



General

# Causing and Controlling Erosion Illinois

**What** Erosion control methods outlined in conservation plans are intended to keep soil and water from leaving the land so that these resources can be available to produce high quality forage, crops, timber, and reduce the amount of sediment in streams, rivers, and water bodies.

**Why** Erosion is a natural occurrence. However, erosion often increases with activities that upset the natural balance of soil erosion and formation. Erosion is not just a cropland problem, but can also occur in hay and pasture systems. Poor grazing management is a major cause of erosion. Trails rutted into the sod, poor control of water drainage from roads, disturbance of natural drainage, livestock trailing, and other land disturbances are also responsible for increasing grassland erosion.

Plant cover on the soil surface, at the time of a rain storm, is the primary factor in preventing erosion because a raindrop that hits bare soil has a different effect than one that falls on a plant or litter and then rolls off onto the soil.

An uninhibited raindrop smashes against bare soil with great force, splashing water and soil particles and packing the surface soil. The process seals the pores of the soil. The result is that little water goes into the soil and runoff occurs. On the other hand, when a raindrop hits a plant, or litter, its force is broken and the water trickles into the soil.

**How** The best treatment for grassland soil erosion is to maintain vigorous plant cover, but long-term improvement of plant cover occurs only with proper management.

The first criteria is to graze pastures properly to provide for growth and maintenance of healthy plants. The plants and litter form the necessary protective cover that breaks the splash of raindrops, slows over land flow, and promotes surface conditions favorable to water intake.

Other practices to control erosion on hay and pasture include brush control, deferred grazing, reseeding and mechanical land treatments. Erosion control structures such as small dams and diversions are helpful. However, the effectiveness of these practices is limited, and often is temporary. Fencing locations and livestock watering sites should be placed to minimize erosion problems.

A combination of erosion-control practices gradually results in higher production of forages improved pasture conditions, a better water supply for livestock, and personal satisfaction in managing natural resources.

## Where to Get Help

For more information about hay and pasture management, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.

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# General How Plants Grow Illinois

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**What** A problem each livestock producer faces is knowing how short they can graze or mow their pastures and still obtain maximum productivity during an extended period. Varying climatic conditions, growth habits of different plants and livestock preferences for different plants, compounds the problem. The time of the year and age of the plant also affect plant growth when leaves are removed.

**Leaf Growth** Plants manufacture food in their leaves through the use of solar energy. Yet some people wrongfully assume plants produce food in their roots. Plants pull water and minerals from the soil, but the "food factory" is located above ground in the leaves and green stems.

Minerals from the soil make up about 5 percent of the solid material in plant roots, stems and leaves. Carbon, hydrogen and oxygen from the air and water make up most of the other 95 percent.

The leaves take in carbon dioxide from the air through tiny pores. Using solar energy, the leaves re-combine the carbon with oxygen and hydrogen to make sugars and starches. The sugars then combine with minerals from soil to make fibers, proteins, plant oils, and fats. The plant uses these sugars, starches, proteins, oils and fats to grow and reproduce.

The ability of perennial grasses, legumes, and forbs to recover quickly after grazing or mowing makes these plants extremely valuable for forage production and soil protection. Removing too many leaves decreases forage production and reduces the extent of the plant's root system. Plants eventually die if overharvest of the leaves continues.

**Leaf Removal and Growth** Root growth is closely related to forage production. Plants maintain optimum root vigor and growth when grazing or mowing during the growing season removes no more than half their leaves. When the plant's food producing mechanism is reduced, leaf and root growth is reduced accordingly.

In all grasses, the volume of leaf removed has a direct effect on the growth of new roots. Roots are the vital supply lines of moisture and minerals to the leaves. Perennial plants store food in the roots after seasonal growth. They use these reserves to live while dormant and make the first new growth the next spring.

A grass plant produces twice the volume of leaves that it needs to complete its growth and remain productive. Generally, when up to 50 percent of the plant, by weight, is grazed, root growth continues unimpaired. When 60 to 90 percent of the plant is removed, 50 to 100 percent of the root growth is stopped, respectively.

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## Other Growth Factors

Other factors influence plant growth. For instance, light grazing is usually more beneficial to plants than several years of no grazing because heavy plant residue depresses growth of many grasses.

## Growing Plants

All plants have growing points where new cells are developed. The growing points of grass are located just above the last completed joints of each stem. Early in the season, the growing joints are situated at the base of the plant. As the season progresses, the joints of most species elongate and push upward to produce a seed stalk, elevating the growing point to a vulnerable position. Removal of the growth point by grazing or mowing forces the plant to send up new leaves from the base of the plant and to start over as if spring had just started. Adequate rest periods must be planned to maintain plant vigor.

The growing points of trees, shrubs, and forbs are located on the outer tips of branches.

## Reproduction

Grazing management schemes can be used to favor the more desirable plants during their reproductive period. Plants reproduce in several ways. Such as:

**Seed.** All annuals, and many perennials, reproduce primarily from seed. Warm-season plants usually produce seed during late summer or fall. Cool-season plants produce seed near the end of their maximum growth period in midsummer.

**Stolons.** Some plants reproduce by stolons, which are prostrate stems, or above ground runners. The stolons grow on the surface of the soil, occasionally tagging down roots at the joints to secure the stolon and to begin a new plant. Bermuda grass reproduces by stolons.

**Rhizomes.** Several grasses reproduce by rhizomes, which are underground stems. Most sideoats grama strains have rhizomes. Big bluestem, Indian grass, and switchgrass have short rhizomes while smooth brome grass and Kentucky Bluegrass have rhizomes that are quite extensive.

**Mixed methods.** Many plants reproduce by stolons or rhizomes as well as by seed. Buffalo grass produces seed and stolons. Most sideoats grama plants produce seed and rhizomes. Common bermuda grass uses all three methods of reproduction.

## Where to Get Help

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November 2000

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General

# Pasture and Hayland Planting

Illinois

Table 1 - Acceptable Planting Dates by Plant Suitability Zones

Type of Seeding	Plant Suitability Zone <sup>1</sup>	Cool Season Species	Warm Season Species <sup>2</sup>
<b>Spring</b>	I	Late Winter - June 1	Late Winter - June 15
	II	Late Winter - May 15	Late Winter - June 6
	III	Late Winter - May 15	Late Winter - June 1
<b>Late Summer</b>	I	August 1 - September 1	Not Recommended
	II	August 1 - September 10	Not Recommended
	III	August 1 - September 20	Not Recommended
<b>Dormant</b>	I		November 1 - Freeze-up
	II		November 15 - Freeze-up
	III		November 15 - Freeze-up
<b>Frost <sup>3</sup></b>	I	February 1 - March 15	February 1 - March 15
	II	February 1 - March 1	February 1 - March 1
	III	February 1 - March 1	February 1 - March 1
<sup>1</sup> -Refer to the "Plant Suitability Zones" map located in Section II, IL-eFOTG-Climate Data or refer to the link: <a href="https://efotg.sc.egov.usda.gov/references/public/IL/c12plant.pdf">https://efotg.sc.egov.usda.gov/references/public/IL/c12plant.pdf</a> <sup>2</sup> -Dates to be used when warm and cool season natives are planted in mixture. <sup>3</sup> -Refer to Table 2 for applicable plant species. Frost seeding may be performed in December and Janu-ary when snow cover is absent.			

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**Table 3; Crop Use Information (E=excellent, G=good, F=fair, P=poor)**

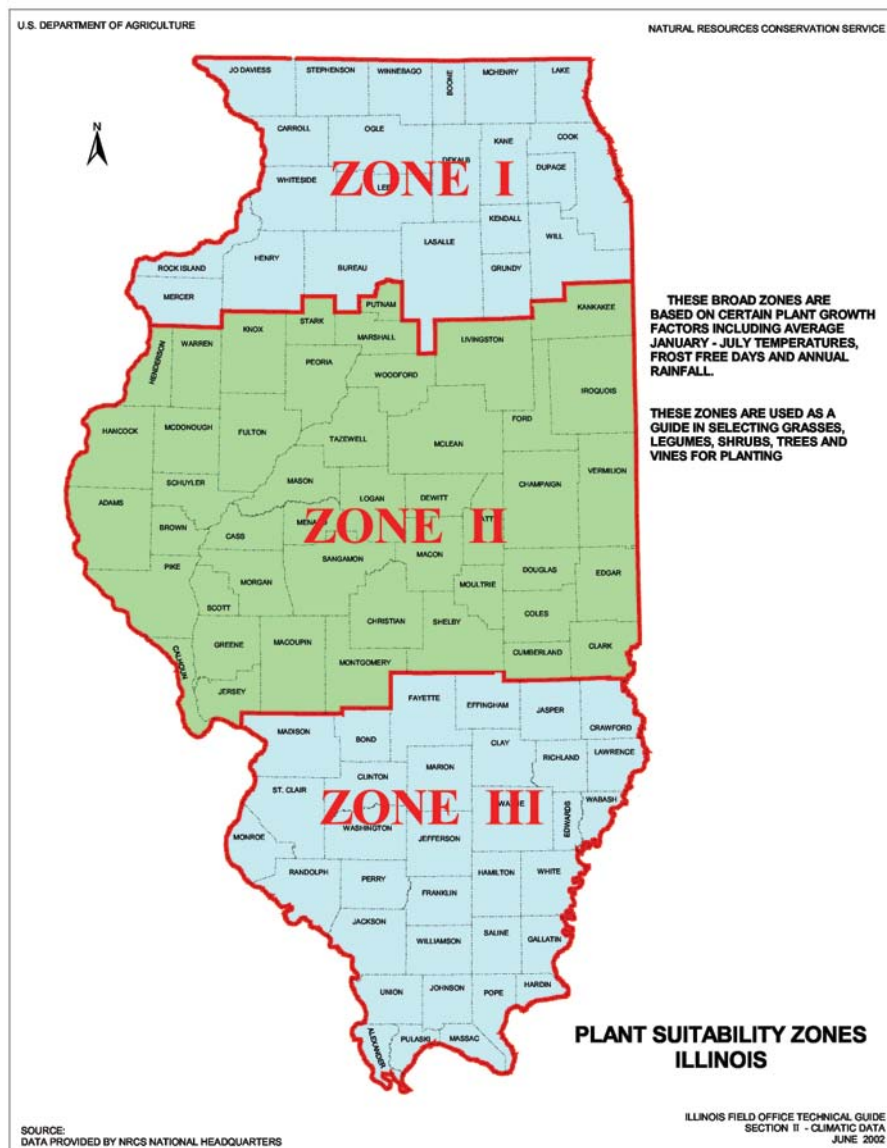
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Forage Species	Annual or Perennial	HAY	Silage	Continuous Grazing	Prescribed Grazing	Palatability	Biomass Production
<b>Legumes</b>							
Alfalfa	Perennial	E	E	P	E	E	NR
Alsike Clover	Short-lived perennial	G	G	P	G	E	NR
Birdsfoot Trefoil	Perennial	G	E	F	G	G	NR
Cicer Milk Vetch	Perennial	F	G	F	G	E	NR
Crownvetch	Perennial	F	G	F	G	G-F	NR
Hairy Vetch <sup>a</sup>	Winter annual	F	P	P	F	F	NR
Kura Clover	Perennial	G	G	E	E	E-G	NR
Lespedeza (Korean)	Annual	F	F	F	G	G	NR
Ladino Clover	Perennial	F	G	G-F	E	E	NR
Mammoth Red Clover	Short-lived perennial	F	G	P	P	G	NR
Medium Red Clover	Short-lived perennial	G	E	P	G	E	NR
Sweetclover	Biennial	F-P	G	P	F	F	NR
<b>Cool Season Grasses</b>							
Canada Wildrye	Perennial	F	F	P	E	E	NR
Kentucky bluegrass	Perennial	F	G-F	E	E	E	NR
Orchardgrass	Perennial	E	G	F	E	F-G	NR
Perennial ryegrass	Short-lived perennial	E	E	F-G	G-E	E	NR
Red Top	Perennial	F	F	F	F	G-F	NR
Reed canarygrass	Perennial	G-F	G	F	G	G-P	NR
Smooth brome	Perennial	E	E	F	E	E	NR
Tall fescue	Perennial	G-F	G	G-E	G-E	F-P	NR
Timothy	Perennial	E	E	F-P	G	E	NR
Virginia Wildrye	Perennial	F	F	F	E	E	NR
<b>Warm Season Grasses</b>							
Big Bluestem	Perennial	G	F	F	E	G-E	G
Caucasian Bluestem	Perennial	F	F	P	G	F	G
Eastern Gamagrass	Perennial	E	F	P	E	E	G-E
Indiangrass	Perennial	F	F	F	G	G	G
Little Bluestem	Perennial	P	P	F	G	G-F	NR
Prairie Dropseed	Perennial	F	F	F	G	G-F	NR
Sideoats Grama	Perennial	F	F	F	G	G	NR
Switchgrass	Perennial	F	F	F	G	G-F	E
<b>Annual Forages</b>							
Chicory	Short-lived perennial	P	P	G	G	G-P	NR
Foxtail/German Millet	Annual	F	F	F	G	G-F	NR
Hyb. Pearl Millets	Annual	F	F	F	G	G-F	NR
Rape	Annual	P	P	F	G	E	NR
Sorghum-Sudan	Annual	F	G	F	G	G-F	G-E
Sudangrass	Annual	F	F	F	G	G-F	G
Turnips	Annual	P	P	F	G	E	NR

<sup>a</sup> - Used primarily as a cover crop

NR = Not Recommended

## Illinois Planting Zones



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# General Plant Succession Illinois

**What** Progressive plant development, or the replacement of one plant community by another, is an ongoing and generally long-term process referred to as plant succession.

**Why** Although the potential plants on an area of pasture are relatively stable, plants change when environmental factors change. If the annual average temperature of a region changes only a few degrees, the plants respond with changes in composition. If the plant cover of the land is removed and soil erodes, the potential plant community also changes. When the potential plant community of an area of pasture is destroyed, nature strives to restore the vegetation to its original state.

Grassland management today is based on sound ecological principles. Continuous overgrazing of pasture changes the potential plant community from desirable, highly productive grasses to low quality, poor producing grasses, and often permits invasions of moisture robbing woody plants. The change to less desirable plants is called plant retrogression.

**How** In order to reverse retrogression and restore pasture productive potential, long-range planning is necessary. First, determine what caused the problem. To address the problem without addressing the cause is a short-term solution that may have a negative long-term impact. Next, inventory the present plant community.

Careful consideration must be given to comparing the present pasture plants in relation to the potential plants that would grow on the soil. A plan for hay and pasture improvement must be carefully considered, and alternatives weighed in order to economically achieve the desired effects.

To promote grassland potential through plant succession, a well-designed grazing system must be incorporated. Various systems are explained in another fact sheet, "Rotation Grazing Systems." Basically, managing animals to graze plants at the proper time and to the right intensity will stimulate plant growth, especially the desirable grasses. Managed grazing, coupled with proper resting of plants, will increase the vigor of the more desirable plants, and allow them to better compete with less desirable plants for sunlight, moisture, and nutrients. Positive plant succession will then begin. The plants that are best adapted and most competitive will begin to dominate the site again.

**Where to Get Help** For more information about hay and pasture management, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.

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# General Water Cycle Illinois

**What** The water cycle is the never-ending movement of water from clouds to earth and to clouds again. Influencing those parts of the cycle that affect grassland is important in hay and pasture management. The cycle begins when precipitation strikes the land, and ends when the water leaves, either through runoff or evaporation. In the interim, livestock producers should store as much water as possible within the soil for use in forage production.

**Why** Water is generally the most limiting factor in hay and pasture production. One of three things happens with the moisture that falls as raindrops, snowflakes, sleet or hail used productively on the site where it falls; goes downstream as clean water; Or, goes downstream, carrying soil. When runoff is dirty, the land's production potential is being removed.

**How** **Impact.** When falling raindrops strike bare soil, the impact causes both splash erosion and soil compaction, resulting in faster runoff and increased erosion. Good plant cover breaks the force of the raindrops, and allows the water to seep into the soil. The soil can act as a large reservoir, holding moisture, reducing flooding and enhancing water quality. Water stored in the soil promotes a greater and more consistent supply of forage.

**Soil.** Coarse soil takes in water faster than fine soil, but stores less within the root zone of most plants. Water that moves below the root zone of plants recharges groundwater supplies, and sometimes reappears down slope as a spring or creek. Because the movement through the soil is slow, the water supply downstream is cleaner, and streams flow longer than where moisture runs off over the soil surface. Where the surface is bare, less moisture enters the soil and surfaces are hotter causing much of the stored water to evaporate during hot, windy days instead of being used for plant growth.

**Plants.** A healthier, more productive grassland water cycle can be achieved by proper grazing. Plants and the litter they produce affect the water cycle in several ways. Plants break the impact of raindrops on the soil surface, and serve as small windbreaks to hold snow. Plants shade the soil's surface causing the soil surface to be cooler, which creates a better environment for plant growth. Litter acts as a sponge, and slows runoff, giving moisture more time to move into the soil. Plant roots increase soil porosity so water moves more readily into and through the soil. Roots also hold soil particles in place, reducing erosion. Vigorous plant cover is an important part of influencing the grassland water cycle, and making effective use of precipitation.

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# Grazing Management **Brush Management Illinois**

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## **What**

What

Brush management attempts to restore balance to the natural plant community by manipulating brush in order to meet the specific needs of the livestock producer.

## **Why**

Why

Brush plants use three to five times more water than native grasses for each pound of leaf growth. Reducing the amount of plants that use a lot of water while increasing the number of water-efficient plants will result in more quality forage for livestock, and will allow more water to infiltrate the soil, recharging underground aquifers.

Brush management also reduces the competition of desirable plants for sunlight and nutrients, which increases forage yields.

As brush management improves the condition of grassland, the healthier and thicker grass slows runoff, allowing more moisture to soak into the soil, and reducing soil erosion by water and wind.

Thinning dense brush in an area also creates diverse wildlife habitat—places for wildlife to find cover, nesting areas, and food. Many livestock producers find that the improved habitat attracts game for hunting. By leasing hunting rights, they can increase income from their farms.

## **How**

How

Unwanted brush can be managed by chemical or mechanical methods, fire, or improved grazing management. The applicable method depends on economics, soil, the type of brush on the land, the topography, and the type of farm operation. Most successful efforts usually involve a combination of methods.

Chemical methods involve applying herbicides to the soil or the plant. Because many brush species are tolerant to some herbicides, results vary. Success depends on applying the right herbicide at the correct rate when weather conditions are favorable and when the species to be controlled is weakest.

Mechanical methods of brush management include mowing, axing, root plowing and bulldozing. These methods have proven to be effective, but are often costly.

In order to manage undesirable woody plants, many livestock producers are utilizing prescribed burning. Historically, nature's most effective brush management tool was fire. Deciding factors for use include sufficient fuel for the fire, favorable weather conditions, and safety.

Proper grazing management prevents overgrazing and assures healthy, vigorous forage. In a healthy grass ecosystem, brush problems are reduced.

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**How**  
(Continued)

To be effective, any option used to manage brush on hay land and pasture must be preceded and followed by proper harvesting management. Forage yields will improve after the desirable grasses have had a chance to recover and plant succession has begun. On grassland where brush has been removed, the pasture should be rested and grazing time should be limited during the first growing season after treatment; allowing for the desirable species to establish themselves. Reseeding these areas may be necessary if a natural seed source or remnant plants of desirable forage species are not available. Grazing management must be a continuous process. Uncontrolled grazing probably contributed to the brush problem. Treating the problem without addressing the cause is only a short-term solution.

Most hay and pasture improvement practices take time to show changes. Do not be discouraged if drastic changes are not noticed immediately. With careful planning and management of the practices, grassland will improve.

**Where to  
Get Help**

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## Grazing Management

# Drought Planning Considerations

## Illinois

### General Information

Drought occurs almost every year in some part of the country that has an effect on agriculture. The definition is: "(1) A prolonged chronic shortage of water. (2) A period with below normal precipitation during which the soil water content is reduced to such an extent that plants suffer from lack of water; frequently associated with excessively high temperatures and winds during spring, summer and fall in many parts of the world." (National Range and Pasture Handbook (HRPH) USDA/NRCS)

### Drought Plan

The best managers prepare a Drought (drouth) Plan ahead of time and stick to it. A Drought Plan definition is: "The livestock operator's contingency plan to make necessary adjustments during unfavorable years of low forage production." (NRPH)

### Impacts of Drought

Drinking water is normally the least expensive nutrient for livestock. However, water has the most impact on the forage production or lack of production. The impact of reduced forage production can and will impact the animal's productivity and health if not managed properly. An animal's nutrient requirements are in the following order: 1. Maintenance, 2. Fetus Development, 3. Lactation, 4. Growth, 5. Breeding, 6. Fattening. (Dr. John Merrell Texas Christian University, TCU)

Usually it will take 1200 -1500 pounds of water to produce 1 pound of forage dry matter. If brush is controlled in a normal year, forage will increase by 18 percent. If brush is controlled during a year of drought, forage production can increase about 50 percent. If you have doubts, take a look at any corn field along a wooded fence row and see how far out the corn is stunted in a dry year.

### Forages

Cool season grasses (CSG) are considered C3 plants which are made up of three carbon chains. C3 plants, such as Orchardgrass, fescue, Bromegrass, Reed Canarygrass and Timothy, convert light energy at less than 3 percent. These plants start growing in early spring and go into their summer slump in the hot weather of June-August. They start growing again in September with cooler temperatures and moisture. The CSG usually produce about 60 percent of their forage in the spring, April – June, and 40 percent the remainder of the year. Their root systems can grow to a depth of three to four feet maximum; but to achieve this depth, they will have to receive excellent management. The root depth usually equals the plant's height above the ground, considered top growth and leaf length.

Warm season grasses (WSG) are C4 plants and convert light energy at the rate of 5-6 percent. Examples of WSG perennials are Eastern Gamma grass, Big Bluestem, Indian grass, Switchgrass. Some annual WSG are Pearl Millet, Sudangrass, and Corn. These plants produce 100 percent of their forage in the summer months from June through September. The WSG have a much deeper root system than the CSG. Many of these taller WSG can grow roots to a depth of 10-15 feet or more. Because of their growth patterns, the WSG have the potential for higher yields than the C3 plants. This is partly due to the fact the C4 plants utilize full sunlight.

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## Management Techniques

These management techniques can be looked at as “Reducing the need-Increasing the feed”. By this we mean reducing the forage needs which can be done through several methods or practices.

Some options to consider in developing a drought plan are as follows:

Implement a Managed Grazing System, or rotational grazing system. This will consist of dividing the pasture into smaller units, called paddocks, and grazing each for a short period of time and then moving the animals to another paddock. The grazed area will be rested for usually a 30-day period before being grazed again. During a drought, the rest period may need to be lengthened to 40 or more days, or until adequate re-growth has occurred. Over-grazing will hinder the forage re-growth and create more plant stress. If over-grazing occurs for a long period, this can stress the plants enough to eventually kill them. The key to more and better forage, even in a dry year, is to manage your plants and root systems. If the leaf area is left at an optimum length, the roots will support more plant growth. A balanced fertility plan will allow the plants to be more efficient in their water usage. For recommended grazing heights refer to the NRCS Field Office Technical Guide, Practice Standard, Prescribed Grazing 528.

Creep feed nursing calves/lambs (offspring) to maintain optimum gain and lessen the forage stress of the pastures while with their mothers.

Provide supplemental forage or feed when the forage is grazed to a minimum height, CSG 3-4” or WSG 8-10”. Supplementation can be done in the pastures by feeding corn or hay or some of the by-products available on market today. [If corn is used, a pound of corn will replace two pounds of forage consumed. (Cliff Little OSU 2005)] If by-products are used, consult a University of Illinois Extension Animals Systems Educator because there are maximum amounts that you should not exceed in the livestock ration. Don’t overlook crop residues. They can provide a forage source for a period of time. If using annuals, check for nitrates. After a frost, check for prussic acid on sorghums and Sudangrasses. When supplemental feeding, be aware of the cost. You can spend your way into debt quickly. Many ranches have been lost to debt accumulated from trying to feed their way out of a drought.

Graze the hay fields. In dry years the forage will usually be short and thinner. If you try to harvest this short forage mechanically, you will incur a higher harvest loss. The livestock will be much more efficient in harvesting the shorter forage. This will also lengthen the rest period for your pasture forages. Use bloat –prevention strategies if legumes are in the forage mixture such as alfalfa, red clover, white clover etc.

Early wean calves/lambs (offspring). Offspring can be weaned at an early age and still have a good rate of gain in the feedlot. Many times near a 4:1 ratio or better on feed conversion. [By early weaning, the mother’s energy and nutritional needs decline dramatically, up to 40 percent over a normal lactation and 205 day weaning. (Myers et al. 1999)] This in turn reduces their intake rate and stretches the forage resources farther

Separate the animals according to nutrient needs, by age and body condition score. The younger animals and any lactating animals will have a much higher nutrient demand.

Move stockers that are part of the operation to the feed lots. This will allow more rest for the forage acres and for the breeding herds or flocks.

## Management Techniques (continued)

Reduce the animal numbers (open females [heifers, cows, ewes, nannies & mares], older less productive females, and 1<sup>st</sup> bred females). If drought persists, you may want to keep bred heifers and liquidate more cows if you have been making genetic improvements in your herd. The heifers should genetically be the best animals that you have. A 400 pound calf will only eat about 1/3 as much as a mature cow. In drought prone areas, livestock will run 75 percent of their carrying capacity in breeding stock, and stockers, are used for the remainder. This allows more management flexibility during a drought.

Dry lot the herd or flocks until the forage growth reaches the recommended height: CSG = 8-10" and WSG = 16-20". Placing livestock into the dry lot should be the last resort! Some farms will have a "sacrifice area" that is also used during winter or other short forage situations. This can also be used as a method to renovate some pastures in a rotation. You can usually feed at the maintenance level of the animal; however, you will need to balance the ration with other sources for energy and nutritional levels. Stored feed is the most expensive and many farms and ranches have been ruined by trying to "feed out" of a drought!

## Prevention

The quicker that you recognize the short forage problem and address it, the less damage your operation will incur, both financially and environmentally. Some operations will wait for the government to pay them disaster assistance. An example of this is the CRP drought release dates that normally occur on Aug. 1<sup>st</sup>. This is well after the forage has gone dormant (i.e. cool season grasses and forage quality has decreased dramatically.)

Another concern is poisonous plants. Usually in the dry years, livestock will start grazing in wooded and odd areas that are not frequently used. The animals will tend to feed on other plant species and this increases the chance of poisoning. Many of the poisonous plants grow in the wooded or shaded areas.

It is recommended that you routinely check conditions or rainfall totals. This will allow you to forecast and make plans if it looks like a drought will continue or is foreseen. Typically, if 50 percent of the normal moisture, rainfall, is not received by June 1<sup>st</sup>, you should be prepared to initiate a Drought Plan. Check climate conditions at the Climate Prediction Center web site: <https://www.cpc.ncep.noaa.gov/>.

"Drought is a recurring characteristic of our business which should become an integral part of a continuous, coordinated management planning and application process. This process should be flexible, with timely adjustments to address ever changing situations in order to maximize continuing net return from available resources. Whether currently in the middle of a drought, going into or coming out of one, or waiting for the next one, the time to prepare for the next drought is now." (Dr. John Merrill et al: 1983)

## References

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## Grazing Management

# Forage Quality Illinois

**What** Forage quality can be defined in many different ways. As presented here, forage quality is considered as the value of pasture grasses and legumes as a nutrient for grazing livestock. Forage quality can be described in terms of protein, fiber, and other components.

The area of forage quality has specific terminology. The terminology includes different components of forages that are actually measured, such as protein, and fiber. Predicted values, such as intake and energy are also included. The following terms are commonly used in forage testing.

### Forage Quality Terms

**Crude Protein (CP)** in forage is the total amount of protein, some of which is insoluble or nondegradable. Crude protein measures only the nitrogen content of the feed. The nitrogen contained as “amino acid nitrogen” or “non-protein nitrogen” is not distinguished. The value is obtained by multiplying the amount of the nitrogen in the feed by 6.25. The value comes from the fact that most protein contains about 16 percent nitrogen ( $16 / 100 = 6.25$ ).

**Degradable Intake Protein (DIP)** - protein that is broken down in the rumen, mainly into ammonia. Most rumen microbes need ammonia in order to maintain adequate microbial growth.

**Undegradable Intake Protein (UIP)** - the protein fraction also referred to as bypass protein. UIP is resistant to rumen microbial degradation and therefore bypasses the rumen. Most UIP can be broken down.

**Soluble Protein (SP)** - protein that is degradable in the rumen very rapidly. Soluble protein is converted to ammonia in the rumen within minutes of being ingested. The remainder of the degradable fraction may take hours to be broken down.

**Neutral Detergent Fiber (NDF)** - an estimate of the portion of a forage sample consisting of the walls of the plant cells. Estimate is determined by boiling a forage sample in a neutral detergent and weighing the residue. Boiling removes the soluble components of the cell—most of the sugars, fats, starches, and proteins. The remaining residue; therefore, is made up of plant cell walls composed mostly of cellulose, hemicellulose, and lignin. The amount of NDF residue is negatively related to forage intake, so high quality forages have low amount of NDF.

**Acid Detergent Fiber (ADF)** is considered the indigestible portion of a forage sample. Measurement of ADF is similar to NDF except that a forage sample is boiled in an acidic detergent. The boiling process, with the detergent, removes sugars, fats, starches, and protein, but removes hemicellulose as well. The amount of ADF residue is negatively related to energy, so high-quality forages contain low amounts of ADF.

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## Forage Quality Terms (Continued)

**Total Digestible Nutrients (TDN)** -an estimate of digestible forage. TDN is not measured directly but is calculated from ADF. TDN is used by many beef producers to balance rations.

**Net Energy (NE)** - calculated from ADF. Net energy estimates are used largely by dairy producers in ration balancing for maintenance ( $NE_M$ ), gain ( $NE_G$ ), and lactation ( $NE_L$ ).

**Relative Feed Value (RFV)** - estimate of hay and forage quality. Calculations are from NDF, and ADF, with primary emphasis, on NDF. The average or reference RFV equals 100. Higher scores denote higher quality and lower scores denote lower quality.

**Digestible Organic Matter (DOM)** - percentage of energy and protein in forages expressed as organic matter intake.

**Digestible Dry Matter (DDM)** or digestibility is determined in several ways. Estimated mathematically from ADF, the higher the ADF, the lower the digestibility. Digestibility is also measured chemically. Sometimes measured with actual rumen fluid and other times measured with laboratory enzymes.

**Dry Matter Intake (DMI)** - can be determined with feeding trials. Usually intake is simply estimated from NDF. The higher the NDF, the lower the intake.

## Factors That Affect Forage Quality

In a pasture there are three major factors that affect forage quality. The first factor that affects forage protein and fiber is **plant species**. Legume species tend to have higher quality than grass species. The second factor affecting quality is **plant maturity**. As a plant matures from the leafy, vegetative stage into the stemmy, reproductive stage, protein decreases and fiber increases. The third factor-affecting forage quality in a pasture is **plant part**. Leaves contain more protein and less fiber than stems and are therefore higher quality.

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# Grazing Management **Forage Quality Testing** Illinois

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**What** It is important to know the quality of pasture if animal performance is going to be optimized. The difficulty is that pasture plants are constantly changing in growth and physiological maturity. Also, through the growing season, environmental changes affect forage quality. Grazing pressure affects the degree of selectivity by the grazing animal, thus, influencing the quality of the forage consumed.

**Why** Greater net profit is the primary reason livestock producers need to know the quality of forages their animals are grazing. Not knowing the exact quality of forages the animals are consuming acts as a two-edge sword that can cut into profits either way it swings. It is very important to know the quality of forages that animals are consuming as this help you determine the amount of forages that animals are consuming and if it is meeting the nutritional demands of the animal.

**How** If pasture forage is to be tested for chemical constituents, the sampling method needs to be such that it closely approximates what the animal will consume. This approach would be near impossible to achieve in continuous grazing systems where animals have a high degree of selectivity. With intensive or rotational grazing, sampling which closely approximates the animal should be possible. One approach would be to observe the most recent post-grazing paddocks and then samples the next pre-grazing paddock accordingly. by occasionally sampling throughout the season, one could develop a good picture of pasture forage quality in a particular system. Of course, sampling will need to continue if botanical composition changes during the grazing season or over years.

**Sampling techniques.** Different techniques for taking pasture samples can be used, but the basic principles will be the same for each technique. Sample strips of 1 ft. wide by 2 ft. in length at random throughout the paddock, or sample a 2.5 sq. ft. area. Take 3-5 samples per acre or 10-15 samples from a 5 acre area and combine samples to make one composite sample for grazing area.

Collect each paddock sample and place in a plastic bag. Then properly identify sample and mail to testing laboratory carefully avoiding weekend mail or over holidays.

## **Sample Analysis**

Once you have gone to the effort of collecting a sample correctly, how can you insure the results you receive from the testing laboratory are accurate? Concerns about laboratory testing often focus on methods used for determining forage quality. Concern should be focused, however, on the accuracy of results and not on the technique used. To help you determine if test results are accurate listed below are some questions to ask the laboratory.

1. Is the lab certified or does it participate in a check sample program. The National Forage Testing Association has a certification program that compares a laboratory's performance with that of other labs to warn of potential inaccuracies.
2. Does the lab include duplicate samples analyzed? One of the easiest ways for a laboratory to monitor results is by analyzing replicates of a sample. If the analysis

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## **Sample Analysis** (Continued)

for replicates is not similar, there is a problem in the testing procedure. In addition, the inclusion of standards or check samples (material of known quality) in each group of samples analyzed can indicate if the analytical procedure is working correctly or not.

3. What analytical methods does the laboratory use? There is more than one method of analysis for most plant constituents. Laboratories should use methods that are well validated and approved by the Association of Official Agricultural Chemists.

Laboratories that use infrared reflectance spectroscopy (NIRS) to analyze forage for quality can be asked three additional questions that will help determine if the results are accurate. Like other laboratory analyses, NIRS analysis is sophisticated and should be conducted and monitored by trained personnel.

4. How often are NIRS instruments and calibration equations monitored? NIRS Running a check sample daily should monitor instruments or after every 25<sup>th</sup> sample, whichever is more frequent.
5. Does the laboratory do chemical analysis in addition to NIRS? NIRS methods are based on calibrations derived from chemical methods. NIRS labs without a chemical analytical capability has no way to monitor the reliability of their calibration equations.

## **Where To Get Help**

For more information about forage testing contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone Directory under "U.S. Government," or the University of Illinois Extension.

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Grazing Management

# Grazing Management Effects on Plants Illinois

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**What** Proper grazing is allowing livestock to graze at an intensity that maintains or improves the ability of plants to provide forage for livestock and wildlife, and to protect the soil.

**Why** Proper Grazing will:

1. Increase the vigor and reproduction of desirable plants.
2. Improve—or at least maintain—the general condition of the pasture.
3. Increase forage production.
4. Improve plant cover and plant litter necessary to prevent soil erosion and to provide for water conservation and water quality.

**How** Grass manufactures food in leaves and stems. Leaves convert radiant energy to chemical energy.

Proper grazing intensity leaves the most important plants in a pasture with sufficient leaf growth to maintain plant vigor and to effectively reproduce. Also, providing enough plant cover throughout the year to protect the soil from erosion. The maximum leaf growth that can be removed and still meet these objectives vary according to grazing season and climate.

**Growing points.** All plants have growing points, areas where new cells are developed. The growing points of grass are just above the last completed joints of each stem. Early in the season, the growing points are situated at the base of the plant. As the season progresses, the joints of most species elongate and push upward to produce a seed stalk. During elongation, the growing point is elevated and is in a vulnerable position. Removal of the point by grazing or mowing forces the plant to send up new leaves from the base of the plant, and to start over as if spring were beginning. Therefore, causing additional drain on root reserves and can weaken the plant.

The growing points of trees, shrubs, and forbs are on the outer tips of branches.

**Season.** The time of year affects how much leaf removal a plant can tolerate. Removing two inches in the spring has a greater effect on a plant than removing several inches while the plant is dormant.

**Deferment.** Plants rested or deferred from grazing during the growing season are usually more vigorous, and can withstand a higher percentage of leaf removal than plants that are not rested. However, excessive harvest of any forage plant is undesirable.

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**How**  
(Continued)

In general, proper grazing removes no more than 50 percent, by weight, of the annual growth by the end of the grazing season. If the plants are grazed only during the dormant season, or if they are grazed using an intensive short duration grazing system, the key species on the site may be grazed to use 65 percent of the growth by the end of the grazing season.

**Wildlife use.** If land is used to produce game birds and big game animals, wildlife food, especially browse plants such as trees, shrubs, and forbs must be considered. Because these plants grow from the outer tips of branches, proper grazing is based on removal of available twigs and leaves.

Proper grazing of browse plants removes no more than 50 to 60 percent of available twigs and leaves during the growing season, or no more than 65 percent during the dormant season of deciduous species. No more than 65 percent of twigs and leaves should be removed from evergreens.

**It's Up  
to You**

You need to know all you can about the kinds of plants growing on your farm or ranch including their value, growth habits, and how to judge proper grazing of the desirable plants.

**Where to  
Get Help**

For more information about hay and pasture management, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.

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## Grazing Management

# Hog Pastures and Conservation Compliance Illinois

### General Information

Significant problems exist in meeting conservation compliance requirements for livestock producers. These include high intensity grazing of hogs on forages in rotation with row crops, grazing crop residues, and manure injection of HEL fields.

Swine pasture trials have been conducted to learn more about the interrelationships of pasture species selection, seeding rate, stocking density, grass stand (plants per sq. ft.), and per cent ground cover. These trials have networked the experience, knowledge, and skills of pro-active swine producers, the Natural Resources Conservation Service and University of Illinois Extension.

Initial trials were seeded in the spring of 1992 utilizing alfalfa and grass mixtures. The grass species included were: 1) Tetraploid perennial ryegrass, 2) Matua Rescuegrass, 3) low endophyte Tall Fescue, and 4) Orchardgrass. These trial plots were intensively grazed and evaluated during 1993 with a mean stocking rate of 11.6 sows and litter per acre. Grass stands and % cover were evaluated throughout the year.

Results indicated that tetraploid perennial ryegrass exhibited a very vigorous growth habit and was able to withstand high levels of grazing and trampling. It maintained higher levels of ground cover throughout the season. Tall Fescue established well, exhibited high stand counts, and even with very high grazing intensity was able to maintain over until late in the season. Tall Fescue also reduced the seed cost per acre. The use of alfalfa-orchardgrass under high intensity use, held up through mid season but declined rapidly to only 20% cover in the fall. Matua rescuegrass was found to be unsuitable under these harsh conditions.

Another trial was established in (4) locations during the spring of 1994 with an oat cover crop. Species selected included: 1) Tetraploid perennial ryegrass @ 20 lbs./A, 2) Low endophyte Tall Fescue @ 16 lbs./A, 3) Alfalfa-Orchardgrass-Ladino @ 6-6-1 lbs./A, and 4) A combination of Tetraploid perennial ryegrass and Tall Fescue @ 12-8 lbs./A. The goal was to increase the initial number of plants per square foot to maintain a higher % cover throughout the year.

Mean plant residue % (ground cover) in November 1995 showed Tall Fescue - 66.85 % A; Tall Fescue-Ryegrass - 65.05 % A; Orchard-Alfalfa-Ladino 54.8% B; Tetraploid intermediate ryegrass - 51.9% B. LSD=9.3326. Means with the same letter are not significantly different at .05 level. (Oswald 1997)

High levels of management are necessary to maintain compliance in the conservation farm plan.

- Species selection is the first step toward establishing a vigorous cover. Species must be suited to the soil and climatic conditions, fit the particular farm plan and crop rotation and endure heavy grazing and trampling.

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## **General Information**

(Continued)

- Seeding rates higher than traditional recommendations may be needed to increase the number of plants/sq. ft.
- Stocking density is perhaps the greatest obstacle in maintaining cover and compliance. No more than 10 sows and litters per acre would be recommended. Have additional pasture to rotate depending upon crop, livestock or environmental conditions.

Most research work with hog pastures has historically dealt with nutrition and economics. Today's nutrient-dense diets and environmental concerns turn the focus toward **Conservation Compliance**.

Rearing swine on pasture has traditionally been a profitable low-cost alternative to the higher initial investment of confinement housing. As of January 1995, Farm Plans are to be fully implemented. Non-compliance means loss of programs/income available for the producer.

In order for intensive outdoor swine production to be profitable, sustainable and in compliance with USDA programs - producers must manage pastures carefully. Good planning should include: species selection, establishment, stocking rate, and environmental concerns.

Further study is needed to evaluate grasses under typical farm conditions. Pork producers and government agencies must continue to work together to achieve compliance in conservation farm plans under intensive management systems.

## **Recommendations**

Since ryegrass is much more competitive in initial growth and the fescue is slower to establish, a mixture of 12 lbs. Tall fescue and 8 lbs. Ryegrass should be considered. This would also reduce the seed cost per acre. Diploid cultivars of ryegrass are more vigorous in growth and tiller production than tetraploids. More winter hardiness may be exhibited in northern areas.

Producers need to be aware of livestock-plant relationships such as fescue endophyte fungus, fescue foot, bovine fat necrosis and the forage management necessary to prevent these problems in ruminants. Low endophyte varieties are available but not as persistent as infected varieties. Ergot control by controlled grazing or clipping can keep grasses vegetative and more productive while keeping livestock healthy.

## **Forages for Swine**

For decades, forage crops were an essential part of a swine feeding program. The development of synthetic vitamins in the 1950's and the shift toward confinement production systems reduced the use of forages in the swine diet. Today, most producers rely upon complex fortified diets to maintain optimum growth and production.

High-quality forages can still be utilized to simplify the feeding and management of the breeding herd. Sows, for example, can be fed less often with a smaller amount of concentrate when fed high-quality forages. Honeyman and Roush, Iowa State University, showed a feed cost reduction of over \$3.00/gilt in a 56-day gestation trial grazing alfalfa. Sows may be more content when fed diets containing a significant amount of forage compared to limit-fed sows.

Some negatives are also connected to feeding forages such as the seasonal availability of pastures, and the low dry matter content of the feed. Contamination of pastures by parasites and/or bacteria are potential problems in nonrotated outdoor systems. Hogs maintained outside have a higher energy requirement due to exercise and weather-related stresses. This may require more feed and cause slower gains and less efficiency.

The legumes, alfalfa, red clover and ladino clover have been included in hog pasture mixes because of the high protein content (14-22%) depending upon the maturity. The fiber content is in the 25 to 30% range. Legumes provide energy in the range of 900 to

1200 Kcal./lb. Legumes are also very palatable and seem to be more acceptable than grasses to the hogs. Grasses are normally seeded with legumes because of their ability to prevent soil erosion. They provide less protein, with similar energy and fiber amounts. Plant species selected for hog pasture must be adapted to the soil and climatic conditions. They must also fit satisfactorily into the crop rotation, be palatable, and yet have good ground cover potential.

They must have the ability to endure trampling and grazing. Different grazing intensities may change the morphology of plant growth. Animals may also affect pasture species composition. Pasture should have a high carrying capacity but not be overgrazed. Reduced leaf area would tend to increase erosion potential. In Northwestern Illinois, many producers are using farrowing pastures that are about two and one-half acres in size for 25 sows.

There is probably no perfect forage crop for swine pastures that combines nutrition, palatability, yield, length of grazing season, as well as conservation use. Alfalfa (*Medicago sativa* L.) is generally considered the number one forage for swine. Alfalfa is the basis for most forage mixtures in Northwestern Illinois. Other legumes suited to swine are ladino (white clover) (*Tribolium repens* L.) and red clover (*Trifolium pratense* L.) These legumes are not ready for pasturing as early in the spring and do not yield as much as alfalfa. Assuming good drainage and adequate fertility, alfalfa is the highest protein producer of all legumes, is more resistant to diseases than red clover, and is more drought resistant due to its deep root system.

Smooth brome grass (*Bromus inermis* L.), a sod-forming perennial, is often used with alfalfa. Orchardgrass (*Dactylis glomerata* L.), a cool-season bunchgrass, matches well with the life cycle of alfalfa. Growth begins in the early spring and is heavy yielding with nitrogen fertilization. It produces well under high summer temperatures and all of its regrowth is vegetative. Orchard grass will grow on a wider range of soil types with slightly lower fertility than will smooth brome grass.

Timothy (*Phleum pratense* L.) is considered a short-lived perennial bunch grass. Timothy is considered less valuable as a forage for swine because it is not a sod-forming species and cannot withstand heavy use.

Summer annuals may be used for additional pastures. Sudan grass is palatable when seeded thickly and provides forage during the hot part of the growing season. The early growth of Sudan contains a cyanogen that can be converted to prussic acid, which can be toxic to pigs. It is safe for grazing after it reaches 18 to 24 inches in height. Pearl millet, an annual, also provides hot season growth without the potential of prussic acid. Brassicas such as Rape, Kale, and Swede can provide high energy in a palatable form. However, Rape can lead to photosensitization (sunburning) in white-skinned pigs.

**Summary** Forages can be used successfully in pork production. Because of their low-energy density and high fiber content, they should be used only to a limited extent for young pigs. Forages are best utilized at an early stage of maturity. Forages may be used to reduce both grain and protein costs. Both the pasture and the forage crop must be well managed to provide optimum feed savings.

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# Grazing Management **Livestock Distribution** Illinois

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**What** One of the objectives of a grassland management program is to force livestock to uniformly graze the vegetation in an entire pasture. Livestock prefer to graze the flattest areas of a pasture and areas close to water. Unless forced to do otherwise, they will continue to graze the preferred areas. Such grazing patterns result in portions of pastures being overgrazed and portions being lightly grazed.

**Why** When cattle are evenly distributed within a pasture, more of the available plants in a pasture are grazed, and overgrazing of the easily accessible plants is reduced. Even distribution results in a larger amount of a pasture receiving proper grazing, which may reduce the necessity of supplemental feeding. A grazer must look at each pasture to ensure that the animals are grazing most of the plants. When livestock are allowed to follow their natural habits, the forage yield in some areas will continue to decrease because of overgrazing, and useable forage on the less accessible areas will be wasted.

## **Distribution Factors**

Several factors influence the way livestock graze a pasture:

**Water Location.** Generally, cattle drink water at least once a day. They may drink more often, depending on the temperature and availability. Therefore, where water supplies are located within a pasture has a significant effect on grazing patterns.

**Natural barriers.** Steep slopes or cliff faces, large gullies and rock outcrop influence the movement of livestock.

**Slope.** Animals have trouble walking and grazing on steep slopes. Therefore, they tend to avoid such areas.

**Prevailing wind direction.** Animals do not like to graze into a strong wind, but choose to graze into gentle winds. Therefore, wind direction and intensity have an effect on grazing distribution.

**Shaded or protected areas.** Animals seek shelter from cold, heat, and strong winds. Pasture areas that provide shelter with plant cover are used more during temperature extremes and when the wind is strong.

**Exposure.** West-facing and south-facing slopes are warmer, and may be used more on cooler days or in the winter. East-facing and north-facing slopes are cooler, and may be used more on warmer days.

**Season of use.** Some pasture areas are attractive to livestock because of their vegetation. Animals seek the most palatable plants growing at the time. For example, they are attracted to cool-season growing plants during the winter and spring. The location of different plants within a pasture and the time of year often influence grazing patterns.

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## Ways to Control Distribution

After a pasture is analyzed, there are several methods to consider when attempting to change the animals' grazing habits. They include:

**Grazing Systems.** "Rotation Grazing Systems" are discussed in another fact sheet. However, remember that every grazing system has an effect on livestock distribution. Concentrating livestock into as few herds as possible, and assigning each herd to a planned grazing system with two or more pastures tends to improve grazing for each pasture.

**Water Development.** In large pastures where areas are too far from water, the development of a new water supply may improve grazing patterns.

**Fencing.** With the development of lower-cost fencing, new fences to control animal movement is practical. Small pastures generally improve distribution. Separating rugged terrain and gentle terrain will improve use on the steeper pastures.

**Trails.** Where natural barriers occur, the construction of trails or walkways can open up new areas of pasture grazing.

**Salt or Feed Location.** Moving the location of salt or feed bunks may cause animals to increase grazing on lightly-used areas of a pasture.

**Animal Herding.** Drifting or herding animals from heavily-used to lightly-used pasture areas will redistribute the grazing pressure.

**Brush Management.** When controlling trees or large shrubs, keep clusters of them to provide necessary shelter if desired. Shelter will draw the stock when needed, and encourage grazing in nearby open areas. However, livestock often avoid areas with thick brush, opting to graze in open prairie areas. Therefore, plan and evaluate the effects of brushy areas on livestock grazing.

Shelter may also concentrate livestock numbers during times of extreme temperatures.

Other practices also may influence livestock distribution. Keep in mind that anything you do in a pasture will have an impact. The results should be analyzed before you apply any practice to ensure a positive effect on grazing, and will result in more plant and animal production.

## Where to Get Help

For more information about hay and pasture management, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.

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# Grazing Management

## Managing Year-Round Forage

### Illinois

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**General** Livestock operations that have high quality forage available for grazing throughout most of the year are more flexible and have the greatest chances for success. There is no one plant that will provide high quality forage throughout the year. However, there are plants that produce high quality forage during their individual growth cycle. Producers should select a combination of forages with different growth cycles that will best support the objectives of their operation. It is especially important to have quality forages available for livestock during weaning, prior to breeding or during any other stressful time.

**Planning** Selecting an effective forage program will require thoughtful planning. Decisions based on one forage source seems simpler than managing several different types of forages, but there are pitfalls. A farm with all the pastures planted to only one species will be totally dependent upon that one species. Should disease, weather conditions, insect outbreaks, or other catastrophes occur, extra costs would be incurred to restore the stand; possibly leaving the business operation vulnerable by having to buy costly feed or sell on forced markets. A diversity of forages allows options.

Permanent tame pasture should have perennial grasses as the foundation. Each pasture should include enough legumes to maintain nutrient balance, providing a forage supply that is high in protein and total digestible nutrients.

*Considerations for planning a forage system include:*

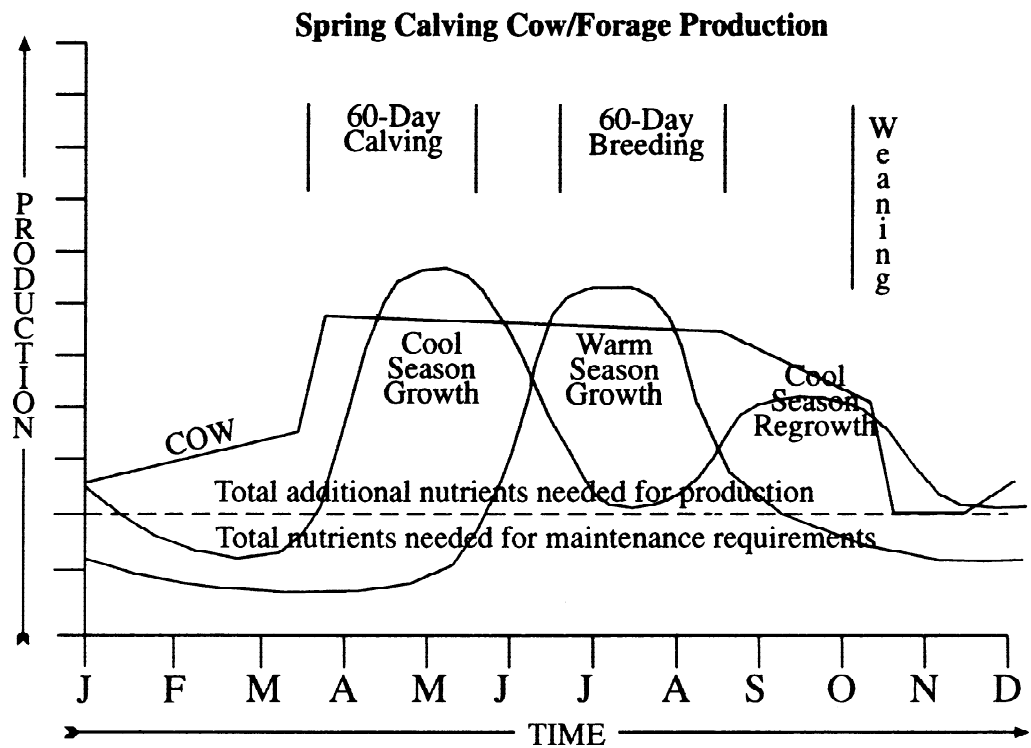
- Overall forage/livestock system objectives
- Management ability of the system's manager
- Nutritional needs of the animals in the system
- Time of year livestock will be on the system
- Total amount and time of forage need
- Capabilities and needs of the land resource
- Adaptability of the forages to the land resource
- Management requirements of the selected forage
- Nutrient requirements of the selected forage
- Economic performance of various forages

*("Optimum" rather than "maximum" production, should be the goal)*

### Complimentary Forages

Overlaying the nutrients provided by the forage onto the nutritional needs of the animals gives a good visual profile of where deficiencies may occur during these deficient time periods. Complimentary forages can be used. For example, annual plants can be overseeded into existing forages to meet obvious needs. Lespedeza, red, or white clover overseeded into fescue pasture offers both cool season and warm season forage on the same pasture and dilutes the effect of endophyte. Fescue pasture, fertilized in late summer

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## Complimentary Forages

(Continued)

takes advantage of normal fall precipitation and cooler temperatures and provides good quality stockpiled forage well past January 1. Winter grazing is more cost-effective than feeding hay. Remember, any nutrients not provided by the forages must be purchased, increasing the cost of production.

Some pastures may not be available for grazing at all times of the year because of wet soil. Wet soils cause feeding difficulties and boggy conditions for livestock. Well-drained fields should be planted to sod-forming forage plants that can be used during problem periods.

Planting forages that grow during different times of the year allow the grazer to manage his animals so they will have access to high quality forage for the longest possible period. Optimizing production and return from the forage resource system makes sense to the prudent forage manager.

For additional information see the factsheet on "Extending the Grazing Period".

## Where to Get Help

For more information, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.



## Grazing Management

# Native Warm Season Grass

## Illinois

### What are Native Warm Season Grasses?

Native warm season grasses (NWSG) are plants that grow most vigorously during the late spring and summer; in contrast to the grasses many of us are more familiar with—orchardgrass, timothy brome, fescue, and bluegrass, which do most of their growth during the spring and fall. The ones discussed here grew in the prairie areas of Illinois before the European settlers came—big and little bluestem, indiangrass, switchgrass, eastern gamagrass, and sideoats grama. They grew with other plants of the prairie—native cool seasons like Canada and Virginia wildrye and western wheatgrass, legumes like Illinois bundleflower, leadplant, purple clover, and catclaw sensitivebriar, and forbs such as gayfeather, coneflowers, maximilian sunflower, pitcher's sage and compassplant.



### Why they are important

To the livestock producers, they can provide high quality forage in the late spring and summer after their cool season pastures have quit growing, cutting down or even eliminating summer haying. To the hay and crop producer, they can enable them to cut high quality hay in June and July, (instead of May, when cool seasons should be cut). To the crop producer, they can reduce erosion if planted as contour strips on sloping ground or improve water quality as filter strips along streambanks, rivers, and pond banks—an added advantage here is that these plants are tolerant to many herbicides used on corn, unlike cool season grasses. To the person interested in wildlife, their later haying season and more open upright growth habit makes them great nesting and brood-rearing places for quail, pheasants, prairie chickens, ducks, upland plovers, and other wildlife. These benefits are magnified even more if mixtures of prairie plants, or even compatible introduced legumes such as alfalfa, birdsfoot trefoil, or Korean or Marion lespedeza, are planted with them.

What are the differences between NWSG and traditional forage species?

(1) Cost of seed can be expensive, although switchgrass can be cheaper than seeding fescue, due to the lower rates of seed and fertilizer required. Costs should be looked at over the long haul. Alfalfa is much costlier, since it often has to be replanted every 4-8 years. Native plants do not require reseeding once established. (2) Planting big and little bluestem and indiangrass can be difficult because of the awns and appendages attached to the seed. It may be best to pay an extra 50¢ to \$1 per pound to get the seeds debearded. Either way, a drill with oversized seed tubes and agitator in the seed box should be used, or broadcast the seed over a clean, firm seedbed. (3) Establishment periods are often long. Sometimes a person gets lucky and has a great stand the first year—more often it takes 2 or 3 years to get a good stand. A plant every square foot the end of the second growing season can become a successful stand. (4) NWSG requires different management practices than traditional forage species. NWSG grow more upright than prostrate; therefore, they should not be grazed less than 9 inches of stubble height. Grazing shorter than 8 inches limits regrowth and reduces stand life.

-more-

## What are the yields?

NWSG yields varies greatly, just as cool season forages, on the management, fertility, depth of soil, and weather—all the way from 1.5 tons/acre/year on poorer soils to 10 tons/ac with eastern gamagrass on well managed, highly fertile bottomland soils. Under moderate management with most soils, one may expect 3-7 tons/acre. Forage tests on warm season grasses often show them very low in protein. Animal performance, though, doesn't bear this out. The scientific community widely accepts the fact that the testing equipment is calibrated for cool season grasses and alfalfa, and will be consistently low for NWSG (Frank Ireland, U of I DSAC). Studies in Missouri and Kansas have shown steers gaining 0.8 to 2.5 lbs/head/day during the summer on warm season forages. This is compared to similar animals gaining less than 1 lb/head/day on fescue with a legume. It is unclear why the forage tests are not accurate—theories range from a bypass protein not measured by the instruments, but absorbed by the livestock; or perhaps the livestock are eating more NWSG. The addition of compatible legumes will add nitrogen to feed the grasses and improve the nutritional value for the livestock.

## Where to plant

If you take care in selecting the right grass for the site, NWSG can be planted almost anywhere. On wet sites, Kanlow switchgrass (if not too wet, Cave-in-Rock) and eastern gamagrass do well. The bluestems, Blackwell switchgrass, sideoats, and indiangrass do well on dry, rocky sites. In between, you have many choices. They do need sun, so avoid planting them in shaded areas.

## How to plant

As mentioned earlier, you can use a specialized warm season grass drill for the fluffy seeds of the bluestems and indiangrass (or a mixture). Indiangrass and Bluestem seeds are rough to debarbed. Even then, they may or may not work in a regular grass drill. Eastern gamagrass can be planted on 10"-40" rows with a corn planter. A regular grass drill can be used for switchgrass and sideoats gama. Switchgrass can also be planted with a Brillion-type seeder on a clean seedbed.

Broadcasting seed on a firm, clean seedbed is preferred if erosion is not severe. "Clean" seedbeds—those with little residue—give good consistent results when rolled with a roller or a cultipacker; the seed is broadcast and then the field is rolled again. This almost always insures that the seed will not be planted too deep and there will be good soil to seed contact.

Planting depth should be no deeper than 1/4 inch. A firm seedbed can help keep the seed from being planted too deep. Good soil to seed contact is a must, as it is when planting anything. Dates to plant vary depending on whether you are in northern, central, or southern Illinois. Northern Illinois planting season is from around mid-April to June 15. Planting times in central Illinois range from mid-April to June 5, and in southern Illinois from early April until June 1. Planting methods and dates are the same with native forbs (flowers) and legumes.

## Find out more

For more information on planting warm season grasses on your land, contact your local USDA Service Center, NRCS office. Someone there can give you the information you need or direct you to someone who can.

December 2006



## Grazing Management

# Prescribed Grazing Tables

# Illinois

**Table 1: Minimum Heights of Pasture Species for Initiating and Terminating Grazing**

Species and Mixtures	Minimum/Optimum Height of Vegetative Growth 1/	Minimum Grazing Height 2/	Minimum Regrowth Before Killing Frost	Approximate Date to begin Res for Winter Protection, by Plant Suitability Zones 3/		
				I	II	III
Cool Season (C3s)	INCHES Begin Grazing	INCHES End Grazing	INCHES			
Alfalfa/Timothy/Orchardgrass	6-8	3	8	9/1-10/1	9/15-10/15	9/10-10-20
Alfalfa/Orchardgrass	6-8	3	8	9/1-10/1	9/15-10-15	9/20-10/20
Alfalfa/Timothy/Bromegrass	6-8	3	8	9/1-10/1	9/15-10-15	9/20-10/20
Ladino Clover/Orchardgrass	8	3	8	9/1-10/1	9/15-10-15	9/20-10/20
Red Clover/Ladino Clover/Orchardgrass	8	3	8	9/1-10/1	9/15-10-15	9/20-10/20
Red Clover/Ladino Clover/Tall Fescue	8	3	5		9/15-10-15	9/20-10/20
Birdsfoot Trefoil/Timothy	5	3	6	9/1-10/1	9/15-10-15	
Ladino Clover/Bromegrass	5	3	6	9/1-10/1	9/15-10-15	
Orchardgrass	6-8	3	8	4/	4/	4/
Tall Fescue	6-8	3	8	4/	4/	4/
Alfalfa/Tall Fescue	6-8	3	8		9/15-10-15	9/20-10/20
Ladino Clover/Tall Fescue	5	3	8		9/15-10-15	9/20-10/20
Alsike Clover/Ladino Clover/Timothy	5	2	5	9/1-10/1	9/15-10-15	
Ladino Clover/Alsike Clover/Reed Canarygrass	6	4	6	9/1-10/1	9/15-10-15	9/20-10/20
Ladino Clover/Alsike Clover/Tall Fescue	5	3	8		9/15-10-15	9/20-10/20
Alfalfa/Bromegrass	6-8	4	6	9/1-10/1	9/15-10-15	9/20-10/20
Sericea Lespedeza/Tall Fescue	10	4	8			9/20-10/20
Korean Lespedeza/Tall Fescue	6	4	8			9/20-10/20
Bluegrass 5/	4	2	4	N/A	N/A	N/A
WARM SEASON (C4s)						
Switchgrass	18	8 6/	10	9/1-10/1	9/15-10-15	9/20-10/20
Indiangrass	18	8 6/	10	9/1-10/1	9/15-10-15	9/20-10/20
Big Bluestem	18	8 6/	10	9/1-10/1	9/15-10-15	9/20-10/20
Eastern Gammagrass	20	10	15	9/1-10/1	9/15-10-15	9/20-10/20

1/ Minimum plant heights are to be reached before grazing is permitted in the spring or following a rest period resulting from rotational grazing. Management Intensive Grazing (MIG) systems (8 or more pastures) can reduce the height by 50%.

2/ Minimum plant heights below which grazing is not permitted.

3/ Protection from fall grazing is required for one month before a killing frost. Remove livestock on or before the dates shown and do not permit grazing before a killing frost occurs.

4/ No restrictions.

5/ May include other species such as redtop, timothy, quackgrass, or white clover.

6/ Leave a 10" stubble at end of grazing season until after first killing frost.

**Acknowledgments** NRCS, Illinois, April 1997

December 2006



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# Grazing Management **Prescribed Grazing Illinois**

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**What** A planned grazing system involves an orderly sequence of grazing and resting grassland.

**Why** Livestock are selective about the plants they eat. They tend to repeatedly graze some plants, and ignore others. Selective grazing weakens the more desirable plants, and allows unwanted plants to thrive and multiply. Nearly all pastures have areas where livestock concentrate, such as around water, bedding grounds, and feed grounds. If the pasture is continuously used, these areas become overused, resulting in pasture deterioration.

Grazing and resting grassland plants in a planned sequence increases the vigor of better plants, giving them a chance to grow and multiply. Therefore, gradually increasing the number of high-quality plants per acre.

Improved grass conditions increase livestock production, improves wildlife habitat, reduces soil erosion, and conserves water. By resting pastures, overused areas are allowed to become productive.

**How** Combining livestock from several pastures into one herd, and grazing one pasture at a time, tends to disperse cattle. Grazing distribution is improved in the pastures, and provides a rest period for the pastures when the cattle are in a different pasture.

**Kinds of Systems** Planned grazing systems vary from unit to unit, depending on the type of livestock, the kind of pasture, and the objectives of the operator. Listed below are some commonly used systems.

**Two-pasture, one-herd system** – a herd is rotated between two pastures. Each year, pastures are rested during a different part of the growing season to benefit the entire plant community. The system takes advantage of the various growth periods of the more desirable plants.

**Three-pasture or four-pasture, one-herd system** – are similar to the two-pasture, one herd system, except that the herd is moved through more pastures. Grazing and rest periods vary with three-pasture and four-pasture systems, depending on the producer's objective and the time of year. The length of each grazing period may be as short as 10 days or as long as 120 days. With some three-pasture systems, livestock are moved every four months. With some four-pasture systems, they are moved every three months. With some three-pasture and four-pasture systems, livestock are rotated through each pasture two or more times during the year.

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## Kinds of Systems

(Continued)

**Merrill-four pasture system** – three herds of livestock graze three pastures while a fourth pasture is rested. About every four months, one herd is moved to the rested pasture and the pasture they were in is rested. Each pasture is grazed 12 months, then rested four months.

**High-intensity, low-frequency system** – one herd of livestock grazes eight or more pastures in a planned sequence. Livestock are moved into one pasture and the other pastures are rested. When the forage is grazed to the desired intensity, livestock are moved to the next pasture in the rotation. Livestock typically stay in a pasture 10 to 25 days. The frequent moves allow long rest periods for each pasture. The system greatly improves grassland condition, but individual livestock performance may decline due to the > 10-day grazing sequence.

**Short-duration system** (*Management Intensive Grazing*) – similar to the high-intensity, low-frequency system, except the speed of the rotation is adjusted according to the growth rate and the required rest period of the plants. During the peak of the growing season, livestock are moved rapidly - every three to five days - with slower moves when pasture growth rates slow down. A grazing cycle is completed every 25 to 35 days, depending on forage species and time of season. When the system is operated properly, good livestock performance and good grassland improvement are the result.

**Cell-grazing system** – is a form of short-duration grazing, but usually contains 12 or more pastures in a cell. In cell grazing, the same basic principles of short-duration grazing are used. Layout often uses a design of radiating fences to facilitate the movement of livestock. In these cases, water usually is located in the center of the cell and fences radiate out from the center forming pastures. Because livestock come to the center daily for water and minerals, they should be moved between pastures away from the center to encourage better distribution of grazing. Producers with cell grazing usually use electric fences to reduce fencing costs.

## The Best System

The best system, or systems, may depend on present pasture and topography, available water supplies, economics, grass condition, kinds and classes of livestock, long-range goals for grassland improvement, and the time necessary to supervise the operation. The point is, pasture greatly benefits from the graze/rest sequences of properly managed grazing systems.

## Where to Get Help

For more information about hay and pasture management, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.

November 2000

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## Grazing Management

# Steps for a Year-Round Grazing Management Plan

## Illinois

### January

Start grazing stockpiled Tall Fescue. Graze to within 2 inches; strip grazing is the best method. Strip grazing refers to temporarily subdividing a grazing area into subunits with temporary fences so grazing for short periods can be achieved; 1-3 days.

- Inventory feed supplies and use stockpiled forage to best advantage.
- Review grazing system to make any needed changes.
- Look for grazing meetings to attend the next few months and check the Illinois Forage and Grassland Councils web site: [www.illinoisforage.org](http://www.illinoisforage.org) for dates and agendas.

### February

Start over seeding legumes into grass stands, (red clover 8#/ac. the first year; 4#/ac. every other year). For best results with red clover the pH level should be above 6.2. On low fertility and/or very poor soils, plant Lespedeza at 15#/ac the first year and 6-8 periodically afterwards as stand thins.

- Annual Korean or Marion can be used.
- Seed amounts are listed as Pure Live Seed, PLS.
- Unroll hay for feeding to spread nutrients on fields.
- Install changes needed in grazing system.
- Start warm-season grass burns when conditions are favorable to control weeds and brush and remove litter.

### March

Complete burns on warm-season grasses for weed and brush control and to remove litter, as early as possible.

- Finish stockpiled Tall Fescue.
- Finish over seeding legumes into pastures. Inter seed legumes with no-till or light disking, depending upon ground conditions and your location.
- Fertilize cool season pastures.
- For conversion to new forage seedings, spray 4"-6" growth for vegetative control.
- Apply lime according to soil test. Consider adding magnesium to mineral mixes to off-set possible grass tetany.
- Graze cereal rye, if available until pastures green-up, strip grazing will work well again to allow the rye to re-grow for additional forage resources and grazing.
- Control animal movements if ground conditions are excessively wet, as they can tramp out the forage before the ground hardens.
- Fertilize cool season forages, 30# of N, for early green-up and to jump start a few acres for grazing. N will not need to be applied on many acres because it will stimulate the grass growth and compete with the newer seeded legumes. A 30-40 % legume stand (red clover, alfalfa, Birds-foot trefoil or Lespedeza) can produce up to 100-150 units of N annually for the grasses to use once established. Therefore no nitrogen will be required for optimum production. The taller the legumes are the more nitrogen they create for the grasses.

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## April

- Finish interseeding legumes with no-till or light disking.
- Plant new stands of cool season grasses to reestablish pastures and hay lands.
- Spray to control winter weeds.
- Flash graze grass stands to control canopy competition over new legume seeding and avoid grazing new legume stands until after the 2-leaf stage.
- Begin grazing when forages are about 6 inches tall and move animals when they have grazed forages to a 3-inch stubble height. This will allow the plant to capture sunlight and grow back quicker while also protecting the root system.
- To keep the legumes in the stand, allow a minimum of a 30-day rest period between grazing cycles.

Livestock will need to be rotated quickly in the spring, when the forages are growing faster, to top them off. As the growth slows down your rest period should lengthen. In the spring during faster growth some pastures may need to be skipped and baled to keep them vegetative. By the time the animals get back to the baled pastures in their grazing cycle, the forage should be re-grown.

Always move the animals by the plant height not by the calendar. When Orchard grass and Tall Fescue has been grazed to a 3-inch height, animals should be moved to fresh forage. For the proper grazing heights see table 1 in the NRCS, 528 Prescribed Grazing Standard, electronic Field Office Technical Guide (eFOTG).

- After making hay, allow the forage to grow to 6-8 inches before turning the animals out to graze again.

## May

If summer annuals are needed they should be planted.

- Oats and turnips can be planted and grazed in the summer months as well as in the winter.
- Sorghum-Sudan grass, brown mid rib (BMR), and pearl millet are both good choices for summer annuals and grazing needs. Pearl millet does not have prussic acid. The Sorghum-Sudan grass families will have prussic acid after a frost, especially any new tillers. Nitrates can be an issue in a dry year on pearl millet, sorghum and sorghum sudan grass. Always let these summer annual grasses grow to a minimum of 18 inches before grazing. Pearl millet may work better for grazing than Sorghum-Sudan grasses.
- Strip grazing is advised to get the most from your forage production.
- Soil test for fall fertility applications on pastures. Fertilize warm season perennial grasses last half of month.
- Cut hay on cool season grass fields in boot stage and legume fields in 1/10 bloom stage.
- Clip pastures to control seed heads for better quality forages.
- Flash graze or clip grass stands to control canopy competition over new legume seedlings.

## June

- Cut warm season grass hay in the boot stage.
- A second cutting of legumes at 1/10 bloom stage.
- Spray or clip to control weeds before seed formation.
- Clip pastures to control seed heads for better forage quality.
- Graze forages as needed in a rotation to fill the forage gap.
- Monitor rest periods on grazing systems as cool season grass growth starts to slow, be aware of minimum grazing heights.

## July

- Cut warm season perennial and annual grass hay in the boot stage.
- Harvest the third cutting of legumes during the 1/10 bloom stage.
- Use slow rotation (longer rest periods) through cool season pasture fields to clean up excess forages.
- Clip or graze excess growth, opening plant crown to sunlight and stimulating next year's shoots.
- Monitor critical heat index days and provide some paddocks with shade for livestock.
- Closely monitor grazing heights and rest periods. This is essential for legume survival.
- Evaluate fields for brush and weed control needs. Inspect fields for invader species as well. Fertilize perennial warm season grasses with 50-80# N for added fall growth.

If small grain is in the rotation, such as wheat or oats, this is a time to graze any legumes that may have been over seeded in them. Red clover works well for stubble hay or for grazing. If stubble is grazed you may want to clip the straw stubble first to avoid eye irritation on animals. Sometimes the summer annual weeds and grasses can make good forage for a short period of time, like Foxtail, as long as it is vegetative.

## August

- Graze or clip pastures and apply 50# of N to allow for Tall Fescue or other forages to stockpile. Clipping will destroy the old growth and allow the plants to start their fall vegetative re-growth. This should be completed at least 75 days ahead of the first killing frost for your location, a longer time period is better. For maximum yield, N should be applied in early to mid August.
- Fescue is the best forage to stockpile, the nutritional value stays with it longer into the winter than any other cool season grass. Any of the grasses can be stockpiled; however, to receive their best nutritional value, they will need to be grazed before the tall fescue.
- If possible, mow waterways throughout the year in crop fields. This will keep them vegetative and, if grazing crop aftermath, the waterways will stockpile and make a good source of forage as well.

During August, you should also be planting or flying on any winter annuals, such as Cereal rye, Oats, Turnips, and Annual Ryegrass, or other winter annuals that you are going to use. If flying on annual forages, over seeding into standing corn should occur as early in the month as possible. In the northern half of Illinois, all flown on annuals should be completed by the 15th of August. If there are small grains in the rotation that does not have legumes in them, those fields will make an excellent site for planting a crop of winter annuals for winter use.

- Leave sufficient plant height on annual legumes, lespedeza, to reseed for the following year.
- Clip brush to weaken the root systems and open canopy for fall forage growth.
- Complete fall seedings as planned or needed, for improved forage base.

## June, July and August

During the summer, slow down you rotation and lengthen the rest periods 35-40 days as the cool season grasses begin a summer slump. This is the time of year when you can use warm season perennials or annuals to increase production and forage growth. The perennial warm season grasses are more deeply rooted and in many cases will give you as much annual production as cool season forages, however, it all comes during the summer growing season. Native warm season perennials, such as Switch grass, Indian grass, Big Bluestem and E. Gamagrass, should not be grazed until they reach 18-20 inches and then move animals when grazed down to 8-10 inches.

- Begin grazing the annuals once they are 18-24 inches tall.
- Strip grazing is most efficient and allows the plants to rest and re-grow.
- Legumes tend to grow better than the cool season grasses in the summer.
- Nitrates can be a concern in dry years on pearl millet and Sorghum-Sudan grass.
- Always wait until the annual plants are 18 inches tall before starting to graze.
- If a drought occurs/persists refer to the fact sheet on drought management or place livestock in a dry lot for feeding.

## September

If you have warm season grasses, legumes or other forages, other than fescue and orchard grass, they should be rested from mid-September to mid-October to allow the plant to store nutrient reserves back down into its roots for the winter. If silage is cropped, this is a good time to drill or no-till in some additional winter annuals.

- Rotate grazing on fall pastures while stockpiling growth on reserve fields for winter needs.
- Graze Ky31 fescue heavily to weaken stands for over seeding with legumes next winter.
- Complete any fall forage plantings by the regionally appropriate seeding dates.
- Refer to seeding dates and regional map in Establishment/Renovation section.
- Inventory winter feed supplies.
- Plant additional annuals, purchase hay or stockpile more Tall Fescue, if necessary. The forage that you are stockpiling may be the best quality that will be produced all year.

## October

Once corn is harvested, allow the animals to graze stalks first to allow the forages and pasture to rest while stockpiling. Strip grazing or rotationally grazing stalks is best since it restricts the animal movements to only the area of grazing and not trampling the entire field. This is assuming that no winter annuals are growing in the stalks. The winter annuals that are growing in the stalks should have 45-60 days of sun light to grow for optimum yields before the animals graze them.

- Soil test for next years fertility needs and for spring seeding.
- Evaluate weed pressure, such as musk thistle, and apply needed herbicides to fields with severe infestations.
- Start spraying musk thistle while in the rosette stage for best control.
- Continue to stockpile fescue since the longer it grows the more forage dry matter you will have to graze in the winter.

## November

- Spray to kill Tall Fescue for conversion to other forages.
- Spray musk thistle in rosette stage, if not already completed.
- Test forages and hay before feeding begins to improve winter feeding efficiency.
- Separate animals by nutritional needs, lactating cows and stockers need the best forages.
- Prepare water systems for freezing temperatures.
- Start planning ahead for next year.

Identify the weak links in the system. Ask yourself: Can I change anything to grow better forages longer? What will make my system easier to manage? Check with the Natural Resources Conservation Service, Farm Service Agency and Soil and Water Districts for available cost share assistance on forage program improvements.

- Start grazing the winter annuals and corn stalks, depending upon the growth, or feed hay to allow for more time and growth potential on the winter annuals.
- The turnips will stay green until the temperature gets down to 15 degree F. Once the temperature gets that low, the turnip leaves will be burnt and frozen. The animals will still eat them but their value will drop. The bulbs will be grazed until the ground is frozen or too muddy. Turnips should be consumed in the fall and early winter as they will not over winter.
- Oats will freeze once the temperature reaches 26 degrees.

## December

Once all of the winter annuals and stalks are grazed, begin feeding hay stored outside first before the quality declines. The test results on endophyte in the Tall Fescue, according to the University of Missouri (U of MO), the later into the winter the fescue is used, the lower the endophyte levels. Also, the freezing temperatures will help break down the waxy cuticle of the leaves and the animals will prefer it better. According to U of MO research, it is best to feed your stockpiled Tall Fescue starting in January. Use the Tall Fescue wisely and it should be adequate for beef cattle until late February or early March.

- Strips graze the forages to make them last longer into the winter and reduce the loss. Research shows the endophyte levels will fluctuate from year to year, even in stockpiled tall fescue, K31. To avoid this, you can plant friendly endophyte or endophyte free tall fescues.
- The problem with this is controlling the seed bank of infected seed, already on the ground, that will come back in your old pastures.
- If you are planting friendly or endophyte free seed, try to plant into cropland that will allow your stand to remain purer for a longer time. For best results, always follow the suggested seeding dates for your area when planting.

**Grazing Management** is as much an Art as it is a Science! In applying any plan of action you must constantly evaluate where you are and your outcomes. Therefore, these steps will need to be modified according to rainfall and weather conditions as they change with each season. This is a guide, or road map, to get from where you are to where you want to be and should be used as such!

**Prepared by** Roger Staff, NRCS Grazing Specialist:

**References** *Soil & Pasture Health Guide for Missouri; Illinois Agronomy Handbook; and NRSC Field Office Technical Guide, Prescribed Grazing Std 528.*



# Grazing Management **Stockpiling Forages** Illinois

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## **General Information**

Stockpiling forage is an excellent method of saving forage for overwinter use without harvesting. Stockpiled forage can provide adequate protein and energy for dry cows, heifers, weaning calves and ewes for grazing in the fall and winter after forage growth has stopped. Grazing can be provided as long as the forage lasts and as long as grass tips are visible under the snow.

The primary reason for using stockpiled forage is to reduce feed and feeding costs. For each week that the grazing season is extended, total annual feed costs for a forage-fed animal (i.e., ewes or beef cows) are reduced by about 1%. The savings reflect the harvesting costs for grazed forage as compared to hay or silage harvesting, primarily on account of machinery, labor and other inputs not experienced in harvesting the same forage by grazing. Also, livestock grazing stockpiled pasture, spread their manure back onto the pasture without the cost of conventional manure hauling and spreading.

## **Stockpiled Forage Quality**

Stockpiled forage is surprisingly high in forage quality. Data from the University of Wisconsin reported stockpiled bromegrass forages over winter seldom fell below 18% crude protein. Similar analyses from Iowa have indicated about 15% crude protein. Several reports from other research of stockpiled tall fescue all indicated about 20% crude protein. Forage quality is high because stockpiled forage has a high percentage of leaf material due to reduced grass stem growth and heading in late summer.

## **Stockpiled Management**

Several strategies can be employed to supply forage into the fall or winter and effectively extend the grazing season, thus reducing the need for stored feeds. These strategies can be categorized into two major groups: 1) Stockpiling (conserving cool-season forages in late summer for use in the fall and winter), and 2) utilizing forage crops that continue to grow into the fall and early winter.

The normal procedure for stockpiling forage is to remove the animals from the pasture and allow forage to accumulate on a pasture beginning about August 1<sup>st</sup> to August 15<sup>th</sup>. Allow regrowth to occur for about 60 to 75 days. The late season growth will produce 0.75 to 1.5 tons of forage per acre, allow pastures to rest and legumes to rebuild root reserves for winter. An application of 40 to 80 pounds of nitrogen between August 1<sup>st</sup> and August 15<sup>th</sup> will greatly increase late season pasture tonnage where there is less than 40% legumes.

Not all cool-season species are adapted to stockpiling because most species reduce growth in the fall because of shorter day lengths and/or lose leaves (quality) after being frosted. Tall fescue and birdsfoot trefoil are two forage species which are suited to stockpile management because they continue to grow into fall and do not lose leaves as readily as other cool-season species due to frost. Bromegrass can be stockpiled but should be grazed first in the rotation.

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## **Stockpiled Management**

(Continued)

Strip grazing or rotational grazing is recommended when grazing stockpiled forages. Livestock should be limited to a few days up to a week of forage at one time so the use of temporary fencing is recommended. Watering stock on stockpiled pasture is a concern in freezing temperatures. Even in November, pasture forage is between 50 and 70% moisture. Hauling water is an option, as is pumping from pond or stream or using frost-free water systems. Sheep have low water requirements in cool weather and dry ewes can be supplied from only good quality stockpiled forage. For beef cows a water source is essential.

### **Summary**

Stockpiled pastures can be a low-cost source of forage for livestock during the fall and winter months. By adopting management practices, the stockpiled forage can provide high quality and high yielding forages for fall and wintertime grazing. Producers can tailor the type of stockpiled forage to livestock requirements. Managing animals on stockpiled pastures requires rotational or strip grazing with moves every few days. Although experience has indicated little concern with soil compaction or increased winterkill from fall or winter grazing, use caution in wet conditions or on heavy soils.

### **Reference**

University of Wisconsin, Dan Undersander, Forage Crop Specialists, Stockpiled Forages.

Ontario Ministry of Agriculture, J. Johnston and C. Wand, Stockpiling Perennial Forages for Fall and Winter Grazing

Penn State University, Fact Sheet: Strategies for Extending the Grazing Season.

University of Missouri, Missouri Grazing Manual. Revised 3/99.



## Grazing Management

# Weed Management in Established Pastures *Illinois*

Unless properly managed, weeds can reduce the quantity, stand life, and in some cases the quality and palatability of pastures. Certain weed species are also poisonous to livestock. Weed management begins with proper identification.

This fact sheet is a follow-up to an earlier version (November 2000) titled Weed Control.

This fact sheet will discuss various management practices so the grazing land operator can adopt an integrated approach for weed management in established pastures. No single practice will result in weed-free pastures.

### Weed ID Critical

If you are unable to positively identify the plants in your pasture, take samples to a credible person who can help you. It is impossible to make sound management decisions on weed management until you know which weeds you have.

### Soil Fertility

Performing soil tests every 4 years to determine pH and nutrient levels and to serve as a basis for application of essential plant nutrients and lime is a valuable management choice.

Having pH and nutrients (especially P and K) at proper levels will help increase the stand density of the desirable, adapted forages and help them out compete many undesirable plants. Proper soil fertility levels help grasses and legumes recover quickly after grazing.

In pure grass pastures, nitrogen applications at the proper time will maintain the vigor of the forage, ultimately helping to control weeds.

### Grazing Management

Weed seeds germinate and become established whenever pasture stands are thin. In the early vegetative stage, many weeds can be a good source of nutrition. However, as the weed matures, the forage quality drops rapidly.

Continuous grazing at high stocking rates weakens the sod and allows for weed invasion. Continuous grazing at low stocking rates leads to selective grazing, which weakens desirable species, whereas in other areas of the pasture excessive growth will occur and forage will not be utilized or be of low quality.

A rotational grazing system, where a paddock is grazed again only when it has had time to recover, helps maintain a healthy, vigorous sward, which makes it more able to compete with weeds. Utilizing a rotational grazing system helps keep most pasture weeds under control. However, certain weeds like thistles, brush, and poisonous weeds may still continue to be a problem and additional control practices will be needed.

### Walk Your Pastures

This is a good way to detect weed problems before they become serious. It also provides an opportunity to observe changes in the spectrum of weeds present and to monitor the results of weed management practices.

Weeds can be hoed, pulled, or cut before they set seed and multiply. Biennial weeds (see partial list below) need to be cut an inch below the soil surface to prevent regrowth from buds in the crown. This approach is feasible in small areas or in large pastures with few weeds.

### Mowing or Clipping

Annual and biennial weeds reproduce only by seed, so the key to long-term control is to prevent seed production.

Mowing annual weeds (lambsquarters, ragweed, foxtail, etc.) once will usually control them if the pasture is healthy and has vigorous growth. Annuals need to be mowed before flowers are produced.

Mowing biennial weeds (bull thistle, plumeless thistle, musk thistle, burdock, wild carrot, wild parsnip, etc.) when they are in the bud to early flower (bolting) stage is helpful. Timely, repeated mowings are beneficial since they reduce seed production. Biennial thistles should be cut as close to the ground as possible.

Mowing perennial weeds (Canada thistle, milkweed, horsenettle, goldenrod, etc.) will rarely eliminate an infestation since they spread by both seed and vegetative structures (rhizomes, tubers, budding roots, etc.). But, mowing to prevent seed production is encouraged and if done on an interval that allows perennials to regrow to 8 -12 inches between mowings will, over a few years, weaken and eventually kill these weeds. However, this degree of mowing will also weaken

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desirable pasture species.

Not all weeds are inhibited by mowing. Low-growing plants, like dandelions, tend to be more prevalent in frequently mowed pastures. Many annual and biennial plants also regrow after mowing, especially if they have not flowered when cut.

It is important to mow pastures that have been selectively grazed by livestock. This can reduce or prevent seed production of weedy plants and promote regrowth of desirable forage species.

## Biological Methods

This technique uses living organisms to control pests (weeds in this case). One example is the use of the musk thistle weevil to control the musk thistle. The musk thistle weevil larvae (worm) feed on the developing tissue of the musk thistle seed head, thereby resulting in a sterile plant. The weevil will not eradicate musk thistle, but can somewhat reduce their numbers. This strategy has been used especially in hilly, rough terrain where mowing or herbicide application is not feasible. Musk thistle weevils can be ordered from biological insect supply companies for release onto existing musk thistles in early summer.

## Herbicides

Herbicide selection depends upon the forage and weed species present, stage and severity of weed growth, time of the year, temperature and rainfall, potential damage to nearby sensitive crops, grazing/haying/slaughter restrictions following application, and cost.

Be sure to read and follow the label. For postemergence herbicides to be effective, the weeds must be actively growing when treated.

Herbicides that kill broadleaf weeds in pastures also kill legumes. Where possible, only treat areas with weeds as determined by careful pasture monitoring. Some legumes may reappear spontaneously in 12 - 24 months from hard seeds left in the soil that germinate. Otherwise, legumes can be reseeded once weeds are controlled.

Be sure to clean herbicide spray equipment thoroughly after use.

Annual weeds are easier to control when young. Spring and early summer applications are best for summer annuals. As previously mentioned, most annuals are successfully managed with timely mowing and a competitive forage stand.

Biennial weeds need to be treated with a translocated herbicide while in the rosette (a compact, low-growing cluster of leaves) stage. This is the entire growing season in the year they germinate and up to the time they begin forming a flower stalk (bolting) the next season. Many biennials will bolt by mid May, so application needs to be completed by that time in their second year of growth. Herbicides are not as effective when plants start to bolt—at this point mowing is a better option (see above). An early fall application, while biennial weeds are actively growing, will be effective since the biennial weeds are in the rosette stage and will actively translocate the herbicide to the crown and roots.

Perennial weeds should be treated with a translocated herbicide in the bud to early flowering stage (perhaps early July) or the fall regrowth stage. One strategy is to mow perennial weeds when the first flowers appear and then spray when regrowth is 18 - 24 inches tall (perhaps 25 - 40 days later).

Herbicide options (products, rates, effectiveness) and guidelines for pastures are listed in the latest edition of the Illinois Agricultural Pest Management Handbook. To order a copy, contact your local Extension office or the publications office at the University of Illinois (phone 1-800-345-6087, or on-line at <https://www.press.uillinois.edu/>)

Two on-line sources of information on pesticide labels are:

<http://www.greenbook.net/> and <http://www.cdms.net/manuf/manuf.asp>

## Summary

To be successful, weed management in established pastures needs an integrated approach involving a wide range of tactics and practices.

## Where to Get Help

For more information about weed management in pastures contact the local office of the Natural Resources Conservation Service (NRCS) or University of Illinois Extension.

## Acknowledgements

Information in this fact sheet was adapted from a number of sources, including the University of Illinois, University of Wisconsin, University of Kentucky, and Purdue University.





Establishment/Rotation

# Alfalfa Autotoxicity Illinois

**What Is It?** For this topic, knowing the definition of two terms is important. *Allelopathy* is the effect of one plant on another as a result of the plant producing chemical compound(s). *Autotoxicity* is a form of allelopathy where a plant species releases chemical compound(s) that inhibit germination and growth of the same plant species.

Alfalfa contains water-soluble inhibitory substances that are autotoxic.

**Where are Autotoxic Substances Located?**

The greatest concentration is found in the alfalfa leaves and seed.

**What Does Autotoxicity Cause?**

Autotoxicity causes a negative effect on seed germination and seedling growth, especially reducing the growth of the radicle or the young developing taproot. Reduced seedling growth is seen as stunting in the field. This effect may be apparent for at least 3 years.

The autotoxic substance(s) can move with water, and thus will leach out of the root zone faster in a sandy soil than in a clay soil. Amount of rainfall is also an influencing factor.

**What's the Impact of Autotoxicity?**

Research has shown a "zone of influence" where older alfalfa plants release the autotoxic substance(s) that affects new seedlings in a "wagon wheel" pattern radiating outward from the older plants. New plants established within 8 inches of the old plant rarely survive and yield 30% of maximum, new plants established 8 to 16 inches away from the old plant yield 75% of maximum, and new plants 16 to 24 inches away from the old plant achieve maximum growth and yield.

**When to Interseed With Alfalfa?**

Using this "zone of influence", one would successfully interseed with a plant density of 0.2 old plants per square foot. At 0.4 old plants per square foot new seedlings can be established but will be low yielding. If there are greater than 1.3 old plants per square foot reseedling will not be successful due to "zone overlap."

The practice of interseeding alfalfa into alfalfa to thicken a stand usually fails due to this "zone of influence" and competition from existing plants.

**Reseeding Guideline**

If the alfalfa stand is greater than a year of age, the Illinois recommendation would be to plant a grass crop (corn is best) for one year and the following year reestablish alfalfa. If the alfalfa stand is less than a year of age, one would reestablish or reseed alfalfa.

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**Other Factors to Consider** Research has shown that high rates of fungicide on alfalfa seed interseeded into old alfalfa stands had no impact on emergence and establishment, and stands were not successfully interseeded. Grazing-tolerant varieties produce autotoxicity.

Studies suggest that there may be genetic differences in varieties to the autotoxic substance(s). Alfalfa seed companies are exploring the development of genetic resistance.

**Options to Thicken a Stand** Thickening old stands of alfalfa can be done with red clover (medium type) and/or good quality cool-season grasses.

**Optimum Alfalfa Plant Density** Optimum stand of alfalfa grown for hay is 55 stems per square foot and if less than 39 stems per square foot consider replacing the stand. Excellent gains on pasture have been obtained with alfalfa plant density less than the optimum for hay production.

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Establishment/Renovation

# Establishing Warm-Season Grasses Illinois

## Introduction

Care and attention to detail must be considered when establishing warm-season grasses. Farmers and ranchers familiar with planting techniques for cool-season grasses may need to change some of their management methods to ensure that their warm-season grasses develop into thrifty, profitable forage crops.

When establishing warm-season grasses, consider:

- Soil testing
- Seed quality
- Seeding rates
- Seedbed preparation
- Planting techniques
- Evaluation of newly-seeded fields
- Weed control and fertilization

Some steps necessary to ensure success with warm-season grasses.

## Soil Testing

Each field should have an independent soil test. Generalizations about soil types within a field and characteristics cannot be made because of soil variances within relatively small areas. The tests will show the pH of the soil and reveal any nutrient deficiencies.

Soil pH should be above 5.5 in order to establish warm-season grasses. If soil tests reveal a need, lime, which increases the alkalinity of soil, should be added to the soil at least five months before planting. Deficiencies of phosphate or potash can be corrected during seedbed preparation. Nitrogen should not be applied during early establishment of warm-season grasses since nitrogen will promote competition from undesirable plants.

## Seed Quality

Quality of warm-season grass seed is extremely important and quite variable. Warm-season grass seed is sold on a "pure live seed" (PLS) basis. PLS refers to the percentage of seed that is capable of germinating. Information is usually included on a tag attached to the seed bag. For example, a 50-pound bag of bulk grass seed might contain 40-pounds of pure live seed and 10 pounds of dead seed or trash. The PLS percentage of the seed would be 80 percent. If you purchase untested warm-season grass seed, there is no way of knowing how much pure live seed you are purchasing. In addition, weed seeds could be included in your purchase.

## Seeding Rates

Seeding rates for warm-season grasses are dependent on the method of planting as well as the intended use of the grass. Seeding rates also depend on the type of seed planted. Increasing the seeding rate may compensate for poor seed placement by inadequate seeding equipment or poor seedbed preparation.

Depending on the species, warm-season grasses, are seeded from mid-April to mid-June in northern Illinois. In southern Illinois, planting can begin as early as April 1. When there is a choice, the earlier dates are recommended.

## Seedbed Preparation

Minimum seedbed preparation usually includes chisel plow, disk, harrow, and cultipack in order to firm up a seedbed. To check for adequate firmness, walk across the prepared seedbed. Your footprints should only be as deep as the sole of your shoe. If the field contains cool-season grass, you may need to chemically kill the sod before preparing the seedbed since

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## **Seedbed Preparation**

(Continued)

some cool-season grasses may survive tillage. If the sod has been chemically treated, you have the option of preparing a clean-tilled seedbed or no-tilling into the residues. For clean-tilled seedbeds seed can be broadcast on to a firmly packed seedbed but drilling is the preferred method of seeding. Take extra care in treating existing sod with herbicides if no-till is the chosen method of seeding and use a drill that will place the seed at the proper depth and offer good soil contact.

## **Planting Techniques**

When planting warm-season grass seed, two things are important - a firm seedbed and proper seed depth. Plant shallow. The ideal planting depth is one-quarter to one-half inch. Many conventional grain drills place the seed too deep. Planting deeper than one-half inch usually results in failure. De-bearded seed is recommended, and more costly, but specialized planters are needed if bearded seed is used.

## **Evaluation of Newly-Seeded Areas**

An important step that is often overlooked is proper evaluation of a new seeding. Warm-season grasses require a soil temperature of 55°F or 13°C or above for germination. With sufficient moisture and soil temperatures new seedlings should emerge in 10-20 days. Problems arise because other grasses and weeds also emerge. People unfamiliar with grass seedlings often assume a planting has failed because of improper identification; especially true when seeds are broadcast because rows are not apparent. Digging up a few new seedlings and looking at the attached seed can help. In addition, consulting a native grass specialist with the Illinois Department of Natural Resources, Natural Heritage, Natural Resources Conservation Service or the University of Illinois Extension may prove worthwhile.

When proper steps are taken, warm-season grasses establish themselves quite rapidly. They generally establish themselves more slowly than cool-season grasses. But, while the aboveground growth of newly planted, warm-season grasses may seem slow, native warm-season grasses are busy developing extensive root systems.

If seedling density does not appear to be high with your warm-season grasses, don't panic. An adequate, mature stand of native warm-season grass might have only one plant per square foot. A stand with only one plant per square yard may be salvaged with good management. Individual plants can become quite large, and may fill in poor stands by self-seeding or spreading vegetatively.

## **Weed Control and Fertilization**

Since native warm-season grass seedlings grow slowly at first, competition from other grasses and broad-leaf weeds can be severe. Weed control is a must. Mowing or spraying can control weeds. Mowing weeds is effective when they reach a height of 18 inches. Don't mow lower than four to six inches or native grass seedlings could be damaged. Up to three mowings the first year may be needed, but remember to always mow above new seedlings. In addition, don't mow after August 1 when plants are storing carbohydrates for the winter. For chemical control check with Natural Resources Conservation Service, the Illinois Department of Agriculture, or the University of Illinois Extension Service, and pay close attention to label instructions. Do not graze a new planting the first winter because grazing can pull new seedlings loose. New plantings that exhibit a dense stand of grass with few weeds can be fertilized in May or early June of the second year or when grasses are about eight inches tall. In general, 50 pounds of actual nitrogen per acre is recommended.

## **Summary**

Warm-season grass seedlings offer few opportunities the first year for hay and grass producers. Don't be over anxious. Plantings may not develop their full potential until the third growing season. Graze lightly, even during the second growing season. Correct timing of haying and grazing along with proper cutting and grazing heights will ensure maximum production of native warm-season grasses

## **Where to Get Help**

For more information about warm-season grasses, contact your local office of the Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.

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Establishment/Rejuvenation

# Frost Seeding Illinois

**What** Frost seeding (sometimes called overseeding or surface seeding) is the broadcast, surface placement of seed in late winter, early spring. Ideally, the soil should still be frozen. This method is dependent upon the freezing and thawing cycles of soil, plus late snowfall or early spring rain, and perhaps livestock traffic to provide seed-to-soil contact/coverage. One should avoid frost seeding on heavy snow. Probability of success will be lessened in years with dry springs and on sandy soils.

**Why** Interest in this old technique has increased with efforts to improve pasture productivity and quality. Frost seeding is one of the most cost effective and energy efficient seeding methods. Since it works well on slopes, frost seeding reduces soil erosion that could occur if the soil was tilled.

**How** Cyclone-type spreaders that mount onto ATVs or tractor 3-point hitches are commonly used for frost seeding. One must determine the effective seeding width for each type of seed or mixture.

Better stands are obtained when frost seeding into a bunch grass or into thin sods of old sod forming grass. Pastures to be frost seeded need to be grazed heavily or closely clipped in the fall to reduce plant competition.

Frost seeded pastures need to be grazed regularly in the spring and summer to allow sunlight to penetrate the plant canopy. But, livestock should not be allowed to closely graze the new seedlings until they are established.

Since there may not be uniform seed germination and emergence, frost seeding is designed for pastures and not for establishing hay fields.

**Species to Seed** Species that germinate rapidly are best for frost seeding. Medium red clover is the easiest legume to frost seed due to its good seedling vigor, shade and cold tolerance. A second option would be ladino clover. Even though slower to establish, lespedeza may be considered in southern Illinois. Frost seeded legumes need to be properly inoculated, the soil pH must be in the proper range, and soil drainage must fit the species.

Most cool-season grasses do not establish from frost seeding as well as legumes. However, farmer experience and university data indicate that ryegrass (forage type) and orchardgrass can be successfully frost seeded.

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## Seeding Rates

Red clover can be seeded at 4 to 6 pounds per acre and ladino clover at 2 to 3 pounds per acre. If mixed, seed 3 to 4 pounds of red clover plus 1 to 2 pounds of ladino clover per acre. Lespedeza can be seeded at 3 to 10 pounds per acre.

Ryegrass (forage type) can be seeded at 3 to 10 pounds per acre and orchardgrass at 3 to 4 pounds per acre.

## Summary

With proper management and cooperation from Mother Nature, frost seeding is an economical, effective way to improve the quality and quantity of pastures.

## Where To Get Help

For more information about forage testing contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone Directory under "U.S. Government," or the University of Illinois Extension.

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## Establishment/Renovation

# Seed Quality

## Illinois

### Pure Live Seed Calculations

All seed shall be of high quality and comply with Illinois Seed and Weed Laws. Pure Live Seed (PLS) is an indication of seed quality however it is rarely shown on the seed tag. All Natural Resource Conservation Service, NRCS, and U of I Agronomy Handbook seeding recommendations are provided on a Pure Live Seed basis. To assist in determining the calculations for this we are providing the formula and an example to assist in calculating the proper amount of seed to be sown per acre.

Seed quality shall not drop below 70% Pure Live Seed, PLS, for bromegrass and 80% for other cool season grasses and legume species.

Percent PLS is calculated by multiplying the purity of the bulk seed lot by the percent germination plus percent dormant seed rates, then dividing that sum by 100. If planting a bag of seed that is 94% pure and a germination rate of 80%, with 5% dormant seed then you would calculate it this way:

$$PLS = [(\% \text{germination} + \% \text{dormant seed}) \times \% \text{purity}] \text{ divided by } 100.$$

$$(80\% \text{ germination} + 5\% \text{ dormant seed}) \times 94\% \text{ purity} = 79.9\% \text{ Pure Live Seed}$$

If planting 12 pounds per acre PLS and the seed used had a PLS of 79.9% then you would need to purchase 15 pounds of seed per acre to have the proper amount to plant.

$$12 \text{ divided by } 79.9 \times 100 = 15.01 \#/\text{acre}$$

In other words, you would have to plant 15 pounds of material from the seed bag of that species in order to plant 12 pounds of PLS per acre.

Minimum germination percent for warm season grasses shall be as follows:

Switchgrass – 75%

Indiangrass – 60%

Big Bluestem – 60%

Eastern Gamagrass – 50%

Germination tests should be no older than 6 months on warm season grasses. Farmer-produced seed will be tested for germination prior to seeding.

### References

References: USDA/NRCS Field Office Tech Guide Pasture and Hayland Planting 512, U of I Agronomy Handbook Chapter 8.





Establishment/Reproduction

# Weed Control Illinois

## Introduction

In pastures, woody and herbaceous weeds can become troublesome. A weed is defined as a plant out of place and in places they may be toxic or unpalatable, compete for light, moisture, and nutrients, and take the space needed for desirable species. However, some weeds at certain growth stages can be nutritious.

## Basic Principle and Life Cycles

Successful weed management begins with correct identification. Weeds can be classified as annual (completing their life cycle within one year), biennial (lives for two years), or perennial (lives for more than two years). There are winter annuals and summer annuals. Annuals and biennials reproduce only from seed, and perennials reproduce from seed and vegetative reproductive parts (rhizomes, stolons, etc.). Plants of all life cycles are easiest to control when they are seedlings. Annuals and biennials are much easier to control than perennials.

## Control Practices

Serious weed control problems should be taken care of before implementing or changing a grazing program. Pasture weed control includes cultural, mechanical, chemical, and biological management practices.

Cultural management consists of maintaining a dense, uniform, and vigorously growing sward. Good grazing management (leaving the appropriate stubble height and providing pasture rest periods) and maintaining optimal soil fertility are important weed control strategies. Continuous grazing at high stocking rates will weaken the stand and cause weed problems to increase rapidly.

Mechanical management includes mowing or clipping and hand digging. If this practice is repeated during the growing season, annual and biennial weeds can be reduced since the food reserves in the roots are depleted and seed production is reduced. Some graziers clip pastures after every grazing period to slow uniform regrowth and to weaken weed species. Mowing is less successful in controlling perennial weeds.

Chemical management starts with reading and following label directions. Weeds vary in their susceptibility to herbicides and the timing of application may affect the degree of control.

Annuals and biennials are most easily controlled when small. A fall or early spring herbicide application works best. Perennials or winter annuals are the main problem. Apply translocated herbicides to control established perennials when these weeds are in the bud-to-bloom stage.

Herbicides can be broadcast or spot applied. Be sure to follow the grazing restrictions and reentry periods. Be aware of the rain-fast period for foliar applied herbicides. Remember that many pasture herbicides will damage legumes as well as control broadleaf weeds.

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## Control Practices (Continued)

Details on herbicide options for pasture weed control are found in the current Illinois Agricultural Pest Management Handbook, available at University of Illinois Extension offices.

Biological management is the use of living organisms to control pests (weeds in this case). One example is the use of the musk mistle weevil to control the musk mistle. The weevil will not eradicate musk mistle, but can certainly reduce their numbers. This strategy has been used especially in hilly, rough terrain where mowing is not feasible.

## Summary

Weeds can reduce the vigor, yield and quality of pastures. The first step in weed management is proper identification. No one single management practice (cultural, mechanical, chemical, and biological) will result in weed free pastures. The grazer must adopt an integrated approach utilizing each of the above mentioned management practices.



Species  
Cool-Season Grass  
**Reed Canary**  
**Illinois**

NOTE: *Reed Canary grass is NOT recommended in Illinois due to aggressive nature.*

### General Information



Reed canary grass is a tall-growing, cool-season perennial with a rhizomatous root system. Tolerant of flood and drought, and is used for pasture, hay and erosion control. Reed Canary grass is one of the first grasses to begin spring growth.

Animals grazing reed canary grass during spring and summer perform similar to those grazing orchard grass, timothy or brome, and they perform better than animals grazing fescue. However, Reed Canary grass is not as well suited for fall and winter grazing as tall fescue, due to being one of the first cool-season grasses to stop growing and lose of green color. Reed Canary makes excellent hay for horses, who have shown preference over good quality timothy hay.

Reed Canary grass was first used in the southern corn belt to control erosion in ditches, waterways and gullies, and excellent for that purpose wherever the grass is adaptable. Several improved varieties of reed canary grass are available. Breed and Rise are high alkaloid varieties while Palaton and Venture have low alkaloid levels.

### Adaptability

No other forage plant is more adapted to wet, marshy areas as Reed Canary grass, and has withstood flooding for as long as 49 days without permanent injury. Reed Canary grass also has been found to be one of the most drought tolerant of the cool-season grasses.

Reed Canary grass has been widely used in the northern region of the central United States for many years, is adapted to all of Illinois. Some of the most vigorous, productive stands are in the extreme southeast part of the state.

CAUTION: *Reed Canary grass is very aggressive and has been removed from NRCS standards.*

### Establishment

Reed Canary grass may be established in the same manner as other cool-season grasses. Purchase only pure live seed to be seeded during August or early in the spring. Check with Natural Resources Conservation Service or University Extension for current recommended seeding rates and dates.

### Management

Reed Canary grass may be used as sod in areas where seeding is difficult. Small pieces of sod are embedded at one to two-foot intervals across gullies in early spring, or in the fall when the soil is wet. Shoots will emerge through six to eight inches of sediment.

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## Management

(Continued)

Reed Canary grass should not be allowed to get higher than 14 inches for best results in a pasture system. In pure stands, reed canary grass will respond to extremely high rates of nitrogen, and will make more summer growth under these conditions than any other cool-season grass in Illinois.

Reed Canary grass can be made into hay, but should not be allowed to become coarse and stemmy. Because of early spring growth, graze the grass first to delay the haying period. If cut for hay without grazing the first growth, mow grass when heads first begin to appear.

Legumes can be maintained with Reed Canary grass despite the ability to form thick sod. Upright growth characteristic allows substantial light to reach the legumes. In wet, low areas, ladino or alsike clover make good companion legumes. On upland sods, ladino, red clover, birdsfoot trefoil and alfalfa grow well with Reed Canary grass.

Seed production usually is a problem with Reed Canary grass because of shattering. The seed head matures downward from the top of the panicle, and the first mature seed shatters before the remainder of the seed in the head is ready to harvest. Only two or three days separate the ripening of the first seed and the start of extreme shattering. For seed production, nitrogen should be applied from December through January. Seed yields will be increased by applying 100 to 125 pounds of nitrogen per acre.

## Where To Get Help

For more information about reed canary grass, contact your local office of the USDA Natural Resources Conservation Service, listed in the telephone directory under "U.S. Government," or the University of Illinois Extension.



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# Species Warm-Season Grass **Johnsongrass** Illinois

## **General Information**

Johnsongrass is a perennial sorghum that closely resembles sudan grass, is native to the Mediterranean region, and was introduced into the United States about 1830 from an unknown source.

Taken by Col. William Johnson to Selma, Alabama, for use as a forage plant, Johnsongrass grew luxuriantly there, and became known as Johnsongrass.

In Illinois, Johnsongrass is usually not planted or thought of as a desirable species, but is hayed, and grazed incidental to other grasses. Good quality hay and grazing can be expected. Johnsongrass is considered a pest and a noxious weed in cultivated areas.

## **Characteristics**



Johnsongrass is an erect, perennial, warm-season plant that grows from three to 10 feet high and is sometimes confused with switch grass or eastern gamagrass.

The leaves usually have reddish spots on them from a pathogen. Stems are about the size of a pencil. The broad-bladed leaves are one-half inch to one inch wide with a distinct, light green midrib. The plant usually grows in bunches.

Branching seed heads form at the tip of the stem becoming reddish at maturity. Established plants have large, fleshy root stock called rhizomes, often as much as one-half inch in diameter.

The most undesirable forage characteristic of the plant is its tendency to be toxic under certain conditions.

## **Adaptation**

Johnsongrass is adapted to a wide range of soils, has spread over much of the United States, and does not seem to adapt well to very shallow, wet or saline soils.

## **Establishment**

Johnsongrass readily establishes from seeds or from rhizomes.

## **Management**

Johnsongrass is very palatable when green and growing, and is easily grazed out of grasslands.

To make the best pasture, graze under a planned grazing system.

Leave about eight inches of leaf, followed by a recovery period of 30 to 45 days, depending upon growing conditions.

Under careful management, maintaining a full stand of Johnsongrass can be difficult. In fact, grazing is a recommended control measure.

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## Management (Continued)

Haying operations should leave about six inches of leaf. Johnsongrass should be cut when the plants are in the early boot stage. Forage yields of two to five tons per acre are possible, with crude protein of 10 to 14 percent and total digestive nutrient values of 50 to 60 percent.

## Toxic Properties

Johnsongrass responds well to nitrogen fertilizer, but has the potential for nitrate poisoning.

The risk is greater on fields fertilized heavily with nitrogen during wet, cool, cloudy weather, or even drought.

The grass does not assimilate the nitrogen quickly enough to prevent toxic build-up under these conditions. The hay is also susceptible because the nitrogen level does not decrease with time.

Nitrate poisoning affects grazing animals very suddenly.

Prussic acid poisoning is normally associated with stress in the grass.

Dangerous times are immediately after a killing frost or in young regrowth after a drought.

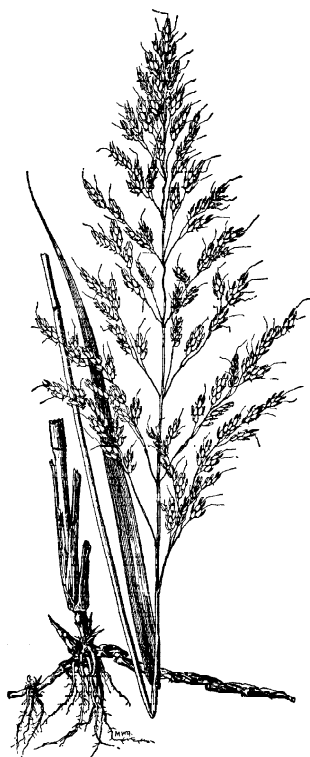
Prussic acid levels in the plant will decrease with time, unlike nitrates which do not decrease with time.

Generally, one week is needed on standing plants, and about three weeks on ensilage.

To reduce the risk of prussic acid poisoning, do not turn hungry animals into suspect pasture. Also, release only a few cattle, and observe their reaction. Animals also are affected quickly by prussic acid poisoning.

## Where To Get Help

For more information about Johnsongrass, contact the local office of the Natural Resources Conservation Service listed in the telephone directory under "U.S. Government," or the University of Illinois Cooperative Extension Service.



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## Noxious/Invasive Species

# Black Locust

(Poisonous Plant)

Illinois



### Plant Characteristics

***Robinia pseudoacacia* L:** Black locust is a medium-sized tree reaching 60 feet in height and 1 to 2 ½ feet in diameter, although it may grow larger on favorable sites. The trunk is usually short, and divides 10 to 15 feet above the ground into several stout, ascending branches. The trunk and branches lack large thorns. The pinnately compound, alternately arranged leaves, 8 to 14 inches long, have 7 to 19 nearly sessile leaflets. The flowers appear after leaf emergence, in May or June, and are borne in drooping racemes 4 to 5 inches long. Each flower is about 1 inch long and very fragrant. Its fruit is a flattened brown pod, 2 to 4 inches long and about ½ inch wide, that contains 4 to 8 kidney-shaped, compressed seeds.

### Occurrence

Black locust is apparently native in the United States from Georgia to Louisiana and Arkansas, north to Pennsylvania, West Virginia, southern Indiana, southern Illinois, southern Missouri, and eastern Oklahoma. It was commonly planted farther north, and escaped to become a tree of roadsides, open woods, and waste places. Black locust has been widely used for erosion control. It reproduces itself by seeds, and also spreads by underground stems.

### Condition of Poisoning

Animals have been poisoned from browsing black-locust sprouts, eating the pods and seeds, gnawing the bark, eating the leaves, and drinking water in which pods had remained for some time. Cattle are the most frequently poisoned of all animals. Horses are occasionally poisoned from gnawing the bark of black-locust trees to which they are tied.

### Control

Woodlands and open pastures should be cleared of black-locust sprouts and seedlings. Do not let animals graze near black-locust trees or drink water containing the pods. Do not tie horses to black-locust trees.

### Toxic Principles

The leaves, bark, flowers, and seed pods are poisonous. There are several substances in locust trees that appear to be toxic, but the principle one is robinine.

### Clinical Signs

Animals stand with feet spread apart and do not respond to commands. The main clinical signs are rapid, irregular heartbeat, rapid, shallow respiration, pale mucous membranes, depression, occasional evidence of abdominal pain, diarrhea, and periods of nervousness. Death results from cardiac failure. Since many animals exhibit extreme depression, some veterinarians have referred to the action of the toxic principle as that of a narcotic.

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**Necropsy** There are no tissue changes characteristics of this poisoning.

**Treatment** If you suspect black-locust poisoning, call a veterinarian at once. Any animal that shows suspicious signs after having fed on any part of the tree is in immediate danger of death. A hypodermic injection of digitalis to improve the heart action may be helpful. A veterinarian may administer other indicated treatment.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Bouncing Bet

(Poisonous Plant)

# Illinois

Plants of fencerows, roadsides, barnyards, fields, and waste places



### Plant Characteristics

*Saponaria officinalis* L.: Bouncing bet is an erect perennial herb from 1 to 3 feet tall, with smooth, little-branched stems that arise from rhizomes. The oppositely arranged, elliptic leaves are 3 to 4 inches long, and have 3 to 5 main veins. The margins of the leaves lack teeth. The pink to white flowers, which appear from July to September, usually form congested clusters at the summits of the stems. The fruit is a many-seeded capsule that opens by 4 teeth. The seeds are round or kidney-shaped, black, and minutely roughened.

### Occurrence

Bouncing bet, a native of the Old World, was formerly cultivated, but has escaped and become a weed of roadsides, railroad trackways, and fallow fields throughout North America. It seems to prefer sandy soil, and in such situations, forms sizable colonies.

### Conditions of Poisoning

The abundance of bouncing bet along roadsides and in other wastelands makes it easily accessible to animals allowed to graze in these areas. Although the entire plant is poisonous, the seeds contain the largest concentration of the poisonous principle. Most animals, however, refuse to eat the grain or screenings containing the seeds, and poisoning from browsing the leaves is usually mild.

### Control

If roadside and pasture grasses are dry in late summer, animals should not be grazed in places where bouncing bet is abundant. The plant should be controlled because it is a nuisance as a weed as well as a danger to livestock.

### Toxic Principles

The stems and leaves and, especially, the roots and seeds of bouncing bet contain a peculiar chemical substance known as a saponin that is undoubtedly the poisonous principle.

### Clinical Signs

The poison irritates the digestive tract. Depending upon the amount eaten, an animal may exhibit the following signs: nausea, vomiting, rapid pulse, dizziness, and diarrhea. Depressed breathing has also been reported. Animals rarely die of bouncing-bet poisoning.

### Treatment

Treatment is the same as that used to cure poisoning by corn cockle and cow cockle or cow-herb—the judicious use of digitalis, together with oils and demulcents given by mouth.

### References

Evers, Robert A., and Roger P. Link. *Poisonous Plants of the Midwest and Their Effects on Livestock*, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Bracken (or Brake Fern)

(Poisonous Plant)

# Illinois



### Plant Characteristics

*Pteridium aquilinum* (L.) Kuhn, vars. *latiusculum* (Desv.) Underw., *pseudocaudatum* (Clute) Heller, and *pubescens* Underw.: Bracken is a typical fern with large fronds that grow up to 5 feet tall. The broadly triangular blades that terminate the erect, stiff, straw-colored stipes are 8 to 30 inches long, and are divided into 3 main parts, with each part bipinnately or tripinnately subdivided. Numerous fronds arise from the long, black, creeping rootstocks. For this reason, bracken usually grows in colonies. Spores are produced in specialized structures, the sori, that form a continuous line along the margins on the lower surfaces of the mature blades. Spores mature in late summer. In addition to spores, rootstocks also spread bracken

### Occurrence

Bracken is a plant of dry, sterile, sandy or stony soil of open woods and railroad trackways. The typical variety is grown in Europe and Africa. Three varieties occur in North America, with variety *latiusculum* (Desv.) Underw., ranging throughout much of the Midwest. The variety *pseudocaudatum* (Clute) Heller is chiefly found in the Coastal Plain, but its range extends northward in the interior to southern Ohio, southern Illinois, southern Missouri, and eastern Oklahoma. The third variety, *pubescens* Underw., has a more western range, but occurs in South Dakota and Michigan.

### Conditions of Poisoning

Bracken is usually the cause of poisoning in late summer when there is little pasture available. The plant is occasionally found in hay meadows; and since it retains its toxic principle even when in the dry state, it may be a problem during the winter months. Horses, sheep, and cattle have been poisoned by eating bracken. Clinical signs in horses differ greatly from those in cattle and sheep.

### Toxic Principle

The toxic principle has not been definitely identified, although in horses it has thiaminase activity.

### Clinical Signs Horses

Loss of condition and weight and minor incoordination are observed when the horse is made to walk. It will not move unless forced, becomes lethargic, and stands with its feet apart in a crouched position with the back arched. If an attempt is made to turn the animal, it will usually cross its front legs. When forced to move, a severely affected horse will often develop extensive twitching of the muscles that progresses to severe tremors, and it may be unable to remain standing. The horse will frequently regain its feet only to undergo another series of tremors that almost reach the convulsive stage. It will usually stop eating or is prevented from eating by muscle twitchings and trembles. Marked cardiac irregularities occur, particularly a slow heartbeat.

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## **Necropsy**

No significant gross lesions characteristic of this disease are observed in horses on postmortem examination. A clinical pathological examination discloses marked lowering of the blood thiamine, increased pyruvate concentration, and a decrease in platelet count. In horses that have survived for a number of days after the onset of clinical signs, there is also a reduction in the red blood cells.

## **Treatment**

Large doses of thiamine, 0.25 to 0.5 milligram per kilogram of body weight, are given intravenously. Some veterinarians recommend a comparable dose administered intramuscularly.

## **Clinical Signs Ruminants**

Clinical signs in ruminants are sudden in onset, and death may occur in 4 to 8 days. Sheep are somewhat more resistant than cattle. Before severe clinical signs appear, the animals usually develop a rough hair coat and become listless. A mucous discharge from the nostrils may also be observed during this period. As the first severe clinical signs appear, the body temperature may become elevated, with readings as high as 109° F. There is rapid weight loss, dyspnea, salivation, bleeding from the nose, and congested or hemorrhagic mucous membranes and conjunctivae. In young cattle, edema in the throat region develops early. The clot-retraction procedure is an aid in diagnosing bracken poisoning. When blood from ruminants that have not been poisoned is collected in a clean glass tube and incubated at 37° C., the clot will retract and squeeze out the serum. This condition does not occur with blood from bracken-poisoned ruminants.

## **Necropsy**

In typical cases of ruminants, almost every organ is splashed with hemorrhages varying from petechiae to ecchymoses. Ulcers are commonly found in the intestine, and occasionally in the abomasums. Bacteria may be isolated from the liver or other tissues. These appear to be secondary invaders, and fatalities have occurred in animals from which no pathogenic organisms have been recovered. Examination of the blood of a severely affected animal will reveal a marked reduction in the platelets, leucocytes, and red blood cells if hemorrhage has occurred, and examination will reveal hypoplasia of the bone marrow.

## **Treatment**

Batyl alcohol supported by anti-infective agents, anti-heparin, and antihistamine therapy has reportedly given good results in bracken-poisoned ruminants. A blood transfusion often effects a dramatic improvement in the animal's condition.

## **References**

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Buffalo-bur

(Poisonous Plant)

Illinois

Plants of fencerows, roadsides, barnyards, fields, and waste places



### Description

*Solanum rostratum* Dunal: Buffalo-bur is an annual plant that grows up to 3 feet tall, with spiny, widely branched stems clothed with minute, branched or star-shaped hairs. The egg-shaped leaves are pinnately lobed, covered on both sides with hairs like those on the stem, and have prickles on the principal veins. The flowers are from  $\frac{3}{4}$  to  $1\frac{1}{4}$  inches across, and have yellow petals and a spiny calyx. The berry, measuring up to  $\frac{1}{4}$  inch in diameter, is clothed with numerous yellow spines.

### Occurrence

Buffalo-bur is a native of the western plains, but has become an aggressive weed through most of the eastern and northern states.

### Conditions of Poisoning

Animals are likely to eat buffalo-bur plants if turned out to graze where these plants are abundant. The poisonousness of the plant apparently varies with the soil, climate, and other conditions. The berries, especially, become less poisonous as they mature, and the ripe berries are almost harmless. The poisoning of animals, then, is to be attributed to the browsing of foliage and green berries. Most cases of poisoning occur in sheep, goats, calves, pigs, chickens, and ducks.

### Control

Animals should not be grazed in pastures infested with buffalo-bur. If the plant is mowed, dried, and burned as soon as blossoms appear, seeds will not be produced, and it will be easier to keep pastures from becoming heavily infested.

### Toxic Principles

The toxic principle is solanine, a glycoalkaloid. When hydrolyzed, this compound yields several alkaloids.

### Clinical Signs

The alkaloids, which are readily absorbed, are responsible for the major nervous signs. The clinical signs in a given case depend upon the balance between the irritant effect of the intact glycoalkaloid and the nervous effects of the released alkaloids. The irritant action of the solanine may vary in severity, causing anorexia, nausea, vomiting, abdominal pain and diarrhea. The effect on the nervous system causes apathy, drowsiness, dry mouth, labored breathing, trembling, progressive weakness or paralysis, prostration, and unconsciousness. The pupils are usually dilated. Death results from respiratory paralysis.

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**Necropsy** Variable degrees of inflammation ranging from hyperemia to hemorrhage to ulceration are found in the alimentary tracts. Edema in the perirenal tissues and ventral abdominal wall has been reported in some animals.

**Treatment** Administration of a parasympathomimetic drug (pilocarpine) will usually relieve most of the clinical signs.

For a description and discussion of other solanum plants, see black nightshade and deadly nightshade, and potato.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Buttercups (Pastures & Meadows) (Poisonous Plant)

## Illinois



Usually found in moist, open pastures and meadows

### Description

**Cursed Crowfoot, *Ranunculus sceleratus* L.:** Cursed crowfoot is an erect plant 4 to 24 inches tall, with smooth, hollow stems that are branched above and support many flowers. Basal and lower stem leaves are kidney-shaped and deeply 3-parted, with segments cleft again or lobed. Upper stem leaves are smaller, and commonly of 3 linear segments. The yellow petals, 1/8 inch long, are shorter than the green sepals. The numerous seeds, which develop when the flower withers, form short cylindrical heads.

### Occurrence

Cursed crowfoot is a plant of marshes, ditches, and swampy meadows. It ranges from Newfoundland and Quebec to Alaska, south to Virginia, Kentucky, Missouri, New Mexico and California.

### Description

**Tall or Common buttercup, *Ranunculus acris* L.:** Tall buttercup is an erect herb, up to 3 feet tall, with smooth or hairy stems that are leafy below the middle. The rosette or basal leaves are stalked. The leaves are kidney-shaped in outline, and are deeply cleft into 3 segments that are in turn cleft into oblong or linear lobes. The flowers have deep-yellow (sometimes cream-colored) obovate petals that are 3/8 to 5/8 inch long – about twice the length of the sepals. The seeds are obliquely obovate and smooth, and have erect or curved beaks.

### Occurrence

A native of Europe, tall buttercup was introduced into North America, where it has become naturalized from Labrador to Alaska, south to North Carolina, West Virginia, Ohio, Indiana, Illinois, Missouri, Kansas, and Oregon. In the northeastern states, it is a common weed of lawns, fields, roadsides, meadows, and clearings. In the Midwest, especially in Indiana, Illinois, and Missouri, it occurs only along railroads or roadsides, and is not a common cause of poisoning among livestock.

### Conditions of Poisoning

Buttercups usually inhabit moist areas. Animals allowed to graze in woods, in wet meadows, and by ditches and streams browse the buttercups with other succulent plants. All animals are susceptible to buttercup poisoning, but cows are most often poisoned. Dried buttercups are not poisonous, however, and buttercup-infested hay can be fed without danger.

### Control

Animals should not be grazed in pastures heavily infested with buttercups, especially when other forage is scant or dry. Buttercups are difficult to destroy because of their tendency to inhabit moist and wet places. Mowing the plants each year before they produce seed will keep them from increasing, and may eventually destroy them.

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## Toxic Principles

All known species of buttercups are poisonous. Cursed crow-foot, the most poisonous of our native species, contains anemonal, an acrid, volatile, very poisonous substance. Presumably, other buttercups contain the same or a similar substance in varying, usually lesser, amounts.

## Toxic Principles

All species of livestock are susceptible to the toxic principle. In lactating cows there is a sharp drop in milk production, and the milk is bitter and red-tinted. Severe poisoning causes abdominal pain, diarrhea, nervousness, twitching of the ears and lips, labored breathing, partial paralysis, and convulsions. Sheep may collapse suddenly; pigs may show paralysis but only minor involvement of the digestive system.

## Necropsy

Inflammation throughout the digestive system is the most significant lesion. In ruminants, there is usually extensive hyperemia in the abomasums and small intestine, with minor involvement of the large intestine.

## Treatment

Demulcents or other agents to protect the stomach and intestine are recommended. There is no known antidote for the toxic principle.

## Information Sources

For a description and discussion of hooked buttercup, small-flowered crowfoot, and swamp buttercup, which usually grow in wooded and old woodland pastures, see Buttercups for wooded areas fact sheet.

### Cockleburs

*Xanthium* species. For a description and discussion of cockleburs, see that fact sheet.

## References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species



# Buttercups (Wooded)

(Poisonous Plant)

# Illinois

Plants of wooded and old woodland pastures

### Description

#### Hooked Buttercup

*Ranunculus recurvatus* Poir.: Hooked buttercup is an erect herb from 8 to 28 inches tall, with sparsely hairy, little-branched stems. The leaves are all stalked except the uppermost, and are broadly kidney-shaped or round. They are usually 3-cleft to below the middle, and are more or less clothed with hairs. The flowers have pale-yellow oblong petals approximately 1/4 inch long that are about the same size as the sepals. The seeds have a firm hooked or coiled beak.

### Occurrence

Hooked buttercup is a plant of moist or dry woods. It ranges from Quebec and Main to northern Minnesota, south to Oklahoma, Georgia, and Mississippi.

### Description

#### Small-Flowered Crowfoot

*Ranunculus abortivus* L.: Small-flowered crowfoot is an erect plant from 4 to 20 inches tall, with smooth or slightly hairy stems that are branched above. The basal leaves are kidney-shaped to round, more or less heart-shaped at the bases, and round-toothed on the margins, although 1 or more of these leaves may be variously divided. The stem leaves are without stalks, or on very short stalks, and are deeply 3-parted to 5-parted. The segments are broadly linear and without teeth, or oblanceolate or obovate and irregularly toothed. The flowers are quite small. The yellow diamond-shaped petals are less than 1/8 inch long, and are shorter than the green sepals. The numerous seeds form small, globose heads on the summit of the flower stalks when the flowers wither.

### Occurrence

Small-flowered crowfoot is a plant of moist or dry woods, and ranges from Labrador to Alaska, south to Colorado, Florida and Texas.

### Description

#### Swamp Buttercup

*Ranunculus septentrionalis* Poir.: Swamp buttercup is an erect or ascending plant when the first flower appears, but the stems then elongate, recurve to the ground, and root at the nodes. The basal leaves and principal stem leaves are similar. The blades are at least as broad as they are long, and are 3-parted, with the terminal segment stalked and the lateral segments either stalked or almost stalkless. The margins of the segments are variously toothed. The flowers have yellow obovate petals from 3/8 to 5/8 inches long.

### Occurrence

Swamp buttercup is a plant of wet places in meadows, woods, low alluvial ground along streams, and in ravines and valleys. It ranges from Labrador to western Ontario, south to Virginia, Kentucky, Arkansas and Texas.

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## Conditions of Poisoning

Buttercups usually inhabit moist areas. Animals allowed to graze in woods, in wet meadows, and by ditches and streams browse the buttercups with other succulent plants. All animals are susceptible to buttercup poisoning, but cows are most often poisoned. Dried buttercups are not poisonous, however, and buttercup-infested hay can be fed without danger.

## Control

Animals should not be grazed in pastures heavily infested with buttercups, especially when other herbage is scant or dry. Buttercups are difficult to destroy because of their tendency to inhabit moist and wet places. Mowing the plants each year before they produce seed will keep from increasing, and may eventually destroy them.

## Toxic Principle

All known species of buttercups are more or less poisonous. Cursed crowfoot the most poisonous of our native species, contains anemonal, an acrid, volatile, very poisonous substance. Presumably, other buttercups contain the same or a similar substance in varying, usually lesser, amounts.

## Clinical Signs

All species of livestock are susceptible to the toxic principle. In lactating cows there is a sharp drop in milk production, and the milk is bitter and red-tinted. Severe poisoning causes abdominal pain, diarrhea, nervousness, twitching of ears and lips, labored breathing, partial paralysis, and convulsions. Sheep may collapse suddenly: pigs may show paralysis but only minor involvement of the digestive system.

## Necropsy

Inflammation throughout the digestive system is the most significant lesion. In ruminants, there is usually extensive hyperemia in the abomasums and small intestine, with minor involvement of the large intestine.

## Treatment

Demulcents or other agents to protect the stomach and intestine are recommended. There is no known antidote for the toxic principle.

## References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Climbing Bittersweet

(Poisonous Plant)

# Illinois



### Plant Characteristics

*Celastrus scandens* L.: Climbing bitterweet is a woody twiner with stems up to several yards long. These stems support alternately arranged, elliptical leaves and clusters of orange and scarlet fruits. The stems are green at first, but become gray by the end of the season. The leaves, 2 to 4 inches long, are long-pointed at the apices and round-toothed on the margins. The whitish or greenish flowers are disposed in terminal clusters from 1 to 3 inches long.

### Occurrence

Climbing bitterweet is a common plant of woodlands and fencerows. Its fruits are widely scattered by birds, and the plant ranges from Quebec to Ontario, Manitoba, and Wyoming, south to Georgia, Alabama, Tennessee, Louisiana, Oklahoma, Texas, and New Mexico.

### Conditions of Poisoning

Horses have occasionally been poisoned by eating climbing bitterweet leaves. Poisoning of sheep and cattle has also been reported.

### Control

Although bitterweet poisoning is rare, the vine should be destroyed in all places where animals are grazed.

### Toxic Principles

The toxic principle in climbing bitterweet is not definitely known, but it is thought to be the bitter substance euonymin.

### Clinical Signs

Climbing bitterweet acts as a mild to severe purgative, and sometimes produces nausea and even prostration, depending upon the amount eaten. It also has a mild effect on the heart, somewhat like the effect of digitalis. The poisoning is not usually fatal.

### Treatment

Move poisoned animals immediately to pasture where there is no climbing bitterweet. A veterinarian may administer other indicated treatment.

### References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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Noxious/Invasive

# Common Cucklebur

(Poisonous Plant)

Illinois



## Plant Characteristics

*Xanthium pensylvanicum*: This coarse, widely branching, annual herb can grow to .2 to 1.7 m (1-2 ft.) tall. The leaves are alternate, simple, coarsely pubescent, shallowly 3 to 5 lobed. The flowers are green, inconspicuous, male and female borne in separate clusters. The fruit is a bur, broadly cylindrical, to nearly spherical, spiny, 1.5 to 3 cm long, including spines. The two seeded bur is greenish to brown at maturity. This plant is a native annual weed, found throughout the south and across much of the Midwest in row crop fields, gardens, roadsides, and other areas exposed to full sun. It is most abundant in fertile, moist soils.

## Toxicity

The toxic principle is the glycoside, hydroquinone. It is concentrated in the seeds and seedlings (cotyledon stage). Mature plants are distasteful to animals and contain less of the toxin. The tender, juicy cotyledons, which are long and narrow, contain carboxyatractyloside, which affects the nervous system.

## Symptoms

Signs of poisoning include anorexia, depression, and weakened heartbeat. Swine are the animals most commonly poisoned. They root up and ingest the two-leaf stage of the plant in the springtime. Symptoms include vomiting and gastrointestinal irritation with occasional diarrhea. Large amounts often cause nervous symptoms including spasmodic running movements and convulsions. Chickens and other animals have also been poisoned. Sheep have been known to eat the two leafed stage plants as well.

## Treatment

Treatment is of little to no value once the symptoms have been observed.

## Information Sources

- Poisonous Plant of the Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition Ohio State University.

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Noxious/Invasive

# Comon Pokeweed

(Poisonous Plant)

Illinois



## Plant Characteristics

*Phytolacca Americana*: often called pokeberry. This is a perennial herb that can grow to 3 m (10 ft.) tall, often with many stems from a large fleshy root stock. This can grow from seeds as well. The stems are green to purplish, fleshy, hairless, hollow and smooth, they can reach a diameter of 4 inches. The leaves are alternate, light green, lanceolate, 8 to 23 cm (12-20 inches) long, 3 to 12 cm wide, glabrous, margins entirely. Flowers are white to purplish in drooping axillary racemes, that bloom from July to August. The ripe fruit is black, juicy, many seeded and when mashed produces a red "ink". The is distributed throughout the south and Midwest: most commonly on waste ground, fence rows, pastures and old home sites. Young leaves are often used as cooked greens; older leaves are quite poisonous.

## Toxicity

The poisonous principles are oxalic acid and a saponin called phytolaccotoxin. In addition, alkaloids may also be present. The root of the plant is the most toxic portion, although all of the other parts of the plant contain smaller amounts of the toxic principles. Cattle, horses, swine and man have all been poisoned after consuming this plant. Recognizable clinical cases are rare, however. Swine are the most often affected since they often grub out the roots and eat them.

Poisoning occurs during spring, summer or fall. In the springtime humans cook the leaves and consume them. This "poke salad" is generally considered safe if the water in which the leaves are cooked is poured off.

## Symptoms

The most commonly observed symptom is a severe gastroenteritis with cramping, diarrhea and convulsions. Postmortem lesions include severe ulcerative gastritis, mucosal hemorrhage and a dark liver. In most cases the animal recovers within 24-48 hours.

## Treatment

Gastrointestinal protectives and sedatives are suggested.

## Information Sources

- Poisonous Plant of Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition Ohio State University.

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## Noxious/Invasive Species

# Corn Cockle

(Poisonous Plant)

# Illinois

Plants of fencerows, roadsides, barnyards, fields, and waste places



### Description

*Agrostemma githago* L.: Corn cockle is an erect, branched, silky stemmed annual herb that grows up to 3 feet tall. Its oppositely arranged, linear or lanceolate leaves are 3 to 5 inches long, smooth on the margins, and clothed with silky hairs. The red flowers are borne singly at the ends of the branches. The calyx lobes of the flowers are longer than the calyx tubes. A large seed capsule develops within each flower. This seed capsule contains many warty-covered dark-brown or black seeds that are about the size of a grain of wheat.

### Occurrence

Corn cockle, a native of Europe, grows throughout most of North America. It is widely established weed of grainfields, roadsides, railroads, fallow fields, and waste places. Modern seed cleaning has reduced its abundance considerably.

### Conditions of Poisoning

The green parts of corn cockle contain so little poison that animals can browse them freely without showing any ill effects. But the seeds are so poisonous that any animal may die from eating  $\frac{1}{4}$  to 1 pound ground cockle seed per 100 pounds of body weight. Although unbroken seed contains as much poison as cracked or ground seed, it can be eaten in greater quantities without danger because the toxic principle is rarely released from the unbroken seed.

Cockle poisoning occurs most frequently among poultry, and is the result of feeding grain or screenings containing considerable quantities of whole and broken cockle seed. Sheep, cattle, and hogs may graze enough seed directly from plants to be poisoned, but most poisoning occurs from cockle infested grain or screenings. Among animals, pigs are the most easily poisoned. Human poisoning, now very rare, used to occur from eating bread made of flour ground from cockle-infested wheat.

### Control

Remove corn cockle from pastures and grainfields, and use only seed that is free from corn cockle seed in planting grainfields. Do not feed screenings or grain that contains cockle seed in planted grainfields. Do not feed screenings or grain that contains cockle seed, and do not graze animals where corn cockle is growing.

### Toxic Principles

The entire corn cockle plant, but especially the seed, contains a glucoside, githagin, and the saponin agrostemmic acid.

-more-

## Clinical Signs

Although chronic corn-cockle poisoning may follow the eating of small amounts of corn cockle seed over a long period, acute poisoning from eating large amounts of the seed occurs more frequently. Some of the signs of corn cockle poisoning vary with different species of animals, but the following are common to all: colic, inability to stand, rapid breathing, and coma preceding death.

Pigs, the most susceptible of all animals to cockle poisoning, lie down with their snouts on the ground. Vomiting occurs, along with colic, diarrhea, and evacuation of foul-smelling, frothy fecal material. Spasms may precede death.

The first observable signs in cattle are nervousness, slobbering, and grinding of the teeth, followed by excitement, colic, and coughing lasting from 5 to 8 hours. Fetid diarrhea, rapid and noisy respiration, rapid and weak pulse, a progressive decline in temperature, and coma precede death. Death occurs about 24 hours after the onset of clinical signs. Corn cockle poisoning in horses begins with slobbering, yawning, colic, rapid, weak pulse and respiration, and ends in a coma and death. Cockle poisoning does not cause convulsions.

## Necropsy

Hemorrhages on the heart and diaphragm and extensive congestion in the liver, kidneys, and spleen are constant findings in corn-cockle poisoning. The gall bladder and bile duct are edematous and contain scattered hemorrhages. Variable degrees of inflammation may be found in the stomach, with severe inflammation in the small intestine. Microscopic examination reveals congestion, hemorrhage, and necrosis of some cells in the liver. Hemorrhage and albuminous degeneration have been found in the kidneys.

## Treatment

Any animal suspected of suffering from corn cockle poisoning should have immediate treatment. If a cockle poisoned animal is not properly treated, it is likely to die. Digitalis, a potent drug that should be administered only by a veterinarian, will counteract some of the poisonous effects of cockle. If given soon enough and in proper dosage, digitalis may save the poisoned animal. Oils and demulcents given by mouth have also been recommended.

## References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006



Noxious/Invasive

# Eastern Black Nightshade

(Poisonous Plant)

Illinois



## Plant Characteristics

*Solanum nigrum*: This is an annual, thorn-less, essentially glabrous herb, .1 to 1 m tall. Leaves alternate, sinuately or coarsely toothed with slight pubescence on the undersurface, 5 to 10 cm long and 2 to 5 cm wide. Flowers are white to purple borne in an open cluster, 6 to 8 mm broad. Fruit is shiny and black when ripe and produces several seeds, which are 5 to 9 mm in diameter. Can be found throughout the south and in most of Illinois; grows along stream banks, thickets, roadsides, row crop fields and other open disturbed areas.

## Toxicity

A toxic alkaloid, solanine, has been isolated from this group of plants. Toxicity of these plants varies depending upon maturity, environment and portion of the plant ingested. The berries are the most toxic part and are more toxic when they are matured. The berries of both Carolina horsenettle and black nightshade are green when immature. However, horsenettle berries turn yellow when mature and nightshade berries become purplish black. The leaves are also toxic, but to a lesser degree.

## Symptoms

All classes of livestock and humans have been poisoned. Two syndromes have been described: acute and chronic. The acutely poisoned animals are characterized by irritation of the mouth and gastrointestinal lesions. In the chronic form, unthriftiness, jaundiced mucous membranes, abdominal dropsy and constipation have all been seen.

## Treatment

Non-specific.

## Information Sources

- Poisonous Plant of the Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition, Ohio State University.

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## Noxious/Invasive Species

### Great Lobelia or Blue Cardinal Flower (Poisonous Plant)



Illinois

Plants of streams, ditches, ponds, springs, and swampy meadows

#### Description

*Lobelia siphilitica* L.: Great lobelia, or blue cardinal flower, is an erect, stout, sparsely branched perennial herb that grows to a height of 2 to 5 feet. The tall, angular stem is smooth or slightly hairy above, and supports alternately arranged, oval to lanceolate leaves that are 3 to 5 inches long, and have coarsely toothed margins. The numerous bright-blue flowers, about  $\frac{3}{4}$  inch long, are crowded among numerous smaller leaves along the upper portion of the stem.

#### Occurrence

The great lobelia is a plant of swamps and wet ground from Main to Manitoba and Colorado, south to North Carolina, Alabama, and Texas.

#### Conditions of Poisoning

Animals browsing in moist places may eat the lobelia along with other plants. Only a few cases of animal poisoning have been attributed with certainty to the eating of the great lobelia.

#### Toxic Principles

The great lobelia, like other species of lobelia, contains the two alkaloids lobeline and lobelanine, as well as a volatile oil.

#### Clinical Signs

Since the alkaloids are identical with those of the Indian tobacco plant, the signs of poisoning are the same. Clinical signs include dilated pupils, salivation, nausea, vomiting, diarrhea, ulceration about the mouth and on the eyes, nasal discharge, and coma.

#### Necropsy

Lesions include ulcers in the mouth and on the cornea and edema of the conjunctiva. The stomach and intestine become severely inflamed, with hemorrhages in the muscle layers. Edema and congestion in the kidneys and fatty changes in the liver are also found.

#### Treatment

Atropine will relieve some of the clinical signs. A purgative may be administered if the animal shows signs of poisoning soon after eating the plants. Tannic acid given by mouth will combine with the toxic substances and delay absorption.

#### References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Ground Ivy or Creeping-Charlie

(Poisonous Plant)



# Illinois

Plants found in hay and grain

### Description

*Glechoma hederacea* L.: Ground ivy is a creeping perennial herb with slender, square stems that root at the joints. The oppositely arranged leaves are round or kidney-shaped, and have scalloped teeth on their margins. The small bluish flowers are found in the axils of the leaves, usually 3 per axil, and appear from April to June and sometimes into July.

### Occurrence

A native of Eurasia, ground ivy has become thoroughly naturalized in North America as a plant of moist woods and as a troublesome weed of moist gardens and lawns. Ground ivy ranges from Newfoundland to Ontario, Minnesota, and North Dakota, south to Georgia, Alabama, Missouri, Kansas, and Colorado. It also occurs from Alaska to California.

### Conditions of Poisoning

Ground-ivy poisoning is rare, probably because most animals do not like the bitter taste of the plant. Horses, the animal most often affected, are poisoned only after eating large quantities of the plant, either green or dried in hay.

### Control

Animals should not be grazed in areas that are heavily infested with ground ivy, particularly when other herbage is dry or scarce, and hay should not be made in meadows where the plant is abundant. Ground ivy should be eradicated in all places where it is a danger to animals. It is easily destroyed by cultivation.

### Toxic Principles

Like other members of the mint family, ground ivy contains a volatile, aromatic oil. It also contains a bitter substance of unknown chemical constitution. It is collected as a drug plant, and is used medicinally in small amounts as a stimulant and tonic.

### Clinical Signs

After eating large amounts of ground ivy, poisoned animals, especially horses, slobber and sweat, and the pupils of their eyes become dilated. They pant for breath as if from over-stimulation. Poisoning from ground ivy is rarely fatal.

### Treatment

Affected animals should be given feed that does not contain ground ivy. A veterinarian may administer other indicated treatment.

### References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Hemp or Marihuana

(Poisonous Plant)



Illinois

Plants of fencerows, roadsides, barnyards, fields, and waste places

### Description

*Cannabis sativa* L.: Hemp is a coarse, rough-stemmed annual herb that grows up to 9 feet high and resembles giant ragweed in general appearance. The palmately compound leaves are oppositely arranged on the lower part of the stem, but alternately arranged above. Each leaf has 5 to 9 long-pointed, narrowly lanceolate, coarsely toothed leaflets. The flowers are of two kinds—one bearing pollen, the other bearing seeds—but they do not occur on the same plant. Both kinds are small and greenish, and are borne at the tip of the stem and in the axils of the upper leaves.

### Occurrence

Hemp, a native of Asia, is found as a weed along roadsides, railroads, and waste places. It is also a plant of sandy pasturelands and of moist soil of bottomlands and along drainage ditches. The distribution of hemp in the United States is peculiar. It has been reported from 39 of the contiguous states. Hemp is most common from Main to Minnesota and South Dakota, south to Virginia, Missouri, and Kansas, with the greatest abundance in the Corn Belt.

### Conditions of Poisoning

Since there have been few cases of animal poisoning from the eating of hemp, poisoning is to be suspected only when it is certain that the poisoned animal has eaten a considerable quantity of hemp and no other poisonous plant. Except in the seedling and younger stages, hemp is coarse and unpalatable. The poison is concentrated especially in the upper part of the mature plant as it flowers and produces seed. This part of the plant, if eaten in quantity, may produce narcotic signs and cause death.

### Control

Hemp should be eradicated as soon as it makes its appearance. In August, 1969, Illinois classified hemp as a noxious weed under the Illinois Noxious Weed Law, and failure to eradicate the plant in that state can result in prosecution.

### Toxic Principles

Hemp contains the alkaloid cannabidiol, the glucoside cannabinol, and the resin tetrahydrocannabinol. These poisonous substances occur in greatest abundance in the crude resin that is formed in the flowering part of the plant. Hemp seed is an important ingredient in bird-seed mixtures, and it is probably the small amounts of poisons in the seed that causes birds to sing more readily.

### Clinical Signs

Hemp poisoning produces no clear-cut clinical signs. The signs that do appear are those of narcotic poisoning. The animal may at first appear highly nervous; later, it may give evidence of mental depression and derangement of the central nervous system. If death follows, it results from the depressing effect of the poison upon vital centers and organs.

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**Treatment** An animal suspected of being poisoned by hemp should be removed at once to a pasture in which no hemp is growing. If the animal appears to be severely poisoned, it should be placed under cover and restricted to a limited diet of hay or fresh forage, with plenty of water at hand. A veterinarian may be called to administer tannic acid and a stimulant.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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Noxious/Invasive

# Hemp dogbane

(Poisonous Plant)

Illinois



## Plant Characteristics

*Apocynum cannabinum*: Hemp dogbane, Indian hemp, Choctaw root, rheumatism weed and snake's milk are some of the common names for this native perennial. This erect, branching, perennial can be .8 to 1.8 m (1-4 Ft.) tall with a silky sap arising from creeping, underground root stock. It reproduces by creeping roots and seeds. The leaves are opposite and ovate to elliptic, 4 to 14 cm long, 1.5 to 6 cm wide with smooth margins. The underside of the leaf is finely-hairy. Dogbane branches freely, unlike common milkweed. The flowers are white to greenish in terminal flat-topped clusters, usually overtopped by the leafy branches. The fruit is long and slender, paired drooping follicles, 10 to 22 cm long (4-8 inches) and 2 to 3 cm in diameter. The seeds are elongated and smooth. This plant is found throughout the south and much of the Midwest. It is abundant in the edges of woods, roadsides, pastures, waste areas and in some crop fields.

## Toxicity

A resinoid and glucoside are found in the leaves and stems of this plant, whether green or dry. It is quite toxic and requires only 15-30 grams (< 1 ounce) of green leaves to kill a horse or cow. Livestock can be poisoned in spring, summer and fall.

## Symptoms

Symptoms include increased temperature and pulse, sweating, dilated pupils and off feed, along with refusing to eat or drink. The mucous membranes (mouth and nostrils) are discolored and extremities are cold.

## Treatment

Intravenous fluids and gastric protectives are suggested.

## Information Sources

- Poisonous Plant of the Southern United States
- <http://plants.usda.gov>
- Bulletin 762 Horse Nutrition, Ohio State University.

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## Noxious/Invasive Species

# Hogwort

(Poisonous Plant)

## Illinois

Plants found in hay and grain



### Description

*Croton capitatus* Michx.: Hogwort is an erect, stout, sparingly branched annual that grows up to 4 feet tall. The stem and the alternately arranged, narrowly oblong leaves are clothed with white, woolly hairs. The leaf margins lack teeth. The flowers are crowded at the ends of the branches, and are small, inconspicuous, and clothed with hairs. Some flowers have five sepals, five petals, and 10 to 14 stamens; others lack petals, have 5 to 10 sepals, and a single ovary with three styles that are divided 2 or 3 times so that there are 12 to 24 stigmas. Fruits produced from these flowers are capsules containing three seeds.

### Occurrence

Hogwort is a plant of dry, sand, gravelly, or stony soil in orchards, fallow fields, roadsides, and railroad trackways. It ranges from Ohio to Indiana and Kansas, south to Florida and Texas.

### Conditions of Poisoning

Hogwort has such a disagreeable taste that most animals will not eat it. For this reason, there are only a few reported cases of poisoning that can be attributed to browsing. Since the plant sometimes grows abundantly in pastures, however, it is sometimes cut with hay, and the hay can poison animals that eat it.

### Control

Do not cut hay from pastures and fields in which hogwort plants are numerous. Destroy the plant in all places where animals graze.

### Toxic Principles

Hogwort is believed to contain croton oil. This oil, besides being a powerful cathartic, can blister and irritate the skin. Pure croton oil is reportedly so poisonous that 10 drops of it will kill a dog.

### Clinical Signs

Animals with skin irritations may be suffering from contact with hogwort. When animals eat hay that is infested with hogwort, they become nervous, show evidence of colic, and have diarrhea. Fatal poisoning by hogwort is rare.

### Treatment

Treatment is largely directed toward easing the discomfort of the affected animal. Bland oils and sedatives are given when poisoning occurs from eating the plant.

### References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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Noxious/Invasive

# Horsenettle

(Poisonous Plant)

Illinois



## Plant Characteristics

*Solanum carolinense*: This plant is in the nightshade family. This plant is sometimes called bull nettle, devil's potato and wild tomato. This is a perennial, thorny herb, .2 to .8 m tall that can spread by rhizomes and seeds. Leaves are alternate, simple, irregularly pinnately lobed, 7 to 12 cm long, 3 to 8 cm wide, stellate pubescent. The flowers are white to purple and are star shaped with five bright yellow anthers, 2.3 to 3.1 cm broad: borne in few-flowered, terminal racemes. Fruit is green, but turns yellow, like a small tomato, 1 to 1.5 cm in diameter. Plants are found throughout the south, but are also common in the Midwest in pastures, old fields, waste areas and sometimes in cultivated fields. Horsenettle is characterized by hard, sharp, yellowish spines found on the stems and leaves. They are easily found in pastures since most animals avoid eating it.

## Toxicity

All parts of the plant are poisonous, with the level of solanine being highest in the fall. Toxicity of these plants varies depending upon the maturity, environment and portion of the plant ingested. The berries are the most toxic when they are mature. The berries of both Carolina horsenettle and black nightshade are green when immature. However the horsenettle berries turn yellow when mature and the black nightshade berries become black. The Leaves are toxic also, but to a lesser degree.

## Symptoms

All classes of livestock and humans have been poisoned by them. Two syndromes have been described: acute and chronic. The acutely poisoned animal is characterized by irritation of the mouth and gastrointestinal lesions. In the chronic form, unthriftiness, jaundiced mucous membranes (mouth and nostrils), abdominal dropsy and constipation have all been seen.

Non-specific.

## Treatment

## Information Sources

- Poisonous Plants of Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition, Ohio State University.

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## Noxious/Invasive Species



# Horsetails and Scouring Rushes

(Poisonous Plant)

# Illinois

Usually found in moist, open pastures and meadows

### Description

*Equisetum* species: Horsetails are small rush-like plants with jointed stems and whorled branches. The aerial stems, usually less than 3 feet tall, arise from much-branched underground stems called rhizomes. Aerial stems may be evergreen and perennial, or they may be annual and die at the frosts of autumn. Although the stems appear to be leafless, tiny leaves are found at the nodes or joints. They are fused on the margins but have free tips, and soon become blackish and scale-like. The number of leaves is the same as the number of ridges on the stem. Cones are borne at the tips of the stems. In the common horsetail (*Equisetum arvense* L.), there are two kinds of stems, sterile and fertile. The sterile stems are green and much-branched. Fertile stems, which appear in early spring, are brownish and support a single cone at the apex of each stem. These stems die after the spores are shed from the cones.

### Occurrence

Horsetails grow in damp and wet places. The common horsetail also often grows in railroad ballast. It is a cosmopolitan plant found throughout most of the United States and Canada. Three other species occurring in the Midwest are reported to be poisonous. These are the tall scouring rush (*Equisetum hyemale* L.), smooth scouring rush (*Equisetum laevigatum* A. Br.), and marsh horsetail (*Equisetum palustre* L.). The tall scouring rush and smooth scouring rush are widespread in the Midwest. The marsh horsetail ranges from Quebec, Ontario, and Minnesota, south to Maine, Vermont, and Illinois. It also occurs from Alaska south to Montana and California. Some *Equisetum*s are called scouring rush because the stems contain silica, and were used by the pioneer women as a scouring material for cleaning pots and pans.

### Conditions of Poisoning

Horsetails are troublesome as poisonous plants, especially when they are abundant in hay. There is some evidence that horses are less susceptible than sheep and cattle to the toxic principle in green plants. *Equisetum palustre* may be lethal to cattle, but *Equisetum arvense* is rarely if ever lethal. Horsetail poisoning in horses may be distinguished from bracken poisoning because animals poisoned with horsetails maintain their appetites even after clinical signs appear.

### Toxic Principles

Extracts of *Equisetum* possess thiaminase activity. Some authorities believe that the toxic principle in these plants also has other actions.

### Clinical Signs

Animals poisoned by eating horsetails may die within a few hours after signs of poisoning appear, but they usually live several days or even weeks. Unthriftiness, excitability, loss of condition, staggering gait, rapid pulse, difficult breathing, diarrhea, and emaciation may be noted. Death is preceded by convulsions and coma. Lowered milk production in cows and trembling in sheep have also been observed.

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**Necropsy** Specific lesions caused by the toxic principle have never been reported.

**Treatment** If horsetail poisoning is suspected, a change to uncontaminated hay should be made at once. Thiamine hydrochloride (0.25 to 0.5 milligram per kilogram of body weight) produces dramatic improvement in horses, but is less successful in relieving clinical signs in ruminants.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006





## Noxious/Invasive Species

# Indian Tobacco & Pale Spiked Lobelia

(Poisonous Plant)



# Illinois

Usually found in dry, open pastures and meadows

### Description

*Lobelia inflata* L.: Indian tobacco is an erect annual herb with a hairy, branched or unbranched stem up to 3 feet tall. The leaves are alternate, ovate, 1 to 33 inches long, and with toothed margins. They may be stalked or almost stalkless. Branches arise from the axils of the leaves. Racemes of pale blue or white flowers terminate the main stem and branches. Each flower is about ¼ inch long and 2-lipped, but has 5 petals and is subtended by a bract. The lowermost flowers have leaf-like bracts; the upper bracts are greatly reduced. The fruit is a small capsule embedded in the calyx tube that becomes inflated at maturity. Each capsule produces numerous tiny, yellow-brown seeds.

*Lobelia spicata* Lam.: Pale spiked lobelia is an erect perennial herb with a simple, smooth or slightly hairy stem up to 3 feet tall. It has alternate, lanceolate, oblanceolate, or obovate leaves up to 3 inches long, with scarcely toothed margins. The leaves are scattered on the stem, and form a rosette at the base of the stem. Upper leaves are gradually reduced to bracts. Slender racemes crowded with pale blue or white flowers terminate the stem. Each flower is about 3/8 inch long, and is subtended by a small bract. The calyx tube does not inflate in fruit.

### Occurrence

Indian tobacco, ranging from Labrador to Saskatchewan, south to George, Alabama, Mississippi, Arkansas, and eastern Kansas, is found in open woods creekbanks, and pasturelands. It is sometimes a weed in gardens. Pale spiked lobelia is a plant of prairies, open woods, roadside ditches, railroad trackways, and pasturelands. It ranges from Quebec and New Brunswick to Saskatchewan, and south to Georgia and Arkansas.

### Conditions of Poisoning

Cattle or sheep in pastures infested with Indian tobacco or pale spiked lobelia do not usually browse these plants except accidentally or when other plants are dry or in short supply. Nevertheless, in heavily infested pastures or during very dry periods, enough of the plants may be eaten to cause serious poisoning.

### Toxic Principles

Indian tobacco, pale spikes lobelia, and other lobelias contain several alkaloids similar to nicotine in composition—among them lobeline and lobelanine—and a volatile oil.

### Clinical Signs

Diagnosis is supported by evidence that the affected animal has browsed these plants in pasture, or by finding recognizable parts of the plants in the animal's stomach. Clinical signs include dilated pupils, salivation, nausea, vomiting, diarrhea, ulceration about the mouth and on the eyes, nasal discharge, and coma. These signs are like those produced by an overdose of the alkaloid lobeline. Lobeline has been detected in the plants in a large enough quantity to account for poisoning.

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**Necropsy** Lesions include ulcers in the mouth, on the cornea, and in the intestine, and hemorrhage in the intestine and kidney cortex. Edema in the conjunctiva and kidneys and fatty changes in the liver are consistent findings.

**Treatment** Atropine will relieve some of the clinical signs. A purgative may be administered if the animal shows signs of poisoning soon after eating the plants. Tannic acid given by mouth will combine with the toxic substances and delay absorption.

(for a description and discussion of great lobelia or blue cardinal flower, which is a plant of streams, ditches, ponds, springs, and swampy meadows, see "Great Lobelia.")

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006



Noxious/Invasive

# Jimsonweed

(Poisonous Plant)

Illinois



## Plant Characteristics

*Datura stramonium*: This is a foul-smelling glabrous annual, .5 to 1.5 m tall with a green to purple-tinged stems. The leaves, resemble a poinsettia, are alternate, coarsely and irregularly toothed, 7 to 15 cm long, 2 to 12 cm wide. Flowers are large white to lavender, tubular (funnel shaped), 7 to 10 cm (2-5 inches long and 1-2 inches across). The fruit is a distinctive, hard, prickly, many seeded capsule that splits into four sections. This erect dry spiny capsule is 2.5 to 4 cm long and 2 to 2.5 cm wide and contains many shiny black seeds. The plant is native to the tropics but is naturalized to most of Illinois and the Midwest. It is most abundant in fertile fields and gardens and barn lots.

## Toxicity

The toxic principles of this common hog lot and barnyard plant are the alkaloids atropine, hyoscyamine and scopolamine. All parts of the plant are considered poisonous, whether green or dry. Usually poisoning occurs from eating the dry plant in hay or silage or the seeds mixing in grain. However the seeds are particularly poisonous. Usually, this plant is not eaten except when other forage is unavailable. Cattle and swine are primarily affected but horses, poultry, dogs and humans have been affected. Cows can be poisoned by consuming one-half to one pound of the green plant.

## Symptoms

Early symptoms include a weak and rapid pulse and heartbeat. The eyes are dilated, the mouth and other mucous membranes are dry and animals may appear blind. Later, slow breathing may be observed as well as lowered temperature, convulsions or coma. After eating the plants sheep have been observed to have abnormal leg movements, disturbed vision, intense thirst and to bite at imaginary objects in the air.

Pregnant sows consuming jimson weed during their second and third months of gestation have produced deformed pigs. Some pigs may be born alive but exhibit varying degrees of flexed hips, stifles and forelegs. The hocks may be overextended.

## Treatment

Non-specific. Weeds should be destroyed in order to prevent problems.

## Information Sources

- Poisonous Plant of the Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition, Ohio State University.

June 2004



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Noxious/Invasive

# Milkweed

(Poisonous Plant)

Illinois



## Plant Characteristics

*Asclepias tuberosa*, and other species: Common milkweed, is an erect perennial that spreads by creeping roots and seeds. Stems can reach 3-6 feet and are unbranched and covered with short downy hairs. The leaves are oblong, 3-8 inches long with a rounded to tapered leaf tip and base. The leaves are attached directly to the stem. The plant has a milky sap arising from thick rootstock or rhizomes. The leaves are opposite and whorled or rarely alternate, simple linear to widely ovate. The under side of the leaves are covered with fine velvet-like hairs. The upper surface, which can be hairless or hairy, shows a prominent white midrib. The flowers are borne in a large ball-like cluster and are sweet smelling, pink-lavender in color and bloom from June to August. The fruit is an elongated follicle splitting on one side and releasing many seeds topped with white silky hairs that enables them to be widely dispersed by the wind. The milkweed genus is found throughout the southern states, since it is native to North America, in reduced tillage fields, along roadsides, fence rows, open woods, pastures and waste areas. It grows best in warm, dry soils with full sunlight.

## Toxicity

All parts of the plant, whether green or dry in hay are toxic to cattle, horses, sheep, goats and poultry. Various species of milkweeds have yielded resinoids, alkaloids and glycosides. Animals consuming 2% of their body weight of the toxic plant can cause symptoms.

## Symptoms

Losses usually occur when animals are forced to graze the plant due to lack of other forage. Usual signs include staggering, depression, weakness, rapid and weak pulse, labored respiration and dilated pupils. Animals go down and exhibit tetanic spasms before going into a coma and dying, death is rare.

## Treatment

Laxatives and intravenous fluids are suggested.

## Information Sources

- Poisonous Plants of the Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition, Ohio State University.

June 2004



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## Noxious/Invasive Species

# Oaks

(Poisonous Plant)

## Illinois



Plants of wooded and old woodland pastures

### Plant Characteristics

Quercus species: Oaks are easily recognized by their fruit, the acorn. Most oaks in the Midwest have broad blades that are shallowly to deeply cut or lobed on the margins. Some have rounded or blunt teeth or lobes, and are classed as white oaks; others have bristle tips on the teeth or lobes, and are classed as black oaks. Two species in the Midwest—the shingle oak (*Quercus imbricaria* Michx.) and the willow oak (*Quercus phellos* L.)—have leaves with margins that are not toothed or lobed, but entire. The shingle oak has leaves that are densely pubescent beneath.

### Occurrence

Oaks are found in woodlands. Some species are restricted to dry, sandy soils; some to bluffs; some to uplands; and some to flood plain forests. Certain species have broad ranges while others have limited distribution. The shingle oak is common in parts of the Midwest. The willow oak, a Coastal Plain species, has glabrous leaves, and is rare in the Midwest, found primarily in the extreme southern tip of Illinois and southeastern Missouri.

### Condition of Poisoning

Oak leaves emerge from the buds in early spring, and remain on the trees or on the ground below the trees through the fall and winter. Animals turned into woodlots to graze before grass becomes abundant may eat large quantities of the young leaves. Or, in seeking the young grass and other browse on the ground, they may eat quantities of old leaves with whatever else they can pick up. Small amounts of oak leaves do not seem to be injurious. But large amounts can cause severe illness, usually resulting in the death of the poisoned animal in a timeframe of two weeks to one month. In the Midwest, cattle and sheep are most often reported as suffering from oak poisoning, and the majority of cases occur in the early spring.

### Control

The initial reaction to either acorns or leaves of oak trees appears to result from tannin. Later clinical signs are attributed to two toxic agents found in the leaves and in acorns—quercitrin and quercetin. Although the toxic principles are not readily water soluble, animals have been poisoned by drinking water in which oak leaves have soaked.

### Clinical Signs

Anorexia, rumen stasis, constipation, rough hair coat, dry muzzle, evidence of abdominal pain, excessive thirst, and frequent urination are observed in ruminants. Feces are dry and dark-brown in color, followed by diarrhea that may be blood-tinged, and frequently there is edematous swelling in the ventral portions of the body. The pulse is rapid and weak, respirations are rapid and shallow, and there may be a brownish discharge from the nostrils. Lowered milk production in lactating animals follows subtoxic doses of acorns.

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**Necropsy** Gastritis and enteritis, with a bloody false mucoid membrane forming in the intestine, are typical. Increase peritoneal and plural fluids and petechiation on the subserous tissue, kidney, and heart are constant findings. Necrosis of the proximal tubules, abundant hyaline casts in the kidney, and necrosis of the liver are observed on microscopic examination.

**Treatment** Supportive treatment and stimulants have been recommended. An oil-type laxative will help clear the intestinal tract and coat the inflamed mucosa. Blood transfusions, parenteral fluid, nutrient therapy, and glucocorticoids have been found helpful. Feeding calcium hydroxide reportedly prevents the development of signs of poisoning.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006



## Noxious/Invasive Species

# Ohio Buckeye

(Poisonous Plant)

Illinois

Plants of wooded and old woodland pastures



### Plant Characteristics

*Aesculus glabra* Willd.: The Ohio buckeye is a medium-sized tree that sometimes grows to heights of 70 feet but is usually shorter. The bark of young stems and branches is dark-brown and scaly; on old trunks, it is ashy gray, furrowed, and broken into plates. The oppositely arranged, palmately compound leaves have a slender petiole from 4 to 6 inches long and 5 (rarely 7) obovate leaflets. The yellowish-green flowers are borne in large clusters at the ends of the branches, and appear in April or May after the leaves are expanded. The fruits are spiny-roughened, globular capsules that contain 1 to 3 large, glossy, chocolate-colored nuts, each with a whitish scar.

### Occurrence

Ohio buckeye prefers the rich soil of river bottoms and banks of streams. It ranges from Pennsylvania to southern Michigan, southern Wisconsin, and eastern Nebraska, south to Alabama, Arkansas, and Oklahoma.

### Conditions of Poisoning

Sprouts, leaves, and nuts of the Ohio buckeye have caused illness or death of cattle, sheep, and hogs when these animals were pastured where sprouts were present and where other forage was scarce. The young sprouts and the seeds are especially poisonous. Poisoning does not always follow when animals feed on the tree. In experimental feeding, signs of poisoning appeared in only a small number of animals.

### Control

Until grass or other forage is abundant, animals should not be allowed to graze in woodland pastures where there are buckeye sprouts. Sprouts and seedlings should be grubbed out of pastures. If the trees are few, as they usually are, it may be advisable to collect the nuts to keep hogs from getting them. Ohio buckeye has little commercial value. Since the tree is uncommon, however, it should not be destroyed unnecessarily.

### Toxic Principles

The poisonous principle in the Ohio buckeye is a narcotic alkaloid. It is apparently different from the glucosides aesculin and fraxin found in the bark of the European horse chestnut.

### Clinical Signs

Ohio-buckeye poisoning affects the central nervous system. Prominent signs are an uneasy or staggering gait, weakness, severe trembling, and sometimes vomiting. Coma usually precedes death. Dilated pupils and congestion of the visible mucous membranes are commonly observed. Colic has been reported in poisoned horses.

### Treatment

Poisoning caused by Ohio buckeye is rarely fatal, but a veterinarian should be called to give stimulants and purgatives.

### References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006



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## Noxious/Invasive Species

# Pigweed

(Poisonous Plant)

## Illinois



Plants of fencerows, roadsides, barnyards, fields, and waste places

### Description

*Amaranthus retroflexus* L.: Pigweed is an erect, branched, stout-stemmed annual herb that grows up to 7 feet tall. The stem, which is clothed with fine hairs, supports alternately arranged, egg-shaped leaves with long leaf stalks. The flowers are aggregated into terminal clusters of several to many short (2 to 8 inches long), ovoid, blunt, densely crowded spikes that terminate the stems but also arise from the upper leaf axils. The individual flowers are very small (1/4 inch long), lack petals, and are subtended by rigid, pointed bracts that are longer than the calyx. The fruit is a compressed, small, bladdery, 1-seeded structure less than 1/8 inch in diameter that opens along a circular line. The seeds are small (about 1/16 inch across), round, and dark red-brown.

### Occurrence

A native of tropical America, pigweed ranges from Prince Edward Island, Canada, west to the Pacific Ocean, and south beyond the borders of the United States.

### Conditions of Poisoning

Pigs with continuous access to this plant rarely eat enough to be poisoned. But, when pigs raised in confinement are allowed to graze a pasture containing pigweed, they may become poisoned. The poisoning is not acute and the pigs may not show clinical signs until one week after exposure to the plant. About one-half of the animals will be affected. Mortality is usually low.

### Toxic Principles

Nitrate and oxalate up to 30 percent or more expressed as oxalic acid have been found in pigweed. Although oxalate has not definitely been identified as the cause of the edema and clinical signs, it is suspect in this type of poisoning.

### Clinical Signs

There is rapid onset of weakness, trembling, and incoordination 5 to 10 days after initial access to the weed. Soon there is knuckling of the pastern joints and almost complete paralysis of the pelvic limbs. Affected pigs usually maintain an attitude of sternal recumbency, followed by coma and death. If disturbed, they may drag themselves with the front legs. Edema in the caudal-ventral area of the abdomen is observed in most cases. The body temperature remains normal.

### Necropsy

There is usually edema of the connective tissue around the kidneys, with considerable blood in the edema fluid, and edema of the ventral abdominal wall and perirectal area. The kidneys are normal in size and pale in color, with scattered areas of hyperemia extending into the cortex. Congestion and hemorrhage in the kidney cortex have been reported in a few cases.

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**Treatment** Remove animals from the source of the weeds. Medicinal treatment has not been found satisfactory.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006



Noxious/Invasive

# Poison Hemlock

(Poisonous Plant)

Illinois



## Plant Characteristics

*Conium maculatum*: This is a glabrous, branching biennial herb that can grow to 3 m (10 ft.) tall with a hollow spotted stems arising from a thick taproot. This tall erect biennial produces a vegetative rosette the first season of growth and an upright reproductive stem in the second season. Hemlock usually has only one fleshy taproot; there are partitions in a hollow area at the juncture of the root; stem and upper stem leaves are divided. The basal and stem leaves are finely dissected with a lace-like appearance, resembling the non poisonous wild carrot. Flower heads at the top of the plant are large one to three inches in diameter, white and umbrella-shaped. Flowers develop into a green, deeply ridged fruit with several seeds. The plant has an unmistakable and disagreeable mouse like odor. This plant grows in much of Illinois in waste areas, especially partially shaded, poorly drained sites, stream banks or edges of cultivated fields. This plant stays green into late winter and greens up early in the spring.

## Toxicity

The poison hemlock contains coniine, an alkaloid, and eight other compounds that are capable of poisoning livestock, poultry and humans. The stems, leaves and mature fruits are all toxic but the roots are the most toxic. The leaves are more dangerous in the springtime, and the fruit in the most dangerous in the fall. Livestock can be severely injured by eating this plant, usually by eating contaminated fresh hay or silage.

## Symptoms

Signs of poisoning include dilated pupils, weakness, staggering gait, and respiratory paralysis two to three hours after ingestion. Other symptoms include gastrointestinal irritation, nervousness, trembling, staggering, coldness of extremities, slow heartbeat and eventually coma and death.

## Treatment

Respiratory stimulants may be used advantageously. Intestinal protectives are suggested.

## Information Sources

- Poisonous Plant of Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition, Ohio State University.

June 2004



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## Noxious/Invasive Species

# Potato

(Poisonous Plant)

Illinois



Plants of fencerows, roadsides, barnyards, fields, and waste places

### Description

*Solanum tuberosum* L.: The potato is a plant with weak, smooth or hairy stems that arise from a tuber. The odd-pinnate leaf (4 to 10 inches long), has 3 or 4 pairs of pointed, egg-shaped leaflets, with numerous smaller leaflets standing between the larger ones. A few bluish-white flowers (1 to 1 ½ inches across), grow in clusters at the tips of long stalks. The fruits, which are infrequently produced, are yellowish or green globular berries about ¾ inch across.

### Occurrence

Potato is a plant of the temperate belts of the Andes of South America. It is commonly cultivated in the United States, and occasionally escapes, persisting for only a year or two.

### Conditions of Poisoning

Animals may browse potato plants or eat sprouted potatoes. The poisonousness of the plant apparently varies with the soil, climate, and other conditions. Most cases of poisoning occur in sheep, goats, calves, pigs, chickens, and ducks.

### Control

Animals should not be grazed in pastures infested with potato plants. If the plant is mowed, dried, and burned as soon as blossoms appear, seeds will not be produced and it will be easier to keep pastures from becoming heavily infested.

### Toxic Principles

The toxic principle is solanine, a glycoalkaloid. When hydrolyzed, this compound yields several alkaloids.

### Clinical Signs

The alkaloids, which are readily absorbed, are responsible for the major nervous signs. The clinical signs in a given case depend upon the balance between the irritant effect of the intact glycoalkaloid and the nervous effects of the released alkaloids. The irritant action of the solanine may vary in severity, causing anorexia, nausea, vomiting, abdominal pain, and diarrhea. The effect on the nervous system causes apathy, drowsiness, dry mouth, labored breathing, trembling, progressive weakness or paralysis, prostration, and unconsciousness. The pupils are usually dilated. Death results from respiratory paralysis.

### Necropsy

Variable degrees of inflammation ranging from hyperemia to hemorrhage and ulceration are found in the alimentary tract. Edema in the perirenal tissues and ventral abdominal wall has been reported in some animals.

-more-

**Treatment** Administration of a parasympathomimetic drug (pilocarpine) will usually relieve most of the clinical signs.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006



## Noxious/Invasive Species

# Rocket Larkspur

(Poisonous Plant)

Illinois

Plants of fencerows, roadsides, barnyards, fields, and waste places



### Description

*Delphinium ajacis* L.: Rocket larkspur is a branching annual from 12 to 28 inches tall, with alternately arranged leaves that are deeply dissected into narrowly linear segments. The flowers,  $\frac{3}{4}$  to  $1\frac{1}{2}$  inches wide, are disposed in racemes, and have blue, violet, pink or white petals united into a single spur. Each flower produces a follicle  $\frac{1}{2}$  to  $\frac{3}{4}$  inch long.

### Occurrence

A native of Europe, rocket larkspur has escaped from gardens in North America. It ranges from Nova Scotia to Minnesota and Montana, south to South Carolina and Texas.

### Conditions of Poisoning

The toxicity of larkspur plants under natural conditions depends upon seasonal variations in the amount of toxic principle, the species of animal, and the parts of the plant consumed. Although the minimum lethal dosage (MLD) of rocket larkspur has never been accurately determined for domestic animals, apparently an animal will be poisoned if it eats 0.5 percent of its body weight of the plant. The toxicity seems to be reduced as the plant reaches maturity. The seeds are quite toxic, however, and are often the cause of poisoning late in the growing season. For unknown reasons, sheep are much less susceptible than cattle and horses to the toxic action of the larkspur.

### Toxic Principles

The poisonous principle in larkspur is a combination of diterpenoid alkaloids. Some of these alkaloids, of which delphinine is a major one, have been identified, and structural formulas are known.

### Clinical Signs

The diterpenoid alkaloids seem to affect the central nervous system, and the poisoned animal will appear weak. The animal is uneasy at first, and then exhibits stiffness of gait and a characteristic straddles stance with the hind legs held far apart as though to prop up the body. There is usually twitching of the muscles, especially those of the muzzle, shoulder, flank, and hip. While the animal is standing, the back is arched. Occasionally, the animal will collapse when it attempts to walk backward. A severely poisoned animal will collapse suddenly; a less severely poisoned animal usually rests on its sternum with its head on the ground. In certain cases, the head may remain erect.

Immediately after collapsing, the animal frequently tries to regain its footing. It will often succeed in standing, but signs of weakness return, and it collapses again. Excitement intensifies the clinical signs. Nausea, vomiting, and evidence of abdominal pain have been reported in pigs. During vomiting, ingesta may be drawn into the trachea, and the animal suffocates. In other cases, fatalities result from respiratory paralysis. The pulse and respiration are rapid and weak throughout the course of clinical signs. All animals poisoned with larkspur become constipated, and relief of this condition may hasten recovery. Bloating frequently occurs in ruminants.

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**Necropsy** There are no diagnostic lesions produced by larkspur poisoning. Congestion of the internal blood vessels and various stages of irritation of the mucosa of the alimentary tract are practically the only findings observed.

**Treatment** The following prescription has been recommended: physostigmine, 1 grain; pilocarpine, 2 grains; strychnine, ½ grain. These drugs are dissolved in 20 milliliters of water and administered subcutaneously for each 500 pounds of body weight. Sheep require about ¼ of this dosage.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Sneezeweeds

(Poisonous Plant)

# Illinois



Usually found in dry, open pastures and meadows

### Description

*Helenium Autumnale* is an erect, fibrous-rooted perennial with glabrous or finely pubescent stems that grow up to 5 feet tall. The stems support numerous lance-linear to narrowly egg-shaped leaves that are 2 to 6 inches long. The leaves are narrowed to stalkless bases that extend downward on the stems as greenish wings. The several to many flowering heads are disposed in leafy inflorescences. Each head, hemispheric or subglobose in shape, has a yellow disk from  $\frac{3}{8}$  to  $\frac{3}{4}$  inch across and 10 to 20 yellow rays from  $\frac{3}{8}$  to 1 inch long.

*Helenium flexuosum* Raf. Is an erect, fibrous rooted perennial with more or less pubescent stems that grow 4 feet tall, and are winged by the decurrent leaf bases. The lowermost leaves are oblanceolate in outline, and are soon deciduous; other leaves are oblong or lanceolate and more persistent. The flowering heads are in open, bracted inflorescences. Each head has a purple or brownish-purple disk from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch across and yellow rays from  $\frac{1}{4}$  to  $\frac{3}{4}$  inch long.

*Helenium amarum* (Raf.) H. Rock is a glabrous, glandular-dotted annual plant with stems from 8 to 20 inches tall. The stems support numerous linear leaves that are  $\frac{1}{16}$  inch wide. The flowering heads stand on short, naked peduncles that extend beyond the leafy part of the plant. Each head has a yellow disk from  $\frac{1}{4}$  to  $\frac{3}{8}$  inch across and 5 to 10 yellow rays from  $\frac{1}{4}$  to  $\frac{3}{8}$  inch long that produce achenes.

### Occurrence

*Helenium autumnale* grows in moist, low ground, especially along streams, from Quebec to British Columbia, and south to Florida and Arizona. *Helenium flexuosum* Raf. grows in moist, low ground from Maine to Michigan, and in southern Illinois and southern Missouri, south Florida and Texas. *Helenium amarum* (Raf.) H. Rock is a plant of prairies, open woods, fields, and waste places. It ranges from Virginia, Missouri, and Kansas, south to Florida, Texas, and Mexico, and is apparently spreading northward.

### Conditions of Poisoning

Since sneezeweeds are bitter and sharp-tasting, most animals avoid them. But some animals, usually cows and sheep, develop a taste for sneezeweeds, and will eat large quantities. Although all parts of the plant are poisonous, the blossoms are the most dangerous. For this reason, most of the cases of serious poisoning occur in the late summer and early fall. Sneezeweeds may also cause cows to give bitter milk. The plants remain toxic when dried.

### Toxic Principles

The exact nature of the poison has not been determined. It appears to be the glucoside dugaldin.

### Clinical Signs

The usual signs of sneezeweed poisoning are rapid pulse, restlessness, difficult breathing, staggering, loss of muscular control, and extreme sensitivity to touch. After eating large quantities of sneezeweed blossoms, animals may die suddenly. Spasms and convulsions may precede death.

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**Necropsy**    Gastrointestinal irritation, engorgement of the liver and kidney, and large necrotic areas in the lungs are lesions observed in most animals fatally poisoned by sneezeweed.

**Treatment**    If animals give bitter milk or show other mild clinical signs of sneezeweed poisoning, they should be removed at once to pastures where they will not have access to sneezeweed. Melted lard, if given before the spasms begin, will offset the action of the poison. A veterinarian may administer other indicated treatment.

**References**    Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

December 2006





## Noxious/Invasive Species

# Star-of-Bethlehem

(Poisonous Plant)

## Illinois



Usually found in dry, open pastures and meadows

### Description

*Ornithogalum umbellatum* L.: Star-of-Bethlehem is a plant with a leafless stalk that is 4 to 12 inches tall and several very narrow, channeled leaves that arise from a bulb. Three to 7 flower stalks grow from the leafless stem, and each stalk supports a single flower that is 3/8 to 3/4 inch long, with 6 segments that are white above and have a broad green stripe beneath. The fruits are capsules containing a few dark, roundish seeds.

### Occurrence

A native of Europe, star-of-Bethlehem was cultivated in gardens in North America, and has escaped to fields and roadsides. It is naturalized from Newfoundland to Ontario and Nebraska, south to Mississippi, Missouri, and Kansas.

### Conditions of Poisoning

Poisoning occurs only when the bulbs are brought to the surface by frost-heaving, plowing, or rooting by swine.

### Toxic Principles

Although the toxic principle has not been definitely identified, it appears to be similar to the alkaloid colchicines. It seems to be present only in the white onion-like bulbs.

### Clinical Signs

The clinical signs are depression, salivation, bloating in ruminants, vomiting, diarrhea, labored breathing, rapid pulse, and bloody urine. Death results from respiratory failure.

### Necropsy

Extensive gastroenteritis and hemorrhage in the kidney are the significant lesions. Blood may be found in the intestines.

### Treatment

Because of the extensive loss of body fluids and electrolytes, therapy for the hypovolemic shock-like state is indicated. Blood transfusion and parenteral administration of electrolyte solutions are recommended. There is no antidote for the toxin.

### References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Water Hemlock

(Poisonous Plant)

## Illinois



Usually found in moist, open pastures and meadows

### Description

*Cicuta maculate L.* Water hemlock is an erect, stout, much-branched, leafy herb that grows up to 7 feet tall, with stems arising from tuberous-thickened roots. The alternately arranged leaves, often 1 foot in length, are bipinnately or tripinnately compound, and have completely separated leaflets. The bases of the leaf stalks clasp the stems. The leaflets are from 1 to 4 inches long, and are linear or lance-ovate, with margins that are usually sharply and coarsely serrate. The primary lateral veins from the midvein are directed to the sinuses. Flowers are disposed in umbrella-like clusters called umbels. The umbels are numerous, 2 to 5 inches wide, and surpass the leafy shoots.

This species can be easily identified by two of its characteristics. (1) The primary lateral veins in the leaflets end in the sinuses or notches between the teeth, not in the tips of the teeth. Secondary or weak veins may branch from the primary veins near the sinuses and end in the teeth, but these veins are readily distinguished from the primary ones. (2) The otherwise hollow central cavity at the base of each stem is crossed by horizontal plants of pith. This characteristic can be seen by slicing the base of the stem lengthwise with a knife.

### Occurrence

Water hemlock grows in swamps, marshes, ditches, and wet depressions in prairies and meadows from Quebec to Minnesota and Manitoba, south to North Carolina, Tennessee, Missouri, Oklahoma, and Texas. It sprouts from the tuberous-thickened roots in early spring, and flowers from June to August.

### Conditions of Poisoning

**Water hemlock is one of the most poisonous plants to livestock.** The flowers, seeds, and mature leaves are not toxic in either the green or dried state; but a relatively small amount of the tuber, which contains the toxic principle, may fatally poison an animal within less than 1 hour after being consumed. The young sprouts also contain the toxin. Since the toxic principle is mainly contained in the tuberous roots, poisoning usually occurs in the spring when the soil is moist. In grazing the early growth of the plant, animals, especially cattle, may pull up the roots along with other parts of the plant. After the plants bloom, the quantity of the toxic principle in the roots is decreased.

### Toxic Principles

The toxic principle is cicutoxin, a resinous, thick, yellow liquid with a carrot-like odor. The young leaves are nearly as toxic as the roots. Two ounces of the young leaves, stems, or tubers have been known to fatally poison sheep. Eight to 10 ounces will fatally poison a mature cow or horse. It is estimated that 1 ounce of the tubers will kill a pig.

### Clinical Signs

The toxic principle is irritating, and occasionally pigs will vomit after eating the tubers. In all species, clinical signs develop rapidly. These are salivation, twitching of the muscles, champing of the jaws, grinding of the teeth, and evidence of pain, followed by muscular spasms and convulsions. Running fits and convulsions continue when the animal is recumbent. The body temperature may be elevated, resulting in coma. Death is caused by respiratory paralysis and asphyxia, and may occur within 30 minutes after ingestion of the plant. In general, the clinical signs produced by this toxin are similar to those produced by picrotoxin.

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**Necropsy** Congestion and hemorrhage in the viscera, enteritis, and yellow discoloration of the fat are found in chronic poisoning. Acutely poisoned animals may not show any characteristic lesions.

**Treatment** A central-nervous-system depressant is used to overcome the stimulant effect of cicutoxin. If the poisoned animal survives for 5 to 6 hours, it will usually recover and show no further effect from the toxins.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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Noxious/Invasive

# White Snakeroot

(Poisonous Plant)

Illinois



## Plant Characteristics

*Eupatorium rugosum*: This is a perennial herb, .6 to 1.5 meters tall, with erect branched or unbranched stems arising from a mat of fibrous roots. Leaves are opposite, simple, ovate 3.5 to 17 cm long, 2.5 to 11 cm wide, crenate to serrate. Flowers showy, white: borne in open terminal clusters, blooming late in summer or fall. This is easily confused with relatives that are not poisonous. Positive identification requires the services of a trained botanist. Probably found in all of the southern states east of the Mississippi River except in the state of Mississippi. Plants grow well in rich moist soils and in deciduous woods or bordering streams. This plant is common through out most of Illinois.

## Toxicity

The toxic principle has been identified as a alcohol called tremetol. Tremetol is unusual in that it is a fat soluble molecule that becomes concentrated in the milk of lactating animals. It is found in all parts of the plant whether green or dry. All domestic livestock, some Laboratory animals, and human beings are all susceptible to the effects of this plant. Animals may be poisoned by consuming the actual plant or from ingesting milk from cows, sheep or mares that have eaten the plant. Drinking milk from cows eating white snakeroot has accounted for an illness called "milk sickness" and for deaths in humans.

## Symptoms

Trembling is the most commonly observed sign. The condition has been called "trembles." Animals are stiff and sluggish, stand with feet side apart and may eventually become recumbent. Slobbering, vomiting, sweating, labored and rapid breathing, dilated pupils, constipation and dribbling of urine are also seen. A ketone odor may be detected on the breath. Humans may exhibit delirium after drinking toxic milk. Death may be sudden, this affliction is what reportedly killed Abraham Lincoln's mother.

## Treatment

Laxatives may be of benefit but there is no specific treatment.

## Information Sources

- Poisonous Plants of the Southern United States
- <http://plants.usda.gov/>
- Bulletin 762 Horse Nutrition Ohio State University.

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## Noxious/Invasive Species



# White Sweet Clover

(Poisonous Plant)

# Illinois

Plants found in hay and grain

### Description

*Melilotus alba* Desr.: White sweet clover is an erect, slender, branched biennial herb from 3 to 9 feet tall. The clover-like leaves are made up of three oblong leaflets that are ½ to 1 inch long. The small, fragrant white flowers appear in numerous slender clusters that arise from the axils of the leaves. The fruits are ovoid, smooth pods that contain 1 to 4 seeds.

### Occurrence

A native of Eurasia, white sweet clover was introduced into North America, where it has escaped cultivation to become established along roadsides, in railroad trackways, and in waste places. It occurs throughout the United States and much of Canada. The yellow sweet clover (*elilotus officinalis* (L.) Lam.) is similar to white sweet clover, except that the flowers are yellow. It grows from Quebec to British Columbia, and south beyond the borders of the United States.

### Conditions of Poisoning

Sweet clover, a valuable forage crop, may be used freely as pasture, but the feeding of damaged or spoiled sweet-clover hay or silage may cause the death of cattle. The damaged hay is usually moldy, but not all moldy hay is poisonous. Sweet-clover poisoning usually occurs in winter, and does not become apparent until the animal has been fed damaged sweet clover for 2 weeks or more. Cattle are the most frequently poisoned of all animals.

### Control

Moldy sweet-clover hay or silage should be fed with other kinds of hay, alternating the sweet clover and the other hay at 2-week intervals.

### Toxic Principles

The poisonous principle coumarin has been isolated and crystallized from damaged sweet clover. This crystalline substance can be used to reproduce the disease in susceptible rabbits. The exact action of the toxic substance is unknown, but its prominent effect is interference with the clotting of the blood as a result of a depression of the prothrombin level and certain other conditions essential for coagulation of blood.

### Clinical Signs

The poisoned animal may be dull and stiff and reluctant to move. Marked swellings may occur on any part of the body, but are most common in the hip, shoulder, neck, and chest regions. The swellings are doughy and contain blood. When hemorrhages are extensive, the mucous membranes are pale, the pulse and respiration are rapid, and the animal becomes very weak. Animals may bleed to death even from such minor operations as dehorning or castration. Examination of the blood reveals a loss of red blood cells, a decrease in hemoglobin, and delayed clotting time. Death may occur suddenly or after several days.

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**Necropsy** Extensive localized hemorrhage or diffuse hemorrhage in many tissues are constant findings in sweet-clover poisoning.

**Treatment** Treatment consists of blood transfusions or the intravenous injection of defibrinated or citrated blood from a normal animal. Blood-clotting powers are restored in less than one hour, and complete recovery occurs in 7 to 14 days, provided that the animal is not allowed to eat any damaged sweet clover.

**References** Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# Wild Cherries

(Poisonous Plant)

# Illinois

Plants of wooded and old woodland pastures



### Description

Chokecherry, *Prunus virginiana* L.: Chokecherry is a small tree or shrub with oblong to obovate leaves. The leaves are sharply toothed, and the teeth are slender and ascending. The flowers are produced in long, many-flowered clusters. The fruit is scarcely edible.

### Occurrence

Chokecherry grows in a wide variety of habitats from Newfoundland to Manitoba, south to Virginia, Kentucky, Arkansas, and possibly farther south.

### Description

Pin Cherry, *Prunus pensylvanica* L. f.: Pin cherry is a shrub or small tree with lanceolate leaves and flowers disposed in few-flowered clusters. It grows in dry or moist woods and in recent burns and openings.

### Occurrence

Pin cherry ranges from Newfoundland to eastern British Columbia, south to New Jersey, western Virginia, northern Indiana, northern Illinois, South Dakota, and Colorado.

### Description

Wild Black Cherry, *Prunus serotina* Ehrh.: Wild black cherry is a medium-sized tree that grows up to 60 feet in height. Its furrowed bark forms persistent, recurved scales on the trunk. The almost horizontal branches are smooth and red-brown. The alternately arranged, oblong leaves, 2 to 6 inches long, are abruptly pointed at the apices, wedge-shaped or acute at the bases, and finely toothed on the margins. The midvein beneath is usually clothed with a rusty pubescence. The white flowers appear with the leaves, and are borne in many-flowered clusters from 4 to 6 inches long. The fruits are globular, purplish-black or black edible cherries that ripen from July to September.

### Occurrence

Wild black cherry ranges from Nova Scotia to North Dakota, south to Florida and Texas. It is common in fencerows, along roadsides, and in thickets and open woods. Birds greedily devour the fruit, and are largely responsible for the spread of the tree.

### Conditions of Poisoning

Animals often eat wild-cherry leaves directly from the tree, from branches that have been cut or broken from the tree, or in dried hay. The leaves are poisonous under all these conditions.

### Control

Keep animals from grazing where they can browse wild-cherry leaves.

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## Toxic Principles

Wild cherries, like bitter almond, contain a cyanogenetic material, the glucoside amygdalin. Amygdalin itself is not especially poisonous, but it is broken down by hydrolysis into the toxic hydrocyanic or prussic acid. The acid is formed quickly from bruised cherry leaves. This phenomenon can be observed by crushing several leaves in the hand and then smelling the strong cyanide odor. Johnsongrass, sudangrass, and sorghum may also be sources of prussic acid.

## Clinical Signs

The animal is apprehensive, its respirations are rapid and soon become labored, and it attempts to breathe through its mouth. Muscle weakness and spasms, staggering, convulsions, and coma are usually observed within 10 to 20 minutes after the onset of signs. Respirations become shallow and then cease, although the heart may continue to beat for several minutes after breathing stops. Death results from internal asphyxiation that affects all systems of the body, especially the respiratory centers.

## Necropsy

In acute poisoning, the venous blood is usually dark red, although it may be bright red. There is often great reduction in cardiac output, but the peripheral tissues continue to utilize some oxygen. The blood becomes dark red from accumulated carbon dioxide and clots slowly.

Lesions are congestion of the liver and distension of the venous system, and congestion and hemorrhage in the trachea and lungs and on serous membrane surfaces. The rumen may be distended with gas. The odor of bitter almonds may be detected on the newly opened cadaver. If the dose is low and death is delayed, there will be inflammation in the stomach and small intestine. Large doses of hydrocyanic acid prolong preservation of the carcass.

## Treatment

Any animal suspected of being poisoned by wild cherries should be treated immediately by a veterinarian, since death may occur within a few minutes or a few hours. Treatment for prussic-acid poisoning is directed toward an immediate relief of the toxic effects. Intravenous or intraperitoneal injection of a solution containing sodium thiosulfate and sodium nitrite brings prompt relief. Commercial solutions are available containing these two drugs as well as methylene blue. Methylene blue stabilizes the other two drugs in solution.

An intravenous injection of a solution of methylene blue alone is also effective. Success depends upon prompt treatment and the amount of prussic acid freed in the body. Giving corn syrup by mouth may reduce the rate at which the prussic acid is released. The same treatment is used for prussic-acid poisoning caused by Johnsongrass, sudangrass, and sorghum.

## References

Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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## Noxious/Invasive Species

# YEWS

(Poisonous Plant)

# Illinois

Plants of wooded and old woodland pastures



### Description

Taxus species: Yews are evergreen trees or shrubs with spirally arranged, linear, dark-green leaves that spread in two ranks, and with small, inconspicuous flowers and showy, berry-like red or yellow fruits. The bark is thin, reddish or reddish-brown, and flaking in thin scales. Winter buds have overlapping scales. The linear leaves are 1 to 1-½ inches long, have a prominent midvein and 2 yellowish-green bands on the under surface, and lack resin ducts. They may be abruptly pointed or gradually long-pointed at the apex.

Yews are northern hemisphere plants, usually separated into 7 or 8 species with numerous named cultivars or varieties. Two species are native to North America, the Canada yew (*Taxus Canadensis* Marshall), and western yew (*Taxus brevifolia* Nutt.). Canada yew is a shrub, less than 5 feet tall, with seeds that are broader than they are high. Western yew is a small tree with ovoid, 2- to 4-angled seeds.

### Occurrence

Canada yew, a plant of coniferous woods, bogs, stony deciduous forests, and cliffs, ranges from Newfoundland to Quebec and Manitoba, south to Virginia, Kentucky, Ohio, Indiana, Illinois, and Iowa. Western yew usually grows singly or in small groups on deep soils along streams and on moist flats near the coast. It occurs along the coast from Alaska and British Columbia, south to California, and eastward to Montana.

Several other species of yews are cultivated in the United States. These include the English yew (*Taxus baccata* L.) and the Japanese yew (*Taxus cuspidate* Sieb. and Zucc.). The English yew is a native of Europe, North Africa, and western Asia. The leaves are gradually pointed, and the winter bud scales are obtuse. This species and its numerous cultivars are grown as ornamentals.

The Japanese yew, a native of Japan, Manchuria, and Korea, is widely used as an ornamental. Like Canada yew, it has winter bud scales with acute tips and abruptly pointed leaves. The leaves of Japanese yew are wider than those of Canada yew. Some of the common cultivars are Brown's yew (*Taxus cuspidate* 'browni') and *Taxus cuspidate* 'capitata.'

*Taxus X media* Rehder is a presumed hybrid between the English yew and the Japanese yew. Two of its important cultivars are Hick's yew and Hatfield yew.

### Conditions of Poisoning

Yews are among the most toxic plants. They appear to be poisonous all seasons of the year, although most cases of poisoning have been reported in the spring or summer when the trees have been trimmed and cuttings have been placed where animals have access to them. If the clippings or plant itself are burned, the ashes are still poisonous. Thus don't allow the livestock access to any form or part of the plant or its products.

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<b>Toxic Principles</b>	The toxic principle is taxine. Foliage, bark, or seeds, whether dry or green, are toxic to people and to all classes of livestock.
<b>Clinical Signs</b>	The sudden onset of bradycardia, nervousness, trembling, dyspnea, incoordination, and collapse represents characteristic poisoning by these trees. Gastroenteritis may be present in subacute cases. Death results from cardiac failure. The mechanism of the depressing action of the toxic agent on the heart is unknown.
<b>Necropsy</b>	There are usually no lesions found in animals with acute yew poisoning. In subacute poisoning, mild inflammation may be present in the anterior portion of the intestine. This inflammation appears to be caused by an irritating oil and not by taxine.
<b>Treatment</b>	Atropine sulfate has been reported of value in treating animals suffering from subacute poisoning. No effective treatment has been reported for acute poisoning.
<b>References</b>	Evers, Robert A., and Roger P. Link. Poisonous Plants of the Midwest and Their Effects on Livestock, 1972. Special Publication 24, College of Agriculture, University of Illinois at Urbana-Champaign.

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