Oregon Department of Agriculture
Plant Pest Risk Assessment for
Purple nutsedge, *Cyperus rotundus L.*
2011

Name: Purple nutsedge, *Cyperus rotundus L.*
Family: Sedge, *Cyperaceae*

Findings of This Review and Assessment: Purple nutsedge, *Cyperus rotundus*, was evaluated and determined to be a category **"A"** rated noxious weed, as defined by the Oregon Department of Agriculture (ODA) Noxious Weed Policy and Classification System. This determination was based on a literature review and analysis using two ODA evaluation forms. Using the Noxious Qualitative Weed Risk Assessment v. 3.8, purple nutsedge scored **61** indicating a Risk Category of **A**; and a score of **18** with the Noxious Weed Rating System v. 3.2, indicating an **"A"** rating.

Introduction: Regarded to be the world's worst weed, *Cyperus rotundus* causes serious problems in more crops in more countries than any other weed (Kadir et al., 2000). The nutsedge taxa were used by ancient people of the Nile Valley and eastern Mediterranean as food, perfume, and medicine. Although *C. rotundus* was used in production of these items, literary evidence from 1st century Aegean scholar Dioscorides indicates that it was considered a weed escaping from its marshy native habitat and causing agricultural loss in cultivated fields of the area (Negbi, 1992). This perennial weed causes major agricultural problems in crops such as rice, sugarcane, cotton, corn, soybean, peanut, turf grasses, strawberry, and vegetables (Kadir et al., 2000). Overall, it infests 52 crops in 92 countries, and is present up to 2,500 meters (Jha et al., 1985).

Purple nutsedge flower spikes, photo by Richard Old, XID Services, Inc., Bugwood.org

Purple nutsedge flower spikes, photo by Forest & Kim Starr, Starr Environmental, Bugwood.org

Purple nutsedge roots, photo by Richard Old, XID Services, Inc., Bugwood.org

Purple nutsedge has allelopathic traits that interfere with crops. Phenolic acids and other volatile compounds contained within the plant and its tubers limit growth of surrounding plants (Alsaadawi et al., 2009). It is widely distributed across the country, present in twenty-five states and two territories and is considered noxious in Washington, Oregon, California, and Arkansas (Skinner, 2010). Purple nutsedge is aggressive in a wide array of environments, being tolerant of wet soils and high temperatures. Its distribution increased rapidly due to monocultural practices, lack of crop rotations, and reduced use of hand cultivation (Kadir et al., 2000). Reproduction mainly takes place underground via vegetative propagules, although seeds produced by the plant are also viable and contribute to spread (Jha et al., 1985). Selective herbicides prior to 1987 were ineffective at translocating to the tuber system of *C. rotundus* that prevented death of the plant. Newer herbicides have proven to give better control. The only known incident of *C. calcitrapa* being within Oregon was at a greenhouse in Clackamas County in 1999 where the specimen was found in potting medium. Not enough material was present for an "absolutely positive ID" (Invaders Database, 2010).

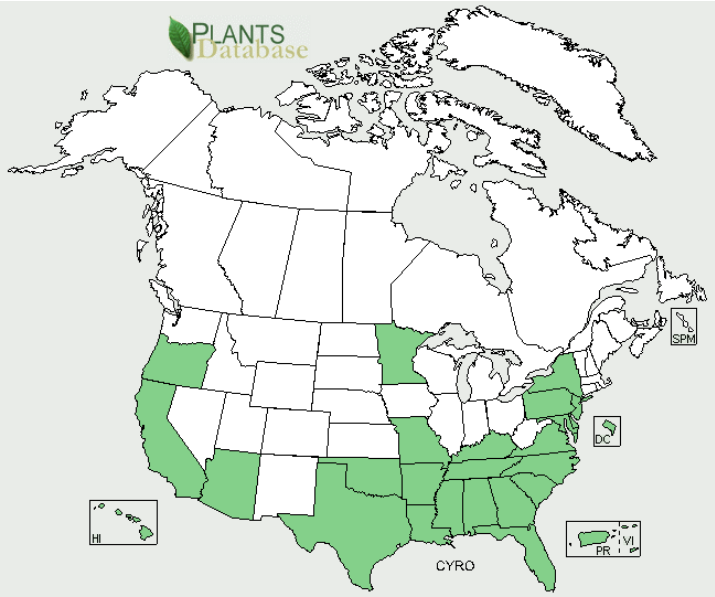
Growth Habits, Reproduction, and Spread: Purple nutsedge is characterized by its red, reddish-brown, or purplish-brown loosely arranged inflorescence, dark green leaves which frown low to the ground with boat-shaped leaf tips, and scaly rhizomes which when mature become wiry and hard to break (Riemens et al, 2008). *C. rotundus* reproduces primarily asexually by successive formation of aerial shoots and a network of subterranean rhizomes and tubers. *C. rotundus* will produce seed in temperate climates, but the bulk of the seeds will most likely be non-viable (Tayyar et al, 2003 and Riemens et al, 2008). Because *C. rotundus* produces mainly by vegetative growth, dense tuber and basal bulb systems are crucial to the establishment *C. rotundus* communities (Kadir et al., 2000). It shows hardiness in areas where other plants would not survive such as arid zones, and develops adaptive strategies to cope with varying environmental conditions (Jha et al., 1985). Because of its tolerance of environments and temperatures ranging from arid to wet soils, this species is particularly aggressive and is widely distributed because of these traits (Kadir et al., 2000).

Human induced disturbances including monoculture, lack of crop rotations and reduced hand cultivation has increased the prevalence of the crop worldwide (Kadir et al., 2000). Allelopathic chemicals produced by live and decaying purple nutsedge reduces competition of surrounding vegetation and promotes monoculture of purple nutsedge. Mature dormant tubers are produced six weeks after shoot emergence from rhizomes in a chain-like manner of up to eight individuals. Under favorable conditions, a single plant can produce more than 200 tubers in four months (Neeser et al., 1997). The basal bulbs form the starting point for the vegetative growth, because they contain the meristems for leaves, rhizomes, roots and flower stalks. The tubers contain quiescent buds and function like the seeds of annuals, acting as the primary dispersal units (Riemens et al, 2008). Populations in fields are often the offspring of one or only a few plants (Riemens et al, 2008). Desiccation and extremely low temperatures can kill the tubers of purple nutsedge (Riemens et al, 2008).

The rapid spread of purple nutsedge worldwide is attributed to human agricultural activities. Seeds and tubers have been spread by dirty equipment, contaminated seed, and growing medium being dispersed both locally and internationally. Flood events have also dispersed seeds and tubers throughout river drainages from infested fields to non-infested areas. Stringent inspections and regulations regarding the sale and transport of agricultural products are critical in preventing further weed dispersal. Early detection on new infestations is the second line of defense against new outbreaks. Though the plant is not showy, it tends to establish in fields where intensive agriculture is practiced. A much higher level of human activity takes place in these fields leading to a greater opportunity of early detection.

Native Range: Nut sedges originate from tropic and subtropical areas (Riemens et al, 2008).

Distribution in North America: In the US, the species can be found in all states where cotton is grown, such as Arizona, California, New Mexico, Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee and Texas (Riemens et al, 2008). The species can also be found in the North and Middle of the American continent in Canada, Alaska, Cuba, Nicaragua, Puerto Rico and Mexico (Riemens et al, 2008).



US distribution of purple nutsedge on Plants Database

Positive Economic Impact: There are no known modern positive economic impacts of purple nutsedge.

Negative Economic Impact: *C. rotundus'* impacts can be staggering. In Australia, tests showed of the plant's ability to negatively impact cotton. It was determined that field densities of 2,000 – 4,000 tubers/meter squared, with corresponding reductions of cotton lint yield up to 92% (Charles, 1997). In cultivated fields, it is propagated primarily by distributed tubers during tillage and other soil management projects. A variety of crops other than cotton have seen loss of yields ranging up to 75% in sugar cane (Skinner, 2007). Approximate quantities of fertilizer that may be mobilized and stored in purple nutsedge equal 815 kilograms of ammonium sulfate, 320 kilograms of potash, and 200 kilograms of phosphate per hectare (Skinner, 2007).

Probability of Detection: The probability of detecting this plant varies from crop to crop and operation to operation. Purple nutsedge is likely to show up in nursery stock or fields of high value crops grown under intensive management. Farm labor would be the first observers of this weed but may not recognize its importance and not report it. An infestation could start in one field and be transported to other fields on farm equipment very rapidly. Well-run operations have a very low tolerance for weeds an can locate new infestations as they appear.

Ecological Impacts: Purple nutsedge contains allelopathic chemicals that inhibit the growth of surrounding vegetation, giving it a competitive edge that can crucially impact native ecosystems. The inhibitory compounds are *C. rotundus* are released through root exudation, volatilization and decaying of plant residues (Alsaadawi et al., 2009). The release of volatile and non-volatile compounds into the environment inhibits the growth of surrounding plant species, particularly impacting the development of seedlings. The impact of phytotoxicity resulting from the allelopathic depends on the receptor plant species (Alsaadawi et al., 2009). Purple nutsedge compete for moisture, nutrient and sunlight resources, and can produce up to 40,000 kilograms of subterranean plant material per hectare (Skinner, 2007).

Control: Potential biocontrols for *C. rotundus* have been investigated by the University of Florida's Department of Plant Pathology, with the fungus *Dactylaria higginsii,* showing control of *C. rotudus*. It was highly pathogenic to a number of sedges within the Cyperaceae family. The pathogen killed the leaves and sometimes the entire plant. Inoculation with *D. higginsii* resulted in significant reductions in shoot numbers (72%), shoot dry weight (73%), and tuber dry weight (67%) of greenhouse grown purple nutsedge plant in 45 days after inoculation (Kadir et al., 2000). Chemical control has proven difficult due to the resiliency of the plant. MSMA and 2,4-D alone have proven ineffectual, but glysophate has shown some success. Inclusion of norfurazon and Halosulfuron-methyl into the herbicide mixture may further enhance weed suppression (Charles, 1997).

Noxious Weed Qualitative Risk Assessment
Oregon Department of Agriculture

Common name: Purple nutsedge
Scientific name: *Cyperus rotundus L.*
Family: Sedge, *Cyperaceae*

For use with plant species that occur or may occur in Oregon to determine their potential to become serious noxious weeds. For each of the following categories, select the number that best applies. Numerical values are weighted to increase priority categories over less important ones. Choose the best number that applies, intermediate scores can be used.

Total Score: 61 **Risk Category: A**

GEOGRAPHICAL INFORMATION

1) 6 Invasive in Other Areas

0 Low- not known to be invasive elsewhere.
2 Known to be invasive in climates dissimilar to Oregon's current climates.
6 Known to be invasive in geographically similar areas.

Comments: Invasive worldwide.

2) 6 Habitat Availability: Are there susceptible habitats for this species and how common or widespread are they in Oregon?

1 *Low* – Habitat is very limited, usually restricted to a small watershed or part of a watershed (e.g., tree fern in southern Curry County).
3 *Medium* – Habitat encompasses 1/4 or less of Oregon (e.g., oak woodlands, coastal dunes, eastern Oregon wetlands, Columbia Gorge).
6 *High* – Habitat covers large regions or multiple counties, or is limited to a few locations of high economic or ecological value (e.g., threatened and endangered species habitat).

Comments: Habitat includes moist regions of Oregon, riparian and irrigated regions of eastern Oregon.

3) 3 Proximity to Oregon: What is the current distribution of the species?

0 *Present* – Occurs within Oregon.
1 *Distant* – Occurs only in distant US regions or foreign countries.
3 *Regional* – Occurs in Western regions of US but not adjacent to Oregon border.
6 *Adjacent* – Weedy populations occur adjacent (<50 miles) to Oregon border.

Comments: Occurs in southwestern states not adjacent to Oregon border.

4) 0 Current Distribution: What is the current distribution of escaped populations in Oregon?

0 *Not present* – Not known to occur in Oregon.
1 *Widespread* – Throughout much of Oregon (e.g., cheatgrass).
5 *Regional* – Abundant (i.e., occurs in eastern, western, central, coastal, areas of Oregon) (e.g., gorse, tansy ragwort).
10 *Limited* – Limited to one or a few infestations in state (e.g., kudzu).

Comments: Not known to occur in Oregon.

BIOLOGICAL INFORMATION

5) 3 **Environmental Factors**: Do abiotic (non-living) factors in the environment effect establishment and spread of the species? (e.g., precipitation, drought, temperature, nutrient availability, soil type, slope, aspect, soil moisture, standing or moving water).

1 *Low* – Severely confined by abiotic factors.
2 *Medium* – Moderately confined by environmental factors
4 *High* – Highly adapted to a variety of environmental conditions (e.g., tansy ragwort, Scotch broom).

Comments: Highly adapted to a wide range of soil types with moisture present.

6) 6 **Reproductive Traits:** How does this species reproduce? Traits that may allow rapid population increase both on and off site.

0 *Negligible* – Not self-fertile, or is dioecious and opposite sex not present.
1 *Low* – Reproduction is only by seed, produces few seeds, or seed viability and longevity are low.
3 *Medium* – Reproduction is vegetative (e.g., by root fragments, rhizomes, bulbs, stolons).
3 *Medium* – Produces many seeds, and/or seeds of short longevity (< 5 years).
5 *High* – Produces many seeds and/or seeds of moderate longevity (5-10 years) (e.g., tansy ragwort).
6 *Very high* – Has two or more reproductive traits (e.g., seeds are long-lived >10 years and spreads by rhizomes).

Comments: Reproduces by seeds, roots and nutlets.

7) 4 **Biological Factors:** Do biotic (living) factors restrict or aid establishment and spread of the species? (What is the interaction of plant competition, natural enemies, native herbivores, pollinators, and pathogens with species?)

0 *Negligible* – Host plant not present for parasitic species.
1 *Low* – Biotic factors highly suppress reproduction or heavily damage plant for an extended period (e.g., biocontrol agent on tansy ragwort).
2 *Medium* – Biotic factors partially restrict or moderately impact growth and reproduction, impacts sporadic or short-lived.
4 *High* – Few biotic interactions restrict growth and reproduction. Species expresses full growth and reproductive potential.

Comments: Species expresses full growth and reproductive potential.

8) 4 **Reproductive Potential and Spread After Establishment - Non-human Factors:** How well can the species spread by natural means?

0 *Negligible* – No potential for natural spread in Oregon (e.g., ornamental plants outside of climate zone).
1 *Low* – Low potential for local spread within a year, has moderate reproductive potential or some mobility of propagules (e.g., propagules transported locally by animals, water movement in lakes or ponds, not wind blown).
3 *Medium* - Moderate potential for natural spread with either high reproductive potential or highly mobile propagules (e.g., propagules spread by moving water, or dispersed over longer distances by animals) (e.g., perennial pepperweed).

5 *High* – Potential for rapid natural spread throughout the susceptible range, high reproductive capacity and highly mobile propagules. Seeds are wind dispersed over large areas (e.g., rush skeletonweed).

Comments: Moved by water, waterfowl.

9) 5 **Potential of Species to be Spread by Humans**. What human activities contribute to spread of species? Examples include: interstate or international commerce; contaminated commodities; packing materials or products; vehicles, boats, or equipment movement; logging or farming; road maintenance; intentional introductions of ornamental and horticultural species, or biofuel production.

1 *Low* – Potential for introduction or movement minimal (e.g., species not traded or sold, or species not found in agricultural commodities, gravel or other commercial products).

3 *Medium* – Potential for introduction or off-site movement moderate (e.g., not widely propagated, not highly popular, with limited market potential; may be a localized contaminant of gravel, landscape products, or other commercial products) (e.g., lesser celandine, Canada thistle).

5 *High* – Potential to be introduced or moved within state high (e.g., species widely propagated and sold; propagules common contaminant of agricultural commodities or commercial products; high potential for movement by contaminated vehicles and equipment, or by recreational activities) (e.g., butterfly bush, spotted knapweed, Eurasian watermilfoil).

Comments: Moved in contaminated soil or commodities.

IMPACT INFORMATION

10) 10 **Economic Impact**: What impact does/can the species have on Oregon's agriculture and economy?

0 *Negligible* – Causes few, if any, economic impacts.

1 *Low* - Potential to, or causes low economic impact to agriculture; may impact urban areas (e.g., puncture vine, pokeweed).

5 *Medium* – Potential to, or causes moderate impacts to urban areas, right-of-way maintenance, property values, recreational activities, reduces rangeland productivity (e.g., English ivy, Himalayan blackberry, cheatgrass).

10 *High* – Potential to, or causes high impacts in agricultural, livestock, fisheries, or timber production by reducing yield, commodity value, or increasing production costs (e.g., gorse, rush skeleton weed, leafy spurge).

Comments: Serious threat to intensive agriculture.

11) 2 **Environmental Impact**: What risks or harm to the environment does this species pose? Plant may cause negative impacts on ecosystem function, structure, and biodiversity of plant or fish and wildlife habitat; may put desired species at risk.

0 *Negligible* – None of the above impacts probable.

1 *Low* – Can or does cause few or minor environmental impacts, or impacts occur in degraded or highly disturbed habitats.

4 *Medium* – Species can or does cause moderate impacts in less critical habitats (e.g., urban areas, sagebrush/ juniper stands).

6 *High* – Species can or does cause significant impacts in several of the above categories. Plant causes severe impacts to limited or priority habitats (e.g., aquatic, riparian zones, salt marsh; or T&E species sites).

Comments: Invades riparian areas and competes for resources with native plants.

12) 0 **Impact on Health:** What is the impact of this species on human, animal, and livestock health? (e.g., poisonous if ingested, contact dermatitis, acute and chronic toxicity to livestock, toxic sap, injurious spines or prickles, causes allergy symptoms.

0 *Negligible* – Has no impact on human or animal health.
2 *Low* – May cause minor health problems of short duration, minor allergy symptoms (e.g., leafy spurge).
4 *Medium* – May cause severe allergy problems, death or severe health problems through chronic toxicity, spines or toxic sap may cause significant injury. (e.g., giant hogweed, tansy ragwort).
6 *High* – Causes death from ingestion of small amounts, acute toxicity (e.g. poison hemlock).

Comments: Has no impact on human or animal health.

CONTROL INFORMATION

13) 6 **Probability of Detection at Point of Introduction**: How likely is detection of species after introduction and naturalization in Oregon?

1 *Low* – Grows where probability of early detection is high, showy and easily recognized by public; access to habitat not restricted (e.g., giant hogweed).
5 *Medium* – Easily identified by weed professionals, ranchers, botanists; some survey and detection infrastructure in place. General public may not recognize or report species (e.g., leafy spurge).
10 *High* – Probability of initial detection by weed professionals low. Plant shape and form obscure, not showy for much of growing season, introduction probable at remote locations with limited access (e.g., weedy grasses, hawkweeds, skeletonweed).

Comments: Plant shape and form obscure, not showy for much of growing season, farmers may detect plants in crops soon after introduction.

14) 6 **Control Efficacy:** What level of control of this species can be expected with proper timing, herbicides, equipment, and biological control agents?

1 *Negligible* – Easily controlled by common non-chemical control measures (e.g., mowing, tillage, pulling, and cutting; biocontrol is very effective at reducing seed production and plant density) (e.g., tansy ragwort).
2 *Low* – Somewhat difficult to control, generally requires herbicide treatment (e.g., mechanical control measures effective at preventing flowering and but not reducing plant density; herbicide applications provide a high rate of control in a single application; biocontrol provides partial control).
4 *Medium* – Treatment options marginally effective or costly. Tillage and mowing increase plant density (e.g., causes tillering, rapid regrowth, spread from root fragments). Chemical control is marginally effective. Crop damage occurs or significant non-target impacts result from maximum control rates. Biocontrol agents ineffective.
6 *High* – No effective treatments known or control costs very expensive. Species may occur in large water bodies or river systems where containment and complete control are not achievable. Political or legal issues may prevent effective control.

Comments: Very difficult to control.

Category Scores:

15 Geographic score (Add scores 1-4)	**22** Biological Score (Add lines 5-9)
12 Impact Score (Add lines 10-12)	**12** Control Score (Add Lines 13-14)

61 Total Score (Add scores 1-14 and list on front of form)

Risk Category: 55-89+ = **A** 24-54 = **B** < 24 = unlisted.

This Risk Assessment was modified by ODA from the USDA-APHIS Risk Assessment for the introduction of new plant species.
1/15/2013 v.3.8

Oregon Department of Agriculture
Noxious Weed Rating System

Common Name: Purple nutsedge
Scientific Name: *Cyperus rotundus L.*

Point Total: 18 **Rating: A**

1) 3 **Detrimental Effects:** Circle all that apply, enter number of circles.
1. *Health*: causes poisoning or injury to humans or animals
2. *Competition:* strongly competitive with crops, forage, or native flora
3. *Host*: host of pathogens and/or pests of crops or forage
4. *Contamination*: causes economic loss as a contaminate in seeds and/or feeds
5. *Interference*: interferes with recreation, transportation, harvest, land value, or wildlife and livestock movement

2) 4 **Reproduction & Capacity for Spread:** Circle the number that best describes, enter that number.
1. Few seeds, not wind blown, spreads slowly
2. Many seeds, slow spread
3. Many seeds, spreads quickly by vehicles or animals
4. Windblown seed, or spreading rhizomes, or water borne
5. Many wind-blown seeds, high seed longevity, spreading rhizomes, perennials

3) 3 **Difficulty to Control:** Circle the number that best describes, enter that number.
1. Easily controlled with tillage or by competitive plants
2. Requires moderate control, tillage, competition or herbicides
3. Herbicides generally required, or intensive management practices
4. Intensive management generally gives marginal control
5. No management works well, spreading out of control

4) 6 **Distribution:** Circle the number that best describes, enter that number.
1. Widely distributed throughout the state in susceptible habitat
2. Regionally abundant, 5 or more counties, more than 1/2 of a county
3. Abundant throughout 1- 4 counties, or 1/4 of a county, or several watersheds
4. Contained in only 1 watershed, or less than 5 square miles gross infestation
5. Isolated infestation less than 640 acres, more than 10 acres
6. Occurs in less than 10 acres, or not present, but imminent from adjacent state

5) 2 **Ecological Impact:** Circle the number that best describes, enter that number.
1. Occurs in most disturbed habitats with little competition
2. Occurs in disturbed habitats with competition
3. Invades undisturbed habitats and crowds out native species
4. Invades restricted habitats (i.e. riparian) and crowds out native species

18 TOTAL POINTS

Note: Noxious weeds are non-native plants with scores of 11 points or higher. Any plants in 4.1, 4.2, and 4.3 should not be classified as "A" rated weeds. *Ratings:* 16 + = A, 15 – 11= B
ODA Weed Rating System 8/30/2012 v.3.2

RA produced by Alex Park, ODA

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Attachment A