizer (D-1) and mix thoroughly. Filter the sample using filter paper into a colour development bottle (Tube No. 3).
4. Add 2 mL of Phosphorus Reagent-2 (P-2) to the clear filtrate and mix well. Allow 1–2 minutes for color development.
5. Match the colour with the phosphorus colour chart and record the result as Low (L1, L2), Medium (M1, M2), or High (H1, H2).
6. Discard the sample solution and wash all apparatus thoroughly.

**ESTIMATION OF AVAILABLE POTASSIUM**

**REAGENTS:**

Potassium Reagent-2 (K-2)

**PROCEDURE:**

1. Using the same clear filtrate obtained from the phosphorus estimation step, add 1 mL of Potassium Reagent-2 (K-2).
2. Mix thoroughly and allow 1–2 minutes for the colour to develop.
3. Compare the colour with the potassium colour chart and classify the result as Low (L1, L2), Medium (M1, M2), or High (H1, H2).
4. Discard the remaining solution and clean all glassware and materials used.

**Table 1: Growth-germination of mustard Seedlings.**

| S. No | Branches | Samples | Height of The Plants (Cm) | Height of The Leaves (Cm) | No. of The Plants |
|---|---|---|---|---|---|
| 1 | 4 | Control | 10 cm | 1.2 cm | 29 |
| 2 | 2 | Layer 1 | 12 cm | 1.4 cm | 25 |
| 3 | 2 | Layer 2 | 9 cm | 1.2 cm | 23 |
| 4 | 4 | Control+layer1 | 12 cm | 1.2 cm | 24 |
| 5 | 2 | Control+layer2 | 10 cm | 1.3 cm | 23 |

**Table 2: Soil Characterization in mustard Seedlings**

| S. No | Samples | Nitrogen | Phosphorus | Potassium |
|---|---|---|---|---|
| 1. | S1 | Medium | Low | Low |
| 2. | S2 | High | Medium | Medium |
| 3. | S3 | Medium | Low | Low |
| 4. | S4 | Medium | Medium | Low |
| 5. | S5 | Low | Low | Low |

### 4. RESULTS AND DISCUSSION:

## DISCUSION

Mustard plants showed superior growth metrics compared to green gram. The higher nutrient availability in the wastewater contributed to enhanced biomass. However, prolonged or excessive application may lead to nutrient imbalances or toxicity. These findings suggest a positive but moderated use of aquarium wastewater for non-legume crops.

## CONCLUSION

Aquarium wastewater, rich in macro and micronutrients, promotes the growth of mustard more effectively than green gram. The study supports the reuse of such effluent for sustainable agricultural practices, especially for non-leguminous crops.

## REFERENCES


- Chhavi Mangla1, Aditya Kumar, Ashok Aggarwal(2012).“Inoculum Production of EndophyticMycorrhiza Using Mustard Seed Waste as Substrate”. Journal on New Biological, 1(2): 61-66 .
- 2.Ankley G.T, Benoit D.A, Hoke R.A, Leonard E.N, W e s t C.W. (1993).“Phytotoxicity of olive mill wastewter fractions and their potential use as a selective Development and evaluation of test methods for benthic invertebrates and sediments: Effects of flow rate and feeding on water quality and exposure conditions”. Archives of Environmental Contamination and Toxicology, 25:12-19.
- Bojovic B, Delic G , Topuzovic M, Stankovic M(2010). “Effects of NaCl on seed germination in some species from families Brassicacae and Solanacae”.Kragujevac j. sci., 32, 83-87.
- Gong P, Wilke B.M. ,Strozzi E, Fleischmann S. (2001).“Evaluation and ferinement of a continious seed germinaton and early seedling growth test for the use in the ecotoxicological assessment of soils”. Chemosphere, 44, 491-500.
- Kanae S . (2009).“Global warming and the water crisis”. J Health Sci, 55, 860–864.
- Kungolos A, Emmanouil C,Bakopoulo u , Petala M (2011).“Bioassays as a means of ecotoxicological evaluation of wastewater quality”. Environ SciPollut Res,74, 188-194.
- Ling T , Fangke Y, Jun R (2010).“Effect of mercury to seed germination, coleoptile growth and root elongation of four vegetables”.Research journal of phytochemistry, 4, 225-233.
- Liu W. H , Z hao J . Z ,Ouyang Z . Y ,Soderlund L , Liu G . H (2005). “Impacts of sewage irrigation on heavy metals distribution and contamination”. Environment International, 31: 805–812.
- Mahmood S, Hussain A , Saeed Z , Athar M (2005).“Germination of seedling growth of maize (Zea mays L.)under varying levels of copper and zink”. Int.J.Environ.Sci.Tech, 2, (3), 269-274.
- Srivastava A. K, Sngh A . K (2009). “Effects of insecticide profenophos on germination, early growth meiotic behavior and chlorphyll mutation on barly (Hordeumvulgare L.)”.ActaPhysiol Plant, 31, 537-544.
- 11.Tal A(2006).“Seeking sustainability: Israel's evolving water management strategy”. Science, 313, 1081–1084.
- 12. Wang X , Sun C, Gao, Shixiang, Wang L, Shokui H (2001).“Validation of germination rate and root elongation as indicator to assess phytotoxicity with Cucumissativus”. Chemosphere, 44, 1711-1721.
- 13. Ayyasamy, P.M., Banuregha, R., Vivekanandhan, G., et al. (2008). Bioremediation of sago industry effluent and its impact on seed germination (green gram and maize). World Journal of Microbiology and Biotechnology, 24, 2677–2684.
- 14. Begum, A., Alam, M., Rahman, M., & Rahman, M. (2021). Effect of industrial effluents on the germination and seedling growth of three leafy vegetables. Academia.edu.
- 15. Jaiswal, P. (2023). Assay on the impact of vegetable oil mill effluent on seed germination and seedling growth of Brassica campestris L. and Oryza sativa L. Academia.edu.
- 16. Rana, M.S., et al. (2019). Effect of industrial effluents on germination of summer leafy vegetables. Academia.edu
- 17. Mizan, S. (2019). Effect of industrial effluents on seed germination and early growth of Cicer arietinum. ResearchGate.
- 18. Ali, H.M., Khamis, M.H., & Hassan, F.A. (2012). Growth, chemical composition and soil properties of Tipuana speciosa seedlings irrigated with sewage effluent. Applied Water Science, 2, 101–108.
- 19. Ayyasamy, P.M., Yasodha, R., Rajakumar, S., et al. (2008). Impact of sugar factory effluent on the growth and biochemical characteristics of terrestrial and aquatic plants. Bulletin of Environmental Contamination and Toxicology, 81, 449–454.
- 20. Doke, K.M., Ejazuddin, M.K., Joseph, R., & Asif, S. (2011). Physico-chemical analysis of sugar industry effluent and its effect on seed germination of Vigna angularis, Vigna cylindrical and Sorghum cernum. Annals of Environmental Science, 5, 7–11.
- 21.Damodharan, U., & Reddy, M.V. (2012). Impact of sugar industrial treated effluent on the growth factor in sugarcane. Journal of Sustainable Bioenergy Systems, 2, 43–48.
- 22. Almodares, A., & Sharif, M.E. (2007). Effects of irrigation water qualities on biomass and sugar contents of sugar beet and sweet sorghum cultivars. Journal of Environmental Biology, 28(2), 213–218.
- 23. Abdul, J.A., & Sirajudeen, J. (2006). Risk assessment of physicochemical contaminants in groundwater of Pettavaithalai area, Thiruchirappalli, Tamil Nadu, India. Environmental Monitoring and Assessment, 123, 299–312.
- 24. Augusthy, P.O., & Annsherin, M. (2001). Effect of factory effluent on seed germination and seedling growth of Vigna radiatus (L.). Journal of Environmental Research, 22(2), 137–139.
- 25. Aery, N.C. (2010). Manual of Environmental Analysis. Anne Books Pvt. Ltd
- 26. APHA. (2005). Standard Methods for the Examination of Water and Wastewater. American Public Health Association.
- 27. Bouwer, H. (2000). Integrated water management: Emerging issues and challenges. Agricultural Water Management, 45(3), 217–228.
- 28. Morrison, G., Fatoki, O.S., Persson, L., & Ekberg, A. (2001). Assessment of the impact of point source pollution from the Keiskammahoek Sewage Treatment Plant on the Keiskamma River. Water SA, 27(4), 475–480
- 29. Kaur, R., Wani, S.P., Singh, A.K., & Lal, K. (2012). Wastewater production, treatment, and use in India. Proceedings of the 2nd Regional Workshop on the Safe Use of Wastewater in Agriculture, New Delhi, India.
- 30. Amathussalam, A., Abusbacker, M.N., & Jayabal, N.J. (2002). Physico-chemical parameters and concentration of heavy metals in the sugar industry. Industrial Pollution Control, 1(3), 118–119
- 31. Antonelli, M., et al. (1999). Effects of wastewater reuse on the soil and crops. Water Science and Technology, 40(4-5), 241–247.