

Ornamentals

for Sustainable Use of Waste Water

1. Babita Singh

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012
Email: bflori17feb@gmail.com

2. Chandushree S.

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

3. Ritu Jain

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

4. Ajai Tiwari

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

5. Keerthana S.

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

6. Madhavi K.

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

7. Naveen K.

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

8. Lava Kumar

Division of Floriculture & Landscaping, ICAR-IARI, New Delhi-110012

Received: May, 2024; Accepted: May, 2024; Published: July, 2024

A significant amount of wastewater is being produced in recent years due to the high rate of industrialization and urbanization. Insufficient choices for treating wastewater can result in the release of untreated wastewater into the aquatic environment, which can degrade its quality. This wastewater can contain organic matter, inorganic and organic compounds, poisonous substances, and disease-causing agents. Because of their high persistence in the environment and detrimental effects on human metabolism and the ecosystem, hazardous substances like heavy metals make us concerned about their remediation. Many different types of contaminants, including pesticides, petroleum hydrocarbons, explosives, radionuclides, heavy metals, wastewater from homes and businesses, textile dye effluents, and more, can be treated with ornamental plants. This treatment approach, which is economical, non-intrusive, and

environmentally friendly, solves the drawbacks of traditional wastewater treatment techniques. Wastewater poses the greatest danger to the immediate ecosystem. Where untreated water discharges fluently, this presents various complications in managing the challenges of giving clean water to rural and urban areas. Water pollution problems are primarily caused by effluents of wastewater, which causes eutrophication. However, these may boost algae growth and increase purification costs, health concerns for cattle and humans, and excessive Oxygen loss can lead to a variety of changes in Population of aquatic ecosystems. Pollutants include dyes, heavy metals, and organic chemicals and inorganic compounds of dangerous nature can pose significant threats to human health. Reducing the contaminant level in soil plants can be used as a cost-effective method that reduces the risk to the ecosystem and human health damaged by contaminated sites. Plants absorb pollutants mostly through

their root systems, preventing toxicity. Furthermore, root systems create a huge surface area that gathers and absorbs the necessary nutrients and water for growth, as well as non-significant impurities, which help to remediate the contaminants from wastewater and make it clean. This process is called phytoremediation.

Types of Wastewater

1. **Greywater:** Relatively clean wastewater from baths, sinks, washing machines, and other kitchen appliances. It's generally safer for use in irrigation.
2. **Blackwater:** Wastewater from toilets and industrial sources, containing human waste and potentially harmful chemicals. It requires extensive treatment before use.



Benefits

1. **Water Conservation:** Reduces the demand on freshwater resources.
2. **Nutrient Supply:** Wastewater often contains nutrients like nitrogen and

Methods of Application

1. **Drip Irrigation:** Minimizes water contact with plant leaves and flowers, reducing the risk of spreading pathogens.
2. **Subsurface Irrigation:** Delivers water directly to the root zone, further reducing the risk of pathogen exposure.

Using wastewater for irrigating ornamental plants can be an effective way to conserve water, especially in areas facing water scarcity. However, it requires careful management to ensure the safety and health of both the plants and the environment. Here are some considerations and guidelines for using wastewater in ornamentals:

- phosphorus, which can benefit plant growth.
3. **Cost Savings:** Reduces the cost of water supply and wastewater treatment.
4. **Environmental Protection:** Reusing treated wastewater can mitigate the discharge of pollutants into water bodies, thus protecting aquatic ecosystems. Properly treated wastewater used for irrigation could reduce nutrient runoff and eutrophication in adjacent water systems.

Considerations

1. **Water Quality:** The quality of wastewater must be monitored to ensure it is safe for plants and the environment. This includes checking for pathogens, chemicals, salts, and heavy metals.
2. **Treatment Level:** The wastewater should be treated to a level appropriate for the type of plants being irrigated. Greywater might require minimal treatment, while blackwater requires more extensive treatment.
3. **Soil Health:** Long-term use of wastewater can affect soil health. Regular soil testing can help manage any buildup of harmful substances.
4. **Regulations:** Compliance with local regulations and guidelines is crucial. Many regions have specific rules governing the use of wastewater for irrigation.

3. **Sprinkler Irrigation:** Should be used cautiously, as it can increase the risk of pathogen spread.

Plant Selection

- **Tolerant Species:** Choose ornamental plants that are tolerant of varying water qualities. Some plants are more resilient to the potential salts and chemicals in wastewater.
- **Native Species:** Often more adaptable to local conditions and can be more resilient to the components of treated wastewater.

Monitoring and Maintenance

1. **Regular Testing:** Monitor water quality, soil health, and plant health regularly.
2. **System Maintenance:** Keep irrigation systems clean and well-maintained to prevent clogging and ensure even distribution of water.

Use in Landscaping

- **Urban Landscaping:** Many cities have implemented wastewater irrigation systems for public parks and green spaces.

- **Botanical Gardens:** Some botanical gardens use treated wastewater to maintain diverse plant collections.

Using wastewater for irrigation can be particularly effective for certain ornamental plants that are more tolerant to varying water qualities. Here's a list of some ornamental plants that are often used with wastewater irrigation, along with brief descriptions of their characteristics and tolerance levels:

Trees

1. **Eucalyptus species:** Fast-growing and drought-tolerant, often used in landscapes and as windbreaks.
2. **Willow (*Salix spp.*):** Known for their high water uptake, they are often used in wastewater treatment wetlands.
3. **Oleander (*Nerium oleander*):** A hardy shrub or small tree that is drought-resistant and tolerant of poor soil conditions.



Nerium oleander



Salix spp.



Lavandula spp.

Shrubs

1. **Lavender (*Lavandula spp.*):** Aromatic and drought-tolerant, ideal for dry climates.
2. **Rosemary (*Rosmarinus officinalis*):** An evergreen shrub that is tolerant to drought and poor soil.
3. **Bougainvillea (*Bougainvillea spp.*):** A colorful, drought-tolerant vine that thrives in sunny conditions.

Groundcovers

1. **Lantana (*Lantana camara*):** Hardy and drought-tolerant, with vibrant flowers that attract butterflies.
2. **Ice Plant (*Delosperma spp.*):** A succulent groundcover that is highly drought-tolerant and blooms brightly.

3. **Sedum (*Sedum spp.*):** A diverse group of succulents that are highly tolerant of dry conditions.

Perennials

1. **Daylily (*Hemerocallis spp.*):** Known for their hardy nature and vibrant flowers.
2. **Agapanthus (*Agapanthus spp.*):** Tolerant to a range of soil types and known for their striking blue or white flowers.
3. **Yucca (*Yucca spp.*):** Drought-tolerant with dramatic, spiky leaves and tall flower stalks.

Grasses and Sedges

1. **Fescue (*Festuca spp.*):** Often used in ornamental grasses, they are tolerant to drought.

2. **Pampas Grass (*Cortaderia selloana*):** An ornamental grass that is very tolerant of drought and poor soil conditions.
3. **Carex (*Carex spp.*):** A type of sedge that can thrive in a variety of conditions, including wetter soils.

Vines and Climbers

1. **Trumpet Vine (*Campsis radicans*):** A vigorous climber with bright, trumpet-shaped flowers.
2. **Honeysuckle (*Lonicera spp.*):** Known for its fragrant flowers and adaptability.
3. **Jasmine (*Jasminum spp.*):** Fragrant and adaptable to various soil conditions.

Flowers

1. **Marigold (*Tagetes spp.*):** Hardy annuals that are easy to grow and tolerant of various soil conditions.



Tagetes erecta



Zinnia aungustifolia



Petunia

2. **Zinnia (*Zinnia spp.*):** Colorful and drought-tolerant, ideal for adding vibrant colors to gardens.
3. **Petunia (*Petunia spp.*):** Tolerant of a wide range of conditions and available in many colors.

Cacti and Succulents

1. **Aloe Vera (*Aloe vera*):** Known for its medicinal properties and tolerance to drought.
2. **Echeveria (*Echeveria spp.*):** A popular succulent that thrives in dry conditions.
3. **Opuntia (*Opuntia spp.*):** Commonly known as prickly pear, it is very drought-tolerant and has attractive flowers.

When selecting ornamentals for wastewater irrigation, it's important to consider the specific quality of the wastewater and the soil conditions. Regular monitoring and adjustments may be necessary to ensure the health of the plants and soil. Ornamental plants can play a significant role in the removal of pollutants from wastewater through various mechanisms. These mechanisms include phytoextraction, phytodegradation, rhizofiltration, and phytostabilization. Here are some ornamental plant species known for their ability to treat wastewater and the pollutants they can help to remove:

Trees and Shrubs

1. **Willow (*Salix spp.*)**
 - **Pollutants Removed:** Heavy metals (cadmium, zinc), nutrients (nitrogen, phosphorus)
 - **Mechanism:** Phytoextraction, rhizofiltration
 - **Description:** High water uptake, fast growth, often used in constructed wetlands.
2. **Eucalyptus (*Eucalyptus spp.*)**
 - **Pollutants Removed:** Heavy metals (lead, cadmium), organic pollutants
3. **Oleander (*Nerium oleander*)**
 - **Mechanism:** Phytoextraction, phytodegradation
 - **Description:** High evapotranspiration rate, suitable for large-scale applications.
4. **Phragmites australis (Common Reed)**
 - **Mechanism:** Phytoextraction, phytodegradation
 - **Description:** Hardy and drought-resistant, suitable for ornamental use in arid regions.

- **Pollutants Removed:** Nutrients (nitrogen, phosphorus), heavy metals, organic pollutants
- **Mechanism:** Rhizofiltration, phytodegradation
- **Description:** Common in wetlands, effective in large-scale wastewater treatment systems.



Phragmites australis

Aquatic Plants

6. Canna (*Canna indica*)

- **Pollutants Removed:** Nutrients (nitrogen, phosphorus), heavy metals
- **Mechanism:** Rhizofiltration, phytoextraction
- **Description:** Attractive flowers, commonly used in constructed wetlands for wastewater treatment.

7. Water Hyacinth (*Eichhornia crassipes*)

- **Pollutants Removed:** Nutrients, heavy metals, organic pollutants
- **Mechanism:** Rhizofiltration, phytoextraction
- **Description:** Rapid growth, effective in removing pollutants from water bodies, but can become invasive.

8. Duckweed (*Lemna minor*)

- **Pollutants Removed:** Nutrients, heavy metals, organic pollutants
- **Mechanism:** Rhizofiltration, phytoextraction
- **Description:** Small floating plant, highly effective in nutrient removal, rapid growth.

Perennials and Flowering Plants

9. Sunflower (*Helianthus annuus*)

- **Pollutants Removed:** Heavy metals (lead, arsenic), nutrients

5. Vetiver Grass (*Chrysopogon zizanioides*)

- **Pollutants Removed:** Heavy metals (lead, zinc), nutrients, organic pollutants
- **Mechanism:** Phytoextraction, phytostabilization
- **Description:** Deep root system, highly effective in soil and water remediation.



Chrysopogon zizanioides

- **Mechanism:** Phytoextraction, phytostabilization
- **Description:** Attractive flowers, known for heavy metal uptake, used in phytoremediation projects.

10. Marigold (*Tagetes spp.*)

- **Pollutants Removed:** Heavy metals (cadmium, lead), organic pollutants
- **Mechanism:** Phytoextraction, phytodegradation
- **Description:** Bright flowers, easy to grow, used in various phytoremediation studies.

Mechanisms of Pollutant Removal

- **Phytoextraction:** Plants absorb contaminants through their roots and store them in their stems, leaves, or other tissues.
- **Phytodegradation:** Plants break down contaminants through metabolic processes.
- **Rhizofiltration:** Plant roots absorb, concentrate, and precipitate heavy metals from contaminated water.
- **Phytostabilization:** Plants immobilize contaminants in the soil, preventing their movement and reducing their bioavailability.

Implementation

- **Constructed Wetlands:** Mimic natural wetlands to treat wastewater using plants like Phragmites, Canna, and Typha.

- **Green Roofs and Vertical Gardens:** Incorporate ornamental plants with phytoremediation capabilities.
- **Landscaped Biofilters:** Integrate ornamental plants in designed landscapes to treat stormwater and greywater.

Conclusion

Using wastewater for irrigating ornamental plants can be a sustainable practice if managed correctly. It requires careful consideration of water quality, plant selection, and irrigation methods to ensure the health of the plants and the environment. By adhering to best practices and local regulations, it is possible to effectively use wastewater in ornamental horticulture. In urban and peri urban regions, ornamental plants can be used to mitigate climate change, reduce soil and air pollution,

Regular monitoring and maintenance are essential to ensure the effectiveness of ornamental plants in pollutant removal. Selecting the right species based on the specific contaminants and environmental conditions is crucial for successful wastewater treatment.

provide food for residents, and create gathering places for young people and seniors. Plants effectively remediate contaminants in wastewater, indicating their potential importance in the future. Plants can remove toxins from wastewater that tiny and microbes cannot. Along with this ornamental plants bring aesthetic appeal to that place. New avenues of phytoremediation have to be addressed using these plants.