

Nutgrass (*Cyperus rotundus*): World's most troublesome weed

Lalita H. Saini¹, A. K. Saini², and Nitaben K. Kuniya³

¹Assistant Research Scientist, Centre for Crop Improvement, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat 385 506

²Assistant Research Scientist, Centre for Natural Resources Management, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat 385 506

³Agriculture Officer, Department of horticulture, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat 385 506

Corresponding Author: aksaini.agro@sdau.edu.in

Weeds are among the most important biological constraints limiting agricultural productivity worldwide. They compete aggressively with crops for water, nutrients, sunlight, and space, resulting in substantial yield losses and increased production costs. Among the thousands of weed species found across agricultural landscapes, *Cyperus rotundus* L., commonly known as purple nutsedge, nutgrass, motha, nagarmotha, or purple sedge, occupies a unique position because of its extraordinary persistence, adaptability, and competitive ability.

Purple nutsedge has been recognized as one of the world's worst weeds due to its widespread distribution and remarkable capacity to survive under diverse environmental conditions. It infests more than 90 countries and affects over 50 crops, including cereals, pulses, oilseeds, vegetables, fruits, plantation crops, and ornamental plants. Its ability to reproduce through underground tubers and rhizomes makes it particularly difficult to eradicate. Unlike annual weeds that can be managed through seasonal control measures, purple nutsedge persists year after year and often becomes more problematic if not managed effectively.

In India, *Cyperus rotundus* is commonly found in irrigated as well as rainfed agricultural systems. It is especially troublesome in vegetables, sugarcane, cotton, maize, soybean, groundnut, orchards, and plantation crops. The weed thrives in both fertile and marginal soils and can survive drought, flooding, and repeated cultivation. Consequently, it remains a major challenge for farmers, researchers, and extension workers.

The successful management of purple nutsedge requires a thorough understanding of its biology, ecology, and reproductive mechanisms, combined with the implementation of integrated weed management strategies.

Taxonomy and Distribution

Purple nutsedge belongs to the family Cyperaceae and is classified as follows:

- Kingdom: Plantae
- Division: Angiosperms
- Class: Monocotyledons

- Order: Cyperales
- Family: Cyperaceae
- Genus: *Cyperus*
- Species: *rotundus*

The weed is distributed throughout tropical, subtropical, and warm temperate regions. It grows abundantly in cultivated fields, orchards, wastelands, roadsides, irrigation channels, and gardens. Its adaptability to a wide range of climatic and soil conditions has contributed significantly to its global spread.

Identification Characteristics: Correct identification is the first step toward effective management. Purple nutsedge possesses several distinguishing characteristics:

Stem: The stem is erect, smooth, and triangular in cross-section. It usually ranges from 15 to 50 cm in height depending on environmental conditions.

Leaves: Leaves are narrow, dark green, glossy, and arranged in three rows arising from the base of the plant. They are generally shorter than the flowering stalk.

Inflorescence: The inflorescence consists of reddish-brown or purple spikelets arranged in umbrella-shaped clusters.

Roots and Underground Structures: The underground system is the most important identifying feature. It consists of:

- Fibrous roots
- Rhizomes
- Chains of tubers
- Basal bulbs

The tubers are brown to black externally and white internally. These structures serve as storage organs and ensure long-term survival.

Biology and Reproduction

Vegetative Propagation: The primary mode of reproduction in purple nutsedge is vegetative propagation through underground tubers and rhizomes. Each tuber can produce multiple shoots and daughter tubers. Under favorable conditions, a single tuber may generate hundreds

of new tubers within one growing season. This reproductive capacity explains why infestations increase rapidly once established.

Seed Production: Although the weed produces seeds, seed propagation plays a relatively minor role compared to vegetative reproduction. Nevertheless, seeds contribute to long-distance dispersal and genetic diversity.

Dormancy: One of the most challenging aspects of purple nutsedge management is tuber dormancy. Tubers may remain dormant in soil for extended periods and germinate when environmental conditions become favorable.

Regeneration Capacity: Even small fragments of rhizomes can regenerate into complete plants. Mechanical injury often stimulates the production of new shoots and tubers. Factors Responsible for Weed Persistence: Several characteristics contribute to the exceptional persistence of *Cyperus rotundus*.

Extensive Underground Network: Tubers may occur at depths exceeding 30 cm, protecting them from cultivation and herbicide exposure.

Carbohydrate Reserves: Tubers store large amounts of carbohydrates that support rapid regrowth following disturbance.

Environmental Adaptability: The weed tolerates: High temperatures, Drought conditions, Waterlogging, Salinity, Repeated cultivation etc.

Rapid Multiplication: Population densities can increase exponentially within a few growing seasons.

Economic Importance: Purple nutsedge causes significant economic losses through direct and indirect effects.

Increased Production Costs: Farmers incur additional expenses for:

- Hand weeding
- Herbicide applications
- Mechanical cultivation
- Labour requirements

Harvesting Difficulties : Dense infestations interfere with harvesting operations.

Pest and Disease Associations: The weed may act as an alternate host for insects, nematodes, and plant pathogens.

Integrated Weed Management Strategies: Since complete eradication is difficult, integrated weed management (IWM) provides the most sustainable solution.

Preventive Measures: Prevention remains the most economical strategy. Important practices include:

- Using weed-free seed and planting material.
- Cleaning farm machinery.

- Avoiding movement of contaminated soil.
- Managing irrigation channels and field boundaries.
- Eliminating isolated infestations before they spread.

Cultural Management

- **Crop Rotation:** Crop rotation disrupts the life cycle of weeds and improves management effectiveness. Suitable crops include:
- **Competitive Cultivars:** Vigorous cultivars establish quickly and suppress weed growth through shading.
- **Cover Crop:** Cover crops provide physical suppression and reduce light availability.
- **Mulching:** Mulching is particularly effective in vegetable and horticultural crops.

Mechanical Control

Deep Summer Ploughing: Deep ploughing exposes tubers to:

- High temperatures
- Solar radiation
- Desiccation
- Predation

Repeated summer cultivation significantly reduces tuber viability.

Biological Approaches: Biological control remains an area of active research. Potential agents include:

- Fungal pathogens
- Bacterial bioherbicides
- Allelopathic plants

Although no widely adopted biological control method currently exists, future developments may provide environmentally friendly alternatives.

Chemical Management

Chemical control becomes necessary when infestations are severe. The choice of herbicide depends on the crop, growth stage of the weed, and cropping system. In non-cropped situations, orchards, field bunds, irrigation channels, and pre-plant situations, glyphosate has proven highly effective. Glyphosate is a systemic herbicide that moves from the leaves to underground rhizomes and tubers. Application should be made when the weed is actively growing and has reached the 4-6 leaf stage. Under these conditions, translocation to underground structures is maximized. Since dormant tubers may produce new shoots later, a second application may be required after four to six weeks. In maize, sugarcane, and several broad-acre cropping systems, pre-emergence herbicides such as atrazine and pendimethalin can suppress initial emergence of nutsedge

and other weeds. However, because purple nutsedge primarily reproduces through tubers, pre-emergence herbicides alone generally provide only partial control. Their effectiveness increases when integrated with post-emergence treatments.

Halosulfuron-methyl has emerged as one of the most effective post-emergence herbicides specifically targeting *Cyperus rotundus*. It belongs to the sulfonyleurea group and inhibits amino acid synthesis in susceptible plants. Following application, weed growth gradually ceases, leaves become chlorotic, and underground tubers are weakened. The herbicide performs best when applied to actively growing weeds under adequate soil moisture conditions. Research across various crops has demonstrated significant reductions in nutsedge density and tuber production following halosulfuron application.

Sulfosulfuron and ethoxysulfuron are also effective against sedges and can be used in specific cropping systems where they are registered and recommended. These herbicides provide systemic activity and help suppress regrowth from underground propagules. However, farmers should always follow locally recommended doses and crop-specific guidelines.

In soybean, groundnut, pulses, and other legume-based systems, imazethapyr has shown effectiveness against young nutsedge infestations when applied at the recommended stage. The herbicide provides both foliar and residual activity, helping suppress subsequent emergence. Nevertheless, repeated monitoring is necessary because dormant tubers can continue to produce new shoots.

The timing of herbicide application is often more important than the dose itself. Young, actively growing plants are more susceptible than mature plants. Applications made during periods of vigorous growth allow greater movement of herbicides into underground tubers. In contrast, applications during drought stress or advanced growth stages often produce unsatisfactory results.

One of the biggest mistakes in nutsedge management is relying on a single herbicide application. Because tubers germinate in successive flushes, follow-up monitoring is essential. Sequential treatments, combined with cultivation and crop competition, gradually exhaust the underground tuber bank. The objective should not be immediate eradication but progressive reduction of the weed population over several seasons.

Importance of Sequential Applications: Since tubers germinate in multiple flushes, repeated applications may be necessary. Integrated use of herbicides and cultural practices generally produces superior results compared with herbicides alone.

Emerging Technologies: Future weed management may increasingly rely on:

- Drone-based herbicide application
- Artificial intelligence for weed detection
- Precision agriculture tools
- Site-specific weed management
- Bioherbicides
- Robotic weeders

These innovations can improve efficiency while minimizing environmental impacts.

Recommendations for Farmers

1. Monitor fields regularly.
2. Remove isolated infestations immediately.
3. Practice deep summer ploughing.
4. Rotate crops strategically.
5. Use cover crops and mulches.
6. Apply recommended herbicides at appropriate stages.
7. Prevent movement of contaminated soil.
8. Integrate multiple management approaches.
