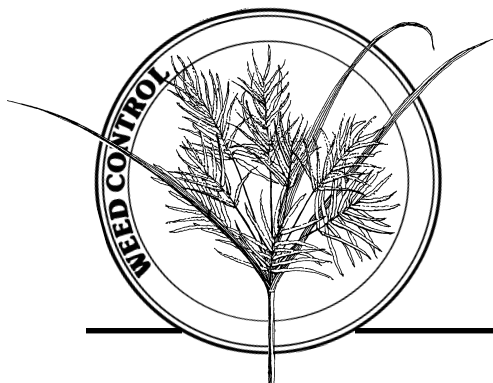


Controlling Yellow Nutsedge in Agronomic Crops (An Integrated Approach)



Yellow nutsedge (*Cyperus esculentus* L.) is an aggressive perennial plant that is native to North America and Eurasia. It is a problem weed in field crops throughout the United States. This weed thrives in low, damp soils, but is also troublesome in cultivated fields and pastures of all soil types. Despite its widespread presence, yellow nutsedge can be effectively managed with a consistent integrated control program that combines cultural, mechanical, and chemical methods.

Yellow nutsedge, a monocot and member of the sedge family, is frequently mistaken for grasses because of its narrow, grass-like leaves. However, this weed is easily distinguished from grasses by its triangular (three-ranked) solid stem, which is free of nodes. The shiny v-shaped leaves, flower stalk, roots, and rhizomes of this plant originate from a basal bulb located just beneath the surface of the ground. Yellow nutsedge has an extensive underground system of rhizomes and tubers (or nutlets) that store large reserves of energy. This system allows the plant to overwinter and produce new shoots the following spring. Brownish to rust-colored oval nutlets, measuring 1/4 to 1/2 inch in diameter form on the ends of the rhizomes in the upper 6 inches of the soil.

Yellow nutsedge primarily reproduces by means of tubers. One plant can produce several hundred to several thousand tubers during a single growing season. The plant's tubers break out of dormancy in winter and begin to germinate in the spring. Each tuber has several buds or 'eyes' that can produce two or three sprouts or plants. Each new plant can eventually grow up to 30 inches in height and is topped by a cluster of straw-colored seed heads (inflorescence). The clusters, which resemble bottle brushes, form at the top of the central stalk about two months after plant emergence. Mature yellow nutsedge can produce hundreds of millions of seeds per acre. However, the viability of a mature seed is relatively low, ranging from 5 to 40 percent. Seed germination and seedling survival are highly dependent on favorable environmental conditions, and seedlings often perish due to their small size and lack of vigor.

Two other nutsedge species, purple nutsedge and chufa, do not grow in cooler regions of the world. Purple nutsedge (*Cyperus rotundus* L.) is a weedy species found mostly in

the southeastern and southwestern parts of the United States. Chufa (*Cyperus esculentus*, var. *sativus*), which is a less aggressive variety of yellow nutsedge, is grown as a food crop in southwestern Europe, Africa, and parts of Asia. Processed nutlets of the chufa plant are used in a variety of foods, beverages, and soaps.

Yellow nutsedge is a troublesome weed in field crops. However, a competitive crop such as corn or soybeans will usually outgrow and shade yellow nutsedge. In general, only severe infestations of nutsedge will reduce corn or soybean grain yields. Even with its lack of competitiveness, it is nearly impossible to eradicate infestations of this weed in croplands. As a result, yellow nutsedge infestations have spread rapidly throughout the region. There are several strategies to control its impact on crop production. As with most weeds, no single measure is adequate for controlling yellow nutsedge. However, an integrated program combining preventative, cultural, mechanical, and chemical methods can be effective in managing yellow nutsedge.

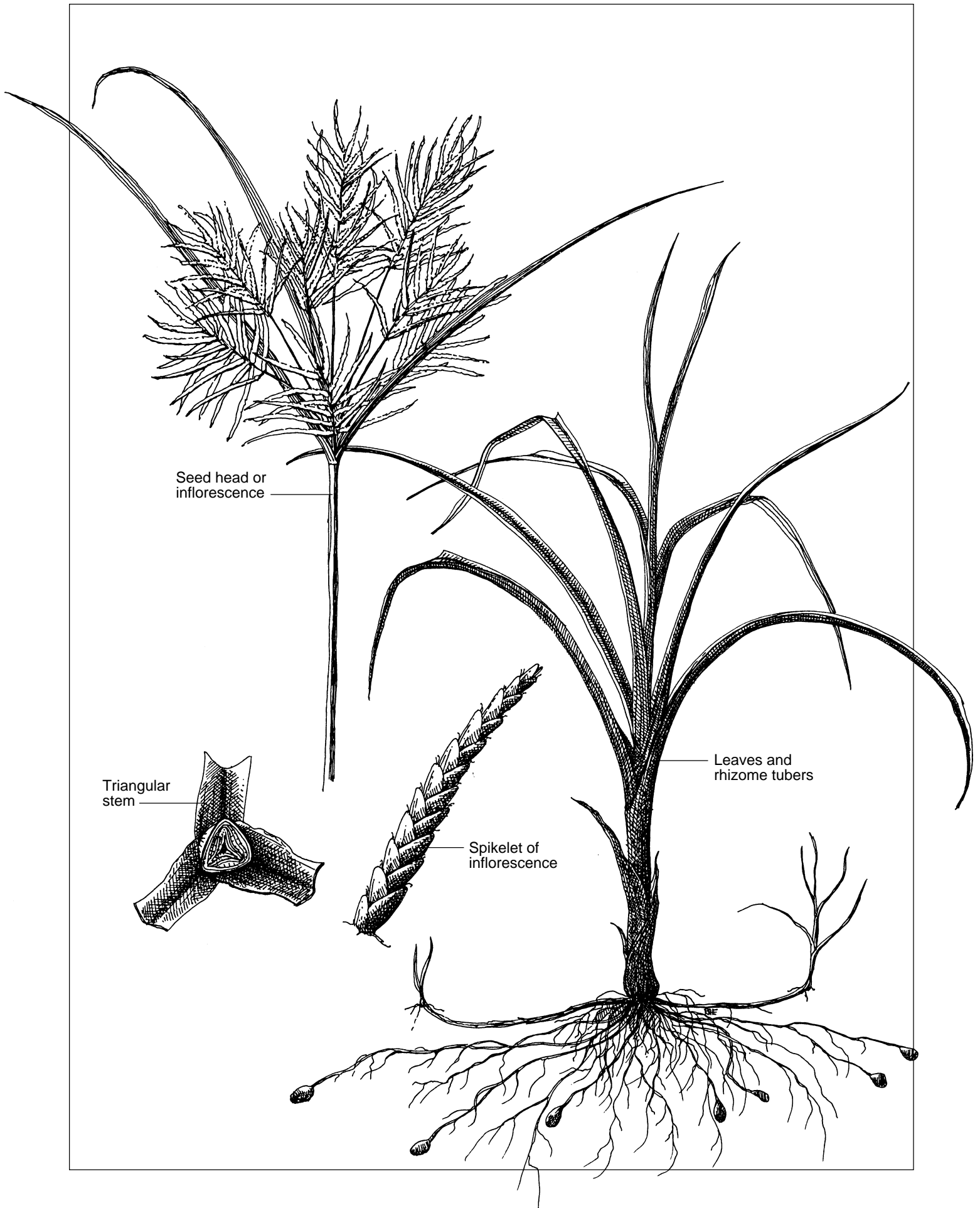
PREVENTION

Yellow nutsedge should be prevented from spreading into new areas. Since soil clumps containing tubers, rhizomes, and seeds can adhere to tillage and harvest equipment, these should be cleaned of any yellow nutsedge remains before they are used in uninfested fields. Because hay, straw, and crop seed may contain nutsedge seeds or tubers, these commodities should be purchased from a reliable source. Also, avoid spreading manure contaminated with nutsedge into uninfested fields.

To further reduce spreading, spot treat isolated patches of yellow nutsedge in fields and other areas with an effective herbicide. Also, maneuver tillage equipment around isolated nutsedge patches to avoid spreading rhizomes and tubers throughout the field. Unlike most livestock, hogs can provide some nutsedge control in pastures (or during fallow cropping periods), because they scavenge and eat the buried nutlets of this plant.

GENERAL CULTURAL CONTROL

While control of yellow nutsedge is difficult in many crops, crop competition can help to minimize its spread. Good cultural practices can promote healthy crop stands,



Seed head or
inflorescence

Triangular
stem

Spikelet of
inflorescence

Leaves and
rhizome tubers

improving crop competition with nutsedge. For example, the canopy shading provided by some crops will inhibit the weed's growth. The following general guidelines will help to maximize cultural control of yellow nutsedge:

- Follow soil test recommendations for lime and fertilizer.
- Plant high-yielding varieties adapted to climate, soil, and field conditions.
- Plant early (if soil temperatures and conditions permit) and use narrow row spacing and high plant populations wherever possible.
- Use practical integrated pest management programs that monitor diseases, insects, and weeds, and use appropriate control tactics when necessary.
- Include corn and soybeans in the crop rotation, because the shading and selective herbicide programs associated with these crops enhances the control of nutsedge.

MECHANICAL CONTROL

Mechanical control methods in field crops include mowing, plowing, disking, and cultivating. Though impractical in corn and soybean fields, mowing or swathing of hay crops and pastures prevents seed production in nutsedge and can help to deplete the plant's energy reserves in its rhizomes and tubers. Hay fields and pastures must be mowed regularly to reduce nutsedge infestations.

Tillage is an important control tactic when used in combination with other measures. Moldboard or chisel plowing and/or disking will destroy germinating tubers and smaller nutsedge plants. Tilling will also move nutsedge tubers to the surface, which will dry out the tubers or expose them to temperature extremes. Fall tillage will expose the tubers to cold temperatures, which can reduce tuber and rhizome populations. Early spring tillage may be less successful in controlling nutsedge because germination and shoot formation does not occur until late May or early June. Cultivation can remove actively growing nutsedge plants between rows, allowing the crops to compete more successfully. Shovel or sweep cultivators (rather than rotary hoes) are more effective on nutsedge. Hot, dry, and breezy weather conditions will enhance the effects of cultivation by quickly drying out the uprooted plants and nutlets. Timely cultivation and tillage for seedbed preparation can be a potent control measure against yellow nutsedge, particularly when used to complement an effective herbicide program.

CHEMICAL CONTROL

Herbicides, when used in combination with mechanical, cultural, and preventive methods, are an integral part of a yellow nutsedge control program. However, some annual weed control programs may actually increase the nutsedge problem. For example, when an herbicide selectively removes annual broadleaf and grassy weeds, yellow nutsedge can thrive and become more difficult to control. Thus, it is important to select control measures that account for the perennial growth of yellow nutsedge. Integrated

control programs for nutsedge usually combine growth suppression from tillage and herbicides followed by shading from competitive crops. Table 1 lists herbicides that control yellow nutsedge in corn, soybeans, and forages.

To ensure that herbicide use is as effective, safe, and economical as possible, always:

- Select the appropriate herbicide for your weed problem and crop. Stage of weed and crop growth, temperature, soil moisture, and soil pH can affect herbicide performance. For additional information, refer to the *Penn State Agronomy Guide* or consult with your county extension agent.
- Read the herbicide label carefully and follow directions. The label provides important information on safe use, application, disposal, and storage.
- Apply herbicides at the proper time.
- Apply the recommended amount to avoid injury, soil residues, or poor control.
- Calibrate application equipment several times during the season to ensure that the correct amount of herbicide is applied.
- Wear proper protective clothing.
- Learn to predict weed problems. Scout fields regularly and record the types and locations of weeds present. Use field records to plan an integrated control program.

Control in Corn

Although foliar-applied herbicides can provide good control of nutsedge, soil-applied herbicides (applied near planting time) usually provide better control, particularly when used with cultivation. Traditional annual grass herbicides (e.g., Dual, Lasso) are still a key component in many nutsedge control programs. However, herbicide rates for yellow nutsedge control may be higher than for annual weed control. There are several herbicides that are labeled for controlling or reducing competition from yellow nutsedge in agronomic crops. However, only the herbicides that provide more consistent nutsedge control will be discussed in the following sections.

PREPLANT OR PREEMERGENCE TREATMENTS

For effective soil-applied treatments, a uniform concentration of herbicide must be placed within the upper 2 inches of the soil surface. This allows for adequate uptake by shoots and roots of germinating tubers or seeds. Mechanically incorporated (PPI) herbicide treatments provide more consistent weed control results than do surface-applied (PRE) treatments, which require timely rainfall or irrigation for mobilization. Some herbicides require mechanical incorporation for effective control. The depth and thoroughness of incorporation depends upon the type of equipment used, the depth and speed of operation, the texture of the soil, and the amount of soil moisture. A field or tandem disk incorporates most herbicide to about half the depth of operation. For yellow nutsedge control, the depth of operation for most tillage tools is 3 to 4 inches. In addition,

Table 1. Herbicides for yellow nutsedge control in field crops.

HERBICIDE	CROP	PRODUCT/A	CONTROL RATING ^a	COMMENTS
PPI				
Eptam 7E/10E (EPTC)	Alfalfa, birdsfoot trefoil, clovers, lespedeza	3.5–4.5 pt 7E or 30 lb 10G	8	Incorporate to a depth of 2–3 inches immediately after application. Follow label recommendations for proper incorporation procedures. Do not use if atrazine was applied within 12 months of planting. Do not use on white Dutch clover.
Eradicane 6.7E (EPTC+safener)	Corn	4.75–7.33 pt	9	Incorporate immediately after application. Incorporation may be delayed 4 hours if applied to a dry surface. If Eradicane is impregnated on dry fertilizer and applied to dry soil, incorporation must be completed the same day.
Sutan+ (butylate+ safener)	Corn	4.75–7.33 pt	9	Sutan+ must be incorporated into soil within 4 hours of application if soil surface is dry. If surface is moist, incorporate immediately.
PPI or PRE				
Dual 8E (metolachlor)	Corn, soybeans	2–3 pt	8	Incorporation improves control of yellow nutsedge. Apply Dual to the soil and incorporate uniformly into the top 2 inches of soil up to 14 days before planting with shallow incorporation equipment. Avoid deeper incorporation or reduced weed control and/or crop injury may result. (<i>Groundwater advisory.</i>)
Frontier 7.5E (dimethenamid)	Corn, soybeans	20–24 fl oz	7+	Incorporation improves control of yellow nutsedge. Apply Frontier to the soil and incorporate uniformly into the top 2 inches of soil up to 14 days before planting with shallow incorporation equipment. Avoid deeper incorporation or reduced weed control and/or crop injury may result. (<i>Groundwater advisory.</i>)
Harness 7E or Surpass 6.4E (acetochlor)	Corn	2.5–3.4 pt or 2.5–3.3 pt	7+	Incorporation improves control of yellow nutsedge. Apply Harness or Surpass at the recommended rate to the soil and incorporate uniformly into the top 2 inches of soil within 14 days prior to planting with shallow incorporation equipment. Avoid deeper incorporation or reduced weed control and/or crop injury. (<i>Restricted-use pesticide and groundwater advisory.</i>)
Micro-Tech 4ME (alachlor)	Corn	3–4 qt	7+	Micro-Tech is an encapsulated formulation of alachlor. Incorporation improves control of yellow nutsedge. Apply Micro-Tech to the soil and incorporate uniformly into the top 2 inches of soil within 7 days prior to planting with shallow incorporation equipment. Avoid deeper incorporation or reduced weed control and/or crop injury may result. (<i>Restricted-use pesticide and groundwater advisory.</i>)
POST				
Atrazine 4L/90DF	Corn	1.5–2 qt 4L or 1.7–2.2 lb 90DF	8	Apply while nutsedge is 4–8 inches tall and before corn is 12 inches in height. Add 1 qt of crop oil concentrate/A to spray solution. If corn is under stress from prolonged cold, wet weather, or other factors, this treatment may cause crop injury. Refer to current atrazine label for use restrictions and additional information. (<i>Restricted-use pesticide and groundwater advisory.</i>)

Table 1. (continued)

HERBICIDE	CROP	PRODUCT/A	CONTROL RATING ^a	COMMENTS
POST (continued)				
Basagran 4S (bentazon)	Corn, soybeans	1.5–2 pt	8	Basagran application should be made when nutsedge is 6–8 inches tall and actively growing. Add 1 qt/A of crop oil concentrate to spray solution. Apply in a minimum of 20 gal of water/A and at a minimum pressure of 40 psi. Split-applications are suggested for improved nutsedge control. Make second application 7 to 10 days after the first, if necessary.
or Laddok 3.33L (bentazon + atrazine)	Corn	3.5 pt	9	Laddok application should be made to actively growing nutsedge but before corn is 12 inches in height. Add 2 pt/A of crop oil concentrate to spray solution. For best results, cultivate 7 to 14 days after application. (<i>Restricted-use pesticide and groundwater advisory.</i>)
Classic 25DF (chlorimuron)	Soybeans	0.5–0.75 oz	8	Apply treatment when nutsedge is 2–4 inches tall and soybeans have at least one trifoliate leaf (Both should be actively growing.) Always include a proper adjuvant with this product. Use a minimum of 10 gal of water/A at a pressure of 25–40 psi. If the soil pH is less than 7.0 at Classic rates of 0.5 oz/A or greater, do not plant corn for at least 9 months after application. Classic must be applied 60 days before harvest.
Permit 75DF (halosulfuron)	Corn	1–1 1/3 oz	9	Permit can be applied over the top or with drop nozzles from spike through lay-by of corn and when nutsedge is 4–12 inches tall and actively growing. A nonionic surfactant or crop oil concentrate must be added to the spray solution. Spray volumes of 10 or more gallons of water/A at a pressure which provides thorough and uniform weed coverage is optimal. Refer to label for any additional information.
Tough 3.75E (pyridate)	Corn	2 pt	8	Apply 2 pt product/A when nutsedge is 6–8 inches high. Treatment will burn back top growth but regrowth may occur. Use a spray solution of 20–30 gal of water/A at 30–40 psi. Tank-mixing with atrazine enhances activity.
Roundup 4S (glyphosate)	Burndown/ spot treatment	1–3 qt or 1–2% solution	9	Apply initial treatment of 1–3 qt/A when nutsedge is > 6 inches but before flowering. Sequential applications at lower rates will be necessary for long-term control. Lower spray volumes/A (≤ 10 gpa) provide better control. Add proper adjuvant as specified on label. Roundup is a nonselective herbicide and will injure or kill any plant it comes into contact with.

^a10=95–100%,9=85–95%,8=75–85%,7=65–75%,6=55–65%. Ratings based on optimal application timing.

thorough incorporation usually requires two passes in different directions. Improper application and incorporation may result in erratic or poor weed control and problems from carryover residues.

Although preplant incorporated treatments provide more consistent control of yellow nutsedge, this practice has some disadvantages. Incorporation requires extra equipment, time, labor, and cost beyond that of the herbicide application. In addition, incorporated treatments may require higher herbicide rates, cause difficulty in coordinating schedules with custom applicators, and may contradict conservation tillage programs.

The soil-applied treatments for corn are as follows:

Dual 8E (metolachlor), **Frontier 7.5E** (dimethenamid), **Harness 7E/Surpass 6.4E** (acetochlor), and **Micro-Tech 4ME** (alachlor) are all members of the chloroacetamide chemical family. These products provide fair to good control of yellow nutsedge. Application rates per acre for nutsedge control are as follows: Dual—2 to 3 pints; Frontier—20 to 24 fluid ounces; Harness—2.5 to 3.4 pints; Micro-Tech—3 to 4 quarts; and Surpass—2.5 to 3.3 pints. Incorporation of these herbicides improves their effectiveness on yellow nutsedge, but they also work reasonably well when applied as a preemergence surface treatment (assuming adequate rainfall). These products can be tank mixed with atrazine or Bladex to enhance the control of nutsedge, as well as other weeds. There are several other commercial products that contain these same active ingredients. *Harness, Micro-Tech, and Surpass are restricted-use pesticides.*

Eradicane 6.7E (EPTC + safener) and **Sutan+ 6.7E** (butylate + safener), which are members of the thiocarbamate chemical family, also provide good control of nutsedge. (Eradicane works slightly better on yellow nutsedge than Sutan+.) Each is applied at 4.75 to 7.33 pints per acre, with the higher rates used on medium or fine textured soils and for heavy infestations of nutsedge. Both products will volatilize rapidly, so they must be incorporated into the soil. If the soil surface is moist, the herbicide must be incorporated immediately after application. Otherwise, these chemicals should be incorporated within four hours. When possible, application and incorporation should be done in one operation. Atrazine or Bladex may be tank mixed with either herbicide to broaden the spectrum of control.

POSTEMERGENCE TREATMENTS

Foliar-applied herbicides can help reduce yellow nutsedge populations. Postemergence (POST) applications are generally used as spot treatments or 'rescue' treatments when a soil-applied herbicide or cultivation fail to provide adequate control. Application timing is important. Spraying before or after the recommended weed or crop growth stage could result in poor control or crop injury. Weather conditions also affect the performance of foliar-applied herbicides. If dry weather precedes application or if rainfall

occurs shortly afterwards, yellow nutsedge control could be reduced. The following foliar-applied herbicides are for use in corn. For additional information on the principles of postemergence applications, see the *Penn State Agronomy Guide*.

Atrazine 4L or 90DF plus crop oil concentrate can result in fair to good nutsedge control. Post-applied atrazine is more effective on yellow nutsedge than soil-applied atrazine treatments. When actively growing nutsedge reaches 4 to 8 inches in height, apply 1.5 to 2 quarts per acre of 4L, or 1.7 to 2.2 pounds per acre of 90DF, plus 1 quart per acre of crop oil. Applications must be made before corn exceeds 12 inches in height. *Do not exceed 2.5 pounds total atrazine (PRE and POST) per acre, per season. Due to water quality concerns, products containing atrazine are restricted-use herbicides. (Certain restrictions apply to all herbicide programs that contain atrazine, so read the label carefully.) This treatment will not control triazine-resistant weeds.*

Basagran 4S (bentazon) provides fair to good control of yellow nutsedge. For best results, split applications are suggested. When actively growing nutsedge reaches 6 to 8 inches in height, apply 1.5 to 2 pints per acre of Basagran plus 1 quart per acre of crop oil concentrate. Make a second application at the same rate seven to ten days later, if needed. Tank mixing Basagran with atrazine enhances yellow nutsedge control. **Laddok 3.33L** is a commercial pre-mix of Basagran and atrazine. Apply 3.5 pints per acre of Laddok plus 2 pints per acre of crop oil concentrate when nutsedge is actively growing, but before corn reaches 12 inches in height. For best results, cultivate seven to fourteen days after Laddok has been applied. Corn is tolerant to Basagran at all stages of growth.

Permit 75DF (halosulfuron) is a broadleaf, sulfonylurea herbicide that provides good control of yellow nutsedge. Apply 1 to 1 1/3 ounces Permit per acre and include 1 to 2 quarts nonionic surfactant per 100 gallons of spray solution, or include crop oil concentrate at 1 gallon per 100 gallons of spray mixture. Apply when actively growing nutsedge is 4 to 12 inches tall. Permit can be applied over the top, or with drop nozzles from the spike through lay-by stage, or as the tank-mix partner limits.

Tough 3.75E (pyridate) will suppress the growth of nutsedge. Apply Tough at 2 pints per acre when nutsedge is 6 to 8 inches tall. Tough will burn back the top growth of nutsedge, but regrowth can occur. Tough may be applied at any growth stage of the corn crop, or as the tank-mix partner limits. Tough should be tank mixed with atrazine or another compatible foliar-applied product to broaden the spectrum of weed control.

Control in Soybeans

A dense stand of narrowly spaced soybeans combined with a good herbicide program will provide excellent nutsedge control. Several herbicides can be effectively used in soybeans.

PREPLANT OR PREEMERGENCE TREATMENTS

As with corn, soil-applied treatments in soybeans may be incorporated or surface-applied. The spacing between the rows of soybeans will determine whether cultivation and/or another herbicide treatment can be used as a subsequent measure for nutsedge control.

Dual 8E (metolachlor), **Frontier 7.5E** (dimethenamid), and **Micro-Tech 4ME** (alachlor) provide fair to good control of yellow nutsedge. Refer to the Control in Corn section for application information. Sencor or Lexone (metribuzin) can be tank mixed with these herbicides to enhance activity.

POSTEMERGENCE TREATMENTS

Foliar-applied treatments are most effective when used in a planned application program that is timely and advantageous to crop development. Postemergence treatments can also provide a 'rescue' tactic when previous control measures have failed.

Basagran 4S (bentazon) provides fair to good control of nutsedge. Split applications are suggested when the nutsedge population is dense. Soybeans are tolerant to Basagran at all stages of growth. Slight yellowing or speckling may occur, but soybeans will quickly outgrow this injury. Refer to the Control in Corn section for application information.

Classic 25DF (chlorimuron) also provides fair to good control of yellow nutsedge. Apply 1/2 to 3/4 ounce per acre when nutsedge is 2 to 4 inches tall. Always include a nonionic surfactant at 1 quart per 100 gallons of spray solution, or use crop oil concentrate at 1 gallon per 100 gallons. Classic may be applied anytime after the first trifoliolate emerges. Crop rotation restrictions may apply to Classic if soil pH is greater than 7.0. (See the label or consult the *Penn State Agronomy Guide*.) Classic is a component in **Canopy 75DF** pre-mix, which will provide some suppression of nutsedge in preemergence applications.

Control in Forages

The best approach to managing yellow nutsedge in forages is prevention or suppression before crop establishment. Once the crop is established, there are no registered herbicides that have activity on nutsedge. The following herbicide may be used prior to planting.

Eptam 7E or 10G (EPTC) can provide fair to good control of yellow nutsedge. Just before planting, apply 3.5 to 4.5 pints per acre of Eptam 7E, or 30 pounds per acre of Eptam 10G. Each should be thoroughly incorporated immediately after application. Eptam will control or suppress yellow nutsedge for four to six weeks following application.

NONSELECTIVE MAINTENANCE APPLICATIONS AND SPOT TREATMENTS

Roundup 4S (glyphosate) can be used to clean up fields prior to planting or to kill isolated patches of yellow nutsedge. Roundup can effectively kill yellow nutsedge prior to seeding late summer forages or before planting double-crop soybeans. To control emerged nutsedge plants, apply 1 to 3 quarts of Roundup per acre as a broadcast spray, or use a 1 to 2 percent solution (1 to 2 quarts per 25 gallons of water) with hand-held equipment. For best results, apply treatment when plants are taller than 6 inches but before flowering, which occurs in mid-June to early August. Mature nutsedge tubers are unaffected by systemic herbicides. Sequential treatments of Roundup at 1 to 2 quarts per acre plus 2 quarts nonionic surfactant per 100 gallons can improve the level of control. In the near future, the introduction of certain Roundup-resistant crops will allow Roundup to be used as an over-the-top application.

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