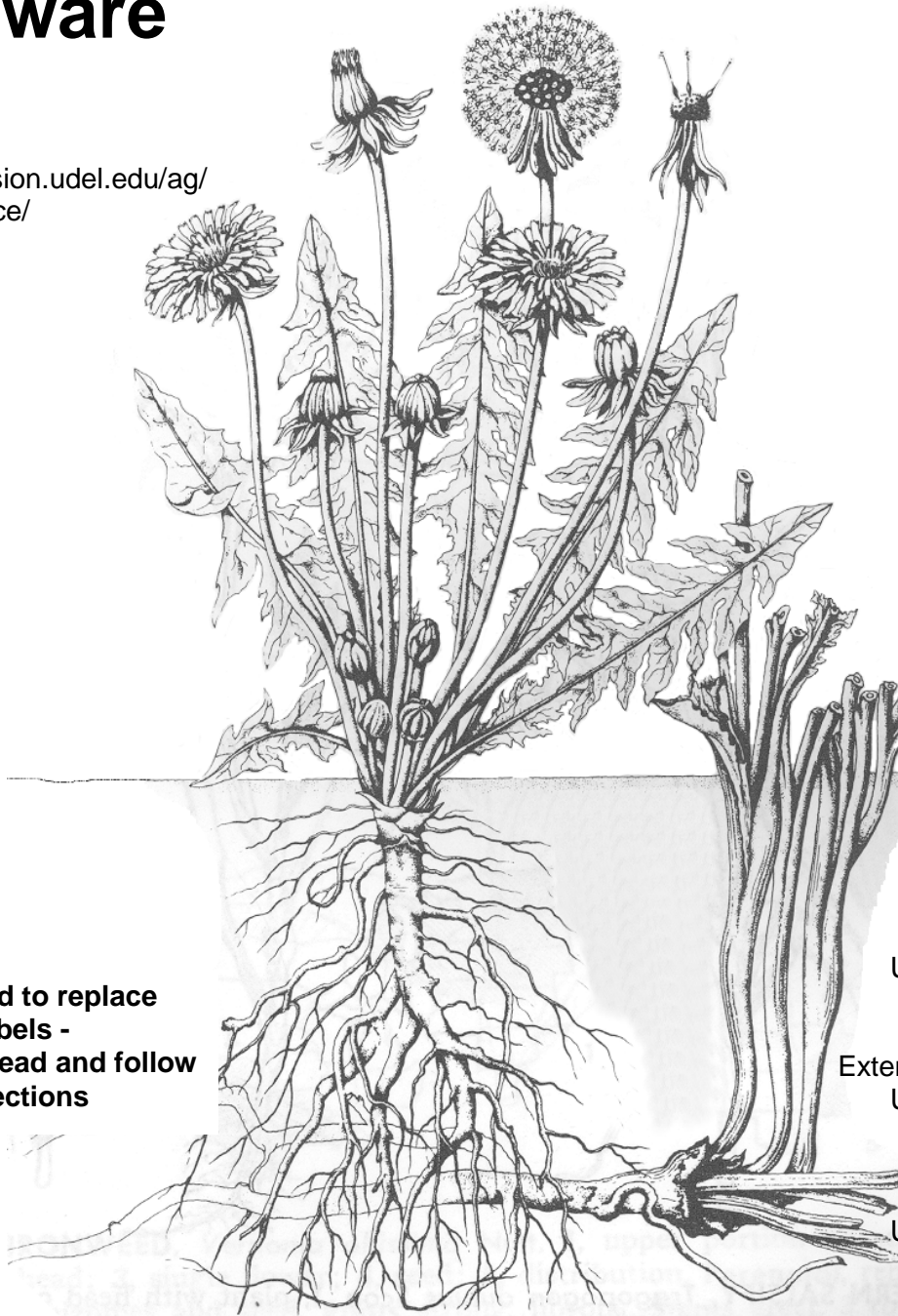


# Pasture and Hay Weed Management Guide

Delaware

2014

<http://extension.udel.edu/ag/weed-science/>



**Not intended to replace  
pesticide labels -  
Be sure to read and follow  
all label directions**

Quintin Johnson  
Extension Associate  
University of Delaware

Mark VanGessel  
Extension Weed Specialist  
University of Delaware

Richard W. Taylor  
Extension Agronomist  
University of Delaware

# 2014 Pasture and Hay Weed Management Guide

## Purpose and Scope

The purpose of this guide is to provide weed management information for alfalfa, clover, and cool-season perennial grasses grown for forage (grazing, green harvest, hay, or silage). Cool-season perennial grasses include Kentucky bluegrass, orchardgrass, perennial ryegrass, smooth bromegrass, tall fescue, timothy, reed canarygrass and others. Summer annual forage grasses (sorghum, sudangrass, millets, teff, etc.) are covered briefly. General information is also included for chemical weed control on Conservation Reserve Program (CRP) acres, and chemical weed control in farmstead areas. Do not use this guide for chemical weed control in annual broadleaf or winter annual grass crops such as brassicas, chicory, small grains (barley, oats, rye, wheat), or other annual crops. Do not use this guide for chemical weed control in forestry sites, industrial sites, right-of-ways, roadsides, turf, or other non-agricultural uses.

Trade names or brand names given herein are supplied with the understanding that no discrimination is intended and no endorsement by Delaware Cooperative Extension is implied.

Pesticides recommended in this publication are designed to be toxic to target pests. They can be hazardous to human health and the environment if used improperly. Follow all directions, precautions, and restrictions listed on the pesticide labels. Use of any pesticide that is inconsistent with its label is a federal offense, and the user can be liable for injury and damages resulting from misuse.

## Table of Contents

Pasture and Hay Weed Management _____	1
Cultural Practices _____	2
Planning _____	2
Establishment _____	2
Maintenance _____	3
Grazing Management _____	4
Hay Cutting Management _____	6
Scouting for Weeds _____	6
Potential Plant Toxicity Awareness _____	7
Mechanical Weed Control _____	8
Chemical Weed Control _____	9
Table1: Herbicides Labeled for use in Pasture, Forage, or Hay _____	13
Chemical Weed Control in Alfalfa and Clover Forage _____	14
Table 2: Application Timings for Herbicides used in Alfalfa _____	15
Table 3: Application Timings for Herbicides used in Clover _____	16
Table 4: Comparison of Restrictions and Precautions for Herbicides in Alfalfa or Clover _____	17
Table 5: Rotational Crop / Over-seeding Restrictions for Herbicides in Alfalfa and Clover _____	20

Table 6: Susceptibility of Grass Weeds to Herbicides in Alfalfa - First Year _____	21
Table 7: Susceptibility of Broadleaf Weeds to Herbicides in Alfalfa - First Year _____	22
Table 8: Susceptibility of Grass Weeds to Herbicides in Alfalfa - Established Stands _____	23
Table 9: Susceptibility of Broadleaf Weeds to Herbicides in Alfalfa - Established Stands _____	25
Table 10: Adjuvants and Rainfastness for Postemergence Herbicides in Alfalfa and Clover _____	27
Table 11: Comments for Alfalfa or Clover Herbicides _____	28
Preplant, Stand Renovation, or Preplant Incorporated Applications _____	28
In-crop Applications _____	29
Spot-Spray Applications _____	34
Chemical Weed Control in Grass Forage _____	36
Table 12: Application Timings for Herbicides used in Grass Pasture or Hay _____	38
Table 13: Comparison of Restrictions and Precautions for Herbicides in Grass Pasture or Hay ____	40
Table 14: Rotational Crop / Over-seeding Restrictions for Herbicides in Grass Pasture or Hay ____	43
Table 15: Grazing, Harvest, and Slaughter Restrictions for Herbicides in Grass Pasture or Hay _	44
Table 16: Susceptibility of Weeds to Herbicides in Grass Pasture or Hay _____	45
Table 17: Adjuvants and Rainfastness for Postemergence Herbicides in Grass Pasture or Hay__	49
Table 18: Comments for Grass Pasture or Hay Herbicides _____	50
Preplant or Stand Renovation Applications _____	50
Postemergence Broadcast Applications _____	51
Spot-Spray, Wiper Applicator, or Grazed Fencerow Applications _____	57
Table 19: Herbicides Labeled for Summer Annual Grass Crops _____	61
Table 20: Herbicides Labeled for use on Conservation Reserve Program (CRP) Acres _____	62
Table 21: Herbicides Labeled for Farmstead Use _____	63
General Information _____	64
Table 22a: Comparison of Premix or Prepackaged Products Containing 2,4-D and/or Dicamba__	64
Table 22b: Other Prepackaged Products (not containing 2,4-D or dicamba) _____	64
Table 23: Herbicide Site of Action for Reducing the Risk of Developing Herbicide- Resistant Weeds _____	65
Table 24: Comparison of Various Glyphosate Formulations _____	69
Table 25: General Herbicide Mixing Procedures _____	70
Table 26: General Jar Test Procedures _____	71
Table 27: Accurate Herbicide Volume and Weight Measurements for Small Volume Applications	72
Forage ID Keys _____	73
Cool Season Forage Legume Identification Key _____	73
Cool Season Forage Grass Identification Key _____	75
Precautions for Pesticide Use _____	Inside Back Cover

## Pasture and Hay Weed Management

A wide variety of pasture systems exist in Delaware to support the growth and health of various grazing animals. While no two systems are identical, dealing with the presence of undesirable vegetation is a challenge common to all forage managers. Regardless of farm or pasture size, number of paddocks, or number of animals, anyone who has grazing animals on their land is a forage manager. The management level that is practiced is dependent on many factors including available time, land resources, equipment, financial resources, and access to information. Poor management can result in reduced or lost forage yields, lower animal performance, illness caused by toxic plants or parasites, and loss of soil productivity. Overall, the long term health of most grazing animals is improved when the majority of their diet is obtained through direct grazing of well managed forages.

Effective weed management requires proper weed identification. Characteristics of individual weed species influence the level, type, and timing of weed control that will be effective. Important weed characteristics include life cycle, growth habit, reproductive type, competitiveness, toxicity, and palatability. An excellent resource for weed identification is "Weeds of the Northeast", which can be purchased through Cornell University Press (phone: 607-277-2338). Another helpful resource is the Virginia Tech Cooperative Extension on-line Weed Identification Guide at <http://www.ppws.vt.edu/weedindex.htm>. The Weed Science Society of America (WSSA) has an interactive weed identification program on CD available for purchase through their website (<http://www.wssa.net/>). The University of Maryland has an extension publication (Fact sheet 721) that describes some of the more common poisonous plants, available at <http://extension.umd.edu/publications/PDFs/FS721.pdf>. Local cooperative extension staff can also aid in weed and poisonous plant identification.

Weeds in forage crops reduce forage yield by competing for light, nutrients, and moisture. The presence of most weed species can reduce forage quality. Weeds are often less palatable, and many animals, particularly equine, will avoid weeds when grazing. Weeds are often detrimental to hay quality, particularly when hay harvest is delayed and weeds mature to the reproductive stage, resulting in weed seed in the hay. Furthermore, some weed species have coarse or spiny stems that are undesirable or irritating to animals consuming the hay. Some weeds are considered toxic, and if consumed in large enough quantities can produce photosensitization, tainted meat or milk, mouth irritations, illness, or even death.

There are times when weeds appear that have never before been seen in a particular field or farm. Weed seeds are spread by many different means. Grass or legume seed may have a small amount of weed seed in the bag when purchased. Certified seed has been inspected and only a very small amount of weed seed is allowed. It is strongly encouraged to buy certified seed. Birds can transport seed in their droppings, and many weed seed can travel in the wind. Some seeds survive in the digestive tract of new animals or in animals that have been off the farm and returned. Hay that is contaminated with weed seed can be purchased from other farms or regions. Weed seed can be spread by contaminated seeding, tillage, or mowing equipment. Some weed seed have a long dormancy period and can remain viable in the soil for many years before finally germinating and producing a plant. Manure brought in from other locations and used as a fertilizer source or contaminated bedding or soil can be sources of foreign weed seed.

Successful weed management requires the coordination of cultural practices, mechanical weed control, and chemical weed control to produce a *healthy, competitive and productive* forage crop. Weed seedlings need space and light to germinate, grow, and compete with forage. Therefore, if a forage crop is maintained to eliminate open space and penetration of light to the soil surface (a closed canopy), weeds will have difficulty in becoming established. Often when sound cultural practices are implemented and mechanical weed control (primarily mowing) is practiced, the need for chemical weed control is minimized or eliminated.

## Cultural Practices

Cultural practices are those associated with planning, establishment, maintenance, and management of a forage system. This publication is not designed to address all of these practices in detail but a brief description and explanation will follow. Contact your local county agricultural extension agent for more detailed information or search university extension web sites such as Penn State University, University of Kentucky, Virginia Tech University, University of Maryland, and Rutgers, The New Jersey State University.

**Planning:** The ability to properly manage a forage system requires planning ahead to develop a system that will provide for animal needs within the framework of available resources. Consideration must be given to topography, surface water drainage, soil drainage, and land productivity when arranging barns, paddocks, arenas, watering or loafing areas, sacrifice lots, or hayfields. Animal needs must be determined and balanced with the carrying capacity of the system (how many animals the system can support). Some factors that influence carrying capacity include the type of grazing system used (continuous or rotational), the use of permanent, medium term (semi-permanent) and/or short term (annual) pastures, the use of cool-season grasses, warm-season grasses, and/or stockpiled forage, the availability of alternative forage species (small grains, corn stalks, brassicas, etc.), the ability to mow and save underutilized forage for hay, and the use of supplemental feed (hay or concentrates).

**Establishment:** Successful forage establishment is critical to ward off potential weed infestations. Begin as much as a year in advance of seeding with a soil test to determine soil pH and nutrient status. If the soil pH needs correcting or a nutrient is critically deficient, make corrections and retest in six to nine months to be sure the problem is corrected before planting. Small corrections in soil pH can be made with surface applications of lime in no-tillage systems. If larger corrections are needed (2 ton/A or more) or if the seeding will be in a conventional seedbed, incorporating lime into the top four to six inches of the soil provides quicker and more uniform pH corrections. Avoid applications of weed seed-infested manure prior to seeding, and start "clean". This means creating a firm, level, weed-free seedbed in conventional-tillage systems or using non-selective herbicides to kill all existing vegetation in no-tillage systems. If time allows, a stale seedbed approach can be used to help deplete weed seed in the soil. This works best with conventional-tillage where the soil is tilled at least three to four weeks prior to planting, allowing weeds to germinate, emerge, and be killed with final tillage. Fertilizer applications (nitrogen, phosphorus, potassium, etc) as recommended by soil testing or local county extension staff can be surface applied or lightly incorporated prior to seeding in no-till or reduced-tillage situations. Phosphorus (P) and potassium (K) additions in conventionally tilled seedings are best worked into the soil during the final stages of seedbed preparation unless large additions (more than 120 lb/A P or 180 lb/A K) are required. Large additions should be applied early enough to retest the soil to ensure that the nutrient deficiency has been corrected.

Forage species and varieties must be selected that are adapted to the region, topography, drainage, soil moisture, and forage management system, while meeting the nutritional needs of the grazing animals. Purchase certified seed that has good germination and is free of weed seed. In situations where a mixed forage stand (two or more species planted together) is recommended, avoid the temptation to buy an off-the-shelf "pasture mix" that contains multiple species. These mixes often contain species that are not adapted to the situation and end up competing with the desirable species. In addition, the various seed sizes sometimes separate in the seed box, resulting in poor stand uniformity.

It is very important to plant in a timely fashion. In our region, the optimum time to seed cool-season grasses is late August (when sufficient soil moisture is present) through September. These seedings usually can be hayed or grazed the following spring after vigorous growth begins. Later seeding dates can be successful but the potential for slower or poor germination, winter-kill due to inadequate seedling establishment, and slowed spring growth make late-season plantings less desirable. Spring seeding of cool-season grasses from March into May is possible, but weed competition from late-emerging winter

annual and summer annual weeds can severely compete with forage seedlings for moisture, nutrients, and sunlight. Cool and wet spring conditions can delay planting or make seedbed preparation difficult. Spring seedings can take three to four months to become sufficiently established to withstand animal grazing and traffic. Plants should have well developed root systems before grazing to prevent animals from pulling up entire plants.

Perennial warm-season grasses produce more forage during July and August when cool-season grasses experience the “summer slump”, and can be used in our. Warm-season grasses are generally seeded in May or June, although some species such as Eastern gamagrass can be dormant seeded in the late fall. Some warm-season grasses such as the hybrid bermudagrasses have shown winter-kill or damage during severe winters, although they often will recover during the next summer. Many warm-season grasses do not produce much forage before June or after September unless they are over-seeded with annual species and must be control grazed to prevent stand injury. Hybrid bermudagrass is the most tolerant of frequent grazing and can be protected from winter-kill by no-till over-seeding rye in the fall or by not haying or grazing the last summer regrowth.

Summer annual grasses can be used as supplemental forage. Planted in late May or June, they establish quickly, grow rapidly, have moderate to high drought tolerance, and can typically be grazed within 5 to 8 weeks of planting. Summer annual grasses should not be grazed once damaged by frost. Cattle can graze or be fed forage sorghum, sudangrass, sorghum-sudan hybrids, foxtail or hybrid pearl millet, or crabgrass. Horses can graze hybrid pearl millet or crabgrass, and teff can be used for hay then grazed before frost. Grazing of sorghum, sudangrass, sorghum-sudan hybrids, and foxtail millet must be managed to prevent possible prussic acid poisoning, and all summer annual grasses must be managed to prevent possible nitrate poisoning. Plant stage and condition, fertility, and environmental conditions are the primary factors that affect prussic acid and nitrate levels in annual grasses. See Virginia Tech fact sheet “Warm-Season Annual Grasses for Summer Forage” at <http://pubs.ext.vt.edu/418/418-004/418-004.html>

Proper seeding rate and depth are very important for successful establishment. Use seeding equipment that can be calibrated to provide a consistent and accurate seeding rate and adjusted to provide a uniform seeding depth. In conventional-tillage, a seeder with front and rear rollers (Brillion type seeder) provides good soil-to-seed contact in a firm seedbed. Also a grain drill equipped with a small seed box can be used but depth control (how deep the seeds are buried) is more difficult. The seedbed must be firm enough so that tractor or drill tires do not create ruts. In no-tillage, a no-till drill with rows spaced seven or eight inches apart or less should include packing wheels set to maintain an appropriate seeding depth. With drills, best results are obtained by calibrating the seeder or drill for half the desired seeding rate and seeding twice, with the second pass at an angle to the first. As a general guideline, if 5 to 10 percent of the grass seed is visible on the surface after planting, the seeding depth is about right.

**Maintenance:** It is very important to maintain soil pH and fertility in established forage stands. Soil pH (a measure of acidity or alkalinity), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and manganese (Mn) should be monitored every two or three years and amended as prescribed by the soil testing lab or local county extension staff. Fall is a good time to begin a soil test program, but regardless of when sampling is begun, the samples should be taken at the same time each year. Nitrogen (N) applications should be adjusted and applied based on annual yield goals, stand maturity and composition, grazing or cutting schedules, irrigation, and other management practices. The total seasonal N requirement in mature grass stands is 40 to 70 pounds of N per acre per ton of expected forage yield. For example, if the expected annual forage yield for a cool-season grass pasture is 3 ton/A, the annual nitrogen requirement would be 120 to 210 pounds of N per acre, which is equivalent to 1,200 to 2,100 pounds of a 10% nitrogen fertilizer. The total annual N requirement should be split into three or more separate applications. For early spring grazing, a minimum of 35 to 40 pounds of N should be applied at or just before spring green-up, usually the first or second week in March.

To maintain forage productivity and health, forage stands should be visually evaluated on a regular basis. If forage stands become thin, or bare areas occur in a hayfield or pasture, try to determine the cause of the stand decline and take steps to eliminate the suspected problem. If undesirable species and/or bare ground comprise less than 30% of the total ground cover, good forage management practices coupled with timely herbicide applications will usually be sufficient to improve the stand. If the forage stand has been compromised to the point where undesirable species and/or bare ground comprise 30 to 50% of the total ground cover, over-seeding will need to follow any required herbicides applications. Herbicides must be chosen that will allow over-seeding of forages within a reasonable period of time. Over-seeding is accomplished by clipping or grazing the existing vegetation to a uniform close height and then using a no-till drill to seed into the existing sod, or using a disk or other implement to lightly scarify the soil surface followed by a broadcast seeding. Some of the Brillion type seeders have PTO-driven knives that rotate ahead of the rollers to scarify the soil surface and work nicely for over-seeding. If more than 50% of the total ground cover is comprised of undesirable species and/or bare ground, total renovation will be necessary to improve the stand. Unless the underlying cause of the poor stand is determined and corrected, stand improvement will be temporary. Renovation is accomplished by killing all of the existing vegetation, either by primary tillage (plowing, disking, etc.) or by using a non-selective burndown herbicide, and then reseeding the forage crop. Refer to fact sheet "Pasture Renovation", University of Delaware Agronomy Facts Series AF-08 at <http://ag.udel.edu/pasturesandhay/Forage%20Site%20Documents/AF08%20Pasture%20Renovation%20revised.pdf>. When renovating or over-seeding with grasses and/or legumes, follow the appropriate establishment guidelines to assure successful forage germination and seedling growth.

To improve existing grass stands, clovers can be over-seeded by a method called "frost-seeding". Clover seed is broadcast onto frosted soil in late winter, usually late February before the final frost. The thawing action creates soil to seed contact, and the clover will germinate when the soil warms.

Dragging and clipping are two important maintenance practices that are simple to accomplish, yet often ignored. Various implements, either purchased or homemade, can be used to drag pastures and spread manure. Equine in particular are selective grazers, and will overgraze other areas while ignoring those areas immediately adjacent to manure piles, resulting in spots of lush coarse growth. Spreading the manure distributes nutrients over the entire pasture and promotes a more even grazing pattern. It also aids in destroying internal parasites in manure. Pastures should be dragged at least two to three times per year or more, depending on type of livestock and stocking rate, or after each grazing cycle in rotational grazing systems.

Mowing will be discussed in more detail in the Management section relative to hay cutting and the Mechanical Weed Control section relative to weed control, but strictly from a forage maintenance standpoint, "clipping" is an important practice. Clipping, either as a maintenance practice or to harvest a supplemental hay crop from a pasture, should be practiced whenever forage grasses are not evenly consumed by livestock or excess forage is available. Clipping should take place before grasses enter the reproductive stage (seed-head production). Prior to seed-head production, grass stems begin to elongate and then thicken as the spike (immature seed head) moves up through the stem. This is called the "boot" stage and mowing at or before this stage keeps the forage in a vegetative state, promoting more leaf growth and a more uniform, dense forage stand. Tall grasses (orchardgrass, fescue, etc.) should be clipped to a uniform height of about 4 to 6 inches, and short grasses (Kentucky bluegrass, perennial ryegrass) to a height of 2 to 4 inches. Clipping, when necessary, should take place after each grazing cycle in rotational grazing systems.

**Grazing Management:** Grazing management is probably the most ignored cultural practice, particularly on small-acreage operations; yet it is available at some level to every forage manager. The goal of grazing management is to economically provide quality forage to meet some if not all of the animal's nutritional requirements during the grazing season, while maintaining the forage in a healthy vegetative state. The process involves cycles of forage removal followed by rest periods for recovery and regrowth.



The closeness to which forage is grazed is called grazing pressure. Nutrients and carbohydrates that plants need to regrow above-ground vegetation are stored as reserves in the lower stems, crowns, and roots. Overgrazing occurs when animals are allowed to graze too closely or are returned to pastures before the pasture species have had enough time to recover and replace energy reserves. Overgrazing results in slower regrowth and incomplete recovery, and eventual stand decline. Consequences may include reduced animal intake and production, shifts to less desirable plant species, and a pasture that is susceptible to weed infestations. An undergrazed pasture provides excess forage to the animals, but promotes selective grazing, where animals eat certain plants and leave others untouched. Preferred plants often are overgrazed and stressed, while undergrazed plants advance to the reproductive stage, making seed and becoming even less desirable and of lower quality. This results in poor uniformity, shifts to less desirable species, wasted forage, and reduced animal gains per acre.

Managing optimum grazing pressure, where available forage matches animal needs, is a result of balancing animal stocking rates with available forage. Fact sheets are available, or consult cooperative extension staff, to help you determine the carrying capacity of your grazing system.

Due to significant variability throughout the grazing season in the amount of available forage and the length of rest periods required for regrowth, managing grazing pressure is seasonally dynamic. Optimum grazing pressure is more easily maintained in rotational grazing systems, where pastures are subdivided into two or more sections (or paddocks) that are grazed and rested in turn. Grazing on tall grasses such as orchardgrass or tall fescue should begin when they reach a height of 6 to 8 inches, and animals should be transferred to the next paddock when the height is reduced to 3 inches. For grasses with more basal leaves (lower growth habit) such as Kentucky bluegrass or perennial ryegrass, grazing should begin when they reach a height of 4 to 5 inches, and animals should be transferred to the next paddock when the height is reduced to 2 inches.

Grazing pressure can be managed in rotational grazing systems by varying stocking rate, number and size of paddocks, and length of grazing and resting periods. Cool-season grasses often produce more forage in the spring than animals can use. The excess forage can be harvested from one or more paddocks to make hay for winter feed. If forage from undergrazed paddocks will not be harvested, paddocks should be clipped to encourage vegetative growth and more uniform regrowth. Continuous grazing systems require less management, but there are fewer management options available for maintaining optimum grazing pressure. Use forage species that are somewhat better adapted to continuous grazing systems such as bluegrass, ryegrass, and white clover. When possible, maintain the height of tall grasses at 4 to 5 inches and short grasses at 2 to 3 inches. Grazing pressure can be managed in continuous grazing systems by varying stocking rate and providing supplemental harvested forage during rest periods. Regular clipping and dragging are critical to promote more even grazing. When possible, continuously grazed pastures should be rested during periods of low growth (drought, summer slump, etc.). Excess forage can be harvested from part of the pasture in the spring, although fouling and trampling usually prevent the use of this option unless animals are temporarily fenced out of the area to be harvested.

Some forage managers will use "stockpiled" tall fescue for winter grazing. Tall fescue is more adapted to winter grazing than the other grasses because it grows better in the fall, experiences less leaf loss after frost, and maintains sugar levels in frosted leaves better than other species. Stockpiling is accomplished by discontinuing grazing a tall fescue pasture or paddock in mid to late August, fertilizing with 50 lb/A nitrogen, and allowing the crop to regrow through the fall. Tall fescue managed for lush leaf growth in the fall generally produces fewer tillers for spring regrowth, can be more susceptible to winterkill or cold injury, and show slower spring recovery. Therefore, it is important not to overgraze stockpiled tall fescue.

Regardless of how well a pasture is planned, established, and maintained, one that is continuously overgrazed will eventually become limited in function to that of an exercise or loafing lot. Resources



spent on the pasture will have been wasted. Therefore, consideration should be given to the practice of establishing a “sacrifice area” where animals can be placed during periods when pastures are too wet to support the animals without damaging the forage, when grazing pressure becomes too high and pastures need to be rested, or during winter months when no forage is available. Sacrifice areas can be temporary or permanent. They should be in a high, dry area and sized appropriately for the species and number of animals. In rotational grazing systems, a particular paddock may be used as a winter sacrifice area, and then renovated or over-seeded in the spring while the other paddocks are being grazed. During periods of high forage production, when sacrifice lots are rarely used, they can be seeded to annual forage crops to supply supplemental forage later during periods of low production.

University of Maryland (<http://extension.umd.edu/publications/PDFs/FS786.pdf>) and Penn State University (<http://pubs.cas.psu.edu/FreePubs/pdfs/uc114.pdf>) have fact sheets with detailed information on grazing management.

**Hay Cutting Management:** The factor that has the greatest effect on hay quality is stage of maturity when harvested. As forages advance from the vegetative stage through the reproductive stages, fiber and lignin content increases while protein content, digestibility, and acceptability to animals decreases. Cool-season grasses, for example, should be cut at the boot to early head stage for the first cut. When cutting is delayed until the bloom, milk, or seed stage, quality steadily declines. Timely hay harvest also benefits weed management. Most weeds will not have produced seed by the time the forage reaches its optimal harvest stage. Delayed hay harvest may allow weeds to reach reproduction and add viable weed seed to the field. Furthermore, forages harvested prior to the onset of reproductive growth will maintain more stored energy reserves, allowing quicker recovery and regrowth, and providing greater competition with weeds. A good winter forage cover provides competition with winter annual weeds. The benefit of late fall hay cuttings that leave little winter ground cover should be evaluated against the loss of weed suppression resulting from the open forage canopy.

University of Kentucky (<http://www.ca.uky.edu/agc/pubs/agr/agr62/agr62.pdf>) has a fact sheet with detailed information on hay cutting management.

**Scouting for Weeds:** Scouting for weeds should take place on a regular basis. Keep dated records of which weed species are found in each pasture or hayfield and where large concentrations occur, particularly for problem species (biennial, perennial, woody, and poisonous species). Scouting in late fall, mid-summer, and early spring, when forages are not as lush, allows for easier weed location and identification. Scouting should also occur after each grazing cycle in rotationally grazed systems, monthly in continuously grazed systems, or one to two weeks after each hay cutting. Visits to pastures or hayfields to conduct other management practices (fertilizing, soil sampling, manure management, etc.) provide excellent opportunities to scout. Proper weed identification is vital. Small plants in the cotyledon or seedling stages are more difficult to see and identify than mature or flowering weeds, but small weeds are easier to control with herbicides. Use previous year’s scouting records that noted concentrations of mature weeds to direct scouting efforts when weeds are in the seedling stage. Try to cover a good cross-section of the pasture. Understand that plant populations may change based on landscape positions such as upland areas, wet areas, forest edges, or floodplains. Pay particular attention to high traffic areas, hay feeding stations, bare spots, fence-lines, and field edges where new weed infestations most often begin.

**Potential Plant Toxicity Awareness:** Effects on the health of grazing animals from consuming or contacting potentially toxic plants can range from none to death. To protect the financial and often emotional investments in animals, it is important to have an awareness of how toxic plant poisoning most often occurs.

It is difficult to make generalizations about toxic plant species. Plants with toxic potential (the ability to cause detrimental effects) are numerous and varied. The toxic potential of a plant species is dependent

upon the species and status of animal consuming it, the plant part, growth stage, and amount consumed, season, environmental conditions, or combination of factors. In some species the toxic compound remains in hay or silage. In others it is reduced or eliminated. Some tree leaves are more toxic after wilting. Some toxic compounds occur naturally in plants, while others are released by fungi (fungal endophytes) growing in association with a living host forage plant (tall fescue toxicosis, ryegrass staggers, red clover slobbers); fungi in molded hay or clippings (botulism, sweet clover poisoning); or undesirable bacteria in silage (listeriosis). Blister beetle poisoning in horses results from consuming a toxin in dead beetles that are baled into alfalfa hay.

Toxic plant consumption most often occurs when animals are undernourished, when they are introduced to new grazing areas, when toxic plants are fed directly to them, or when they escape enclosures and feed on toxic plants. It can also occur when the forage provided is not suitable for the species, or is grazed at the wrong growth stage or while experiencing stress. In addition, otherwise suitable feed, hay, or forage can have toxic effects when animals are transitioned to the new source too quickly.

Grazing animals should be provided adequate pasture that meets their nutrient and energy requirements, or their diet should be supplemented with a balanced ration to reduce the chance that they will consume enough toxic plants to cause severe problems. Make sure new foods are safe for the animal species and make gradual transitions. Be aware of environmental, seasonal, and fertility conditions that may cause forages to accumulate toxic compounds and test if necessary. Scout for toxic plants, implement good forage and weed management practices, spray for weed control when needed, and remove dangerous plants from your property. Minimize the potential for accidental introductions of toxic plants via downed tree limbs, yard cuttings (especially ornamentals), or others feeding your animals. Provide animals with safe bedding materials.

Scouting for toxic plants should occur on a regular basis. In addition to the general methods covered in the Scouting for Weeds section, it is important to know potential hazards outside the pasture fence. Sacrifice lots are often heavily infested with weeds. Animals can get free and wander into barnyards, trails, woods, or ornamental plantings where they can't resist feeding. Well-meaning neighbors like to feed livestock or horses, or find it convenient to dispose of grass, ornamental, or tree clippings in a pasture. Weather conditions can cause leaves, limbs, or entire trees to snap and fall into a pasture, where wilted leaves can cause significant risk of toxicity. Hay can also contain toxic plants (or blister beetles - alfalfa hay), particularly if purchased blind from far away or from an unknown source through a hay broker. Bedding materials such as straw or wood shavings can serve as sources of contact with toxic plant material.

If you suspect plant poisoning has occurred, call a veterinarian immediately. Remove all animals from the area. Identify the suspected plants. Remove accidentally introduced plant material, or eradicate toxic plant species by hand-weeding, herbicide applications, pasture renovation, or other recommended practices. Monitor the grazing area over time to assure the toxic species has been eradicated.

For more information refer to Weed Facts WF-18 "Awareness of Potential Plant Toxicity to Grazing Animals" at <http://extension.udel.edu/factsheet/awareness-of-potential-plant-toxicity-to-grazing-animals/>.

## Mechanical Weed Control

Mowing is the primary mechanical weed control tool available to forage managers. Mowing equipment is relatively inexpensive and readily available. In many cases weeds will not be killed with one or even multiple mowings. The growth, competitiveness, and/or seed production of most weeds, however, can be reduced or delayed by timely mowing. For effective weed suppression, mowing must occur on a regular basis and be coupled with cultural practices that improve the forage crop's competitiveness. Mowing is only effective on weeds with upright growth patterns. In addition, some weeds (e.g. annual bluegrass, dandelion) are able to adapt to regular top growth removal by producing shorter flower stalks, and thereby still producing seed. When using mowing for weed control, care should be taken not to damage the forage crop by mowing too close. In new seedings, mow above the height of the forage when weeds reach 8 to 10 inches tall. For best results in established stands, mow at the end of a grazing cycle after the forage has been grazed to the proper height. The tops of remaining weeds will be mowed off, thereby reducing their competitiveness and delaying seed production. Mowing also helps reduce the competitiveness of perennial weeds by lowering their root reserves, but eradication of perennial weeds, even with intensive mowing, is difficult to accomplish. When perennial weeds like Canada thistle grow in dense patches, the mower height can be lowered in the patches to remove more of the plant tops. Regular mowing of fencerows, field borders, and in sacrifice lots helps to prevent weeds from spreading to fields from these areas. Weeds should not be mowed within 10 to 14 days of any planned herbicide application.

Hand-weeding is often dismissed as an effective weed control tool because it can be labor-intensive and time consuming. It usually is not feasible for large acreages or operations. When a manageable acreage is involved, initial and sometimes even established infestations of problem weeds can be managed or eradicated by timely hand-weeding. Scouting for weeds should be incorporated into regular pasture inspections that evaluate grazing pressure and stand uniformity. When small numbers of a new weed are found, serious infestations can be prevented by hand-removal. Perennial weeds can regrow from roots (e.g. curly dock, bull thistle), bulbs (thickened underground shoot; e.g. yellow nutsedge, wild garlic), corms (thickened underground stem; e.g. tall buttercup), stolons (horizontal stem at soil surface; e.g. bermudagrass), or rhizomes (creeping underground stem; e.g. horsenettle, Canada thistle). With perennial weeds, care should be exercised to remove as much of the root system as possible, so digging is usually necessary. Proper disposal of hand-pulled weeds (i.e. burning, burial, or landfill disposal) is important so that seed or vegetative plant parts are not reintroduced.

## Chemical Weed Control

Even when sound forage culture and timely mechanical weed control are practiced, there are times when herbicide applications are needed to complete a successful weed management program. For example, most winter annual and many biennial weeds are beginning their life cycles when late-summer seeded forages are small and not yet competitive enough to prevent weed establishment. The same is true for summer annual and many perennial weeds relative to spring forage seedings. Adverse environmental factors (drought, flooding, extreme heat or cold, insect or disease damage) can also render newly seeded and even well established forages less competitive with weeds. The following are definitions of some terms important to understanding chemical weed control in forages.

Preplant - The herbicide is applied before planting; generally used in no-till systems to control existing vegetation and in some cases provide residual weed control.

Preplant-incorporated (PPI) - The herbicide is applied to the soil after primary tillage, but before planting, and mechanically mixed with the top 1 to 3 inches of soil with one of a variety of secondary tillage implements.

Preemergence (PRE crop/PRE weed) - The herbicide is applied to the soil after the crop is planted but before crop or weed emergence. Rainfall or irrigation is needed to move the herbicide into the zone of weed seed germination before weed emergence for maximum effectiveness.

Postemergence (POST crop/PRE weed) - The herbicide is applied to the foliage of the crop but prior to weed emergence.

Postemergence (POST crop/POST weed) - The herbicide is applied to the foliage of the crop and weeds after they have emerged.

Dormant treatment - The herbicide is applied in the fall, winter, or early spring while forage growth and development is arrested. Some forage species are more tolerant to certain herbicide applications during dormancy. In the mid-Atlantic region, some forage species may not experience full dormancy.

Spot-spraying - The herbicide is applied only to weed-infested areas of the field, and is generally recommended if the infested areas comprise less than one tenth of the total area. For small or localized areas, applications are made with a hand-held sprayer or spray gun. Refer to the spot treatment section of the herbicide label and apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Most backpack sprayers hold only one to three gallons of spray solution. Accurately measuring the small volume or weight of the herbicide product required for mixing one to three gallons of spray solution can be challenging or nearly impossible without the use of specialized equipment (i.e.: gram scales, syringes, etc.), particularly for herbicides that have very low use rates (see Table 27). Larger areas can be sprayed with a field sprayer according to the herbicide label's per-acre rates. Apply all herbicides at least seven days before crop harvest, or harvest around weed patches, leaving them standing to be treated later. Apply all herbicides at least seven days before a killing frost. Spot treatment may kill desirable vegetation that is contacted by the herbicide. Herbicide selection should be based on its effectiveness on the target weed, safety to existing desirable vegetation, and replant or recrop intervals.

Wiper Applications - Wiper applicators are devices that physically wipe a concentrated solution of herbicide directly onto the tops of the weeds. This method can be used on weeds that grow high enough above the crop canopy to allow sufficient contact from the wiper applicator while preventing any contact with the crop. Since only the top few to several inches of the weeds are contacted with herbicide solution, a translocated non-selective herbicide like glyphosate is usually required for effective control. In most instances, perennial weeds will only be suppressed with this method. A healthy actively growing

crop that can develop a canopy over suppressed weeds is important to the success of wiper applications. Wiper applicators must be designed and operated so that the rope, sponge, or panel remains moist enough to transfer a sufficient amount of herbicide to the weed while not allowing drips to contact the crop. An herbicide labeled for wiper applications will usually provide specific application instructions on the label.

Residual activity - Herbicides having residual activity can be taken up by emerging plants' roots and shoots and injure or kill the plant. All soil-applied herbicides have residual activity as well as many postemergence herbicides. Length of residual activity ranges from a few weeks to the entire growing season.

Translocated herbicide – These herbicides move throughout the plant and can cause injury to parts of the plants that do not come in direct contact with the herbicide spray.

Contact herbicide - These herbicides do not move throughout the plant. They cause injury only to those parts of the plant that comes in contact with the spray. Spray coverage is more critical for contact than translocated herbicides.

Selective herbicide - This refers to herbicides that control specific classes or species of plants while leaving other species unaffected. These herbicides are generally used PRE or POST to control specific weeds or classes of weeds in a crop.

Non-selective herbicide - This refers to herbicides that control a broad-spectrum of plant species, including most crops and weeds. These herbicides are generally used with no-tillage production and are sprayed prior to planting when control of all plants is required.

Adjuvants - Products included in the spray tank to improve the herbicide performance. These include non-ionic surfactants (NIS), crop oil concentrate (COC), or nitrogen solutions. Adding additional adjuvants other than what is labeled can increase the chance of crop injury. Surfactants are surface-active agents that reduce the surface tension of the spray solution. Surfactants include both non-ionic surfactants (NIS) and crop oil concentrates (COC). In general, NIS should contain at least 80% active ingredient and COC should contain at least 15% emulsifier. When a surfactant is added, spray droplets fall through hairs to wet the surface of hairy leaves, and spread and stick to waxy leaves, rather than bead up and roll off. This permits a more uniform wetting of hairy or waxy leaf surfaces. Use care not to exceed the recommended surfactant rate. Too little or no surfactant may result in poor wetting. Too much surfactant may cause spray droplets to run together into a thin sheet, reducing spray retention. Many terms are used to describe surfactants, such as detergent, emulsifier, spreader, sticker or wetting agent.

Annual weeds - Summer annual weeds emerge from seed in spring or summer, produce seed in late summer or fall, and die. Winter annual weeds emerge from seed in late summer or fall, produce seed the following spring or summer, and die.

Biennial Weeds - Emerge from seed in the spring of the first year, grow vegetatively in a basal rosette until the spring of the second year, bolt (produce erect stem) and produce seed in summer or fall of the second year, and die.

Perennial Weeds - Perennial weeds emerge and produce seed, depending upon species, at various times throughout the growing season and can live for several years. Perennial weeds may reproduce and spread by seed, roots, rhizomes, stolons, corms, or bulbs.

Mode/site of action - Site in the plant where and method by which the herbicide interacts with the plants processes to kill the plant.

Herbicide resistant weeds - Herbicide resistant weeds have been reported in the Mid-Atlantic region. Populations of herbicide resistant weeds are selected for by repeated use of the same or similar herbicide over a period of time. Resistance is most likely to occur with residual herbicides having one specific mode of action. Weed species with a very high amount of seed production and a variable genetic pool are more likely to develop resistant populations, for example common lambsquarters and pigweed species. Resistance management requires using herbicides with multiple modes of action (see Table 23), and integrating mechanical and cultural weed control with chemical weed control.

Herbicide drift (offsite movement) -

**Physical drift** occurs during application when spray droplets are moved away with wind before reaching the intended spray target. Size of the spray droplets, travel distance to the target, relative humidity, and wind speed all influence how far spray droplets will drift. Spray droplets can drift from a few feet to a few miles. All herbicides have the potential to move as physical drift.

**Vapor drift** occurs only with certain herbicides, which can become volatilized (converted to a gaseous state) and move freely with the air. Volatilization can occur during or after herbicide applications. Volatilized vapor can travel up to several miles. For herbicides subject to volatility, the risk of volatility increases with rising temperatures. Herbicides with a high volatility potential, like Eptam, must be incorporated into the soil to prevent serious losses. Plant growth regulator herbicides (WSSA mode of action group 4) such as Banvel, MCPA ester, 2,4-D ester, or others can be moderately volatile and should not be applied when daytime temperatures are expected to exceed 85F. Herbicide formulation also influences volatility potential. Low volatile esters of 2,4-D and MCPA are more volatile than salt formulations, and the dimethylamine salt of dicamba (Banvel) is slightly more volatile than the diglycolamine or sodium salts (Clarity or Overdrive).

**Injury from Drift** - Herbicide drift can cause serious injury to susceptible plants that come into contact with either spray particles or vapor. Most of the herbicides used in pasture and hay weed management have a moderate to high potential to injure sensitive plants. With highly sensitive plants like grape, tomato, and others, a small amount of drifted herbicide can cause serious injury or death. The potential for injury can be minimized by knowing where sensitive plants are located and minimizing spray drift.

**Minimizing Drift** - Herbicide drift can be minimized by apply the appropriate herbicide(s) with a properly calibrated, equipped, and functioning sprayer while paying particular attention to environmental factors. Use low pressure spray tips that create coarse spray droplets. Maintain spray pressures below 20 psi and spray volumes above 20 gallons per acre unless the herbicide label indicates otherwise. Maintain the boom height as close to the target as possible while maintaining proper spray pattern. Avoid herbicide applications during windy (more than 8-10 mph) or gusty conditions, during temperature inversions, in foggy conditions, or when temperatures are high (>85F). Be certain even slight breezes are blowing away from highly sensitive plants, or leave an appropriate untreated buffer when spraying downwind from sensitive plants. Do not use mist-blower type sprayers, like those used in orchards or vegetable production, to spray pasture or hay. Because backpack sprayers are more difficult to calibrate than field sprayers, over- or under-applications are more likely to occur, resulting in poor weed control or increased crop injury. Limit the use of backpack sprayers to small areas and spot spraying. Follow all the same precautions as with field sprayers. Always read herbicide labels. Many contain important and often specific information concerning herbicide application and drift reduction procedures.

Glyphosate - Glyphosate is the common name of a nonselective, translocated herbicide that is often used in preplant burndown applications, in Roundup-Ready crops, or in spot-spray and wiper bar applications for broad-spectrum grass and broadleaf weed control. Glyphosate is marketed by several manufacturers in different formulations of various salts, which can be confusing when trying to determine how use rates of different formulations compare. Table 24 provides a more detailed description of this issue and a comparison of several of these products.

Generic Herbicides - In most cases, herbicides included in this guide are listed by a common trade name that is readily available. The rates, timings, precautions, and recommendations are based on the product labels for the named herbicide. Other named or generic products may be available that contain the same active ingredient. The generic version of a herbicide may not have the same formulation as the brand-name product, thus use rates may not be the same. Generics may not be labeled for all the same uses as the brand-name product; or supplemental labeling may not cover the generic products. The generic formulation may not be registered for use in all states. Levels of manufacturer support in instances of unsatisfactory herbicide performance may vary. **It is your responsibility to read and understand the label of all pesticides that you use.** Be certain it is labeled for the specific use desired, and follow all recommendations, restrictions, and precautions carefully.

Tank-mixing - Often two or more pesticides in addition to one or more adjuvants need to be applied to the crop at the same time. In many cases, they may be mixed in the same spray tank and applied as a solution. Many pesticide labels have detailed information on which products can be tankmixed as well as detailed procedures for mixing the products. If specific procedures are not included on the label, refer to Table 25 for general pesticide mixing procedures. In some cases a mixing compatibility test, or "jar test", should be performed to insure that the products will mix properly. Always perform a compatibility test when liquid fertilizers are used as the carrier solution. Many labels list detailed procedures for conducting a compatibility test. If specific procedures are not included on the label for either product, refer to Table 26 for general jar test procedures. Any time two or more herbicides are applied together, adhered to the most restrictive label precautions.



**Table1: Herbicides Labeled for use in Pasture, Forage, or Hay<sup>a</sup>**

This is not an exhaustive list, but includes the herbicides most commonly used on alfalfa, clover, and perennial grass forage in Delaware. It provides a quick reference for which crop and use (grazing, green-harvested forage, or hay) each herbicide is labeled. The remainder of this guide is divided into two main sections; chemical weed control in alfalfa and clover forage followed by chemical control in grass forage.

Herbicide	Pasture (grazing)					Harvested forage or hay <sup>b</sup>				
	Alfalfa		Clover		Grass alone	Alfalfa		Clover		Grass alone
	alone	/grass mix	alone	/grass mix		alone	/grass mix	alone	/grass mix	
Aim					X					F, H
Arsenal					X <sup>c</sup>					F, H <sup>c</sup>
Balan	X		X			F, H		F, H		
Banvel/Clarity					X					H <sup>d</sup>
Buctril	X					F, H				
Chateau	X					F, H				
Crossbow <sup>e</sup>					X					P <sup>d</sup>
Eptam	X		X			F, H		F, H		
Facet					X					H <sup>d</sup>
Glyphosate	X <sup>g</sup>	X <sup>h</sup>	X <sup>h</sup>	X <sup>h</sup>	X <sup>n</sup>	F, H <sup>g</sup>	F, H <sup>h</sup>	F, H <sup>h</sup>	F, H <sup>h</sup>	F, H <sup>h</sup>
Gramoxone SL	X	X <sup>h</sup>	X	X <sup>h</sup>	X <sup>n</sup>	F, H	F, H <sup>h</sup>	F, H	F, H <sup>h</sup>	F, H <sup>h</sup>
Karmex	X					F, H				
Kerb	X		X			F, H		F, H		
MCPA	X	X <sup>k</sup>	X	X	X	F, H	F, H <sup>k</sup>	F, H	F, H	F, H
Metribuzin	X	X <sup>n</sup>				F, H	F, H <sup>n</sup>			
Metsulfuron <sup>m</sup>					X					F, H
Overdrive <sup>e</sup>					X					F, H
PastureGard					X					F, H
Poast	X		X			F, H		F, H		
Prowl H <sub>2</sub> O						F, H				
Pursuit	X	X <sup>n</sup>	X			F, H	F, H <sup>n</sup>	F, H		
Raptor	X					F, H				
Remedy Ultra					X					H <sup>d</sup>
Sandea					X					F, H
Select Max	X					F, H				
Sinbar	X					F, H				
Spike					X <sup>p</sup>					H <sup>d,p,r</sup>
Velpar	X				X <sup>q</sup>	F, H				F, H <sup>q</sup>
Weedmaster <sup>e</sup>					X					F, H
2,4-DB	X					F, H				
2,4-D amine/ester					X					H <sup>d</sup>

<sup>a</sup>X = labeled for use.

<sup>b</sup>F = harvested forage (silage, green chop, etc.); H = hay for commercial or private use; P = hay - private use only.

<sup>c</sup>for grazed or harvested fencerows only.

<sup>d</sup>harvested forage is not specifically mentioned on label.

<sup>e</sup>this is a premix product containing 2,4-D and/or dicamba. See table 22a for a comparison of 2,4-D or dicamba concentrations in various premix products.

<sup>g</sup>for establishment prior to crop emergence or spot-spray only; or POST in Roundup-Ready alfalfa.

<sup>h</sup>for establishment prior to crop emergence or spot-spray only.

<sup>k</sup>labeled for both alone, so mix is inferred.

<sup>m</sup>Metsulfuron-methyl is the common name for the herbicide previously marketed as Cimarron. It is currently available in generic formulations under various trade names.

<sup>n</sup>the labeled use is for partial reduction of forage grass stands to reduce grass competition with alfalfa.

<sup>p</sup>for brush control; single plants, multistem clumps, or small stands of woody vegetation.

<sup>q</sup>for brush control; basal treatment.

<sup>r</sup>Spike can be used in hayfields only if hay is not harvested on treated areas for one year after application.

## Chemical Weed Control in Alfalfa and Clover Forage

Choosing the right herbicides for chemical weed control in alfalfa or clover is dependent on the species, crop age (prior to seeding, seedling year, or established), and the seasonal growth stage (dormant, actively growing, or after cutting). The combinations of crop age and seasonal growth stage provide several weed control opportunities. Tables 2 and 3 define these opportunities, list herbicides labeled for use on alfalfa and clover, respectively, and show when during the crop cycle they can be applied. A cool-season forage legume identification key is provided at the end of this publication.

It is very important to consider herbicide restrictions and precautions when choosing an herbicide. Read herbicide labels thoroughly and be certain that you understand the restrictions and precautions before purchasing an herbicide. Labels are available from manufacturers or on-line at [www.cdms.net](http://www.cdms.net). Table 4 provides a comparison of some precautions and restrictions for herbicides in alfalfa and clover. This table is general in nature and should not be used as a replacement for herbicide labels. A brief description of each column in the table and how it is important in choosing an herbicide appears before the table. Table 5 is a more detailed listing of rotational crop and over-seeding restrictions for alfalfa or clover herbicides.

Once the crop's age and growth stage have been determined, and restrictions and precautions have been considered, the spectrum of weed control needed must be determined. Personal experience with which weeds have historically been a problem in the field is important in determining which soil-applied herbicide, if any, will be used. Accurate weed identification is vital when choosing a postemergence herbicide. Tables 6 through 9 list several weed species common to Delaware and the relative effectiveness of various herbicides for their control. Tables 6 and 7 are for grass and broadleaf weed control in first year alfalfa. Tables 8 and 9 are for established alfalfa. The relative effectiveness ratings are based on local or regional experience, which may be limited in some instances, and assume appropriate conditions for optimal herbicide performance. Individual results may vary based on weed size, weed growth stage, and environmental conditions at herbicide application.

The weed lifecycle (annual, biennial, or perennial) and size (width or height) or growth stage at application are also important considerations when choosing an herbicide. Most herbicide labels give the appropriate use rate and maximum height or growth stage for control of specific weeds or classes of weeds.

Often biennial or perennial weeds are more difficult to control with herbicides than annual weeds. Biennial weeds are easier to control while in the rosette stage (year one or prior to bolting and seed production in the second year). Perennial weeds can store vast energy reserves in roots or other underground plant parts, making them difficult to control with contact herbicides. These reserves are used in the spring or summer to produce vegetation and then seed. Perennials are most susceptible to herbicides in the spring at flowering because the reserves are depleted and plant biological activity has peaked. Once seed production occurs, biological activity declines and control may be poor. Fall is also an excellent time for perennial weed control since reserves in underground plant parts are being replenished to prepare the plant for over-wintering and new spring growth. Translocated herbicides move readily to underground storage sites during this period of time, and often provide good control of targeted weeds. Multiple years of good control are needed to dramatically reduce root systems in well established perennial weeds.

Many postemergence herbicides require the addition of adjuvants in the spray mixture to achieve maximum herbicide performance. In addition, most postemergence herbicides require a minimum time period between the herbicide application and rainfall or overhead irrigation (rainfast period) to ensure sufficient absorption into the plant. Table 10 lists rainfast periods and recommended adjuvants for alfalfa and clover herbicides. Additional information including herbicide common names, use rates, and specific comments, is provided for each herbicide in Table 11.

**Table 2: Application Timings for Herbicides used in Alfalfa**

WSSA mode of action (MOA) group: Herbicide mode (or site) of action is important for minimizing the risk of developing herbicide resistant weed populations. See Table 23.

Establishment: Herbicide is applied preplant in no-till establishment to control existing weeds, preplant in existing stands of alfalfa or clover to kill the existing crop and plant a new one (renovation), or preplant incorporated (PPI) or preemergence (PRE) in conventional tillage for residual weed control.

Seedling stand POST: Herbicide is applied postemergence (POST) to seedling alfalfa that has reached a specific growth stage and is actively growing.

Established stand POST: Herbicide is applied POST to alfalfa that has been established for a minimum length of time and is actively growing.

Fall/spring dormant: Herbicide is applied POST to dormant alfalfa; may be for seedling alfalfa at a specific growth stage, for alfalfa established for a minimum length of time, or for either. Herbicide rate may be different for seedling or established stands.

Post-cutting: Herbicide is applied to alfalfa between forage or hay cuttings, but within a certain time period after cutting or before the alfalfa achieves a specified level of regrowth.

Spot-spray application: Herbicide is applied only to weed-infested areas of the field; usually with hand-held equipment. Herbicides labeled for spot applications are footnoted.

Herbicide	WSSA MOA group	Establishment	Seedling stand POST	Established stand POST	Fall/spring dormant		Post-cutting
					seedling	established	
Balan	3	PPI					
Buctril	6		4-trif <sup>a</sup>				
Chateau	14					<6" regrowth	< 6" regrowth
Eptam	8	PPI					
Glyphosate <sup>g</sup>	9	Preplant Renovation					
Gramoxone SL <sup>h</sup>	22	Preplant			< 1 yr	> 1 yr	within 5 days of cut
Karmex	7					1 yr <sup>c</sup>	
Kerb	15				1-trif <sup>a,c</sup>	> 1 season <sup>d</sup>	
MCPA	4					> 1 season	
Metribuzin	5					> 1 yr	
Poast <sup>h</sup>	1		NR <sup>e</sup>	NR <sup>e</sup>			
Prowl H <sub>2</sub> O	3		2-trif <sup>a</sup> to 6"		2-trif <sup>a</sup>	after 1 cut	< 6" regrowth
Pursuit	2		2-trif <sup>a</sup>	fall	2-trif <sup>a</sup>	> 1 season	< 3" regrowth
Raptor	2		2-trif <sup>a</sup>		2-trif <sup>a</sup>	> 1 season	< 3" regrowth
Roundup PowerMAX/ WeatherMax	9		emergence to first cut <sup>b</sup>	after first cut; 1 appl/cut <sup>b</sup>			
Select Max <sup>h</sup>	1		NR <sup>e</sup>	NR <sup>e</sup>			
Sinbar	5					> 1 yr	< 2" regrowth
Velpar	5					> 1 yr <sup>c</sup>	< 2" regrowth
2,4-DB	4		NR <sup>e</sup>	NR <sup>e</sup>			

<sup>a</sup>#-trif = alfalfa trifoliolate leaf stage that must be reached before herbicide application.

<sup>b</sup>for use on Roundup-Ready alfalfa only; up to 5 days before cutting.

<sup>c</sup>spring application.

<sup>d</sup>fall application before soil freeze-up.

<sup>e</sup>NR = no alfalfa size restriction on label; application based on weed stage.

<sup>g</sup>also labeled for spot spray and wiper applications in alfalfa; see Table 11 and consult label for details.

<sup>h</sup>also labeled for spot spray applications in alfalfa; see Table 11 and consult label for details.

**Table 3: Application Timings for Herbicides used in Clover**

WSSA mode of action (MOA) group: Herbicide mode (or site) of action is important for minimizing the risk of developing herbicide resistant weed populations. See Table 23.

Establishment: Herbicide is applied preplant in no-till establishment to control existing weeds, or preplant incorporated (PPI) or preemergence (PRE) in conventional tillage for residual weed control.

Seedling stand: Herbicide is applied postemergence (POST) to seedling clover that has reached a specific growth stage and is actively growing.

Established stand: Herbicide is applied POST to clover that has been established for a minimum length of time and is actively growing.

Fall/spring dormant: Herbicide is applied POST to dormant clover; may be for seedling clover at a specific growth stage, for clover established for a minimum length of time, or for either. Herbicide rate may be different for seedling or established stands.

Post-cutting: Herbicide is applied to clover between forage or hay cuttings, but within a certain time period after cutting or before the clover achieves a specified level of regrowth.

Spot-spray application: Herbicide is applied only to weed-infested areas of the field; usually with hand-held equipment. Herbicides labeled for spot applications are footnoted.

Herbicide <sup>a</sup>	WSSA MOA group	Establishment	Seedling stand POST	Established stand POST	Fall/spring dormant		Post-cutting
					seedling	established	
Balan	3	PPI					
Eptam	8	PPI					
Glyphosate <sup>b</sup>	9	Preplant Renovation					
Gramoxone SL <sup>c</sup>	22	Preplant			< 1 yr	> 1 yr	
Kerb	15				1-trif <sup>d,e</sup>	> 1 season <sup>g</sup>	
MCPA	4		2-trif <sup>d</sup>				
Poast <sup>c</sup>	1		NR <sup>h</sup>	NR <sup>h</sup>			
Pursuit	2		2-trif <sup>d</sup>	fall	2-trif <sup>d</sup>	> 1 season	< 3" regrowth

<sup>a</sup>check the herbicide label to determine if herbicide application is allowed on the species of clover being treated.

<sup>b</sup>also labeled for spot spray and wiper applications in clover; see Table 11 and consult label for details.

<sup>c</sup>also labeled for spot spray applications in clover; Table 11 and consult label for details.

<sup>d</sup>#-trif = clover trifoliolate leaf stage that must be reached before herbicide application.

<sup>e</sup>spring application.

<sup>g</sup>fall application before soil freeze-up.

<sup>h</sup>NR = no clover size restriction on label; application based on weed stage.

## Definitions for Table 4

Risk to desirable (non-target) plants: Herbicides vary in their ability and potential to affect other plants in the vicinity of the crop being treated. Herbicides can affect non-target plants by direct contact through misapplication, herbicide drift with wind or temperature inversions, contact with roots, or in water vapor (volatility). Effects can also be a result of indirect contact through the soil to plants roots, or through contact with herbicide residues in straw, grass clippings, mulch, or compost from treated crops, as well as manure from animals consuming treated crops.

Sensitivity of desirable plants: This column describes the relative toxicity of the herbicide to desirable plants at a low to moderate dose such as would occur with drift or misapplication. A high rating would indicate that the affected plant could suffer severe injury or death.

Translocation in plant: Herbicides that are moved in the plant from the point of contact to other parts of the plant are generally more toxic to non-target plants at low to moderate doses.

Soil activity desirable plants: This column indicates the herbicides potential to cause serious injury or death to desirable plants through root activity in the soil or if sprayed on exposed roots.

Potential for volatility: This column indicates the herbicides relative potential to evaporate and move with water vapor. Most herbicides with a high potential for volatility require immediate soil incorporation to minimize the potential for volatility losses.

Residues in straw, mulch, or compost: Some herbicides can remain in target plants at high enough levels (residues) to cause non-target plant injury when target plant tissue comes into contact with desirable plants. This can occur when straw, mulch, or compost from treated plants are used in plant beds or around ornamental plantings. Manure and urine from animals grazing treated plants can also contain enough residues to injure desirable plants through direct contact or in composted manure.

Environmental (Groundwater advisory): Herbicides with a groundwater advisory have the potential to move through treated soils, particularly sandy soils with low organic matter content, and contaminate groundwater that may be used for drinking water purposes. Use of these herbicides may be restricted on certain soil types or in areas with a shallow water table.

Risk to humans: Herbicides can be toxic to humans when absorbed through the skin, inhaled, or ingested (swallowed). Herbicide labels contain several types of precautions to promote safe use and prevent accidental exposure, provide information on what to do in case of exposure or poisoning, and include requirements for personal protective equipment. Three categories are listed to demonstrate the relative human toxicity of each herbicide.

Signal word: All herbicides are labeled with Caution (slightly toxic), Warning (moderately toxic), or Danger (highly toxic). Precautionary statements will follow that describe how the herbicide is toxic and what modes of entry are important to avoid.

Restricted Use: Restricted use herbicides can only be purchased and used by certified applicators. They are classified as restricted use due to acute toxicity or environmental concerns.

Restricted entry interval (REI): A specified time period is designated between the herbicide application and when workers can re-enter treated areas without designated personal protective equipment (PPE).

Use Rate: The maximum use rate, number of applications allowed per season, and the total amount of all applications allowed in a season are important in determining what species each herbicide will effectively control in a particular crop. Most labels have tables that tell what use rate is required for control of various weed species.

Replant or over-seeding: It is important to know when other crops (rotational crops) can be safely planted into a field treated with an herbicide, particularly for fields that may not be in long-term forage production. In addition, forage producers may want to over-seed grasses into legume crops, or legumes into grass crops (e.g. frost-seeding). Herbicide choices may be limited when over-seeding is planned.

Grazing or harvest restrictions: Grazing restrictions or pre-harvest intervals (PHI) are important in considering whether to use a particular herbicide, or could influence the timing, or in some cases the rate, of herbicide applications.

**Table 4: Comparison of Restrictions and Precautions for Herbicides in Alfalfa or Clover<sup>a</sup>**

Alfalfa / clover herbicide	Restrictions or precautions							
	Risk to desirable (non-target) plants <sup>b</sup>				Environmental	Toxicity to humans		
	Sensitivity of desirable plants	Trans-location in plant	Soil activity - desirable plants	Potential for volatility	Ground-water advisory	Signal word	Restricted use	Restricted entry interval (hours)
Balan	low	yes	low	mod	no	caution	no	12
Buctril	mod	no	none	low	no	warning	no	24
Chateau	mod	no	mod	low	no	caution	no	12
Eptam	low	yes	low	high	no	warning	no	12
Glyphosate	high	yes	none	v. low-low	no	caution	no	4
Gramoxone SL (all applications)	high	no	none	very low	no	danger	yes	12
Karmex	high	yes	high	very low	no	caution	no	12
Kerb	mod	yes	mod	mod	no	caution	yes	24
MCPA	mod	yes	mod	low-mod	yes	danger	no	48
Metribuzin	mod	yes	mod	very low	yes	caution	no	12
Poast	mod	yes	none	very low	no	warning	no	12
Prowl H <sub>2</sub> O	low	slight	mod	low	no	caution	no	24
Pursuit	mod	yes	mod	very low	yes	caution	no	4
Raptor	mod	yes	mod	very low	no	caution	no	4
Select Max	mod	yes	low	very low	no	warning	no	24
Roundup PowerMAX / WeatherMax in RR alfalfa	high	yes	none	v. low-low	no	caution	no	4
Sinbar	high	yes	high	very low	yes	caution	no	12
Velpar	mod	yes	high	very low	yes	danger	no	24
2,4-DB	high	yes	low	low	yes	danger	no	48

<sup>a</sup>see preceding definitions.

<sup>b</sup>none of the herbicides for alfalfa or clover have any restrictions concerning residues in straw, mulch, compost, manure, or urine.

Table 4 cont'd: Comparison of Restrictions and Precautions for Herbicides in Alfalfa or Clover<sup>a</sup>

Alfalfa / clover herbicide	Restrictions or precautions <sup>b</sup>							
	Use Rate			Replant or over-seeding <sup>c</sup> (months)			Grazing or harvest interval <sup>d</sup> (days)	
	Max. use rate/A	Max. # of applic.	Total season max/A	To forage legume	To forage grass	To other crops	Alfalfa	Clover
Balan 60DF	2.5 lb	1	2.5 lb	0	10	10	--	--
Buctril 4EC	0.75 pt	2	1 pt	1	1	1	30 - spring 60 - fall or winter	N/A
Chateau	4 oz	-- <sup>h</sup>	8 oz	8-12	8-12	0-12	25	N/A
Eptam 7E	4.5 pt	1	4.5 pt	0	AH <sup>e</sup>	AH <sup>e</sup>	14	14
Glyphosate <sup>g</sup>								
preplant:	0.3-3.3 qt		5.3 qt	0	0	0 - 1	0	0
renovation:	1 - 3.3 qt	-- <sup>h</sup>	all	0	0	0 - 1	3 (<44oz)	3 (<32oz)
spot:	20-80 oz		applic.	0	0	0 - 1	3	3
Gramoxone 2SL								
preplant:	4 pt	2	8 pt	0	0	0	--	--
dormant seedling:	2 pt	1	2 pt	0	0	0	60	60
dormant estab:	3 pt	1	3 pt	0	0	0	42	60
post-cutting:	1 pt	2 - 3	2 - 3 pt	0	0	0	30	N/A
Karmex 80DF	2 lb	1	2 lb	24	24	24	--	N/A
Kerb 50W	3 lb	1	3 lb	12	12	3 - 12	120	120
MCPA 3.7L	0.5 - 1 pt	1	0.5 - 1 pt	--	--	--	7	7
Metribuzin 75DF	1.33 lb	1	1.33 lb	4	4	4-18	28	N/A
Poast 1.5E	2.5 pt	-- <sup>h</sup>	6.5 pt	--	--	--	7 - forage <sup>k</sup> 14 - hay	7 - forage <sup>k</sup> 20 - hay
Prowl H <sub>2</sub> O								
2.1 qt	2.1 qt	-- <sup>h</sup>	4.2 qt	12 - 24	10 - 24	4 - 24	50- forage 28 - hay <sup>m</sup>	N/A
4.2 qt	4.2 qt	-- <sup>h</sup>	4.2 qt	12 - 24	10 - 24	4 - 24	50	N/A
Pursuit 2AS	6 oz	1 - 2	6 oz	4	40	0 - 40	30	30
Raptor 1AS	6 oz	1	6 oz	3	18	0 - 26	--	N/A
Roundup PowerMAX or WeatherMax 5.5L in RR alfalfa	44 oz	-- <sup>h</sup>	5.3 qt	0	0	0	5	N/A
Select Max 1EC	32 oz	-- <sup>h</sup>	64 oz	0 - 1	1	0 - 1	15	N/A
Sinbar 80WP	1.5 lb	2	1.5 lb	24	24	24	--	N/A
Velpar 2L	6 pt	1	6 pt	24	24	12 - 24	30	N/A
2,4-DB 2L								
seedling	3 qt	--	--	--	--	--	60	N/A
established	3 qt	--	--	--	--	--	30	N/A

<sup>a</sup>see preceding definitions.

<sup>b</sup>an "--" indicates that the information is not specified on the label.

<sup>c</sup>this table provides general comparisons only; see Table 5 for more detailed replant and over-seeding restrictions.

<sup>d</sup>minimum intervals as directed on herbicide labels for all animals including lactating dairy; none of these herbicides for alfalfa or clover have slaughter restrictions.

<sup>e</sup>AH = after normal harvest of crop in which herbicide was applied.

<sup>g</sup>glyphosate rates are from Roundup WeatherMax label.

<sup>h</sup>not specified, but the sum of all applications cannot exceed the maximum seasonal use rate.

<sup>k</sup>forage includes grazing, feeding, or cutting "undried" forage.

<sup>m</sup>this 28-day preharvest interval for hay may be used only once per cropping season.



**Table 5: Rotational Crop / Over-seeding Restrictions for Herbicides in Alfalfa and Clover<sup>a</sup>**

Herbicide	Rotational crops (months after application)							
	Alfalfa	Clover	Forage grasses	Field corn	Small grains	Grain sorghum	Soybean	Other crops <sup>b</sup>
Balan	0	--	10	10	10	10	--	10
Buctril	1	1	1	1	1	1	1	1
Chateau <sup>d</sup>	8-12	8-12	8-12	1-4	1-12	1-4	0-4	1-12
Eptam	0	0	AH <sup>c</sup>	AH <sup>c</sup>	AH <sup>c</sup>	AH <sup>c</sup>	AH <sup>c</sup>	AH <sup>c</sup>
Glyphosate	0	0	0	0	0	0	0	0 - 1
Gramoxone SL	0	0	0	0	0	0	0	0
Karmex	24	24	24	24	24	24	24	24
Kerb	12	12	12	12	12	12	12	3 - 12
MCPA	--	--	--	--	--	--	--	--
Metribuzin	4	12	4	4	8	12	4	4 - 18
Poast	--	--	--	--	--	--	--	--
Prowl H <sub>2</sub> O <sup>d</sup>	12 - 24	12 - 24	10 - 24	12 - 24	4 - 24	10 - 24	0 - NS <sup>e</sup>	0 - 24
Pursuit	4	4	40	8.5	3 - 4	18	0	0 - 40
Raptor	3	18	18	8.5	3 - 18 <sup>f</sup>	9	0	0 - 26
Select Max	0	1	1	1	1	1	0	0 - 1
Sinbar	24	24	24	24	24	24	24	24
Velpar	24	24	24	12 - 24 <sup>g</sup>	24	24	24	12 - 24
2,4-DB	--	--	--	--	--	--	--	--

<sup>a</sup>an "--" indicates that a rotational restriction for that crop is not specified on the label.

<sup>b</sup>refer to herbicide label for specific crops. Consider rotational intervals for annual grass or broadleaf crops that may be over-seeded or rotationally planted for supplemental forage.

<sup>c</sup>AH = after normal harvest of crop in which herbicide was applied.

<sup>d</sup>restrictions are rate dependent; refer to label.

<sup>e</sup>NS = next growing season after application.

<sup>f</sup>restrictions are pH and rainfall dependent for barley; refer to label.

<sup>g</sup>a 12-month rotation is allowed if the use rate did not exceed 3 pt/A.



Alfalfa  
*Medicago sativa*



Red Clover  
*Trifolium pretense*



White Clover  
*Trifolium repens*



Crimson Clover  
*Trifolium incarnatum*

**Table 6: Susceptibility of Grass Weeds to Herbicides in Alfalfa - First Year**

Grass species A = annual W = winter annual P = perennial	Treatment and Application Timing <sup>a</sup>										
	Establishment				Seedling stand						
	PPI		Preplant burndown		POST		Dormant		POST or dormant		
	Balan	Eptam	Glypho- sate	Seq. Gram. SL <sup>b</sup>	Poast Plus/ Poast	Roundup PowerMAX /WthrMax <sup>c</sup>	Gram. SL	Kerb	Prowl H <sub>2</sub> O <sup>d</sup>	Pursuit	Raptor
Barnyardgrass (A)	G	G	G	G	G	G	N	F	G	F-G	F-G
Bermudagrass (P)	P	F	G	P-F	G	G	P	P	N	N	N
Cheat (W, A)	G	G	G	G	P-F	G	G	G	F-G	N	G
Crabgrass spp. (A)	G	G	G	G	G	G	N	F	G	F-G	F-G
Fescue, tall (established) (P)	N	N	G	G	P	G	F	G	N	N	P
Foxtail spp. (A)	G	G	G	G	G	G	N	F	G	G	G
Goosegrass (A)	G	G	G	G	G	G	N	F	G	F	P
Johnsongrass (P)	F	G	G	G	G	G	N	P	P	G	F-G
Nutsedge, yellow (P)	P	G	F-G	P	N	F-G	P	N	N	P-F	P-F
Orchardgrass (established) (P)	N	N	G	G	F-G	G	F	G	N	N	P
Panicum, fall (A)	G	G	G	G	G	G	N	F	G	F	F-G
Quackgrass (P)	P	F	G	F	F-G	G	F	G	N	P-F	P

<sup>a</sup>susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. The rating scale is: G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, and N(none) = <20 percent control.

<sup>b</sup>Seq. Gramoxone SL refers to susceptibility when sequential (two) applications of Gramoxone SL are used 3 to 5 days apart.

<sup>c</sup>for use with Roundup-Ready alfalfa only.

<sup>d</sup>Prowl H<sub>2</sub>O is applied postemergence to the alfalfa but will only control weeds germinating after application. It will not control emerged weeds.

**Buctril and 2,4-DB are labeled postemergence in seedling alfalfa, but have no activity on grass weeds.**

**Table 7: Susceptibility of Broadleaf Weeds to Herbicides in Alfalfa - First Year**

Broadleaf species A = annual W = winter annual B = biennial P = perennial	Treatment and Application Timing <sup>a</sup>											
	Establishment				Seedling stand							
	PPI		Preplant burndown		POST			Dormant		POST or dormant		
	Balan	Eptam	Glypho- sate	Seq. Gram. SL <sup>b</sup>	Buctril	Roundup PowerMAX /WthrMax <sup>c</sup>	2,4-DB	Gram. SL	Kerb	Prowl H <sub>2</sub> O <sup>d</sup>	Pursuit	Raptor
Amaranth, spiny (A)	G	G	G	G	F	G	G	N	N	F-G	F-G	G
Chickweed, common (W)	F	F	G	G	P	G	N	G	G	F	F	G
Dandelion (established) (P)	N	N	G	P	N	G	P-F	P	P	N	P-F	F-G
Dock spp. (established) (P)	N	N	F-G	P	N	F-G	P	P-F	F	N	P	P
Dock spp. (seedling) (P)	N	N	G	G	N-P	G	G	G	F	N	P-F	P-F
Dogbane, hemp (P)	N	N	G	P	N	G	N	N	N	N	N	N
Henbit (W)	P-F	G	G	G	F-G	G	N	G	F	F-G	F	F
Horsenettle (P)	N	N	F-G	P	N	F-G	N	P	N	N	N	N
Horseweed (W, A)	P	P	G	P	P-F	G	F-G	P	P	P	N	N
Knawel (German moss) (W, A)	P-F	P	F-G	F-G	G	F-G	N	F-G	P	P-F	N	N
Lambsquarters, common (A)	G	G	G	G	G	G	G	N	P	G	P	P
Lettuce, prickly (W, A, B)	N	N	G	F	P-F	G	F	F	P	N	N	N
Milkweed spp. (P)	N	N	F-G	P	N	F-G	N	N	N	N	N	N
Mustard spp. (W, A)	P	P	G	G	G	G	G	F	P	P-F	G	G
Nightshade, black (A)	P-F	G	G	G	G	G	G	P	P	P	F-G	F-G
Pennycress spp. (W, A)	P	P	G	G	G	G	G	F	F	P-F	G	G
Pepperweed spp. (W, A, B)	P	P	G	G	G	G	G	F	P	P-F	G	G
Pigweed spp. (A)	G	G	G	G	F	G	G	N	N	G	F-G	G
Plantain spp. (P)	N	N	F-G	P	N	F-G	F-G	P-F	F	N	N	P
Ragweed, common (A)	N	P	G	G	F	G	F	N	N	P	F-G	F
Rocket, yellow (W, B)	P	P	G	F	F	G	G	P-F	P-F	P-F	G	G
Shepherdspurse (W)	P	P	G	G	G	G	G	F	F	F	G	G
Smartweed spp. (A)	P	P	G	F-G	G	G	P	N	P	P	F-G	F-G
Speedwell (W)	P	P	G	G	P	G	P	G	P	P	P-F	F
Thistle, bull (B)	N	N	G	F	P-F	G	F-G	F	P	N	N	P-F
Thistle, Canada (P)	N	N	F-G	P	P	F-G	N	P	N	N	P	P-F
Thistle, plumeless (B)	N	N	G	F	P-F	G	F-G	F	P	N	N	P-F
Thistle, musk (B)	N	N	G	F	P-F	G	F-G	F	P	N	N	P-F

<sup>a</sup>susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. The rating scale is: G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, and N(none) = <20 percent control.

<sup>b</sup>Seq. Gramoxone SL refers to susceptibility when sequential (two) applications of Gramoxone SL are used 3 to 5 days apart.

<sup>c</sup>for use with Roundup-Ready alfalfa only.

<sup>d</sup>Prowl H<sub>2</sub>O is applied postemergence to the alfalfa but will only control weeds germinating after application. It will not control emerged weeds.

**Poast is labeled postemergence in seedling alfalfa, but has no activity on broadleaf weeds.**

**Table 8: Susceptibility of Grass Weeds to Herbicides in Alfalfa - Established Stands**

Grass species A = annual W = winter annual P = perennial	Treatment and Application Timing <sup>a</sup>											
	Established stand											
	POST			Fall/spring dormant								
	Poast Plus/ Poast	Select Max	Roundup PowerMAX /WthrMax <sup>b</sup>	Chateau <sup>c</sup>	Gramox. SL	Karmex	Kerb	Metri-buzin	Prowl H <sub>2</sub> O <sup>c</sup>	Raptor	Sinbar	Velpar
Barnyardgrass (A)	G	G	G	P	N	F	F	P-F	G	F-G	P-F	P-F
Bermudagrass (P)	G	G	G	N	P	P	P	P	N	N	P-F	N
Cheat (W, A)	P-F	G	G	P	G	P-F	G	G	F-G	G	G	G
Crabgrass spp. (A)	G	G	G	P	N	F	F	P-F	G	F-G	P-F	P-F
Fescue, tall (established) (P)	P	F	G	N	F	F	G	P-F	N	P	F	F
Foxtail spp. (A)	G	G	G	P	N	F	F	P-F	G	G	P-F	P-F
Goosegrass (A)	G	G	G	P	N	F	F	P-F	G	P	P-F	P-F
Johnsongrass (seedling) (P)	G	G	G	N	N	P-F	P	P	P	F-G	P	P
Nutsedge, yellow (P)	N	N	F-G	N	P	N	N	N	N	P-F	P	P
Orchardgrass (established) (P)	F-G	G	G	N	F	F	G	P	N	P	F	F
Panicum, fall (A)	G	G	G	P	N	P-F	F	P-F	G	F-G	P-F	P-F
Quackgrass (established) (P)	F-G	F-G	G	N	F	P-F	G	P	N	P	F	P-F

<sup>a</sup> susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. The rating scale is: G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, and N(none) = <20 percent control.

<sup>b</sup> for use with Roundup-Ready alfalfa only.

<sup>c</sup> Chateau and Prowl H<sub>2</sub>O are applied postemergence to the alfalfa but will only control weeds germinating after application. They will not control emerged weeds.

**2,4-DB (postemergence) and MCPA (fall or spring dormant) are labeled in established alfalfa, but have no activity on grass weeds.**



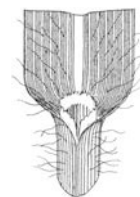
Barnyardgrass  
*Echinochloa crus-galli*



Goosegrass  
*Eleusine indica*



Cheat  
*Bromus secalinus*



Large Crabgrass  
*Digitaria sanguinalis*



Smooth Crabgrass  
*Digitaria ischaemum*



Giant Foxtail  
*Setaria faberi*



Green Foxtail  
*Setaria viridis*



Yellow Foxtail  
*Setaria glauca*



Fall Panicum  
*Panicum dichotomiflorum*

Table 8 cont'd: Susceptibility of Grass Weeds to Herbicides in Alfalfa - Established Stands

Grass species A = annual W = winter annual P = perennial	Treatment and Application Timing <sup>a</sup>							
	Established stand							
	POST or dormant	Post-cutting						
		Pursuit	Chateau <sup>b</sup>	Gramox. SL	Prowl H <sub>2</sub> O <sup>b</sup>	Pursuit	Raptor	Sinbar
Barnyardgrass (A)	F-G	P	G	G	F-G	F-G	G	P-F
Bermudagrass (P)	N	N	P-F	N	N	N	P-F	P-F
Cheat (W, A)	N	P	G	F-G	N	G	G	F-G
Crabgrass spp. (A)	F-G	P	G	G	F-G	F-G	G	P-F
Fescue, tall (established) (P)	N	N	F	N	N	P	F	F
Foxtail spp. (A)	G	P	G	G	G	G	G	P-F
Goosegrass (A)	F	P	G	G	F	P	G	P-F
Johnsongrass (seedling) (P)	G	N	G	P	G	F-G	G	P
Nutsedge, yellow (P)	P-F	N	P-F	N	P-F	P-F	P-F	P
Orchardgrass (established) (P)	N	N	F	N	N	P	F	F-G
Panicum, fall (A)	F	P	G	G	F	F-G	G	P-F
Quackgrass (established) (P)	P-F	N	F	N	P-F	P	F	F

<sup>a</sup>susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. The rating scale is: G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, and N(none) = <20 percent control.

<sup>b</sup>Chateau and Prowl H<sub>2</sub>O are applied postemergence to the alfalfa but will only control weeds germinating after application. They will not control emerged weeds.



Johnsongrass  
*Sorghum halepense*



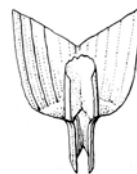
Bermudagrass  
*Cynodon dactylon*



Quackgrass  
*Elytrigia repens*



Tall Fescue  
*Festuca arundinacea*



Orchardgrass  
*Dactylis glomerata*

**Table 9: Susceptibility of Broadleaf Weeds to Herbicides in Alfalfa - Established Stands**

Broadleaf species A = annual W = winter annual B = biennial P = perennial	Treatment and Application Timing <sup>a</sup>											
	Established stand											
	POST		Fall/spring dormant									
	2,4-DB	Roundup <sup>b</sup>	Chateau <sup>c</sup>	Gramox. SL	Karmex	Kerb	MCPA	Metri-buzin	Prowl H <sub>2</sub> O <sup>c</sup>	Raptor	Sinbar	Velpar
Amaranth, spiny (A)	G	G	F	N	F-G	N	P	P	F-G	G	F-G	F-G
Chickweed, common (W)	N	G	G	G	G	G	N	G	F	G	G	G
Dandelion (established) (P)	P-F	G	F-G	P	P	P	F-G	F-G	N	F-G	F	F-G
Dock spp. (established) (P)	P	F-G	N	P-F	P-F	F	P-F	F	N	P	P-F	P-F
Dock spp. (seedling) (P)	G	G	P	G	F	F	G	F	N	P-F	F	F
Dogbane, hemp (P)	N	G	N	N	N	N	N	N	N	N	P	P
Henbit (W)	N	G	G	G	F	F	N	G	F-G	F	G	G
Horsenettle (P)	N	F-G	N	P	P-F	N	N	P-F	N	N	P-F	P-F
Horseweed (W, A)	F-G	G	G	P	F	P	F-G	P	P	N	F	F
Knawel (German moss) (W, A)	N	F-G	P	F-G	F-G	P	N	F	P-F	N	F	F
Lambsquarters, common (A)	G	G	G	N	F-G	P	P	P	G	P	F-G	F-G
Lettuce, prickly (W, A, B)	F	G	N	F	F	P	F	F	N	N	F	F
Milkweed spp. (P)	N	F-G	N	N	N	N	N	N	N	N	P	P
Mustard spp. (W, A)	G	G	F	F	G	P	G	G	P-F	G	G	G
Nightshade, black (A)	G	G	G	P	P-F	P	P	P	P	F-G	F	F
Pennycress spp. (W, A)	G	G	P-F	F	G	F	G	G	P-F	G	G	G
Pepperweed spp. (W, A, B)	G	G	P-F	F	G	P	G	G	P-F	G	G	G
Pigweed spp. (A)	G	G	G	N	F-G	N	P	P	G	G	F-G	F-G
Plantain spp. (P)	F-G	F-G	N	P-F	P-F	F	G	G	N	P	F-G	F-G
Ragweed, common (A)	F	G	P-F	N	F-G	N	P	P	P	F	F-G	F-G
Rocket, yellow (W, B)	G	G	P-F	P-F	G	P-F	G	G	P-F	G	G	G
Shepherdspurse (W)	G	G	P-F	F	G	F	G	G	F	G	G	G
Smartweed spp. (A)	P	G	P	N	F	P	P	P	P	F-G	F-G	F-G
Speedwell (W)	P	G	P-F	G	F-G	P	P	F-G	P	F	G	G
Thistle, bull (B)	F-G	G	N	F	P-F	P	G	F	N	P-F	P-F	P-F
Thistle, Canada (P)	N	F-G	N	P	P	N	P	P	N	P-F	P	P
Thistle, plumeless (B)	F-G	G	N	F	P-F	P	G	F	N	P-F	P-F	P-F
Thistle, musk (B)	F-G	G	N	F	P-F	P	G	F	N	P-F	P-F	P-F

<sup>a</sup>susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. The rating scale is: G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, and N(none) = <20 percent control.

<sup>b</sup>Roundup PowerMAX or WeatherMAX; **for use with Roundup-Ready alfalfa only.**

<sup>c</sup>Chateau and Prowl H<sub>2</sub>O are applied postemergence to the alfalfa but will only control weeds germinating after application. They will not control emerged weeds.

**Poast and Select Max are labeled postemergence in established alfalfa, but have no activity on broadleaf weeds.**

Table 9 cont'd: Susceptibility of *Broadleaf Weeds* to Herbicides in Alfalfa - *Established Stands*

Broadleaf species A = annual W = winter annual B = biennial P = perennial	Treatment and Application Timing <sup>a</sup>							
	Established stand							
	POST or dormant	Post-cutting						
	Pursuit	Chateau <sup>b</sup>	Gramox. SL	Prowl H <sub>2</sub> O <sup>b</sup>	Pursuit	Raptor	Sinbar	Velpar
Amaranth, spiny (A)	F-G	F	G	F-G	F-G	G	G	F-G
Chickweed, common (W)	F	G	G	F	F	G	G	G
Dandelion (established) (P)	P-F	F-G	P-F	N	P-F	F-G	F	F-G
Dock spp. (established) (P)	P	N	P-F	N	P	P	F	P-F
Dock spp. (seedling) (P)	P-F	P	G	N	P-F	P-F	G	F
Dogbane, hemp (P)	N	N	P	N	N	N	P	P
Henbit (W)	F	G	G	F-G	F	F	G	F-G
Horsenettle (P)	N	N	P	N	N	N	P-F	P-F
Horseweed (W, A)	N	G	P	P	N	N	F-G	F
Knawel (German moss) (W, A)	N	P	F	P-F	N	N	F	F
Lambsquarters, common (A)	P	G	G	G	P	P	G	F-G
Lettuce, prickly (W, A, B)	N	N	F	N	N	N	F	F-G
Milkweed spp. (P)	N	N	P	N	N	N	P	P
Mustard spp. (W, A)	G	F	G	P-F	G	G	G	G
Nightshade, black (A)	F-G	G	G	P	F-G	F-G	G	F
Pennycress spp. (W, A)	G	P-F	G	P-F	G	G	G	G
Pepperweed spp. (W, A, B)	G	P-F	G	P-F	G	G	G	G
Pigweed spp. (A)	F-G	G	G	G	F-G	G	G	F-G
Plantain spp. (P)	N	N	G	N	N	P	G	F-G
Ragweed, common (A)	F-G	P-F	G	P	F-G	F	G	F-G
Rocket, yellow (W, B)	G	P-F	F	P-F	G	G	F-G	G
Shepherdspurse (W)	G	P-F	G	F	G	G	G	G
Smartweed spp. (A)	F-G	P	G	P	F-G	F-G	G	F-G
Speedwell (W)	P-F	P-F	G	P	P-F	F	G	G
Thistle, bull (B)	N	N	F	N	N	P-F	F	P-F
Thistle, Canada (P)	P	N	P-F	N	P-F	P-F	P	P
Thistle, plumeless (B)	N	N	F	N	N	P-F	F	P-F
Thistle, musk (B)	N	N	F	N	N	P-F	F	P-F

<sup>a</sup>susceptibility ratings listed in this table assume correct rates and timings of herbicide application for the normal growth habit of each species. The rating scale is: G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, and N(none) = <20 percent control.

<sup>b</sup>Chateau and Prowl H<sub>2</sub>O are applied postemergence to the alfalfa but will only control weeds germinating after application. They will not control emerged weeds.



**Table 10: Adjuvants and Rainfastness for Postemergence Herbicides in Alfalfa and Clover**

Adjuvants are products you include in the spray tank to improve the performance of your herbicides. These include non-ionic surfactants (NIS), crop oil concentrate (COC), methylated or ethylated seed oil (MSO or ESO) or nitrogen solutions. In general, NIS should contain at least 80% active ingredient and is typically used at 0.25% v/v; COC should contain at least 15% emulsifier and is typically used at 1.0% v/v; MSO is typically used at 1.5 pt/A. Nitrogen solutions can be 28%, 30% or 32% ammonium based fertilizer solutions; ammonium sulfate should be spray grade dry ammonium sulfate (21-0-0). Adding additional adjuvants than what is labeled can increase the chance of crop injury. The following is meant as guidelines for recommended adjuvants; refer to herbicide labels for specific adjuvant rates.

Rainfastness is number of hours needed between time of application and rainfall or irrigation to ensure sufficient absorption in the plant.

Growing conditions: **SOFT**: good soil moisture, high humidity, cloudy skies for past few days, warm, and weeds are smaller than mentioned on herbicide labels

**NORMAL**: intermediate weather, consider crop size, weed size, and weed species

**STRESS**: poor soil moisture, hot or cold temps, bright sunlight, low humidity, windy

Herbicides	Rainfast interval (hr)	Additive						
		Growing conditions			Nitrogen solution <sup>a</sup>		AMS <sup>a</sup>	
		Soft	Normal	Stress				
Buctril 4EC	1	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>				
Glyphosate preplant or spot treatment	1-6	-- <sup>c</sup>	-- <sup>c</sup>	-- <sup>c</sup>			optional	8.5 - 17 lb/100gal
Gramoxone 2SL	0.5	NIS	NIS or COC	COC				
Karmex 80DF	-- <sup>d</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				
Kerb 50W	-- <sup>d</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				
MCPA 3.7L	-- <sup>d</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				
Metribuzin 75DF	-- <sup>d</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				
Poast	1	COC	COC	COC	optional	2-4 qt/A	optional	2.5 lb/A
Pursuit 2AS	1	NIS	NIS or COC	COC	required <sup>g</sup>	1.25-2.5%		12-15 lb/100gal
Raptor 1AS	1	NIS	NIS or COC	COC	required <sup>g</sup>	2.5%		12-15 lb/100gal
Roundup PowerMAX or WeatherMax 5.5L in RR alfalfa	-- <sup>d</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>			optional	8.5 - 17 lb/100gal
Select Max 1EC	1	NIS or COC	NIS or COC	COC			optional	2.5-4 lb/A
Sinbar 80WP	-- <sup>d</sup>	-- <sup>h</sup>	-- <sup>h</sup>	-- <sup>h</sup>				
Velpar 2L	-- <sup>d</sup>	NIS <sup>k</sup>	NIS <sup>k</sup>	NIS <sup>k</sup>				
2,4-DB 2L	-- <sup>d</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				

<sup>a</sup>labeled and recommended only to maintain manufacturer's performance guarantees.

<sup>b</sup>an adjuvant is not recommended, but is allowed if tank-mixing with herbicides requiring an adjuvant, although the label warns that increased alfalfa injury will occur.

<sup>c</sup>glyphosate products vary in the amount of adjuvant recommended; refer to product label.

<sup>d</sup>a specific rainfast interval is not given on the label.

<sup>e</sup>no adjuvant is recommended on the label.

<sup>g</sup>AMS may be substituted for UAN.

<sup>h</sup>do not use an adjuvant.

<sup>k</sup>dormant alfalfa only; do not use a surfactant on non-dormant alfalfa.

Table 11: Comments for Alfalfa or Clover Herbicides

Herbicide		Application timing	Rate		Labeled crop(s)
Trade name	Common name		product/A	lb ai/A	
<b>Preplant, stand renovation, or preplant incorporated applications</b>					
<b>Glyphosate</b>	glyphosate	Preplant renovation	11 oz to 3.3 qt 32 to 48 oz	0.47 to 4.5 1.4 to 2.0	alfalfa and clover alfalfa and clover
<p><u>Comments:</u> The rates, timings, and comments for this entry are from the Roundup WeatherMax label. Consult the product label for other glyphosate formulations. Make ground applications in 10 to 40 gal/A of water. Increase the spray volume within this range as the weed density increases. If water is hard, add dry ammonium sulfate at 8.5 to 17 lb/100 gal of water. Preplant applications can be made before, during, or after planting but before the crop emerges. Livestock must be removed from the area before application, but the new crop can be fed or grazed as soon as it reaches sufficient maturity. Glyphosate controls emerged weeds only. Glyphosate is effective on annual, biennial, and perennial weeds as well as small grain cover crops. More than one application may be needed for perennial weed control. Existing stands of alfalfa or clover can be renovated by applying 32 to 48 oz/A to alfalfa or 2 to 3.3 qt/A to clover. If the existing crop is to be grazed or harvested for feed after application, do not apply more than 44 oz/A on alfalfa or 32 oz/A on clover. These lower rates may not provide complete control. Remove livestock before application and wait 3 days before grazing or harvest. Do not graze or harvest if higher rates are used.</p>					
<b>Gramoxone 2SL</b>	paraquat	Preplant	2.5 to 4.0 pt	0.63 to 1.0	alfalfa and clover
<p><u>Comments:</u> Apply in a minimum of 10 gal/A (ground) or 5 gal/A (air) of water before, during, or after planting but before crop emerges. The addition of a nonionic surfactant or crop oil concentrate is required for acceptable weed control. While allowed on the label, aerial applications of Gramoxone SL are not recommended due a higher potential for drift. Gramoxone SL controls emerged weeds only. Gramoxone SL is effective on perennial grass sods when two applications are made. Graze or mow sod to a height of 3 inches or less and apply 2.25 pt/A followed in 10 to 14 days by 1.5 pt/A. Gramoxone SL is also effective on small annual weeds. <b>Gramoxone SL is a restricted use pesticide.</b></p>					
<b>Balan 60DF</b>	benfenin	PPI	2.0 to 2.5 lb	1.2 to 1.5	alfalfa and clover
<p><u>Comments:</u> Balan provides approximately one month of soil residual control of many annual grass weeds and some annual broadleaf weeds. Apply in 5 to 40 gal/A of water or liquid fertilizer to clean, dry soil within three weeks of planting. Soil incorporation must occur within 8 hours after application. Operate equipment to uniformly incorporate into the top 2 to 3 inches of soil. Refer to the product label for specific instructions on soil incorporation equipment and methods. No grazing or harvest restrictions are listed on the label.</p>					
<b>Eptam 7E</b>	EPTC	PPI	2.25 to 4.5 pt	2.0 to 4.0	alfalfa and clover
<p><u>Comments:</u> Eptam provides approximately one month of soil residual control of many annual grass weeds, some annual broadleaf weeds, and yellow nutsedge. Apply in 10 to 50 gal/A of water or liquid fertilizer to clean, dry soil just before planting and incorporate immediately. Operate equipment to uniformly incorporate into the top 2 to 3 inches of soil. Refer to the product label for specific instructions on soil incorporation equipment and methods. Do not use Eptam on alfalfa if atrazine was applied within the previous 12 months. Do not use on white Dutch clover. Do not use on soils with greater than 10% organic matter. Observe all grazing and harvest restrictions (Table 4).</p>					

Herbicide		Application timing	Rate		Labeled crop(s)
Trade name	Common name		product/A	lb ai/A	
<b>In-crop broadcast applications</b>					
<b>Buctril 4EC</b>	bromoxynil	sdIng.-POST	0.5 to 0.75 pt	0.25 to 0.38	alfalfa
<p><u>Comments:</u> Buctril controls several seedling broadleaf weeds (emerged weeds only) when applied prior to the 4-leaf stage or 2 inches in height (1 inch diameter for rosettes). Apply by ground in 10 to 20 gal/A or by air in a minimum of 5 gal/A of water or liquid fertilizer. Apply in the fall or spring to alfalfa with a minimum of 4-trifoliolate leaves. Do not apply if temperatures are expected to exceed 70F for three days after application or unacceptable crop injury may occur. Applications in liquid fertilizer may increase leaf burn to alfalfa. Do not use an adjuvant unless a tank-mix partner requires it. Buctril is labeled for use on seedling alfalfa only, and may be tank-mixed with 2,4-DB or Pursuit. Tank-mixes with 2,4-DB may result in unacceptable crop injury under warm, humid weather conditions. Observe all grazing and harvest restrictions (Table 4).</p>					
<b>Chateau 51WDG</b>	flumioxazin	est.-dormant post-cutting	4.0 oz	0.128	alfalfa
<p><u>Comments:</u> Chateau provides 1 to 2 months of residual control of many annual broadleaf weeds and suppression of some annual grasses as they germinate. It will not control weeds that have already emerged at the time of application. Apply by ground in 10 to 30 gal/A or by air in 5 to 10 gal/A of water. Dormant applications can be made in the fall after the last cutting, during winter dormancy, or anytime in the spring prior to 6 inches of alfalfa regrowth. Post-cutting applications should also be made prior to 6 inches of regrowth. Application to alfalfa with more than 6 inches of regrowth may result in unacceptable crop injury. Wait a minimum of 60 days between applications. Chateau can be tank-mixed with other labeled herbicides. However, do not apply with any adjuvant or tank-mix with any products formulated as an emulsifiable concentrate (EC) unless the application follows the last cutting of the season. Application with paraquat can be used to burndown winter annuals prior to the winter dormant period. Observe all grazing and harvest restrictions (Table 4).</p>					
<b>Gramoxone 2SL</b>	paraquat	sdIng.-dormant est.-dormant post-cutting	1.0 to 2.0 pt 2.0 to 3.0 pt 1.0 pt	0.25 to 0.5 0.5 to 0.75 0.25	alfalfa and clover alfalfa and clover alfalfa
<p><u>Comments:</u> Gramoxone SL controls emerged weeds only. The addition of a nonionic surfactant or crop oil concentrate is required for acceptable weed control. Observe all grazing and harvest restrictions (Table 4).  <b>Gramoxone SL is a restricted use pesticide.</b></p> <p>Dormant applications provide control of many winter annual weeds, control of some seedling biennial and perennial weeds, and suppression of other biennial and perennial weeds. Apply only one dormant application per year by ground in a minimum of 10 gal/A or by air in a minimum of 5 gal/A of water. While allowed on the label, aerial applications of Gramoxone SL are not recommended due a higher potential for drift. To avoid injury, use only on seedling alfalfa or clover stands that are completely dormant, established clover stands with less than 2 inches of remaining fall regrowth that are completely dormant, or established alfalfa stands with less than six inches of remaining fall regrowth or 2 inches of new spring regrowth. Velpar (see Velpar entry for rate) can be tank-mixed with Gramoxone SL (1 to 2 pt/A) for dormant applications on established alfalfa.</p> <p>Post-cutting applications provide control of small summer annual seedlings and suppression of larger, biennial, or perennial weeds. Apply post-cutting applications by ground in a minimum of 10 gal/A of water. On seedling alfalfa stands (first year), two post-cutting applications may be made. First year alfalfa stands and yields may be reduced if alfalfa is allowed to regrow more than 2 inches after cutting and before application. On established alfalfa stands, three post-cutting applications may be made. Do not make post-cutting applications more than 5 days after cutting. Post-cutting applications are not allowed on clover.</p>					

Herbicide		Application timing	Rate		Labeled crop(s)
Trade name	Common name		product/A	lb ai/A	
<b>In-crop broadcast applications, cont.</b>					
<b>Karmex 80DF</b>	diuron	est.-dormant	1.5 to 2.0 lb	1.2 to 1.6	alfalfa
<p><u>Comments:</u> Karmex provides 2 to 3 months of soil residual control or suppression of several annual grass and broadleaf weeds, and also has postemergence activity on some small annual weeds. The use of an adjuvant with Karmex is not recommended. Use only on alfalfa established for 1 year or more. Make applications in water with sufficient spray volume for uniform coverage. Apply in March or early April when alfalfa is dormant but before spring growth begins. No other crops can be planted for two years following an application of Karmex. Do not use on sands, loamy sands, gravelly soils, exposed subsoils, or soils with less than 1% organic matter or serious crop injury can occur. Observe all grazing and harvest restrictions (Table 4).</p>					
<b>Kerb 50W</b>	pronamide	sdIng.-dormant est.-dormant	1.0 to 3.0 lb	0.5 to 1.5	alfalfa and clover alfalfa and clover
<p><u>Comments:</u> Kerb provides 1 to 2 months of soil residual control or suppression of several annual grass and some broadleaf weeds, and also has postemergence activity on several small annual grass weeds. Apply by ground in 20 to 50 gal/A of water. Make applications in fall or winter when temperatures fall below 55F but before soil freeze-up. Kerb may be applied to fall-seeded legumes after they reach the trifoliolate leaf stage. Do not apply to spring-seeded legumes until the following fall or early winter. Rainfall or overhead irrigation is required after application to activate the herbicide. Do not use on soils with greater than 4% organic matter. Kerb has rotational crop restrictions of up to 12 months. Observe all grazing and harvest restrictions (Table 4). <b>Kerb is a restricted use pesticide.</b></p>					
<b>MCPA 3.7L</b>	MCPA	est.-dormant sdIng.-POST	1.0 pt 0.5 pt	0.46 0.23	alfalfa clover
<p><u>Comments:</u> MCPA controls or aids in control of some emerged annual, biennial, or perennial weeds. Follow all label recommendations to reduce the potential for spray drift. Apply to small actively growing weeds by ground in a minimum of 10 gal/A or by air in a minimum of 2 gal/A of water or liquid fertilizer. Follow the label recommendations when using liquid fertilizer as a carrier. Make applications to established alfalfa in late fall following frost or in early spring when crop is completely dormant. Up to 0.5 pt/A may be applied to newly seeded clover after the 2-trifoliolate stage. For best results, spray perennials in bud to early bloom stage. Do not mow for at least 7 days after application. Tankmixing with other herbicides is not mentioned on the MCPA label, but MCPA is often listed on other herbicide labels for tankmixing. MCPA may injure alfalfa, clover, and other legumes at rates above 0.5 to 1 pt/A. Observe all grazing and harvest restrictions (Table 4).</p>					
<b>Metribuzin 75DF</b>	metribuzin	est.-dormant	0.33 to 1.33 lb	0.25 to 1.0	alfalfa
<p><u>Comments:</u> Metribuzin provides both postemergence and 1 to 2 months of soil residual control of several annual broadleaf weeds and a few grasses (<i>bromus</i> species and annual bluegrass, green foxtail, and barnyardgrass). Apply the appropriate rate from the label when weeds are less than two inches tall or two inches in diameter. Apply by ground in 10 to 40 gal/A or by air in a minimum of 2 to 10 gal/A of water or liquid fertilizer. No adjuvants are recommended. Orchardgrass in mixed stands will generally tolerate Metribuzin at rates of up to 0.67 lb/A. Rates of 0.67 to 1.0 lb/A can be used in mixed stands of alfalfa and grass to reduce grass stands and prevent crowding out of alfalfa. Do not use Metribuzin on sand soils or serious crop injury can occur. Crop injury can also occur on loamy sand soils. Observe all grazing and harvest restrictions (Table 4).</p>					

Herbicide		Application timing	Rate		Labeled crop(s)
Trade name	Common name		product/A	lb ai/A	
<b>In-crop broadcast applications, cont.</b>					
<b>Poast 1.5E</b>	sethoxydim	sdIng.-POST est.-POST	1.0 to 2.5 pt	0.19 to 0.47	alfalfa and clover alfalfa and clover
<u>Comments:</u> Poast controls many annual and perennial grass weeds (emerged weeds only). Refer to the label for appropriate rates based on grass species and size. Apply to actively growing grasses by ground in 5 to 20 gal/A or by air in a minimum of 5 gal/A of water. Always add crop oil concentrate to the spray solution. Repeated applications are required for complete control of perennial grasses. Poast can be tank-mixed with 2,4-DB. Observe all grazing and harvest restrictions (Table 4).					
<b>Prowl H<sub>2</sub>O 3.8AS</b>	pendi-methalin	sdIng.-POST sdIng.-dormant est.-dormant post-cutting	0.5 to 1.0 qt 0.5 to 1.0 qt 1.1 to 4.2 qt 1.1 to 4.2 qt	0.48 to 0.95 0.48 to 0.95 1.0 to 4.0 1.0 to 4.0	alfalfa alfalfa alfalfa alfalfa
<u>Comments:</u> Prowl H <sub>2</sub> O provides 1 to 2 months of residual control of most annual grasses and some annual broadleaf weeds as they germinate. It will not control any weeds that have already emerged at the time of application. Apply by ground in a minimum of 10 gal/A or by air in a minimum of 5 gal/A of water. Adequate rainfall or overhead irrigation is required after application to activate Prowl H <sub>2</sub> O. Applications can be made to seedling alfalfa after the legume has two fully expanded trifoliolate leaves. Established alfalfa is defined by the label as alfalfa planted in the fall or spring which has gone through a first cutting/mowing. Dormant applications can be made in the fall after the last cutting, during winter dormancy, or anytime in the spring prior to 6 inches of alfalfa regrowth. Post-cutting applications should also be made prior to 6 inches of regrowth. Some stunting and chlorosis of the alfalfa may occur. Prowl H <sub>2</sub> O can be tank-mixed with other labeled herbicides. Observe all grazing and harvest restrictions (Table 4).					
<b>Pursuit 2AS</b>	imazethapyr	sdIng.-POST est.-POST sdIng.-dormant est.-dormant post-cutting	3.0 to 6.0 fl oz	0.047 to 0.094	alfalfa and clover alfalfa and clover alfalfa and clover alfalfa and clover alfalfa and clover
<u>Comments:</u> Pursuit controls or suppresses many annual and some perennial broadleaf weeds, as well as several grasses when they are small. Pursuit also provides 1 to 2 months of residual control of many emerging weeds. Apply by ground in a minimum of 10 gal/A or by air in a minimum of 5 gal/A of water. The addition of an adjuvant (COC or NIS) and a fertilizer solution (UAN or AMS) is required for all applications. Applications should be made when weeds are 1 to 3 inches tall or rosettes are less than 3 inches in diameter. Applications can be made to seedling alfalfa or clover after the legume has two fully expanded trifoliolate leaves. Dormant applications can be made in the fall after the last cutting or anytime in the spring prior to 3 inches of alfalfa or clover regrowth. Post-cutting applications should also be made prior to 3 inches of regrowth. Do not apply more than 4 oz/A to alfalfa or clover in the last year of the stand. Pursuit can be tank-mixed with Buctril (seedling alfalfa only), 2,4-DB, Poast, or Prism or Select. Pursuit plus glyphosate is available as a premix product called Extreme for use only on Roundup-Ready alfalfa. Observe all grazing and harvest restrictions (Table 4).					

Herbicide		Application timing	Rate		Labeled crop(s)
Trade name	Common name		product/A	lb ai/A	
<b>In-crop broadcast applications, cont.</b>					
<b>Raptor 1AS</b>	imazamox	sdIng.-POST sdIng.-dormant est.-dormant post-cutting	4.0 to 6.0 fl oz	0.031 to 0.047	alfalfa alfalfa alfalfa alfalfa
<p><b>Comments:</b> Raptor controls or suppresses many annual and some perennial broadleaf weeds, as well as several grasses when they are small. Raptor also provides approximately one month of residual control of many emerging weeds. Apply by ground in a minimum of 10 gal/A or by air in a minimum of 5 gal/A of water. Do not apply Raptor in liquid fertilizer as a carrier. The addition of an adjuvant (COC or NIS) and a fertilizer solution (UAN or AMS) is required for all applications. Applications should be made when weeds are 1 to 3 inches tall or rosettes are less than 3 inches in diameter. Applications can be made to seedling alfalfa after the legume has two fully expanded trifoliolate leaves. Seedling alfalfa may experience a temporary reduction in growth. Dormant applications can be made in the fall after the last cutting or anytime in the spring prior to 3 inches of alfalfa regrowth. Post-cutting applications should also be made prior to 3 inches of regrowth. Raptor can be tank-mixed with Buctril (seedling alfalfa only), 2,4-DB, Poast, or Prism or Select. Observe all grazing and harvest restrictions (Table 4).</p>					
<b>Roundup PowerMAX or WeatherMax 5.5L</b>	glyphosate	sdIng.-POST est.-POST	11 to 44 fl oz	0.47 to 1.9	Roundup-Ready alfalfa Roundup-Ready alfalfa
<p><b>Comments: For use on Roundup-Ready alfalfa only.</b> Roundup provides broad-spectrum control of existing grass and broadleaf weeds, but has no effect on weeds emerging after application. Some species of weeds may require retreatment for complete control, as will species with multiple germination flushes. Apply by ground in 3 to 40 gal/A or by air in 3 to 15 gal/A of water. The addition of dry ammonium sulfate at 8.5 to 17 lb/100gal may improve herbicide performance under hard water conditions. Select the appropriate rate (maximum 44 fl oz/A per application) from the weed rate tables on the label. Two applications may be made to seedling stands prior to the first cutting; one from emergence up to the 4-trifoliolate leaf stage and one from the 5-trifoliolate leaf stage to 5 days before the first cutting. After the first cutting in seedling stands, or in established stands, a single application per cutting may be made up to 5 days before cutting. Sequential applications should be at least 7 days apart. The combined total for all in-crop applications can not exceed 4.1 qt/A per year. The combined total for all applications (in-crop and establishment) can not exceed 5.3 qt/A per year. Observe all grazing and harvest restrictions (Table 4). The active ingredient glyphosate is available as a premix with imazethapyr (Extreme 2.17 EC). <b>Note: The Roundup-Ready system in alfalfa is easy to use and very effective on most weeds common to alfalfa plantings. However, herbicide resistant weeds are selected for by repeated use of the same or similar herbicide over a period of time. Weed species with a very high amount of seed production and a variable genetic pool are more likely to develop resistant populations, for example common lambsquarters and pigweed species. Therefore, it is recommended that the Roundup-Ready system be used during the establishment year when the most benefit can be recognized, and then rotate between Roundup and other herbicides with different modes of action through subsequent seasons.</b></p>					
<b>Select Max 1EC</b>	clethodim	sdIng.-POST est.-POST	9.0 to 32 fl oz 12 to 32 fl oz	0.07 to 0.25 0.094 to 0.25	alfalfa alfalfa
<p><b>Comments:</b> Select Max controls many annual and perennial grass weeds (emerged weeds only). Refer to the label for appropriate rates based on grass species and size. Apply to actively growing grasses by ground in 10 to 40 gal/A or by air in a minimum of 10 gal/A of water. Select Max has a partial adjuvant system included. Always add a nonionic surfactant or crop oil concentrate to the spray solution. Repeated applications are required for complete control of perennial grasses. Allow a minimum interval of 14 days between repeat applications. Select Max can be tank-mixed with 2,4-DB, Pursuit, Raptor, or Buctril (seedling alfalfa only). Observe all grazing and harvest restrictions (Table 4).</p>					

Herbicide		Application timing	Rate		Labeled crop(s)
Trade name	Common name		product/A	lb ai/A	
<b>In-crop broadcast applications, cont.</b>					
<b>Sinbar 80WP</b>	terbacil	est.-dormant post-cutting	0.75 to 1.5 lb	0.6 to 1.2	alfalfa alfalfa
<p><u>Comments:</u> Sinbar provides postemergence control (small weeds) and 1 to 2 months of soil residual control of many annual weeds and some biennial and perennial weeds. Use only on alfalfa established for 1 year or more. Apply by ground in water with sufficient spray volume for uniform coverage. Do not use any spray adjuvants. Weeds should be less than two inches tall or two inches in diameter. Dormant applications can be made in the fall through winter to dormant alfalfa or in the spring prior to 2 inches of alfalfa regrowth. Spring post-cutting applications should also be made prior to 2 inches of regrowth. Two applications per year are allowed, but they must be separated by 60 days, and the total amount of Sinbar can not exceed 1.5 lb/A per year. No other crops can be planted for two years following an application of Sinbar. Do not use on sand, loamy sand, or gravel soils, or on soils with less than 1% organic matter or serious crop injury can occur. Sinbar can be tankmixed with up to 2 pt/A (0.5 lb ai/A) of 2,4-DB. Do not apply Sinbar and Gramoxone SL as sequential treatments as severe crop injury can occur. No grazing or harvest restrictions are on the label.</p>					
<b>Velpar 2L</b>	hexazinone	est.-dormant post-cutting	2.0 to 6.0 pt	0.5 to 1.5	alfalfa alfalfa
<p><u>Comments:</u> Velpar provides postemergence control (small weeds) and 1 to 2 months of soil residual control of many annual, biennial, and perennial weeds as well as suppression of some woody species. Use only on alfalfa established for 1 year or more. Apply by ground in a minimum of 20 gal/A or by air in a minimum of 5 gal/A of water. A nonionic surfactant can be used on dormant alfalfa only. Weeds should be less than two inches tall or two inches in diameter. Make dormant applications in the spring prior to 2 inches of alfalfa regrowth, or a post-cutting application prior to 2 inches of regrowth. Only one application per year is allowed. Most crops can not be planted for two years following an application of Velpar. Do not use on gravelly or rocky soils, exposed subsoils, or hardpan, sand, or poorly drained soils or serious crop injury can occur. Unacceptable weed control may occur on soils with greater than 5% organic matter. Tankmixing with other labeled products is allowed, but no tankmix partners are specified on the label. Observe all grazing and harvest restrictions (Table 4).</p>					
<b>2,4-DB 2L</b>	2,4-DB	sdIng.-POST est.-POST	1.0 to 3.0 qt	0.5 to 1.5	alfalfa alfalfa
<p><u>Comments:</u> 2,4-DB controls a relatively narrow spectrum of emerged broadleaf weeds, and is particularly effective on morningglory species. It may be used on seedling and established alfalfa. Apply to healthy, actively growing alfalfa by ground in a minimum of 10 gal/A or by air in 5 to 40 gal/A of water. Weeds should be no more than three inches tall or three inches in diameter. A nonionic surfactant may be added under dry, low humidity conditions but only when spraying seedling alfalfa. Otherwise, do not use any adjuvants with 2,4-DB. Do not spray when the temperature exceeds 90F or is predicted to exceed 90F for 3 days following application. 2,4-DB can be tankmixed with Poast (alfalfa only), Buctril (seedling alfalfa only), or other labeled herbicides. Observe all grazing and harvest restrictions (Table 4).</p>					

Herbicide rates in the following section are given as product per acre, pounds of active ingredient per acre, and ounces (oz.wt.) and grams (gr) of product per gallon of solution for dry products, or fluid ounces (fl.oz.) and milliliters (ml) of product per gallon of solution for liquid products. The “per gallon” amounts are often very small and can be difficult to accurately weigh or measure without specialized equipment (ie: gram scales, syringes, etc.). See Table 27. These per gallon rates or rate ranges are based on an application volume of 1 gallon per 1,000 square ft (gal/1000ft<sup>2</sup>), which is roughly equivalent to 40 gallons per acre (gpa). When using a backpack sprayer or other hand-held equipment, this volume can usually be achieved by spraying to the point where the target foliage is wet, but not to the point where the spray solution begins to run off of the foliage. It is always best to properly calibrate all spray equipment. Spraying to the point of run-off will result in herbicide over-application, which may cause forage injury and/or a longer safe over-seeding interval in treated areas.

Herbicide		Applications allowed	Rate			
Trade name	Common name		product/A	lb ai/A	oz.wt. or fl.oz./gal	gram or ml/gal
<b>Spot-spray applications</b>						
<b>Glyphosate</b>	glyphosate	Spot-spray or wiper applicator	20 to 80 oz	0.86 to 3.4	0.5 to 2 fl.oz.	15 to 59 ml
<p><u>Comments:</u> For use on alfalfa and clover. The rates, timings, and comments for this entry are from the Roundup WeatherMax label. Make applications with hand-held equipment or wiper applicators. Apply only to weed-infested areas of the field, and do not treat more than one tenth of the total area at any one time. Remove livestock before application and wait 3 days before grazing or harvesting. Subsequent applications to the same areas can be made at 30-day intervals. Refer to weed rate tables of the herbicide label for the recommended herbicide concentration. For spot treatment, apply on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. Spot treatment with glyphosate will kill all desirable vegetation that is contacted by the herbicide. Consult the herbicide label for specific wiper applicator recommendations. For best results, do not graze or harvest forage for seven days after application, and make applications at least seven days before a killing frost.</p>						
<b>Gramoxone 2SL</b>	paraquat	Spot-spray	1.0 to 3.0 pt	0.25 to 0.75	0.2 to 0.7 fl.oz.	12 to 35 ml
<p><u>Comments:</u> For use on alfalfa and clover. Spot-spraying with Gramoxone SL is recommended when only small areas are to be sprayed with labeled applications (see earlier entry for labeled application timings and rates). Apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. Always add a nonionic surfactant at 0.5 fl.oz./gal (15 ml/gal). Observe all grazing and harvest restrictions based on the per acre rate (Table 4). <b>Gramoxone SL is a restricted use pesticide.</b></p>						
<b>Poast 1.5E</b>	sethoxydim	Spot-spray	1.0 to 1.5 % v/v solution	0.6 to 0.9	1.3 to 1.9 fl.oz.	38 to 57 ml
<p><u>Comments:</u> For use on alfalfa and clover. Do not make spot treatments in addition to broadcast treatments. Apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. Always add a crop oil concentrate at 1.3 fl.oz./gal (38 ml/gal). Observe all grazing and harvest restrictions based on the per acre rate (Table 4).</p>						



Herbicide		Applications allowed	Rate			
Trade name	Common name		product/A	lb ai/A	oz.wt. or fl.oz./gal	gram or ml/gal
<b>Spot-spray applications, cont.</b>						
<b>Select Max 1EC</b>	clethodim	Spot-spray	0.33 to 0.67 % v/v solution	0.14 to 0.26	0.44 to 0.85 fl.oz.	12.5 to 25 ml
<p><u>Comments:</u> <i>For use on alfalfa only.</i> Do not exceed a total of 64 fl oz/A per season for spot treatments and broadcast treatments. Apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. Always add a crop oil concentrate at 1.3 fl.oz./gal (38 ml/gal). Observe all grazing and harvest restrictions based on the per acre rate (Table 4).</p>						

## Chemical Weed Control in Grass Forage

“Grass forage” in this guide refers primarily to cool-season perennial grass species (fescue, orchardgrass, ryegrass, timothy, and others). A cool-season forage grass identification key is provided at the end of this publication. Weed management in summer annual grasses (forage sorghum, sudangrass, sorghum-sudan hybrids, millets, teff, and crabgrass) is covered briefly in Table 19. Applications to winter annual grasses grown for forage (barley, oats, rye, wheat, and others) are not covered in this guide. Refer to herbicide labels for these grasses.

Choosing the right herbicides for chemical weed control in grass forage is dependent on grass growth stage (prior to seeding, seedling stage, or established). Table 12 shows herbicides labeled for use on grass forage and at which growth stages the herbicides can be applied.

Forage grasses must be tolerant of herbicide applications to remain healthy, competitive, and productive. Forage grass species, or varieties within species, may vary in their tolerance to specific herbicide applications. It is important to read labels carefully to determine the appropriate herbicide, use rate, application timing, and adjuvant recommendations for the species or variety being treated. In addition, grasses that are under stress from extreme environmental conditions (i.e. extreme temperatures, wetness, drought, hail, etc.) or cultural conditions (i.e. pH extremes, poor fertility, insect or disease damage, etc.) are more susceptible to herbicide injury than healthy grasses.

It is very important to consider herbicide restrictions and precautions when choosing an herbicide. Read herbicide labels thoroughly and be certain that you understand the restrictions and precautions before purchasing an herbicide. Labels are available from manufacturers or on-line at [www.cdms.net](http://www.cdms.net). Table 13 provides a comparison of some of the precautions and restrictions for herbicides in grass forage. This table is general in nature and should not be used as a replacement for herbicide labels. A brief description of each column in the table and how it is important in choosing an herbicide appears before the table. Table 14 is a more detailed listing of rotational crop and over-seeding restrictions for grass forage herbicides. Table 15 is a more detailed listing of grazing, harvest, slaughter, and livestock transfer restrictions for grass forage herbicides.

Once the crop's growth stage has been determined, and restrictions and precautions have been considered, the spectrum of weed control needed must be determined. Accurate weed identification is vital when choosing a postemergence herbicide. Table 16 lists several weed species common to Delaware and the relative effectiveness of various herbicides for their control. The relative effectiveness ratings provided in this guide are based on local or regional experience, which may be limited in some instances, and assume appropriate conditions for optimal herbicide performance. Individual results may vary based on weed size, weed growth stage, and environmental conditions at herbicide application.

The weed lifecycle (annual, biennial, or perennial) and size (width or height) or growth stage at application are also important considerations when choosing an herbicide. Most herbicide labels give the appropriate use rate and maximum height or growth stage for control of specific weeds or classes of weeds.

Often biennial or perennial weeds are more difficult to control with herbicides than annual weeds. Biennial weeds are easier to control while in the rosette stage (year one or prior to bolting and seed production in the second year). Perennial weeds can store vast energy reserves in roots or other underground plant parts, making them difficult to control with contact herbicides. These reserves are used in the spring or summer to produce vegetation and then seed. Perennials are most susceptible to herbicides in the spring at flowering because the reserves are depleted and plant biological activity has peaked. Once seed production occurs, biological activity declines and control may be poor. Fall is also an excellent time for perennial weed control since reserves in underground plant parts are being replenished to prepare the plant for over-wintering and new spring growth. Translocated herbicides

move readily to underground storage sites during this period of time, and often provide good control of targeted weeds. Multiple years of good control are needed to dramatically reduce root systems in well established perennial weeds.

Controlling woody plant species (brush) or vines can be very difficult with standard broadcast herbicide applications. Achieving an acceptable level of certain species or severe infestations with one or multiple species can require multiple years of intensive weed management. Product labels often have specific recommendations concerning herbicide rate, spray volume, seasonal application, retreatment, and growth stage. Recommendations are often species specific, and tank-mixes with other herbicides or alternative application methods may be required. Application methods may include basal bark, cut stump, dormant stem, oil-water emulsions, or high volume foliar applications. Carefully read and follow all herbicide label recommendations.

Many postemergence herbicides require the addition of adjuvants in the spray mixture to achieve maximum herbicide performance. In addition, some adjuvant recommendations are specific to the grass species being treated. Most postemergence herbicides also require a minimum time period between herbicide application and rainfall or overhead irrigation (rainfast period) to ensure sufficient absorption into the plant. Table 17 lists rainfast periods and recommended adjuvants for grass pasture and hay herbicides. Additional information including herbicide common name, use rates, and specific comments, is provided for each herbicide in Table 18.

### Definitions for Table 12 (next page)

WSSA mode of action (MOA) group: Herbicide mode (or site) of action is important for minimizing the risk of developing herbicide resistant weed populations. See Table 23.

Establishment: Herbicide is applied preplant in no-till establishment to control existing weeds. There are currently no herbicides registered for preplant incorporated (PPI) or preemergence (PRE) applications in grass forage for residual weed control.

Seedling stand POST: Herbicide is applied postemergence (POST) to seedling grass that has reached a specific growth stage and is actively growing, or at a maximum allowable rate.

Established stand POST: Herbicide is applied POST to grass that has been established for a minimum length of time and is actively growing.

Spot-spray application: Herbicide is applied only to weed-infested areas of the field; usually with hand-held equipment. If the herbicide is labeled for seedling or established stands postemergence, then herbicide use rates, application timing, and minimum establishment periods should be observed unless otherwise stated on the label. Grazing, harvest, slaughter, and transfer restrictions still apply for all spot-spray applications.

Grazed Fencerows: Herbicide is applied along a grazed fencerow to control emerged weeds and/or prevent seedling emergence. Use postemergence broadcast rates and timings unless grazed fencerows are specifically mentioned on the label. If the herbicide is labeled for spot applications, and the total area of the fencerows being treated is less than 10% of the total area inside the fencerows, spot application recommendations can be used. Grazing, harvest, slaughter, and transfer restrictions still apply for all applications to grazed fencerows.

**Table 12: Application Timings for Herbicides used in Grass Pasture or Hay<sup>a</sup>**

Herbicide	WSSA MOA group	Establishment	Seedling stand POST <sup>b</sup>	Established stand POST <sup>b</sup>	Spot-spray application <sup>c</sup>	Grazed Fence-rows <sup>c</sup>
Aim	14		L	L		X
Arsenal	2					X <sup>d</sup>
Banvel	4		1 pt max <sup>e</sup>	L	X	X
Clarity	4		1 pt max <sup>e</sup>	L	X <sup>g</sup>	X
Banvel or Clarity + 2,4-D tankmix	4			L		X
Crossbow <sup>k</sup>	4			after tillering <sup>m</sup>	X	X
Facet L	4 & 26			L	X	X
Glyphosate	9	Preplant Renovation			X <sup>g,n</sup>	X <sup>d</sup>
Gramoxone SL	22	Preplant				
MCPA	4		½ pint max <sup>p</sup>	L		X
Metsulfuron	2			6-24 months <sup>h</sup>	X	X
Overdrive <sup>k</sup>	4 & 19			L	X	X
PastureGard HL	4			after tillering <sup>m</sup>	X	X
Remedy Ultra	4			after tillering <sup>m</sup>		X
Sandea	2			L	X	X
Spike 20P (pelleted)	7			L <sup>q</sup>	X <sup>q</sup>	X <sup>q</sup>
Weedmaster <sup>k</sup>	4		2 pt max <sup>e</sup>	L	X	X
2,4-D ester <sup>r</sup>	4			L	-- <sup>s</sup>	X
2,4-D amine <sup>r</sup>	4			L	-- <sup>s</sup>	X

<sup>a</sup>see definitions on preceding page.

<sup>b</sup>L = allowed on herbicide label with no specific grass size or establishment period restrictions.

<sup>c</sup>X = allowed on herbicide label; follow grass size or growth stage restrictions for seedling or established stand POST, whichever applies, unless otherwise stated. Consult label.

<sup>d</sup>not labeled for postemergence broadcast applications to cool-season grasses, but can be used on fencerows; see details in Table 18.

<sup>e</sup>labels state that “newly seeded areas” may be severely injured if rates greater than 1 pt/A (Banvel or Clarity) or 2 pt/A (Weedmaster) is applied, but no minimum size or growth stage is given. In practice, these products should not be applied until seedling grasses have attained the 3 to 4-leaf stage, have reached a minimum height of 6 inches, and are healthy and actively growing.

<sup>g</sup>also labeled for wiper applications; see spot-spray applications in Table 18 and consult label for details.

<sup>h</sup>6 months after establishment for bluegrass, bromegrass, and orchardgrass; 12 months for Timothy; 24 months for fescue.

<sup>k</sup>this is a premix product containing 2,4-D and/or dicamba. See table 22a for a comparison of 2,4-D or dicamba concentrations in various premix products

<sup>m</sup>grasses should be tillering and have developed a good secondary root system.

<sup>n</sup>not labeled for postemergence broadcast applications to cool-season grasses, but can be used as a spot-spray treatment; see details in Table 18.

<sup>p</sup>this is labeled for mixed clover/grass stands after 2-trifoliate clover.

<sup>q</sup>Spike is labeled for broadcast applications, but because it can persist for several years in the soil, it is generally only recommended for hand treatment of single plants, multistem clumps, or small stands of woody vegetation in land (including fencerows) dedicated to long term grass pasture.

<sup>r</sup>2,4-D is manufactured by various companies; labels may vary among manufacturers.

<sup>s</sup>most 2,4-D labels do not include spot-spray applications while some do.



Orchardgrass  
*Dactylis glomerata*



Tall Fescue  
*Festuca arundinacea*



Timothy  
*Phleum pratense*



Smooth Bromegrass  
*Bromus inermis*



Kentucky Bluegrass  
*Poa pratensis*



Italian Ryegrass  
*Lolium multiflorum*

## Definitions for Table 13

**Risk to desirable (non-target) plants:** Herbicides vary in their ability and potential to affect other plants in the vicinity of the crop being treated. Herbicides can affect non-target plants by direct contact through misapplication, herbicide drift with wind or temperature inversions, contact with roots, or in water vapor (volatility). Effects can also be a result of indirect contact through the soil to plants roots, or through contact with herbicide residues in straw, grass clippings, mulch, or compost from treated crops, as well as manure from animals consuming treated crops.

**Sensitivity of desirable plants:** This column describes the relative toxicity of the herbicide to desirable plants at a low to moderate dose such as would occur with drift or misapplication. A high rating would indicate that the affected plant could suffer severe injury or death.

**Translocation in plant:** Herbicides that are moved in the plant from the point of contact to other parts of the plant are generally more toxic to non-target plants at low to moderate doses.

**Soil activity desirable plants:** This column indicates the herbicides potential to cause serious injury or death to desirable plants through root activity in the soil or if sprayed on exposed roots.

**Potential for volatility:** This column indicates the herbicides relative potential to evaporate and move with water vapor. Most herbicides with a high potential for volatility require immediate soil incorporation to minimize the potential for volatility losses.

**Residues in straw, mulch, or compost:** Some herbicides can remain in target plants at high enough levels (residues) to cause non-target plant injury when target plant tissue comes into contact with desirable plants. This can occur when straw, mulch, or compost from treated plants are used in plant beds or around ornamental plantings. Manure and urine from animals grazing treated plants can also contain enough residues to injure desirable plants through direct contact or in composted manure.

**Environmental (Groundwater advisory):** Herbicides with a groundwater advisory have the potential to move through treated soils, particularly sandy soils with low organic matter content, and contaminate groundwater that may be used for drinking water purposes. Use of these herbicides may be restricted on certain soil types or in areas with a shallow water table.

**Risk to humans:** Herbicides can be toxic to humans when absorbed through the skin, inhaled, or ingested (swallowed). Herbicide labels contain several types of precautions to promote safe use and prevent accidental exposure, provide information on what to do in case of exposure or poisoning, and include requirements for personal protective equipment. Three categories are listed to demonstrate the relative human toxicity of each herbicide.

**Signal word:** All herbicides are labeled with Caution (slightly toxic), Warning (moderately toxic), or Danger (highly toxic). Precautionary statements will follow that describe how the herbicide is toxic and what modes of entry are important to avoid.

**Restricted Use:** Restricted use herbicides can only be purchased and used by certified applicators. They are classified as restricted use due to acute toxicity or environmental concerns.

**Restricted entry interval (REI):** A specified time period is designated between the herbicide application and when workers can re-enter treated areas without designated personal protective equipment (PPE).

**Use rate:** The maximum use rate, number of applications allowed per season, and the total amount of all applications allowed in a season are important in determining what species each herbicide will effectively control in a particular crop. Most labels have tables that tell what use rate is required for control of various weed species.

**Replant or over-seeding:** It is important to know when other crops (rotational crops) can be safely planted into a field treated with an herbicide, particularly for fields that may not be in long-term forage production. In addition, forage producers may want to over-seed grasses into legume crops, or legumes into grass crops (e.g. frost-seeding). Herbicide choices may be limited when over-seeding is planned.

**Grazing or harvest restrictions:** Grazing restrictions or pre-harvest intervals (PHI) are important in considering whether to use a particular herbicide, or could influence the timing, or in some cases the rate, of herbicide applications.

**Table 13: Comparison of Restrictions and Precautions for Herbicides in Grass Pasture or Hay<sup>a</sup>**

Grass herbicide	Restrictions or precautions								
	Risk to desirable (non-target) plants					Environmental	Risk to humans		
	Sensitivity of desirable plants	Translocation in plant	Soil activity - desirable plants	Potential for volatility	Residue in straw mulch compost manure urine <sup>b</sup>	Ground-water advisory	Signal word	Restricted use	Restricted entry interval (hours)
Aim	mod	no	none	very low	no	no	caution	no	12
Arsenal	high	yes	high	very low	no	no	caution	no	48
Banvel	high	yes	mod	mod-low	no	yes	warning	no	24
Clarity	high	yes	mod	low-mod	no	yes	caution	no	24
Crossbow	high	yes	high	mod	no	yes	caution	no	until dry
Facet L	high	yes	high	low	no	yes	caution	no	12
Glyphosate	high	yes	none	v.low-low	no	no	caution	no	4
Gramoxone SL	high	no	none	very low	no	no	danger	yes	12
MCPA	mod	yes	mod	low-mod	no	yes	danger	no	48
Metsulfuron	mod	yes	high	very low	no	no	caution	no	4
Overdrive	high	yes	mod	low	no	yes	caution	no	12
PastureGard	high	yes	high	low	no	yes	danger	no	12
Remedy Ultra	high	yes	high	low	no	yes	caution	no	until dry
Sandea	mod	yes	high	very low	no	yes	caution	no	12
Spike	high	yes	very high	very low	no	yes	caution	no	N/A
Weedmaster	high	yes	mod	mod-low	no	yes	danger	no	48
2,4-D ester	high	yes	mod	mod	no	yes	caution	no	12
2,4-D amine	high	yes	mod	low	no	yes	danger	no	48

<sup>a</sup>see preceding definitions.

<sup>b</sup>due to the risk to broadleaf and mushroom crops associated with potential residues in hay, straw, manure, and urine (fresh or composted), herbicides that have this potential (products containing aminopyralid or clopyralid) are not generally recommended in Delaware at this time. In addition, Dow AgroSciences has discontinued the sale of aminopyralid products in Delaware (including all of the Delmarva Peninsula), and the states of CT, MA, ME, NH, NJ, NY, RI and VT.

Table 13 cont'd: Comparison of Restrictions and Precautions for Herbicides in Grass Pasture or Hay<sup>a</sup>

Grass herbicide	Restrictions or Precautions <sup>b</sup>							
	Use Rate			Replant or overseeding <sup>c</sup> (months)			Grazing or harvest interval (days) <sup>d</sup>	
	Max. use rate/A	Max. # of applic.	Total season max/A	To forage legume	To forage grass	To other crops	For lactating dairy	For other animals
Aim 2EW	2 oz	3	5.9 oz	12	0	0-12	0	0
Arsenal 2AS	3 pt	-- <sup>e</sup>	3 pt	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	0 - 7	0 - 7
Banvel 4L	2 pt	-- <sup>e</sup>	4 pt	AH <sup>h</sup>	1 - 3	AH <sup>h</sup>	7 - 70	0
Clarity 4L	2 pt	-- <sup>e</sup>	4 pt	4	1 - 4	4	7 - 70	0
Crossbow 3L	4 qt	-- <sup>e</sup>	4 qt	NS <sup>k</sup>	1	NS <sup>k</sup>	14 - NS <sup>k</sup>	0 - 14
Facet 1.5L	2 qt	-- <sup>e</sup>	2 qt	24 + FB <sup>g</sup>	10	0 - 24	0 - 7	0 - 7
Glyphosate <sup>m</sup> preplant, renovation, or spot treatment	3.3 qt	-- <sup>e</sup>	5.3 qt	0	0	0 - 1	0 - 56	0 - 56
Gramoxone 2SL preplant	2 pt	3	6 pt	0	0	0	--	--
MCPA 3.7L	4 pt	2	8 pt	--	--	--	7	7
Metsulfuron 60DF	0.4 oz	-- <sup>e</sup>	1.6 oz	12 - 34 or FB <sup>g</sup>	2 - 34 or FB <sup>g</sup>	1 - 34 or FB <sup>g</sup>	0	0
Overdrive 70WG	8 oz	-- <sup>e</sup>	8 oz	1	1	1	0	0
PastureGard HL 4L	2 qt	-- <sup>e</sup>	2 qt	1	0.75	1 - 4	NS <sup>k</sup>	0-14
Remedy Ultra 4L	2 qt	-- <sup>e</sup>	2 qt	NS <sup>k</sup>	0.75	NS <sup>k</sup>	NS <sup>k</sup>	0
Sandea 75DF	1.3 oz	-- <sup>e</sup>	1.3 oz	9	2	0-36	0 - 37	0 - 37
Spike 20P <sup>n,p</sup>	20 lb	1	20 lb	FB <sup>g,n</sup>	NS <sup>k</sup>	FB <sup>g,n</sup>	0 - 365	0 - 365
Weedmaster 3.87L	4 pt	-- <sup>e</sup>	8 pt	4	1 - 2	1 - 4	7 - 37	0 - 37
2,4-D ester 3.8L <sup>q</sup>	3 qt	--	--	NS <sup>k</sup>	NS <sup>k</sup>	NS <sup>k</sup>	7 - 30	0 - 30
2,4-D amine 3.8L <sup>q</sup>	2 qt	--	--	NS <sup>k</sup>	NS <sup>k</sup>	NS <sup>k</sup>	7 - 30	0 - 30

<sup>a</sup>see preceding definitions.

<sup>b</sup>an "--" indicates that the information is not specified on the label.

<sup>c</sup>this table provides general comparisons only; see Table 14 for more detailed replant and over-seeding restrictions.

<sup>d</sup>this table provides general comparisons only; see Table 15 for more detailed grazing, harvest, slaughter, and animal transfer restrictions.

<sup>e</sup>not specified, but the sum of all applications can not exceed the maximum seasonal use rate.

<sup>g</sup>FB = field bioassay required.

<sup>h</sup>AH = after normal harvest of crop in which herbicide was applied.

<sup>k</sup>NS = next growing season after application.

<sup>m</sup>glyphosate rates and restrictions are from Roundup WeatherMax label.

<sup>n</sup>**do not use this product on land intended for rotation to legumes, row crops, shrubs, or trees unless herbicide injury in treated areas can be tolerated for several years.**

<sup>p</sup>for single plant, multistem clump, or small stand woody plant treatment only.

<sup>q</sup>2,4-D is manufactured by various companies; labels may vary among manufacturers.



**Table 14: Rotational Crop / Over-seeding Restrictions for Herbicides in Grass Pasture or Hay<sup>a</sup>**

Herbicide	Rotational crops (months after application)							
	Alfalfa	Clover	Forage grasses	Field corn	Small grains	Grain sorghum	Soybean	Other crops <sup>b</sup>
Aim	12	12	0	0	0	0	0	0 - 12
Arsenal	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>	12 + FB <sup>g</sup>
Banvel	AH <sup>c</sup>	AH <sup>c</sup>	20 days per pint	NS <sup>d,e</sup>	20 days per pint	NS <sup>d,e</sup>	NS <sup>d,e</sup>	AH <sup>c,e</sup>
Clarity	4	4	30 days per pint	4 <sup>e</sup>	30 days per pint	4 <sup>e</sup>	4 <sup>e</sup>	4 <sup>e</sup>
Crossbow	NS <sup>d</sup>	NS <sup>d</sup>	21 days	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>
Facet	24 + FB <sup>g</sup>	24 + FB <sup>g</sup>	10	10	0 - 10	0	10	10 - 24
Glyphosate	0	0	0	0	0	0	0	0 - 1
Gramoxone SL	0	0	0	0	0	0	0	0
MCPA	--	--	--	--	--	--	--	--
Metsulfuron 0.1 - 0.2 oz	34 or FB <sup>g</sup>	12	6 - 34 <sup>h</sup>	34 or FB <sup>g</sup>	1 - 10	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>
0.2 - 0.4 oz	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>h</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>
Overdrive	1	1	1	1	1	1	1	1
PastureGard	4	4	21 days	4	21 days	4	4	4
Remedy Ultra	NS <sup>d</sup>	NS <sup>d</sup>	21 days	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>
Sandea	9	9	2	0 - 2	2	2	5	0-36
Spike <sup>k</sup>	FB <sup>g,k</sup>	FB <sup>g,k</sup>	NS <sup>d</sup>	FB <sup>g,k</sup>	FB <sup>g,k</sup>	FB <sup>g,k</sup>	FB <sup>g,k</sup>	FB <sup>g,k</sup>
Weedmaster	4	4	10 days per pint	4	10 days per pint	4	4	4
2,4-D ester	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d,e</sup>	NS <sup>d</sup>	NS <sup>d,e</sup>	NS <sup>d,e</sup>	NS <sup>d</sup>
2,4-D amine	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d</sup>	NS <sup>d,e</sup>	NS <sup>d</sup>	NS <sup>d,e</sup>	NS <sup>d,e</sup>	NS <sup>d</sup>

<sup>a</sup>an "--" indicates that a rotational restriction for that crop is not specified on the label.

<sup>b</sup>refer to herbicide label for specific crops. Consider rotational intervals for annual grass or broadleaf crops that may be over-seeded or rotationally planted for supplemental forage.

<sup>c</sup>AH = after normal harvest of crop in which herbicide was applied.

<sup>d</sup>NS = next growing season after application.

<sup>e</sup>some crops are labeled for preplant applications of this product, but often at lower rates than normally used in pasture. If the rate used does not exceed what is allowed in the preplant section of the label, shorter rotational restrictions may be allowed. Consult the label concerning preplant applications for each specific crop.

<sup>g</sup>FB = a field bioassay is required prior to planting the crop; refer to herbicide label for instructions.

<sup>h</sup>over-seeding interval to forage grasses is specific to region, soil pH, metsulfuron rate, and grass species. The following applies for soils with a pH of 7.5 or less in our region. Reed canarygrass is not listed on the label.

Metsulfuron rate per acre	Over-seeding interval (months after metsulfuron application)							
	Bermuda-grass	Blue-grass	Brome-grass	Reed Canary	Tall Fescue	Orchard-grass	Rye-grass	Timothy
0.1 to 0.2 oz	6	6	6	34 or FB <sup>g</sup>	18	6	6	6
0.2 to 0.4 oz	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>	34 or FB <sup>g</sup>

<sup>k</sup>do not use this product on land intended for rotation to legumes, row crops, shrubs, or trees unless herbicide injury in treated areas can be tolerated for several years.

**Table 15: Grazing, Harvest, and Slaughter Restrictions for Herbicides in Grass Pasture or Hay**  
Minimum Intervals as Directed on Herbicide Labels

Grass Herbicide	Restrictions for treated forage						Remove meat animals before slaughter (days)
	Grazing (days)		Green forage harvest (days) <sup>a</sup>		Hay harvest (days)		
	For lactating dairy	For other animals	For lactating dairy	For other animals	For lactating dairy	For other animals	
Aim 2EW	0	0	0	0	0	0	0 <sup>c</sup>
Arsenal 2AS	0	0	0	0	7	7	0 <sup>c</sup>
Banvel 4L							
up to 1 pt	7	0	-- <sup>d</sup>	-- <sup>d</sup>	37	0	30
up to 2 pt	21	0	-- <sup>d</sup>	-- <sup>d</sup>	51	0	30
up to 4 pt	40	0	-- <sup>d</sup>	-- <sup>d</sup>	70	0	30
Clarity 4L							
up to 1 pt	7	0	-- <sup>d</sup>	-- <sup>d</sup>	37	0	0 <sup>c</sup>
up to 2 pt	21	0	-- <sup>d</sup>	-- <sup>d</sup>	51	0	0 <sup>c</sup>
up to 4 pt	40	0	-- <sup>d</sup>	-- <sup>d</sup>	70	0	0 <sup>c</sup>
Crossbow 3L	NS <sup>e</sup>	0	-- <sup>d</sup>	-- <sup>d</sup>	14	14	3
Facet 1.5L	0	0	-- <sup>d</sup>	-- <sup>d</sup>	7	7	0 <sup>c</sup>
Glyphosate <sup>g</sup> preplant <sup>h</sup>							
up to 2qt	0	0	0	0	0	0	0 <sup>c</sup>
preplant <sup>h</sup> > 2 qt	56	56	56	56	56	56	0 <sup>c</sup>
spot up to 2 qt	0	0	0	0	0	0	0 <sup>c</sup>
spot > 2 qt	7	7	7	7	7	7	0 <sup>c</sup>
Gramoxone 2SL preplant	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>
MCPA 3.7L	7	7	7	7	7	7	0 <sup>c</sup>
Metsulfuron 60DF	0	0	0	0	0	0	0 <sup>c</sup>
Overdrive 70WG	0	0	0	0	0	0	0 <sup>c</sup>
PastureGard HL 4L	NS <sup>e</sup>	0	NS <sup>e</sup>	0	14	14	3
Remedy Ultra 4L	NS <sup>e</sup>	0	-- <sup>d</sup>	-- <sup>d</sup>	14	14	3
Sandea	0	0	37	37	37	37	0 <sup>c</sup>
Spike 20P	0	0	0	0	365 <sup>k</sup>	365 <sup>k</sup>	0 <sup>c</sup>
Weedmaster 3.87L	7	0	37	37	37	37	30
2,4-D ester 3.8L <sup>m</sup>	7 <sup>n</sup>	0	-- <sup>d</sup>	-- <sup>d</sup>	30	30	3
2,4-D amine 3.8L <sup>m</sup>	7 <sup>n</sup>	0	-- <sup>d</sup>	-- <sup>d</sup>	30	30	3

<sup>a</sup>includes any green harvested forage such as silage, green chop, etc.

<sup>c</sup>slaughter restrictions are not mentioned on the label.

<sup>d</sup>restrictions are not specified on the label.

<sup>e</sup>NS = next season after application.

<sup>g</sup>glyphosate rates and restrictions are from Roundup WeatherMax label.

<sup>h</sup>preplant applications or renovation of existing grass stands.

<sup>k</sup>do not use in hayfields unless hay harvest in treated areas can be avoided for one year after application.

<sup>m</sup>2,4-D is manufactured by various companies; labels may vary among manufacturers.

<sup>n</sup>the 2,4-D labels do not specify "lactating dairy", but states "do not allow dairy animals to graze within 7 days..."

**Table 16: Susceptibility of Weeds to Herbicides in Grass Pasture or Hay<sup>a</sup>**

The tank-mix of dicamba + 2,4-D (or Weedmaster at 4 pt/A) is considered a standard treatment. The shaded treatments offer significantly improved control of those species when compared to the standard.

Weed Species A = annual W = winter annual B = biennial P = perennial	Treatment and Rate (2,4-D rate based on 3.8 lb/gallon formulation)									
	2,4-D		Dicamba (Banvel or Clarity)				2,4-D + dicamba	Over- drive	MCPA	Aim
	1.0 to 1.5 qt	2.0 qt	0.5 pt	1.0 pt	2.0 pt	4.0 pt <sup>b</sup>	1.0-1.5 qt + 1.0 pt	8.0 oz	1.0 pt	0.5 to 2.0 oz
Amaranth, spiny (A)	F-G	G	P-F	F	G	G	G	G	P	L
Aster spp. (P)	G	G	F	F-G	G	G	G	G	—	—
Bedstraw spp. (A)	P	P	N	N	P	P-F	P <sup>c</sup>	N	—	L
Bindweed, field (P)	F	F	P	P-F	F	G	F	P-F	P-F	F
Bindweed, hedge (P)	G	G	P-F	F	G	G	G	F-G	P-F	—
Blackberry (upright P)	P	P	N	N	P	P-F	P-F <sup>c</sup>	F	—	—
Brackenfern (P)	P	P	N	N	P	P-F	P <sup>c</sup>	N	—	—
Burdock spp (B)	G	G	P	P-F	F	G	G	F	F-G	—
Buttercup spp. (P)	G	G	P	F	F-G	G	G	F	F	—
Carrot, wild (B)	F-G	G	P	F	G	G	G	F	—	—
Catsear, Common (P)	F	G	F	F-G	G	G	G	—	—	—
Chamomile spp. (W, A)	P	P	F	F-G	G	G	G	F-G	—	—
Chickweed, common (W)	P	P	P-F	F	G	G	G	F-G	N	—
Chickweed, mouseear (P)	P	P	P	P-F	F-G	G	P-F <sup>c</sup>	P-F	N	N-P
Chicory (P)	G	G	P	P	F	F-G	G	P	—	—
Clover, hop (A)	P	P	N	N	P	P-F	P <sup>c</sup>	N	—	—
Clover spp. (P)	P	P-F	P-F	F-G	G	G	F-G	F-G	—	—
Cockle, corn (W)	F	F	G	G	G	G	G	G	—	—
Cocklebur, common (A)	G	G	F-G	G	G	G	G	G	F-G	N
Cowcockle (W, A)	F	F	G	G	G	G	G	G	—	—
Daisy spp. (P)	G	G	F	F-G	G	G	G	F-G	—	—
Dandelion (P)	G	G	P	F	F-G	G	G	F-G	F-G	—
Dewberry spp. (P)	P	P	N	N	P	P-F	P-F <sup>c</sup>	P-F	—	—
Dock spp. (P)	F	F-G	P	P-F	F	F-G	G	P-F	P-F	—
Dogbane, hemp (P)	P	P	P	P	P-F	F-G	F	P-F	N	—
Dogfennel (P)	F	F-G	P	F	F-G	G	F-G	F	—	—
Evening primrose (W, B)	G	G	P-F	F	G	G	G	F	—	—
Fleabane spp. (A)	G	G	F	F-G	G	G	G	F-G	—	—
Garlic wild (P)	F-G	G	P	F	G	G	G	F	F	—
Goldenrod spp. (P)	F	G	P	P	F	F-G	G	P	—	—
Hawkweed spp. (P)	G	G	P	P	F	F-G	G	P	—	—
Henbit or Deadnettle (W)	P	F	P-F	F-G	G	G	G	F-G	N	—
Honeysuckle spp. (P)	P	P	N	N	P	P-F	P <sup>c</sup>	F	—	—
Horsenettle (P)	P	P-F	P	P-F	F	F-G	F	F	N	—
Horseweed (W, A)	G	G	P-F	F-G	G	G	G	F-G	F-G	—
Jimsonweed (A)	G	G	F-G	G	G	G	G	G	P-F	N
Knapweed, spotted (B, P)	F	F	P	P-F	F-G	G	G	F	—	—
Knawel (Ger.moss) (W,A)	P	P	G	G	G	G	G	G	N	—
Knotweed, prostrate (A)	F	F	G	G	G	G	G	G	—	—

<sup>a</sup>G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, N(none) = <20 percent control, L(labeled) = appears on herbicide label as control but insufficient local data exists for rating.

An “—” indicates that insufficient data or experience is available to give a rating.

<sup>b</sup>for spot application only in grass forage or broadcast application in CRP acres.

<sup>c</sup>better control may be obtained with higher rates of 2,4-D plus dicamba. Consult labels for details and precautions.

Table 16 cont'd: Susceptibility of Weeds to Herbicides in Grass Pasture or Hay<sup>a</sup>

The tank-mix of dicamba + 2,4-D (or Weedmaster at 4 pt/A) is considered a standard treatment. The shaded treatments offer significantly improved control of those species when compared to the standard.

Treatment and Rate									Weed Species
Spike <sup>b</sup>	Arsenal <sup>c</sup>	Metsulfuron		Crossbow		PastureGard HL		Remedy	A = annual W = winter annual B = biennial P = perennial
10 to 20 lb	1.0 to 3.0 pt	0.1 to 0.2 oz	0.3 to 0.4 oz	1.0 to 2.0 qt	3.0 to 4.0 qt	0.75 to 1.0 pt	1.5 pt	2.0 to 4.0 pt	
—	—	F	F-G	F-G	G	P	F	F	Amaranth, spiny (A)
—	—	P-F	F	F-G	G	—	—	—	Aster spp. (P)
—	—	N	N	F	F-G	—	L	F-G	Bedstraw spp. (A)
—	L	N	P	P-F	F	P-F	F	F	Bindweed, field (P)
—	L	N	N-P	F-G	G	F	F-G	F-G	Bindweed, hedge (P)
L	—	P-F	F	F	F-G	P	P, L <sup>d</sup>	F	Blackberry (upright P)
—	—	—	F	P	P	—	—	—	Brackenfern (P)
—	L	P-F	F-G	F-G	G	F-G	G	G	Burdock spp (B)
—	—	F-G	G	F-G	G	F	F-G	F	Buttercup spp. (P)
—	L	F-G	G	F	G	P-F	F-G	F-G	Carrot, wild (B)
—	—	—	—	—	—	—	—	—	Catsear, Common (P)
—	—	G	G	—	F	—	—	F-G	Chamomile spp. (W, A)
—	L	G	G	F	F-G	F-G	G	F-G	Chickweed, common (W)
—	L <sup>d</sup>	G	G	F	F-G	F-G	G	F-G	Chickweed, mouseear (P)
—	—	F	G	P-F	F-G	F-G	G	G	Chicory (P)
—	L <sup>d</sup>	—	—	F	F-G	—	—	F-G	Clover, hop (A)
—	L	F	G	F-G	G	F-G	G	G	Clover spp. (P)
—	—	—	L	F	F-G	—	—	—	Cockle, corn (W)
—	L <sup>d</sup>	F	G	F-G	G	F-G	G	G	Cocklebur, common (A)
—	—	F-G	G	F	F-G	—	—	—	Cowcockle (W, A)
—	L	P	P-F	F-G	G	—	—	—	Daisy spp. (P)
—	L	F-G	G	F-G	G	F-G	G	F-G	Dandelion (P)
—	—	F	F-G	—	F	P	P-F	P	Dewberry spp. (P)
—	L <sup>d</sup>	F-G	G	F-G	G	P-F	G	G	Dock spp. (P)
—	—	P	P	F	F-G	P-F	F-G	F-G	Dogbane, hemp (P)
—	L	P-F	F-G	P-F	F	F-G	G	F-G	Dogfennel (P)
—	—	F	F-G	F-G	G	F	F-G	F-G	Evening primrose (W, B)
—	L	F-G	G	F	G	—	—	—	Fleabane spp. (A)
—	—	G	G	F	F-G	P	P	—	Garlic wild (P)
—	L <sup>d</sup>	F-G	G	F	F-G	P-F	F	F	Goldenrod spp. (P)
—	—	P-F	F	F	G	—	—	—	Hawkweed spp. (P)
—	L <sup>d</sup>	G	G	F-G	G	F-G	G	F-G	Henbit or Deadnettle (W)
—	L <sup>d</sup>	F	F-G <sup>d</sup>	F	F-G	—	L <sup>d</sup>	F	Honeysuckle spp. (P)
—	—	P-F	F	F	F	P	P-F	F	Horsenettle (P)
—	—	F-G	G	G	G	P	P-F	F-G	Horseweed (W, A)
—	—	F-G	G	F-G	G	—	—	F-G	Jimsonweed (A)
—	—	P	P-F <sup>d</sup>	P-F	F-G	P	P-F	P-F	Knapweed, spotted (B, P)
—	—	—	—	P	P-F	—	—	—	Knawel (Ger.moss) (W,A)
—	L <sup>d</sup>	P	P	P-F	F	P	P-F	—	Knotweed, prostrate (A)

<sup>a</sup>G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, N(none) = <20 percent control, L(labeled) = appears on herbicide label as control but insufficient local data exists for rating.

An "—" indicates that insufficient data or experience is available to give a rating.

<sup>b</sup>for treatment of individual plants, multistem clumps, or small stands of woody plants.

<sup>c</sup>for use on grazed fencerows. NOT for broadcast applications to pasture or hay.

<sup>d</sup>included as control on label at higher use rates; may provide control (small weeds) or suppression at these rates.

Table 16 cont'd: Susceptibility of Weeds to Herbicides in Grass Pasture or Hay<sup>a</sup>

The tank-mix of dicamba + 2,4-D (or Weedmaster at 4 pt/A) is considered a standard treatment. The shaded treatments offer significantly improved control of those species when compared to the standard.

Weed Species A = annual W = winter annual B = biennial P = perennial	Treatment and Rate (2,4-D rate based on 3.8 lb/gallon formulation)									
	2,4-D		Dicamba (Banvel or Clarity)				2,4-D + dicamba	Over- drive	MCPA	Aim
	1.0 to 1.5 qt	2.0 qt	0.5 pt	1.0 pt	2.0 pt	4.0 pt <sup>b</sup>	1.0-1.5 qt + 1.0 pt	8.0 oz	1.0 pt	0.5 to 2.0 oz
Kudzu (P)	P	P	N	N	P	P-F	P <sup>c</sup>	N	—	—
Lambsquarters, com. (A)	G	G	F-G	G	G	G	G	G	F-G	G
Lettuce, prickly (W, A, B)	G	G	F	F-G	G	G	G	F-G	P-F	—
Mallow, common (W, A, B)	F	F	F	F-G	G	G	F-G	F-G	—	L
Milkweed spp. (P)	P	P	P	P	P-F	F-G	F	F	N	—
Mugwort (P)	P-F	F	P-F	F	F	F	F	F	—	—
Mullein, common (B)	P	P	N	P	P	P	P	P	—	—
Multiflora rose (P)	P	P	N	N	P	F	P-F <sup>c</sup>	P	—	—
Mustard spp. (W, A)	G	G	F	F-G	G	G	G	F-G	G	L
Nightshade, black (A)	P-F	P-F	F	F-G	G	G	F-G	F-G	P	G
Onion, wild (P)	F-G	G	P	F	G	G	G	F	P-F	—
Pennycress spp. (W, A)	G	G	F	F-G	G	G	G	F-G	G	L
Pepperweed spp. (W, A, B)	G	G	F	F-G	G	G	G	F-G	G	—
Persimmon, common (P)	P	P	P	P	P-F	F	P-F	P	—	—
Pigweed spp. (A)	F-G	G	F	F-G	G	G	G	G	F	G
Plantain spp. (P)	G	G	P	F	F-G	G	G	F	G	—
Poison hemlock (B)	F	G	N	N	P	P-F	G	P	F-G	—
Poison ivy, oak (P)	P	P	N	P	P-F	F-G	F	P	—	—
Pokeweed, common (P)	P	P-F	N	N	P	P-F	P-F <sup>c</sup>	P-F	—	—
Ragweed, common (A)	F-G	G	F	G	G	G	G	G	F	P
Ragweed, giant (A)	F	F	F	G	G	G	G	G	F	N
Rocket, yellow (W, B)	G	G	F	F-G	G	G	G	F-G	F	—
Shepherdspurse (W)	F-G	F-G	F	F-G	G	G	G	F-G	G	L
Smartweed ssp. (A)	F	F-G	P-F	F-G	G	G	G	G	P-F	—
Sneezeweed, bitter (A)	F-G	G	F	F-G	G	G	G	F-G	—	—
Sorrel spp. (P)	P	P	P	F	G	G	G	F-G	—	—
Spurge, prostrate (A)	P	P	F	F-G	G	G	G	F-G	—	—
Stickweed (P)	G	G	P-F	F-G	G	G	G	F-G	—	—
Sumac spp. (P)	P	P	N	N	P	P-F	P <sup>c</sup>	P	—	—
Sunflower spp. (A)	F-G	F-G	F	F-G	G	G	G	G	P-F	—
Teasel spp. (B)	P-F	F	P-F	F-G	G	G	G	F	—	—
Thistle, bull (B)	F-G	G	P	F	G	G	G	F	G	—
Thistle, Canada (P)	F	F	P	P-F	F	F-G	F	F	P-F	—
Thistle, musk (B)	F-G	G	P	F	G	G	G	F	G	—
Thistle, plumeless (B)	F-G	G	P	F	G	G	G	F	G	—
Trumpetcreeper (P)	P	P	P	P	F	F-G	P-F <sup>c</sup>	P	—	—
Velvetleaf (A)	F-G	F-G	F-G	G	G	G	G	G	P-F	G
Water hemlock, spotted (P)	F	G	N	N	P	P-F	G	P	—	—
Woodsorrel spp. (P)	P	P	P	P	P-F	G	P-F <sup>c</sup>	P	—	—
Trees, Shrubs, and Vines	P	P-F	N	N	P	F	P-F <sup>c</sup>	P	P	N

<sup>a</sup>G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, N(none) = <20 percent control, L(labeled) = appears on herbicide label as control but insufficient local data exists for rating.

An "—" indicates that insufficient data or experience is available to give a rating.

<sup>b</sup>for spot application only in grass forage or broadcast application in CRP acres.

<sup>c</sup>better control may be obtained with higher rates of 2,4-D plus dicamba. Consult labels for details and precautions.

Table 16 cont'd: Susceptibility of Weeds to Herbicides in Grass Pasture or Hay<sup>a</sup>

The tank-mix of dicamba + 2,4-D (or Weedmaster at 4 pt/A) is considered a standard treatment. The shaded treatments offer significantly improved control of those species when compared to the standard.

Treatment and Rate									Weed Species A = annual W = winter annual B = biennial P = perennial
Spike <sup>b</sup>	Arsenal <sup>c</sup>	Metsulfuron	Crossbow	PastureGard HL	Remedy				
10 to 20 lb	1.0 to 3.0 pt	0.1 to 0.2 oz	0.3 to 0.4 oz	1.0 to 2.0 qt	3.0 to 4.0 qt	0.75 to 1.0 pt	1.5 pt	2.0 to 4.0 pt	
L	L <sup>d</sup>	—	—	P-F	F	—	—	F	Kudzu (P)
—	L	F-G	G	G	G	G	G	G	Lambsquarters, com. (A)
—	L	F-G	G	F-G	G	G	G	—	Lettuce, prickly (W, A, B)
—	—	—	—	P-F	F	P	P-F	—	Mallow, common (W, A, B)
—	L <sup>d</sup>	P	P	P	F	P	P-F	F	Milkweed spp. (P)
—	—	P-F	F	F	F-G	—	—	—	Mugwort (P)
—	L	F-G	G	N	P	P	P	P	Mullein, common (B)
L	L <sup>d</sup>	F	F-G	P-F	F-G	P	F	F-G	Multiflora rose (P)
—	L	F-G	G	G	G	F	F-G	G	Mustard spp. (W, A)
—	—	F	F-G	P-F	F	P	P-F	—	Nightshade, black (A)
—	—	G	G	F	F-G	—	—	—	Onion, wild (P)
—	—	G	G	F-G	G	P	P-F	—	Pennycress spp. (W, A)
—	L	G	G	F	G	—	—	—	Pepperweed spp. (W, A, B)
—	—	—	—	N	P	—	L <sup>d</sup>	F	Persimmon, common (P)
—	L	G	G	F-G	G	G	G	F-G	Pigweed spp. (A)
—	—	G	G	F-G	G	F-G	G	F-G	Plantain spp. (P)
—	—	P	P-F <sup>d</sup>	F	F-G	P	P	F	Poison hemlock (B)
—	L <sup>d</sup>	P	P	P-F	F-G	P	P-F	F-G	Poison ivy, oak (P)
—	L <sup>d</sup>	N	P	P-F	F-G	P	P	P-F	Pokeweed, common (P)
—	L	P	P-F	G	G	G	G	G	Ragweed, common (A)
—	L <sup>d</sup>	P	P-F	F-G	G	G	G	G	Ragweed, giant (A)
—	—	F-G	G	F	G	P	P	—	Rocket, yellow (W, B)
—	L <sup>d</sup>	G	G	F-G	G	—	—	—	Shepherdspurse (W)
—	L	P-F	F-G	F-G	G	P	P-F	F-G	Smartweed spp. (A)
—	—	F-G	G	F-G	G	G	G	F-G	Sneezeweed, bitter (A)
—	L	F	G	P-F	F-G	P	P-F	F-G	Sorrel spp. (P)
—	L <sup>d</sup>	—	F-G	N	P	—	—	—	Spurge, prostrate (A)
—	—	—	—	F	G	—	—	—	Stickweed (P)
L	L <sup>d</sup>	N	N	F	F-G	—	L <sup>d</sup>	F-G	Sumac spp. (P)
—	L	P-F	F-G	F	F-G	G	G	—	Sunflower spp. (A)
—	—	P-F	F-G <sup>d</sup>	P-F	F	—	—	—	Teasel spp. (B)
—	L <sup>d</sup>	P-F	F-G <sup>d</sup>	F	G	P	P-F	F	Thistle, bull (B)
—	L <sup>d</sup>	P	F	F	F-G	P	P	F	Thistle, Canada (P)
—	—	F	F-G	F	G	P	P-F	F	Thistle, musk (B)
—	—	F	F-G	F	G	P	P-F	F	Thistle, plumeless (B)
L	L <sup>d</sup>	N	N-P	P-F	F	P	P	F-G	Trumpet creeper (P)
—	L <sup>d</sup>	F-G	G	F	F-G	G	G	—	Velvetleaf (A)
—	—	—	—	F	F-G	—	—	—	Water hemlock, spotted (P)
—	L	F-G	G	F	F-G	—	—	F-G	Woodsorrel spp. (P)
F-G	L <sup>d</sup>	P-F	F	P-F	F	—	P-F, L <sup>d</sup>	F-G	Trees, Shrubs, and Vines

<sup>a</sup>G(good) = 80-100 percent control, F(fair) = 60-80 percent control, P(poor) = 20-60 percent control, N(none) = <20 percent control, L(labeled) = appears on herbicide label as control but insufficient local data exists for rating.

An “—” indicates that insufficient data or experience is available to give a rating.

<sup>b</sup>for treatment of individual plants, multistem clumps, or small stands of woody plants.

<sup>c</sup>for use on grazed fencerows. NOT for broadcast applications to pasture or hay.

<sup>d</sup>included as control on label at higher use rates; may provide control (small weeds) or suppression at these rates.

**Table 17: Adjuvants and Rainfastness for Postemergence Herbicides in Grass Pasture or Hay**

Adjuvants are products you include in the spray tank to improve the performance of your herbicides. These include non-ionic surfactants (NIS), crop oil concentrate (COC), methylated or ethylated seed oil (MSO or ESO) or nitrogen solutions. In general, NIS should contain at least 80% active ingredient and is typically used at 0.25% v/v; COC should contain at least 15% emulsifier and is typically used at 1.0% v/v; MSO is typically used at 1.5 pt/A. Nitrogen solutions can be 28%, 30% or 32% ammonium based fertilizer solutions; ammonium sulfate should be spray grade dry ammonium sulfate (21-0-0). Adding additional adjuvants than what is labeled can increase the chance of crop injury. The following is meant as guidelines for recommended adjuvants; refer to herbicide labels for specific adjuvant rates.

Rainfastness is number of hours needed between time of application and rainfall or irrigation to ensure sufficient absorption in the plant.

Growing conditions: **SOFT**: good soil moisture, high humidity, cloudy skies for past few days, warm, and weeds are smaller than mentioned on herbicide labels

**NORMAL**: intermediate weather, consider crop size, weed size, and weed species

**STRESS**: poor soil moisture, hot or cold temps, bright sunlight, low humidity, windy

Herbicides	Rainfast interval (hr)	Additive with water as carrier solution <sup>a</sup>						
		Growing conditions			Nitrogen solution		AMS	
		Soft	Normal	Stress				
Aim 2EW	-- <sup>b</sup>	NIS	NIS	COC	optional	2-4 qt/A	optional	2-4 lb/A
Arsenal 2AS	1	NIS	MSO	MSO	optional	2-3 pt/A	optional	2-3 lb/A
Banvel 4L	-- <sup>b</sup>	NIS	NIS	COC	optional	2-4 qt/A	optional	2.5 lb
Clarity 4L	4	NIS	NIS	COC	optional	2-4 qt/A	optional	2.5 lb
Crossbow 3L	-- <sup>b</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				
Facet 1.5L	6	MSO or COC	MSO or COC	MSO or COC	optional	2-4 qt/A	optional	2.5 lb/A
Glyphosate preplant, renovation, or spot	1-6	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>			optional	8.5 - 17 lb/100gal
Gramoxone 2SL	0.5	NIS	NIS or COC	COC				
MCPA 3.7L	-- <sup>b</sup>	-- <sup>e</sup>	-- <sup>e</sup>	-- <sup>e</sup>				
Metsulfuron 60DF <sup>c</sup>	4	NIS	NIS	NIS				
Overdrive 70WG	4	NIS	NIS or MSO	MSO				
PastureGard HL 4L	-- <sup>b</sup>	-- <sup>k</sup>	-- <sup>k</sup>	-- <sup>k</sup>	-- <sup>k</sup>	1-2 qt/100 gal		
Remedy Ultra 4L	-- <sup>b</sup>	NIS <sup>g</sup>	NIS <sup>g</sup>	NIS <sup>g</sup>				
Sandea	4	NIS	NIS	NIS				
Weedmaster 3.87L	4	NIS <sup>g</sup>	NIS <sup>g</sup>	NIS <sup>g</sup>	optional	2-4 qt/A	no	
2,4-D ester 3.8L <sup>g</sup>	1	-- <sup>n</sup>	-- <sup>n</sup>	-- <sup>n</sup>				
2,4-D amine 3.8L <sup>g</sup>	6	-- <sup>n</sup>	-- <sup>n</sup>	-- <sup>n</sup>				

<sup>a</sup>consult the herbicide label when using liquid fertilizer as the carrier solution.

<sup>b</sup>a specific rainfast interval is not given on the label.

<sup>c</sup>see fescue and timothy precautions on herbicide label for specific adjuvant recommendations.

<sup>d</sup>glyphosate products vary in the amount of adjuvant recommended; refer to product label.

<sup>e</sup>no adjuvant is recommended on the label.

<sup>g</sup>an adjuvant is allowed in water dilutions to provide improved wetting of the foliage, but not required.

<sup>h</sup>an adjuvant (COC or NIS) is recommended for control of woody plants only.

<sup>k</sup>an adjuvant (NIS or UAN) is allowed for improved weed or woody plant control, especially when plants are drought-stressed.

**Table 18: Comments for Grass Pasture or Hay Herbicides**

Herbicide		Application timing	Rate		Can be applied in liquid fertilizer as a carrier (yes/no)
Trade name	Common name		product/A	lb ai/A	
<b>Preplant or stand renovation applications</b>					
<b>Glyphosate</b>	glyphosate	Preplant renovation	11 oz to 3.3 qt	0.47 to 4.5	no
<p><u>Comments:</u> The rates, timings, and comments for this entry are from the Roundup WeatherMax label. Consult the product label for other glyphosate formulations. Make ground applications in 10 to 40 gal/A of water. Increase the spray volume within this range as the weed density increases. If water is hard, add dry ammonium sulfate at 8.5 to 17 lb/100 gal of water. Preplant applications can be made before, during, or after planting but before the crop emerges. Glyphosate controls emerged weeds only. Glyphosate is effective on annual, biennial, and perennial weeds as well as small grain cover crops. More than one application may be needed for perennial weed control. Existing perennial grass stands can be renovated by applying 0.7 to 3.3 qt/A (consult the label for rates for specific species). The existing crop can be grazed or harvested for feed after applications totaling 2 qt/A or less. For applications greater than 2 qt/A, remove livestock before application and wait 8 weeks before grazing or harvest. Observe all other grazing, harvest, and slaughter restrictions (Table 15).</p>					
<b>Gramoxone 2SL</b>	paraquat	Preplant	1.0 to 2.0 pt	0.25 to 0.5	no
<p><u>Comments:</u> Apply in a minimum of 10 gal/A (ground) or 5 gal/A (air) of water before, during, or after planting but before crop emerges. While allowed on the label, aerial applications of Gramoxone SL are not recommended due to a higher potential for drift. The addition of a nonionic surfactant or crop oil concentrate is required for acceptable weed control. Gramoxone SL controls emerged weeds only. Gramoxone SL is effective on perennial grass sods when two applications are made. Graze or mow sod to a height of 3 inches or less and apply 2 pt/A followed in 10 to 14 days by 1.5 pt/A. Gramoxone SL is also effective on small annual weeds. <b>Gramoxone SL is a restricted use pesticide.</b></p>					



Herbicide		Application timing	Rate		Can be applied in liquid fertilizer as a carrier (yes/no)
Trade name	Common name		product/A	lb ai/A	
<b>Postemergence broadcast applications</b>					
<b>Aim 2EW</b>	carfentrazone	sdIng.-POST est.-POST	0.5 to 2.0 fl.oz.	0.008 to 0.031	yes
<p><u>Comments:</u> Aim has a relatively narrow spectrum of weed control (Table 16), and is primarily used for control of winter or summer annual broadleaf weeds up to 4 inches tall (emerged weeds only). Aim also has activity on Star-of-Bethlehem, dayflower species, and speedwell species. Apply in a minimum of 10 gal/A of water or liquid fertilizer. Applying Aim in liquid fertilizer may increase the level of crop response. When applying in water, the addition of an adjuvant is recommended for enhanced weed control. Applications should not be made within 8 hours of rainfall or irrigation or when heavy dew is present or significant crop response may occur. Three applications per season are allowed, but do not make applications less than seven days apart. Tankmixing with other labeled herbicides is allowed. Aim will severely injure alfalfa, clover, and other legumes. <b>Aim has only recently been labeled on forage grasses, so local experience is minimal. Experience in small grains would suggest that some level of crop response (speckling or chlorosis) will occur from Aim applications.</b></p>					
<b>Banvel or Clarity 4L</b>	dicamba	sdIng.-POST est.-POST	0.5 to 1.0 pt 0.5 to 2.0 pt.	0.25 to 0.5 0.25 to 1.0	yes
<p><u>Comments:</u> Dicamba provides postemergence control and less than one month of soil residual control of a relatively broad spectrum of annual, biennial, and perennial broadleaf weeds. Apply by ground in a minimum of 10 gal/A of water or liquid fertilizer, or by air in 2 to 40 gal/A of water. While allowed on the label, aerial applications of dicamba are not recommended due a higher potential for drift. High volume foliar applications for brush control (up to 600 gal/A) are allowed; consult herbicide label for details. Applications to newly seeded areas should not exceed 1 pt/A, and should only be applied to actively growing unstressed grasses that have attained the 3 to 4-leaf stage and have reached a minimum height of 6 inches. Do not make applications when the temperature is expected to exceed 85 degrees that day as drift is more likely to occur. Follow label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Do not mow for at least 7 days after application. Multiple treatments are allowed as long as all treatments do not exceed 2 pt/A during a growing season. Banvel can be tankmixed with metsulfuron, Remedy Ultra, or 2,4-D. Clarity can be tankmixed with metsulfuron, Crossbow, Remedy Ultra, or 2,4-D. Dicamba will severely injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					
<b>Banvel/Clarity 4L + 2,4-D (ester or amine) 3.8 L</b>	dicamba + 2,4-D tankmix	est.-POST	0.5 to 1.0 pt + 0.75 to 1.5 qt	0.25 to 0.5 0.7 to 1.4	yes
<p><u>Comments:</u> Dicamba plus 2,4-D can be applied as a tank mixture or with premix products such as Weedmaster (see entry). This mixture provides excellent postemergence control and less than one month of soil residual control of many annual, biennial, and perennial broadleaf weeds. Use only on established grasses that have developed a good root system and are tillering. Apply by ground in a minimum of 10 gal/A of water or liquid fertilizer, or by air in 2 to 40 gal/A of water. While allowed on the label, aerial applications of dicamba and 2,4-D are not recommended due a higher potential for drift. Do not make applications when the temperature is expected to exceed 85 degrees that day as drift is more likely to occur. Follow label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Do not mow for at least 7 days after application. Multiple treatments are allowed as long as all treatments do not exceed 2 pt/A of dicamba during a growing season. Dicamba + 2,4-D will severely injure alfalfa, clover, and other legumes. The ester formulation of 2,4-D is slightly more effective (more leaf-absorbed) than the amine formulation, but also slightly more volatile. The amine formulation has more soil activity. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					

Herbicide		Application timing	Rate		Can be applied in liquid fertilizer as a carrier (yes/no)
Trade name	Common name		product/A	lb ai/A	
<b>Postemergence broadcast applications, cont.</b>					
<b>Crossbow 3L</b>	triclopyr + 2,4-D	est.-POST	1.0 to 4.0 qt	0.25 to 1.0 + 0.5 to 2.0	yes
<p><u>Comments:</u> The label states “<b>This product may not be applied to forage that is to be cut and sold for commercial purposes</b>”. Apply only to grasses with well-established root systems that are tillering. Follow all label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Apply to actively growing weeds or brush by ground or air (helicopter only) in 10 to 30 gal/A of water or liquid fertilizer. Follow label recommendations when using liquid fertilizer as a carrier. High volume foliar applications for brush control (100-200 gal/A) are allowed; consult herbicide label for details. Crossbow provides postemergence control and 1 to 2 months of soil residual control of many annual, biennial, and perennial weeds as well as many woody plants. For best results, treat biennial or winter annual weeds in the rosette stage. Some hard to control perennial weeds and woody species may require retreatment. Tankmixing with other herbicides is mentioned on the label. Crossbow will severely injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					
<b>Facet 1.5L</b>	quinclorac	est.-POST	0.75 to 4 pt	0.14 to 0.75	no
<p><u>Comments:</u> Facet (formerly Paramount 75DF) provides postemergence control and one to two months of soil residual control or suppression of several annual grass weeds, a few annual broadleaf weeds, and field or hedge bindweed. Rates greater than 2 pt/A and less than 1.4 pt/A are for leafy spurge control and bindweed maintenance respectively. Use only on labeled established grasses (Timothy and reed canarygrass not included) that have developed a good root system and are tillering. Apply to actively growing plants by ground in a minimum of 5 gal/A of water. Aerial applications are not allowed in the northeast region. Do not apply Facet when air temperature is more than 90 degrees. The addition of a methylated seed oil or crop oil concentrate is required for consistent weed control. Follow label recommendations to reduce the potential for spray drift to sensitive plants. Facet can be tankmixed with other herbicides unless excluded on the other product label. Facet will severely injure alfalfa, clover, and other legumes.</p>					
<b>MCPA 3.7L</b>	MCPA	sdIng.-POST est.-POST	0.5 pt 1.0 to 4.0 pt	0.23 0.45 to 1.8	yes
<p><u>Comments:</u> Follow all label recommendations to reduce the potential for spray drift to sensitive plants. Apply to small actively growing weeds by ground in a minimum of 10 gal/A or by air in a minimum of 2 gal/A of water or liquid fertilizer. Follow the label recommendations when using liquid fertilizer as a carrier. MCPA controls or aids in control of some emerged annual, biennial, or perennial weeds. Up to 0.5 pt/A may be applied to newly seeded clover and grass pastures after the clover has reached the 2-trifoliolate stage. Treat established grasses in the fall or spring. For best results, spray perennials in bud to early bloom stage. Do not mow for at least 7 days after application. Tankmixing with other herbicides is not mentioned on the MCPA label, but MCPA is often listed on other herbicide labels for tankmixing. MCPA may injure alfalfa, clover, and other legumes at rates above 0.5 to 1 pt/A. Observe all grazing and harvest restrictions (Table 15).</p>					

Herbicide		Application timing	Rate		Can be applied in liquid fertilizer as a carrier (yes/no)
Trade name	Common name		product/A	lb ai/A	
<b>Postemergence broadcast applications, cont.</b>					
<b>Metsulfuron 60DF</b>	metsulfuron	est.-POST	0.1 to 0.4 oz	0.004 to 0.015	yes
<p><u>Comments:</u> Due to long rotational crop restrictions, metsulfuron is recommended only on land primarily dedicated to pasture and hay production. Apply by ground in a minimum of 10 gal/A or by air in 2 to 5 gal/A of water or liquid fertilizer. Follow the label recommendations when using liquid fertilizer as a carrier. The addition of a nonionic surfactant is required for acceptable weed control. Metsulfuron provides both postemergence control and 2 to 3 months of soil residual control of many annual, biennial, and perennial weed species, and suppression of blackberry and multiflora rose. Postemergence applications are rainfast in 4 hours, after which rainfall or overhead irrigation is required to activate the herbicide in the soil. Soil residual activity will begin once the herbicide is activated, thus preventing further emergence of labeled weed seedlings. Applications up to 0.4 oz/A may be made to grasses that have been established for a minimum amount of time as follows: bermudagrass (2 months); bluegrass, bromegrass, and orchardgrass (6months); timothy (12 months); and fescue (24 months). Special precautions are provided on the label for applications to fescue or timothy. Apply to fescue in late spring or fall or to timothy in late summer or fall. Either species should be at least 6 inches tall and actively growing. Use the lowest recommended rate of metsulfuron (up to 0.4 oz/A) for the target weeds and tankmix with 2,4-D for added safety. Use only a nonionic surfactant at 0.5 pt/100 gal when mixing with water; do not use any adjuvant when mixing with liquid fertilizer. Adhere strictly to these precautions or severe injury may occur. Even when these precautions are followed, some stunting or yellowing of timothy or fescue may occur. <b>Do not use metsulfuron on Italian (annual) or perennial ryegrass or severe injury will occur.</b> Tankmixing with 2,4-D, Banvel, MCPA, Remedy Ultra, or Weedmaster is recommended on the label for some specific weed problems. Tankmixing with other labeled herbicides is allowed. Rates of up to 1 oz/A may be listed on some labels, but applications at rates greater than 0.4 ounce per acre per application are not recommended. Metsulfuron will severely injure alfalfa, clover, and other legumes. The active ingredient metsulfuron is available as a premix with 2,4-D and dicamba (Cimarron Max) or a unit pack with chlorsulfuron (Cimarron Plus).</p>					
<b>Overdrive 70WG</b>	dicamba + diflufenzopyr	est.-POST	4.0 to 8.0 oz	0.125 to 0.25 + 0.05 to 0.1	no
<p><u>Comments:</u> Overdrive provides postemergence control and less than one month of soil residual control of several annual, biennial, and perennial broadleaf weeds. Use only on established grasses that have developed a good root system and are tillering. Apply to actively growing plants by ground in a minimum of 10 gal/A of water. Do not apply by air. The addition of a nonionic surfactant or methylated seed oil is required for consistent weed control. Follow label recommendations to reduce the potential for spray drift to sensitive plants. Use the higher rate when treating large annual and biennial weeds or when treating perennial weeds. Multiple treatments are allowed as long as all treatments do not exceed 8 oz/A during a growing season. Do not mow for at least 7 days after application. Overdrive can be tankmixed with metsulfuron, Remedy Ultra, and 2,4-D. Overdrive will severely injure alfalfa, clover, and other legumes.</p>					

Herbicide		Application timing	Rate		Can be applied in liquid fertilizer as a carrier (yes/no)
Trade name	Common name		product/A	lb ai/A	
<b>Postemergence broadcast applications, cont.</b>					
<b>PastureGard 4L</b>	triclopyr + fluroxypyr	est.-POST	0.75 to 4 pt	0.28 to 1.5 + 0.094 to 0.5	not recommended
<p><u>Comments:</u> Apply only to grasses with well-established root systems that are tillering. Follow all label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Apply to actively growing weeds or brush by ground in a minimum of 5 gal/A or by air in a minimum of 3 gal/A (broadleaf weeds) or 4 gal/A (woody plants) of water. For brush control, high volume foliar applications (50-100 gal/A), basal methods, and cut stump methods are allowed; consult herbicide label for details. PastureGard provides postemergence control and 1 to 2 months of soil residual control of many annual, biennial, and perennial weeds as well as many woody plants. Biennial or winter annual weeds are most susceptible while in the rosette stage. For best results treat blackberry either before first flower or after fruit drop. Some hard to control woody species may require retreatment. Tankmixing with other herbicides is allowed. PastureGard will severely injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					
<b>Remedy Ultra 4L</b>	triclopyr	est.-POST	0.5 to 4.0 pt	0.25 to 2.0	yes
<p><u>Comments:</u> Apply only to grasses with well-established root systems that are tillering. Follow all label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Apply to actively growing weeds or brush by ground in a minimum of 10 gal/A or by air in a minimum of 2 gal/A (broadleaf weeds) or 4 gal/A (woody plants) of water or liquid fertilizer. Follow the label recommendations when using liquid fertilizer as a carrier. Do not use liquid fertilizer as the carrier when treating woody plants (brush). For brush control, high volume foliar applications (100-200 gal/A), basal methods, and cut stump methods are allowed; consult herbicide label for details. Remedy Ultra provides postemergence control and 1 to 2 months of soil residual control of many annual, biennial, and perennial weeds as well as many woody plants. Biennial or winter annual weeds are most susceptible while in the rosette stage. For best results treat blackberry during or after bloom. Some hard to control woody species may require retreatment. Tankmixing with other herbicides is allowed. Remedy Ultra will severely injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					
<b>Sandea 75DF</b>	halosulfuron	est.-POST	0.67 to 1.3 oz	0.031 to 0.063	no
<p><u>Comments:</u> Sandea provides excellent postemergence control of yellow nutsedge and has both preemergence (3-4 weeks soil residual) and/or postemergence activity on several annual broadleaf weeds. Apply by ground in a minimum of 10 gal/A water, or by air in 3-15 gal/A water. Postemergence applications must include a nonionic surfactant at 0.25 to 0.5 %v/v. For best results spray actively growing nutsedge plants at the 3-5 leaf stage and susceptible broadleaf plants that are 1-3 inches tall. Heavy nutsedge infestations may require additional applications. Wait at least 48 hours after application before irrigation. Sandea can be tankmixed with other herbicides including 2,4-D and dicamba; see label instructions. Sandea will injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					

Herbicide		Application timing	Rate		Can be applied in liquid fertilizer as a carrier (yes/no)
Trade name	Common name		product/A	lb ai/A	
<b>Postemergence broadcast applications, cont.</b>					
<b>Weedmaster 3.87L</b>	dicamba + 2,4-D amine	sdlngr.-POST	0.5 to 2.0 pt	0.06 to 0.25 + 0.18 to 0.72	yes
	dicamba + 2,4-D amine	est.-POST	1.0 to 4.0 pt	0.125 to 0.5 + 0.36 to 1.4	
<p><u>Comments:</u> Weedmaster provides excellent postemergence control and less than one month of soil residual control of many annual, biennial, and perennial broadleaf weeds. For brush control, foliar and basal applications in oil and water emulsions and cut surface applications are allowed; consult herbicide label for details. For broadcast applications, apply by ground in 5 to 40 gal/A of water or liquid fertilizer, or by air in 3 to 10 gal/A of water. While allowed on the label, aerial applications of Weedmaster are not recommended due a higher potential for drift. Applications to newly seeded areas should not exceed 2 pt/A, and should only be applied to actively growing unstressed grasses that have attained the 3 to 4-leaf stage and have reached a minimum height of 6 inches. Do not make applications when the temperature is expected to exceed 85 degrees that day as drift is more likely to occur. Follow label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Do not mow for at least 7 days after application. Multiple treatments are allowed as long as all treatments do not exceed 8 pt/A during a growing season. Weedmaster can be tankmixed with Banvel, metsulfuron, and Clarity. Weedmaster will severely injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>					
<b>2,4-D ester 3.8L</b> <b>2,4-D amine 3.8L</b>	2,4-D	est.-POST	1.5 to 3.0 qt 1.0 to 2.0 qt	1.4 to 2.8 0.95 to 1.9	yes
<p><u>Comments:</u> 2,4-D is marketed by various companies under various trade names. Refer to the label provided with the product for specific recommendations and restrictions. 2,4-D provides postemergence control and less than one month of soil residual control of several annual, biennial, and perennial broadleaf weeds. Follow label recommendations to reduce the potential for spray drift or volatility to sensitive plants. Ester formulations are slightly more effective (more leaf-absorbed) than amine formulations, but also slightly more volatile. Amine formulations have more soil activity. Use only on established grasses that have developed a good root system and are tillering. Apply to actively growing plants by ground in a minimum of 10 gal/A or by air in a minimum of 2 gal/A of water or liquid fertilizer. While allowed on the label, aerial applications of 2,4-D are not recommended due a higher potential for drift. Follow the label recommendations when using liquid fertilizer as a carrier. Deep-rooted perennial weeds and woody plants may require repeated treatments. Do not mow for at least 7 days after application. Tankmixing with other herbicides is not mentioned on the labels, but 2,4-D is often listed on other herbicide labels for tankmixing. 2,4-D will severely injure alfalfa, clover, and other legumes. Observe all grazing, harvest, and slaughter restrictions (Table 15 and herbicide label).</p>					

**---Blank Page---**

Herbicide rates in this section are given as product per acre, pounds of active ingredient per acre, and ounces (oz.wt.) and grams (gr) of product per gallon of solution for dry products, or fluid ounces (fl.oz.) and milliliters (ml) of product per gallon of solution for liquid products. The “per gallon” amounts are often very small and can be difficult to accurately weigh or measure without specialized equipment (ie: gram scales, syringes, etc.). See Table 27. These per gallon rates or rate ranges are based on an application volume of 1 gallon per 1,000 square ft (gal/1000ft<sup>2</sup>), which is roughly equivalent to 40 gallons per acre (gpa). When using a backpack sprayer or other hand-held equipment, this volume can usually be achieved by spraying to the point where the target foliage is wet, but not to the point where the spray solution begins to run off of the foliage. It is always best to properly calibrate all spray equipment. Spraying to the point of run-off will result in herbicide over-application, which may cause forage injury and/or a longer safe over-seeding interval in treated areas.

Herbicide		Applications allowed	Rate			
Trade name	Common name		product/A	lb ai/A	oz.wt. or fl.oz./gal	gram or ml/gal
<b>Spot-spray, wiper applicator, or grazed fencerow applications</b>						
<b>Aim 2EW</b>	carfentrazone	Fencerows	2.0 fl.oz.	0.008 to 0.031	0.05 fl.oz.	1.5 ml
<p><u>Comments:</u> No specific recommendations are given on the label for grazed fencerow applications. Follow postemergence broadcast application procedures when applying to grazed fencerows. When making applications with hand-held equipment, apply the recommended per gallon concentration above on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost.</p>						
<b>Arsenal 2AS</b>	imazapyr	Fencerows	1.0 to 3.0 pt	0.25 to 0.75	0.4 to 1.2 fl.oz.	12 to 36 ml
<p><u>Comments:</u> Arsenal is labeled for spot treatment in grass pasture. However, due to its length of residual activity on cool-season grass species, bare spots in the pasture could persist for several months. Therefore, it is only recommended for use along permanent or long-term fencerows. Since this use falls under the spot treatment part of the label, grazed fencerows can be treated so long as the total area to be treated is no more than 10% of the total pasture and fencerow areas combined. Arsenal provides postemergence and 3 to 6 months of soil residual control of many annual, biennial, and perennial grass and broadleaf weeds as well as several vine and brush species. Make applications with hand-held equipment. Refer to weed rate tables of the herbicide label and apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Observe harvest restrictions (Table 15).</p>						
<b>Banvel/Clarity 4L</b>	dicamba	Spot-spray (wiper applica. Clarity only) fencerows	0.5 to 4.0 pt	0.25 to 2.0	0.2 to 1.6 fl.oz.	6 to 47 ml
<p><u>Comments:</u> Dicamba is effective on a broad spectrum of annual, biennial, and perennial broadleaf weeds. It is also effective as a spot spray on many woody species at the higher rates. Make applications with hand-held equipment. Do not treat more than one tenth of the total area at any one time. Refer to weed rate tables of the herbicide label and apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Spot treatment with dicamba will kill alfalfa, clover, or other legumes that are contacted by the herbicide. Observe all grazing, harvest, and slaughter restrictions (Table 15) based on the per acre rate. Clarity is also labeled for wiper applications. Consult the herbicide label for specific recommendations.</p>						

Herbicide		Applications allowed	Rate			
Trade name	Common name		product/A	lb ai/A	oz.wt. or fl.oz./gal	gram or ml/gal
<b>Spot-spray, wiper applicator, or grazed fencerow applications, cont.</b>						
<b>Crossbow 3L</b>	triclopyr + 2,4-D	Spot-spray fencerows	1.8 to 2.5 qt	0.45 to 0.63 + 0.9 to 1.25	1.5 to 2.0 fl.oz.	43 to 59 ml
<p><u>Comments:</u> Crossbow is effective on a broad spectrum of annual, biennial, and perennial broadleaf weeds. It is also effective as a spot spray on many woody species at the higher rates. Make applications with hand-held equipment. Refer to weed rate tables of the herbicide label and apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, treat biennial or winter annual weeds in the rosette stage. Some hard to control perennial weeds and woody species may require retreatment. Spot treatment with Crossbow will kill alfalfa, clover, or other legumes that are contacted by the herbicide. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>						
<b>Glyphosate</b>	glyphosate	Spot-spray wiper applic. fencerows	0.6 to 2.5 qt	0.86 to 3.4	0.5 to 2.0 fl.oz.	14 to 59 ml
<p><u>Comments:</u> The rates, timings, and comments for this entry are from the Roundup WeatherMax label. Make applications with hand-held equipment or wiper applicators. Glyphosate controls emerged weeds only. At rates up to 2 qt/A, any portion up to the entire field may be treated. For rates above 2 qt/A, apply only to weed-infested areas of the field, and do not treat more than one tenth of the total area at any one time. Subsequent applications to the same areas can be made at 30-day intervals. Refer to weed rate tables of the herbicide label for the recommended herbicide concentration. For spot treatment, apply on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. Spot treatment with glyphosate will kill all desirable vegetation that is contacted by the herbicide. Consult the herbicide label for specific wiper applicator recommendations. For best results, do not graze or harvest for seven days after any application, and make applications at least seven days before a killing frost. Observe all grazing and harvest restrictions (Table 15) based on the per acre rate.</p>						
<b>MCPA 3.7L</b>	MCPA	Fencerows	1.0 to 4.0 pt	0.45 to 1.8	0.4 to 1.6 fl.oz.	12 to 47 ml
<p><u>Comments:</u> No specific recommendations are given on the label for grazed fencerow applications. Follow postemergence broadcast application procedures when applying to grazed fencerows. When making applications with hand-held equipment, refer to weed rate tables of the herbicide label and apply the recommended per gallon concentration above on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Observe all grazing and harvest restrictions (Table 15).</p>						
<b>Metsulfuron 60DF</b>	metsulfuron	Spot-spray fencerows	0.4 oz	0.015	0.01 oz.wt.	0.28 gr
<p><u>Comments:</u> Metsulfuron is effective as a spot-spray on several annual, biennial, and perennial weed species, and is a good choice for suppression or control of multiflora rose, blackberry, and Canada thistle. Make applications with hand-held equipment. Apply 1 oz/100 gal (0.28 gr/gal) on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. A nonionic surfactant should be added to enhance foliage wetting. Do not spray to the point of runoff, but dense stands of brush may need to be treated from both sides to achieve adequate coverage. Add a nonionic surfactant at 2 to 4 pt/100 gal. Make applications after plants are fully leafed in the spring up through late summer.</p>						



Herbicide		Applications allowed	Rate			
Trade name	Common name		product/A	lb ai/A	oz.wt. or fl.oz./gal	gram or ml/gal
<b>Spot-spray, wiper applicator, or grazed fencerow applications, cont.</b>						
<b>Overdrive 70WG</b>	dicamba + diflufenzopyr	Spot-spray fencerows	4.0 to 8.0 oz	0.125 to 0.25 + 0.05 to 0.1	0.1 to 0.2 oz.wt.	2.8 to 5.7 gr
<p><u>Comments:</u> Overdrive is effective on several annual, biennial, and perennial broadleaf weeds. Make applications with hand-held equipment. Use the higher rate when treating large annual and biennial weeds or perennial weeds. Apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Spot treatment with Overdrive will kill alfalfa, clover, or other legumes that are contacted by the herbicide.</p>						
<b>PastureGard 4L</b>	triclopyr + fluroxypyr	Spot-spray fencerows	0.5 to 4.0 pt	0.19 to 1.5 + 0.06. to 0.5	0.2 to 1.5 fl.oz.	5 to 44 ml
<p><u>Comments:</u> Apply at rates equivalent to broadcast application rates. When making applications with hand-held equipment, refer to weed rate tables of the herbicide label and apply the recommended per gallon concentration above on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>						
<b>Remedy Ultra 4L</b>	triclopyr	Fencerows	0.5 to 4.0 pt	0.25 to 2.0	0.2 to 1.6 fl.oz.	6 to 47 ml
<p><u>Comments:</u> No specific recommendations are given on the label for grazed fencerow applications. Follow postemergence broadcast application procedures when applying to grazed fencerows. When making applications with hand-held equipment, refer to weed rate tables of the herbicide label and apply the recommended per gallon concentration above on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>						
<b>Sandea 75DF</b>	halosulfuron	Spot-spray fencerows	0.75 oz	0.047	0.019	0.53 gr
<p><u>Comments:</u> No specific recommendations are given on the label for grazed fencerow applications. Follow postemergence broadcast application procedures or spot spray procedures when applying to grazed fencerows. Apply Sandea as a postemergence spot treatment only to those areas of emerged nutsedge. Do not exceed 0.75 oz/A. Use a water volume that will allow good coverage of plants. The per gallon amounts listed above are based on applying on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>). Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. A second postemergence spot application at 0.75 oz/A is allowed where nutsedge has emerged or regrown. Follow the same procedures as first application. The potential for injury to desirable broadleaf and grass plants is increased with a second application. Sandea will injure alfalfa, clover, or other legumes that are contacted by the herbicide. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>						

Herbicide		Applications allowed	Rate			
Trade name	Common name		product/A	lb ai/A	oz.wt. or fl.oz./gal	gram or ml/gal
<b>Spot-spray, wiper applicator, or grazed fencerow applications, cont.</b>						
<b>Spike 20P</b>	tebuthiuron	Individual plant treatment	10 to 20 lb	2.0 to 4.0	0.4 to 0.7 oz.wt./100 ft <sup>2</sup>	11 to 21 gr/100 ft <sup>2</sup>
<p><u>Comments:</u> Spike 20P is a pelleted formulation for control of woody plants (trees, shrubs, etc) and vines. Apply by hand evenly over the area occupied by individual plants, multistem clumps, or small stands of woody vegetation. Make only one application per year. Forage grasses in the treated area may be injured or killed. Dormant season application is recommended to minimize herbicidal activity on forage grasses. For best results, do not disturb treated plants by wood cutting or removal for two years after application. Poor or erratic results are likely to occur in soils containing more than 5% organic matter or more than 30% clay, and in areas where woody plants are rooted directly in a shallow water table. <b>Spike can persist in the soil for several years, and should therefore only be used on land dedicated to long term grass forage production unless severe herbicide injury to legumes, row crops, shrubs, or trees can be tolerated in treated areas for several years.</b> Do not apply Spike 20P in the vicinity of desirable plants. Exposure of even a small part of a plant root system to Spike may cause severe plant injury or death. Treatment setback distance from desirable plants should be one to two times the height or width of adjacent non-target vegetation, whichever is greater. Do not apply more than 10 lb/A on "vulnerable sites" as described on the herbicide label under "Use restrictions for Groundwater Protection". Do not apply in areas where the water table is predominately shallow (5 feet or less), to interior ditch banks, or to ditches used to transport irrigation water or potable water. Do not apply within areas identified by state or local authorities as protected groundwater recharge zones. Observe harvest restrictions (Table 15).</p>						
<b>Weedmaster 3.87L</b>	dicamba + 2,4-D amine	Spot-spray	1.0 to 4.0 pt	0.125 to 0.5 + 0.36 to 1.4	0.4 to 1.6 fl.oz.	12 to 47 ml
	dicamba + 2,4-D amine	fencerows	4.0 to 8.0 pt	0.5 to 1.0 + 1.4 to 2.9	1.6 to 3.2 fl.oz.	47 to 95 ml
<p><u>Comments:</u> Weedmaster is effective on a broad spectrum of annual, biennial, and perennial broadleaf weeds. It is also effective on many woody species as a spot spray at the higher rates. Add a surfactant at 0.5% v/v for improved control. For fencerows, apply as a foliar spray or dormant basal application in either water with surfactant or an oil and water emulsion (consult label for details). Applications in oil and water emulsions will damage or kill desirable grasses and should not be used in pastures or where damage to desirable species cannot be tolerated. Make applications with hand-held equipment. Refer to weed rate tables of the herbicide label and apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Do not make spot treatments in addition to broadcast treatments. Spot treatment with Weedmaster will kill alfalfa, clover, or other legumes that are contacted by the herbicide. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>						
<b>2,4-D ester 3.8L</b>	2,4-D	Spot-spray	1.0 to 3.0 qt	0.95 to 2.8	0.8 to 2.4 fl.oz.	24 to 71 ml
<b>2,4-D amine 3.8L</b>		fencerows	1.0 to 2.0 qt	0.95 to 1.9	0.8 to 1.6 fl.oz.	24 to 47 ml
<p><u>Comments:</u> 2,4-D is marketed by various companies under various trade names, and label recommendations and restrictions can vary among products. Most 2,4-D labels do not mention spot-spray applications. Refer to the label provided with the product you are using to determine if spot-spray applications are allowed and follow the label recommendations carefully. Specific recommendations are generally not given on 2,4-D labels for grazed fencerow applications. Follow postemergence broadcast application procedures when applying to grazed fencerows. When making applications with hand-held equipment, refer to weed rate tables of the herbicide label and apply the recommended concentration on a spray-to-wet basis (1 gal/1000 ft<sup>2</sup>) to provide thorough coverage. Do not spray to the point of runoff. For best results, do not graze or harvest for seven days after application, and make applications at least seven days before a killing frost. Observe all grazing, harvest, and slaughter restrictions (Table 15).</p>						

**Table 19: Herbicides Labeled for Summer Annual Grass Crops**

Weed management in summer annual grasses begins with a clean seedbed; tillage close to planting in conventional tillage, or preplant herbicides like glyphosate in no-tillage. Use fields with fewer perennial and annual grass weeds. Successful establishment begins with properly amended soils (pH and fertility), and appropriate seeding rate, depth, and equipment (see Cultural Practices, Establishment). When moisture is adequate, annual forage grasses emerge and grow quickly, and compete well with weeds. There is often no need for additional weed control. Chemical weed control may be warranted when establishment is slow, weed populations are high, potentially toxic weeds are present, or high quality (weed-free) hay or forage is desired. Herbicide options are limited. Some plant growth regulator (PGR) herbicides are labeled for use in annual grass forages. However, PGR herbicides are not recommended during the hot summer months due to potential injury to sensitive plants with physical or vapor drift. Non-PGR herbicide options are listed below. Pay particular attention to rotational crop restrictions; consult labels for crops not listed. Atrazine is typically not recommended due to its long rotation to other forage crops, and should only be used if corn or sorghum will be planted in the spring. Check labels for weeds controlled. The listed postemergence herbicides typically control only small annual broadleaf weeds, so check labels for maximum weed size or growth stage.

Herbicide	Labeled annual grasses	Application Information				Grazing/harvest interval	Rotational restrictions (months)		
		Timing / weed type	Use Rate	Crop stage	Season maximum rate		Rotation to grasses	Rotation to small grains	Rotation to alfalfa /clover
Atrazine <sup>a</sup> 4L	forage sorghum, sor-sudan hybrid	PPI, Pre, POST / broadleaf	3.2 to 4.0 pt (see label for details)	up to 12 inches	5 pt	PPI/Pre =60 day POST = 45 days	second year	next year to second year <sup>e</sup>	second year
Callisto <sup>a</sup>	pearl millet	Pre / broadleaf	up to 6.0 fl oz	n/a	6.0 fl oz (1 appl.)	n/a	18	4	10/18
Dual II Magnum <sup>b,c</sup>	forage sorghum	Pre / grass	1.0 to 1.67 pt <sup>d</sup>	n/a	1 applic.	n/a	next spring	4.5	4/9
Aim <sup>a</sup>	teff, crabgrass	POST / broadleaf	0.5 to 2.0 fl oz	any	5.9 fl oz (3 appls.)	0	0	0	12/12
Aim <sup>a</sup>	millets	POST / broadleaf	0.5 to 2.0 fl oz	up to jointing	2.0 fl oz	7 days	0	0	12/12
Aim <sup>a</sup>	forage sorghum	POST / broadleaf	0.5 to 1.0 fl oz	up to 6 leaf	1 fl oz	after 6 leaf	0	0	12/12
Basagran <sup>a</sup>	forage sorghum	POST / broadleaf	1.0 to 2.0 pt	before heading	2 pt	12 days	0	0	0
Buctril <sup>b</sup> 2EC (for 4EC formulation cut rates in half)	forage sorghum, sudan-grass, sor-sudan hybrid	POST / broadleaf	1 pt	3 lf but prior to pre-boot	2 pt	45 days	1	1	1
			1.5 pt	4 lf but prior to pre-boot					
Sanda <sup>a</sup>	pearl millet	POST / broadleaf & nutsedge	0.5 to 0.67 oz	2 lf but prior to head	0.67 oz	0/ 0 forage 37 hay	2	2	9
	sorghum		0.67 to 1.0 oz		1.0 oz	30/30			

<sup>a</sup>check label for adjuvant recommendations

<sup>b</sup>no adjuvant recommended

<sup>c</sup>requires the use of Concep-treated seed

<sup>d</sup>coarse soils 1.0 to 1.33 pt; medium soils 1.33 to 1.5 pt; fine soils 1.33 to 1.67 pt

<sup>e</sup>next year if applied before June 10; second year if applied after June 10

**Table 20: Herbicides Labeled for use in Conservation Reserve Program (CRP) Acres**

This table contains a list of herbicides that are available in Delaware for use on Conservation Reserve Program (CRP) acres seeded to grasses or legumes. Many products labeled for use on grass forage have the same label requirements for CRP grasses. These uses are listed in the first column of the table, and the grass forage section of this guide also applies to use on CRP acres. Some products labeled for use on grass or legume forage can be used on CRP acres but have specific label recommendations or supplemental labels for CRP acres (columns 2 & 4). Other products are not labeled for use on forages grown in Delaware, but allow their use on CRP acres (columns 3 & 5). When choosing products for CRP acres, it is very important to consult the herbicide labels to determine non-target plant, environmental, and human risks, grass or legume species tolerance, weed species susceptibility, use rates, rotational crop or overseeding restrictions, and adjuvant requirements.

Herbicide	WSSA MOA group <sup>a</sup>	Labeling for CRP grasses			Labeling for CRP legumes	
		CRP same as forage (use guide)	Specific CRP section (see label)	Labeled for CRP grass, not forage (see label)	Specific CRP section (see label)	Labeled for CRP legume, not forage (see label)
Aim	14	POST				
Banvel/Clarity	4		POST			
Buctril	6			POST	POST	
Cimarron Max	2 & 4		POST			
Cimarron Plus	2		POST			
Crossbow	4	POST				
Facet	4 & 26	POST				
Glyphosate	9		Preplant, renovation, or dormant POST		Preplant or renovation	
Gramoxone SL	22		preplant		preplant	
Journey	2 & 9			Preplant <sup>b</sup>		Preplant
Kerb	15			POST		
MCPA	4		POST		POST	
Metsulfuron	2	POST <sup>c</sup>				
Overdrive	4		POST <sup>d</sup>			
PastureGard	4		POST			
Plateau	2			PRE <sup>b</sup> or POST <sup>b</sup>		PRE or POST
Poast	1				POST	
Prowl / pendimethalin	3					PPI or PRE
Pursuit	2			POST	POST	
Remedy Ultra	4	POST				
Sandea	2	POST				
Starane Ultra	4			POST		
Stinger	4		POST			
Telar XP	2			POST		
Weedmaster	4		POST			
2,4-DB	4			POST	POST	
2,4-D ester/amine	4	POST				

<sup>a</sup>see Table 23.

<sup>b</sup>primarily for use on warm-season grasses.

<sup>c</sup>not on all metsulfuron labels.

<sup>d</sup>this use is on a supplemental label.

**Table 21: Herbicides Labeled for Farmstead Use**

This table lists several herbicides available in Delaware for use in farmstead areas. Farmstead areas may include areas around buildings (storage buildings, poultry houses, greenhouses, etc.), non-grazed fencerows, non-irrigation ditch banks, unpaved lanes, or other non-cropped agricultural areas where selective weed control or bare ground is desired. Some herbicide labels allow grazing or haying of treated areas within or around these sites, others do not. Many of these herbicides are toxic to desirable plants when spray particles contact either above-ground plant parts, bare roots, and/or the soil where plant roots have penetrated. Most of these products should not be used on impervious surfaces such as paved or highly compacted areas. Runoff from treated impervious surfaces or transport of treated soils by erosion can severely injure or kill susceptible non-target plants. Do not apply these products directly to water, and exercise caution when using these products near irrigation or domestic water supplies. Many of these products are not recommended for use on highly permeable soils and/or soils with groundwater near the soil surface. Read herbicide labels carefully to determine allowed uses, environmental risks, human risks, desirable plant species tolerance, weed species susceptibility, application types, use rates, adjuvant requirements, and specific grazing or haying restrictions.

Herbicide	WSSA MOA group <sup>a</sup>	Soil residual <sup>b</sup> (yes/no)	Grass control	Broadleaf control	Woody plant and vine control	Grazing restriction (days)	Haying restriction (days)
Banvel / Clarity	4	limited		X	several	0 to 40	0 to 70
Cimarron Max	2 & 4	yes		X	several	0 to 7	37
Cimarron Plus	2	yes		X	several	0	0
Crossbow	4	limited		X	several	0 to NS <sup>c</sup>	14
Glyphosate	9	no	X	X	several	0 to 56	0 to 56
Karmex / Direx	7	yes	X	X	no	--	--
Metsulfuron <sup>d</sup>	2	yes		X	few	0	0
PastureGard	4	limited		X	several	0 to NS <sup>c</sup>	14
Payload	14	yes	X	X	no	do not	do not
Pendulum	3	yes	X	X	no	do not	do not
Pramitol	5	yes	X	X	no	--	--
Remedy RTU	4	limited		X	several	0 to NS <sup>c</sup>	7 to NS
Sahara	2 & 7	yes	X	X	many	--	--
Solicam	12	yes	X	X	no	do not	do not
Spike	7	yes		X	many	0	365
Starane Ultra / Vista	4	limited		X	no	7	14
Stinger	4	limited		X	no	0	0
Velpar	5	yes	X	X	several	60 - 365	60 - 365
Weedmaster	4	limited		X	several	0 to 7	37
2,4-D	4	limited		X	few	0 to 7	7

<sup>a</sup>see Table 23.

<sup>b</sup>herbicides listed as having limited soil residual activity may, for a short time, provide residual control or suppression of some species, and can injure or kill susceptible desirable plants through soil activity.

<sup>c</sup>NS=next season after application

<sup>d</sup>not on all metsulfuron labels.

**Table 22a: Comparison of Premix or Prepackaged Products Containing 2,4-D and/or Dicamba****Cimarron Max** = 2,4-D + dicamba + metsulfuron**Overdrive** = dicamba + diflufenzopyr**Weedmaster** = 2,4-D + dicamba**Crossbow** = 2,4-D + Remedy**Latigo** = 2,4-D + dicamba**Yukon** = dicamba + Sandea

Herbicide trade name	Product Rate/A	2,4-D (lb ae/A)	2,4-D <sup>a</sup> (4 lb/gal) equiv./A	Dicamba (lb ae/A)	Banvel <sup>a</sup> (4 lb/gal) equiv./A	Other constituent <sup>a</sup> (ai or ae and product/A)
Cimarron Max (part A & B) <sup>b,c</sup>	0.25 oz 'A' 1 pt 'B'	0.36	0.75 pt DMA salt	0.125	4 fl oz DMA salt	0.0094 lb ai metsulfuron = 0.25 oz Metsulfuron 60DF
Cimarron Max (part A & B) <sup>b,d</sup>	0.4 oz 'A' 1.6 pt 'B'	0.57	1.2 pt DMA salt	0.2	6.4 fl oz DMA salt	0.015 lb ai metsulfuron = 0.4 oz Metsulfuron 60DF
Crossbow 3L	1 qt	0.5	1 pt BE ester	--	--	0.25 lb ae triclopyr BE ester = 0.5 pt Remedy Ultra 4L
Crossbow 3L	4 qt	2.0	4 pt BE ester	--	--	1.0 lb ae triclopyr BE ester = 2 pt Remedy Ultra 4L
Overdrive 70WG	4 oz	--	--	0.125	4 fl oz Na salt	0.05 lb ae diflufenzopyr <sup>e</sup> Na salt
Overdrive 70WG	8 oz	--	--	0.25	8 fl oz Na salt	0.1 lb ae diflufenzopyr <sup>e</sup> Na salt
Latigo 4.2L	1.125 pt	0.34	0.67 pt acid	0.25	8 fl oz acid	--
Latigo 4.2L	2.25 pt	0.68	1.4 pt acid	0.51	16 fl oz acid	--
Weedmaster 3.87L	2 pt	0.72	1.5 pt DMA salt	0.25	8 fl oz DMA salt	--
Weedmaster 3.87L	4 pt	1.44	3 pt DMA salt	0.5	16 fl oz DMA salt	--
Yukon 67.5WG	6 oz			0.206	6.6 fl oz Na salt	0.047 lb ai halosulfuron = 1 oz Sandea 75DF

<sup>a</sup>plant growth regulator herbicides are formulated as salts or esters.DMA salt = dimethylamine salt    NA salt = sodium salt    TIA salt = triisopropanolammonium salt  
BE ester = butoxyethyl ester    IE ester = isooctyl (ethylhexyl) ester<sup>b</sup>Cimarron Max is a two part product. Part A is a 5 oz package of Metsulfuron 60DF and Part B is a 2.5 gallon jug of a liquid premix with 1 lb ae/gal dicamba and 2.87 lb ae/gal 2,4-D.<sup>c</sup>at this rate, 5 oz of Part A and 2.5 gal of Part B will treat 20 acres.<sup>d</sup>at this rate, 5 oz of Part A and 2.5 gal of Part B will treat 12.5 acres.<sup>e</sup>diflufenzopyr is not formulated alone for use in forages, so no product rate can be given.**Table 22b: Other prepackaged products (not containing 2,4-D or dicamba)**

Herbicide and constituents trade names	Constituent common names	Formulation	Product rate	Equivalent constituent rates (product/A)
Cimarron Plus Metsulfuron Telar	metsulfuron chlorsulfuron	63 DF 48% 15%	0.5 oz/A	0.4 oz Metsulfuron 60 DF 0.1 oz Telar 75DF <sup>a</sup>
PastureGard HL Remedy Vista	triclopyr fluroxypyr	4L 3.0 lb 1.0 lb	1 pt/A	0.75 pt Remedy Ultra 4L 5.7 fl.oz. Vista XRT 2.8L

<sup>a</sup>Telar 75DF is not currently being marketed in Delaware.

**Table 23: Herbicide Site of Action for Reducing the Risk of Developing Herbicide-Resistant Weeds**

Reducing the risk for developing herbicide-resistant weed populations requires incorporating a number of guidelines in managing your fields. These guidelines include:

- Spray only when necessary
- Use alternative methods of control whenever possible such as mechanical cultivation or delayed planting (row crops), mowing (forage crops), and using weed-free crop seeds
- Rotate crops and their accompanying herbicides' site of action
- Limit number of applications of herbicide(s) with same site of action in a given growing season
- Use mixtures or sequential herbicide treatments having different sites of action that will control the weeds of concern
- Scout fields after herbicide application to detect weed escapes or shifts
- Clean equipment before leaving fields infested with or suspected to have resistant weeds

Rotating herbicides with differing sites of action is important for minimizing the risk of developing herbicide-resistant weeds. However, information on herbicide site of action is often not printed on herbicide labels and thus is difficult to obtain. The following tables are designed to assist with herbicide selection based on herbicide site of action.

Below (Table 23A) is a list of important herbicide groups for agronomic crops grown in the Mid-Atlantic region. To reduce the risk of developing herbicide resistant weeds, **avoid repeated use of herbicides with the same site of action**. Note that more than one herbicide family may have the same site of action.

A list of common pre-package herbicide mixture and their components is contained in Table 23B. Be sure to know the site of action for all the herbicides included in the pre-package mixture.

**Table 23A:** Important herbicide groups for corn, soybean, small grain, commercial vegetable and forage.

Herbicide class	Site of action	Family	Active ingredient	Trade name	WSSA group <sup>1</sup>
Plant growth regulators	<b>IAA-like</b>	phenoxy	2-4-D	various	4
			2,4-DB	Butyrac	
			MCPA	various	
		benzoic acid carboxylic acid (pyridines)	dicamba	Banvel, Clarity	4
			aminopyralid	Milestone	4
			clopyralid	Stinger	Starane, Vista
			fluroxypyr		
picloram	quinclorac	Tordon	Facet		
	triclopyr	Garlon, Remedy			
Auxin transport inhibitor	<b>IAA transport</b>	semicarbazone	diflufenzopyr	none	19
		phthalamate	naptalam	Alanap	19
Amino acid biosynthesis	<b>ALS-enzyme</b>	imidazolinone	imazamethabenz	Assert	2
			imazamox	Raptor, Beyond	
			imazapic	Plateau	
			imazapyr	Arsenal	
			imazaquin	Scepter	
			imazethapyr	Pursuit	
		sulfonylamino-carbonyl-triazolinones	flucarbazone	Everest	2
propoxycarbazone	Olympus				
	thiencarbazone	none			

Herbicide class	Site of action	Family	Active ingredient	Trade name	WSSA group <sup>1</sup>		
<i>(continued)</i>							
Amino acid biosynthesis	<b>ALS-enzyme</b>	sulfonylurea	chlorimuron	Classic	2		
			chlorsulfuron	Glean, Telar			
			halosulfuron	Permit, Sandea			
			iodosulfuron	Autumn			
			mesosulfuron	Osprey			
			metsulfuron	Ally, various			
			nicosulfuron	Accent Q			
			primisulfuron	Beacon			
			prosulfuron	Peak			
			rimsulfuron	Resolve SG			
sulfosulfuron	Maverick						
thifensulfuron	Harmony SG						
tribenuron	Express						
		triazolopyrimidine (sulfonamides)	cloransulam	FirstRate	2		
			flumetsulam	Python			
			pyroxsulam	PowerFlex HL			
	<b>EPSP-enzyme</b>	amino acid derivative	glyphosate	Roundup, Touchdown	9		
Fatty acid (Lipid) biosynthesis inhibitors	<b>ACCase</b>	aryloxyphenoxy propionates	diclofop	Hoelon	1		
			fenoxaprop	none			
			fluazifop	Fusilade			
				quizalofop	Targa, Assure II		
				cyclohexanediones	clethodim	Select Max	1
					sethoxydim	Poast	
			tralkoxydim	Achieve			
		phenylpyrazolin	pinoxaden	Axial	1		
Seedling growth inhibitors (Root)	<b>Microtubule inhibitors</b>	dinitroanilines	benefin	Balan	3		
			ethalfuralin	Curbit, Sonalan			
			pendimethalin	Prowl, Pendulum			
			prodiamine	Barricade			
			trifluralin	Treflan, various			
		pyridazines	dithiopyr	Dimension	3		
	<b>Unknown</b>	none	DCPA	Dacthal	3		
Seedling growth inhibitors (Shoot)	<b>Unknown</b>	chloroacetamides	acetochlor	Harness, Topnotch	15		
				Breakfree, Degree			
				In Intro			
				Outlook			
				Dual, Cinch			
				alachlor	Kerb		
				dimethenamid	Ramrod		
				metolachlor			
				pronamide			
				propachlor			
		acetamides	napropamide	Devrinol	15		
		oxyacetamides	flufenacet	Define	15		
		pyrazole	pyroxa-sulfone	Zidua	15		
	<b>Lipid synthesis inhibitors</b>	thiocarbamates	butylate	Sutan	8		
				cycloate		Ro-Neet	
				EPTC		Eptam, Eradicane	
			vernolate	Vernam			
		none	bensulide	Prefar	8		



Photosynthesis inhibitors (mobile 1)	<b>Photosystem II</b>	phenylcarbamates	phenmedipham	Spin-Aid	5
		triazines	ametryn	Evik	5
			atrazine	Atrazine	
			prometon	Pramitol	
		prometryn	Caparol		
		simazine	Princep		
		triazinones	hexazinone	Velpar	5
			metribuzin	Metribuzin	
		uracils	terbacil	Sinbar	5
Photosynthesis inhibitors (mobile 2)	<b>Photosystem II</b>	ureas	diuron	Karmex	7
			linuron	Lorox	
			tebuthiuron	Spike	
Photosynthesis inhibitors (non-mobile)	<b>Photosystem II</b>	benzothiadiazole	bentazon	Basagran	6
		nitriles	bromoxynil	Buctril	6
		phenyl-pyridazine	pyridate	Tough	6
Cell membrane disrupters	<b>PPO</b> (protoporphyrinogen oxidase)	diphenyl ethers	acifluorfen	Ultra Blazer	14
			fomesafen	Reflex, Flexstar	
			lactofen	Cobra	
			oxyfluorfen	Goal	
		N-phenyl-phthalimides	flumiclorac	Resource	14
			flumioxazin	Valor, Chateau	
			fluthiacet	Cadet	
	oxadiazole	oxadiazon	Ronstar	14	
	pyrimidinedione	saflufenacil	Kixor, Sharpen	14	
	triazolinone	carfentrazone	Aim	14	
		sulfentrazone	Spartan		
	<b>Photosystem I</b>	bipyridyliums	duquat	Reglone	22
			paraquat	Gramoxone	
Pigment inhibitors	<b>PDS</b> (carotenoid biosynthesis)	pyridazinone	norflurazon	Solicam	12
	<b>Diterpenes</b> (carotenoid biosynthesis)	isoxazolidinone	clomazone	Command	13
	<b>HPPD</b> (hydroxy-phenyl-pyruvate-dioxygenase)	isoxazole	isoxaflutole	Balance Flexx	27
			mesotrione	Callisto	
			pyrazole	pyrasulfotole	
triketone			tembotrione	Laudis	
	pyrazolone	topramezone	Impact	27	
Phosphorylated amino acid (N metabolism disrupter)	<b>Glutamine synthetase</b>	amino acid derivative	glufosinate	Liberty, Finale	10
Cell wall biosynthesis inhibitor	<b>Cell wall synthesis - site B</b>	benzamide	isoxaben	Gallery	21
	<b>Unknown</b>	quinoline carboxylic acid	quinclorac	Facet	26
Cellulose inhibitors		alkylazaine	indaziflam	Alion	29

<sup>1</sup>WSSA group is a system of classifying herbicides developed by the Weed Science Society of America, based on mode and site of actions, to help understand and plan for resistance management. The reference for this table is: E. James Retzinger and Carol Mallory-Smith. 1997. Classification of Herbicides by Site of Action for Weed Resistance Management Strategies. Weed Technology volume 11, pages 384 to 393.

**Table 23B:** Common pre-pack or premix herbicides for crops in the Mid-Atlantic region. The WSSA mode of action (MOA) numbers are the WSSA group numbers (right-hand column of Table 23A) for herbicide site of action.

Pre-packaged herbicide	Constituent products	WSSA MOA #'s	Pre-packaged herbicide	Constituent products	WSSA MOA #'s
Anthem	Zidua, Cadet	15, 14	Harness Xtra	Harness, atrazine	15, 5
Anthem ATZ	Zidua, Cadet, atrazine	15, 14, 5	Hornet WDG	Python, Stinger	2, 4
Authority Assist	Spartan, Pursuit	14, 2	Huskie	Buctril, pyrasulfotole	6, 27
Authority Elite	Spartan, Dual	14, 15	Instigate	Resolve SG, Callisto	2, 27
Authority First	Spartan, FirstRate	14, 2	Journey	Plateau, glyphosate	2, 9
Authority Maxx	Spartan, Classic	14, 2	Keystone NXT	Harness, atrazine	15, 5
Authority MTZ	Spartan, Metribuzin	14, 5	Latigo	Banvel, 2,4-D	4, 4
Authority XL	Spartan, Classic	14, 2	Lexar EZ	Dual, Callisto, atrazine	15, 27, 5
AxialStar	Axial XL, Vista	1, 4	Lumax EZ	Dual, Callisto, atrazine	15, 27, 5
Axiom	Define, Metribuzin	15, 5	Marksman	Banvel, atrazine	4, 5
Basis Blend	Resolve, Harmony SG	2, 2	Milestone VM Plus	Milestone, Remedy Ultra	4, 4
Bicep II Magnum	Dual, atrazine	15, 5	NorthStar	Banvel, Beacon	4, 2
Boundary	Dual, Metribuzin	15, 5	Olympus Flex	Olympus, Osprey	2, 2
Breakfree ATZ	Breakfree, atrazine	15, 5	OpTill	Sharpen, Pursuit	14, 2
Bullet	Micro-Tech, atrazine	15, 5	OpTill Pro	Sharpen, Pursuit, Outlook	14, 2, 15
Callisto GT	Callisto, Touchdown	27, 9	Overdrive	Banvel, diflufenzopyr	4, 19
Callisto Xtra	Callisto, atrazine	27, 5	PastureGard	Remedy, Vista	4, 4
Canopy	Classic, Metribuzin	2, 5	Permit Plus	Permit, Harmony SG	2, 2
Canopy EX	Classic, Express	2, 2	Prefix	Dual, Reflex	15, 14
Capreno	Thiencarbazone, Laudis	2, 27	Pulsar	Clarity, Starane	4, 4
Cimarron Max	metsulfuron, Banvel, 2,4-D	2, 4, 4	Realm Q	Resolve, Callisto	2, 27
Cimarron Plus	metsulfuron, Telar	2, 2	Resolve Q	Resolve, Harmony SG	2, 2
Cinch ATZ	Cinch, atrazine	15, 5	Sahara	Arsenal, Karmex	2, 7
Corvus	Balance Flexx, thiencarbazone	27, 2	Sequence	Dual, glyphosate	15, 9
Crossbow	Remedy, 2,4-D	4, 4	Sonic	Spartan, FirstRate	14, 2
Degree Xtra	Degree, atrazine	15, 5	Spartan Advance	Spartan, glyphosate	14, 9
Distinct	Banvel, diflufenzopyr	4, 19	Spartan Charge	Aim, Spartan	14, 14
Envive	Classic, Harmony SG, Valor	2, 2, 14	Spirit	Peak, Beacon	2, 2
Extreme	Pursuit, glyphosate	2, 9	Status	Banvel, diflufenzopyr	4, 19
Fierce	Valor SX, Zidua	14, 15	Steadfast Q	Accent, Resolve	2, 2
Finesse	Glean, Ally	2, 2	Storm	Basagran, Blazer	6, 14
Finesse Gr & BL	Glean, Everest	2, 2	Strategy	Command, Curbit	13, 3
Flexstar GT	Flexstar, glyphosate	14, 9	SureStart	Harness, Python, Stinger	15, 2, 4
ForeFront R&P	Milestone, 2,4-D	4, 4	Synchrony XP	Classic, Harmony SG	2, 2
Fultime	Topnotch, atrazine	15, 5	TripleFlex	Harness, Python, Stinger	15, 2, 4
Fusion	Fusilade, fenoxaprop	1, 1	Valor XLT	Valor SX, Classic	14, 2
Gangster	Valor SX, FirstRate	14, 2	Verdict	Sharpen, Outlook	14, 15
Guardman Max	Outlook, atrazine	15, 5	Weedmaster	Banvel, 2,4-D	4, 4
Halex GT	Dual, Callisto, glyphosate	15, 27, 9	Yukon	Sandea, Banvel	2, 4
Harmony Extra	Harmony SG, Express	2, 2	Zemaz	Callisto, Dual	27, 15

**Table 24: Comparison of Various Glyphosate Formulations**

There are numerous products containing glyphosate in the marketplace, but there is no consistency in how the companies report what is contained “in the jug”. Glyphosate is an acid, but it is formulated as a salt for packaging and handling. Roundup is formulated with the potassium salt, whereas Showdown includes both monoammonium and isopropylamine salts. Some companies report their product as acid equivalent (ae) of glyphosate acid, or some report it as active ingredient (ai) of glyphosate plus the salt, and others report both. In order to compare performance of different formulations it is critical to know how the products were formulated. Since the salt does not contribute to weed control and different salts have different weights, the acid equivalent is a more accurate method of expressing, and comparing, concentrations.

Adjuvant loading refers to the amount of adjuvant already added to the glyphosate product. Fully loaded products contain all the necessary adjuvants. Other products contain only a limited amount of adjuvant (minimal or partial loading) and additional surfactants must be added to the spray tank before application. Refer to product labels for specific recommendations. All glyphosate brands recommend adding ammonium sulfate (AMS) if using hard water as a carrier or under other challenging conditions. If using AMS, always dissolve it in the spray solution before adding glyphosate.

Trade name	Company	lb ae/gal	lb ai/gal	Formulation (salt) of the glyphosate acid	Rate (fl oz) for 0.75 lb ae	Adjuvant load
Duramax	Dow	4.0	5.4	DMA <sup>a</sup>	24	full
Durango DMA	Dow	4.0	5.4	DMA <sup>a</sup>	24	full
Showdown	Helena	3.0	4.0	IPA <sup>b</sup> + MNH <sup>d</sup>	32	partial
Hoss Ultra	Helena	3.0	4.0	IPA <sup>b</sup>	32	full
Roundup PowerMAX	Monsanto	4.5	5.5	K <sup>c</sup>	22	partial
Roundup WeatherMax	Monsanto	4.5	5.5	K <sup>c</sup>	22	full ( <i>TranSorb II</i> )
Credit 41	Nufarm	3.0	4.0	IPA <sup>b</sup>	32	partial
Credit 41 Extra	Nufarm	3.0	4.0	IPA <sup>b</sup>	32	full
Credit Xtreme	Nufarm	4.5	5.5	IPA <sup>b</sup> + K <sup>c</sup>	22	full
Extra Credit 5	Nufarm	3.75	5.0	IPA <sup>b</sup>	26	partial
Touchdown Pro	Syngenta	3.0	4.0	DA <sup>e</sup>	32	full ( <i>IQ</i> )
Touchdown HiTech	Syngenta	5.0	6.25	K <sup>c</sup>	19	minimal
Touchdown Total	Syngenta	4.17	5.1	K <sup>c</sup>	24	full ( <i>IQ</i> )
Mirage	UAP	3.0	4.0	IPA <sup>b</sup>	32	partial
Mirage Plus	UAP	3.0	4.0	IPA <sup>b</sup>	32	full

<sup>a</sup>dimethylamine salt

<sup>b</sup>isopropylamine salt

<sup>c</sup>potassium salt

<sup>d</sup>monoammonium salt

<sup>e</sup>diammonium salt

## Table 25: General Herbicide Mixing Procedures

Specific mixing or tank-mixing procedures may vary among product labels. When using a product alone, adhere to the mixing instructions on the product label. When tank-mixing two or more products, adhere to the most restrictive label's instructions. If it is difficult to determine which instructions to follow or when the instructions on the labels contradict each other, use the general instructions outlined below.

- 1) Make sure the spray equipment is properly cleaned according to the labels of the products that were last applied with the sprayer.
- 2) Make sure the sprayer is properly calibrated, has good agitation, and is equipped with the appropriate screens (no finer than 50 mesh; 100 mesh is finer than 50 mesh) and spray tips.
- 3) If tank-mixing two or more products, make sure there are no label restrictions prohibiting those products from being tank-mixed.
- 4) If tank-mixing two or more herbicides that are not specifically allowed on the labels, or if the labels require it, perform a compatibility test (such as a jar test) to assure that the products mix properly.
- 5) If a suspension or liquid fertilizer is being used as the carrier, perform a compatibility test (such as a jar test) to assure that the products dissolve properly and remain stable.
- 6) Fill the spray tank  $\frac{1}{2}$  to  $\frac{3}{4}$  full with clean water or suspension or liquid fertilizer (if being used as the carrier) and begin agitation. If possible, maintain agitation until all applications are completed.
- 7) If ammonium sulfate (AMS) is being added as a water conditioner, add the AMS first. This is particularly important if glyphosate (Roundup, Touchdown, etc.) or paraquat (Gramoxone) products are being used. Make sure the AMS is completely dissolved before continuing.
- 8) If compatibility agents are required, follow the herbicide label first, followed by the directions with the compatibility agent. Compatibility agents are generally either mixed or slurried with the products and/or added to the carrier solution prior to adding any products.
- 9) Add water soluble packets and thoroughly mix. Make sure the packets are completely dissolved.
- 10) Add wettable powders (WP) and thoroughly mix.
- 11) Add dispersible granules (DG) and dry flowables (DF) that are not in water soluble packets and thoroughly mix.
- 12) Add liquid flowable (FL) formulations and thoroughly mix.
- 13) The products in steps 9-12 can be slurried in water to assure that the products are completely dissolved before adding them to the spray tank. Some labels require that the product be slurried, particularly when using a suspension or liquid fertilizer as the carrier. Make sure to use enough water to allow the products to be completely dissolved.
- 14) Add water soluble concentrates (SC) and other aqueous solution products and thoroughly mix.
- 15) Add emulsifiable concentrate (EC) formulations and thoroughly mix.
- 16) Add spray adjuvants (nonionic surfactants, crop oil concentrates, methylated seed oil, etc.).
- 17) Add nitrogen fertilizer solutions such as urea ammonium nitrate (UAN) or ammonium sulfate (AMS) that is not being added as a water conditioner.
- 18) Add other tank products such as defoamers, drift control agents, dyes, etc., unless labels require their addition earlier in the mixing process.
- 19) Finish filling the spray tank.

**Table 26: General Jar Test Procedures**

A “jar test” is a type of compatibility test used to determine if two or more herbicides will mix properly, or if an herbicide(s) will mix properly with a carrier solution such as a suspension or liquid fertilizer.

Incompatibility of tank mixtures is more common with suspensions of liquid fertilizers and pesticides. The idea of the jar test is to create a miniature of the actual spray tank mixture with all of the components in the proper ratios. Many herbicide labels have specific jar test procedures. If possible, follow the procedures outlined on the product label(s). If it is difficult to determine which label instructions to follow or when the instructions on the labels contradict each other, use the general instructions outlined below.

- 1) Use only water or carrier solution from the intended source and at the source temperature.
- 2) One jar will usually be adequate if only herbicide compatibility in water is being tested. Two or three jars may be needed if compatibility agents and/or adjuvants will be compared to the tank mixture alone. Use quart-size jars with re-sealable lids.
- 3) Add the appropriate amount of water or carrier solution to each quart jar using this formula [spray volume (gal/A) x 0.04 = carrier to add in pint/jar]. For example, for a spray volume of 20 gal/A, add  $20 \times 0.04 = 0.8$  pint (378 ml) of carrier to each jar.
- 4) If a compatibility agent will be used, add the appropriate amount of the compatibility agent to one labeled jar based on this formula: [compatibility agent rate (pint/100 gal) x spray volume (gal/A) x 0.005 = compatibility agent to add in teaspoons/jar]. For example, if the label rate for the compatibility agent is 3 pints/100 gal and the spray volume is 20 gal/A, then  $3 \times 20 \times 0.005 = 0.3$  teaspoon (1.5 ml) of compatibility agent to one jar.
- 5) Add the appropriate amount of pesticides in the proper order (wetable powders, dispersible granules, dry flowables, liquid flowables, soluble concentrates and other aqueous solutions, and emulsifiable concentrates) to all jars according to one of the methods below. After each addition shake, invert several times, or stir gently to thoroughly mix.
  - a. Use the formula [product rate/A x 0.005], and convert to an appropriate measurement using the conversion factors below. Or,
  - b. For dry products add 1 teaspoon per pound of product per acre, and for liquid products add  $\frac{1}{2}$  teaspoon per pint of product per acre.
    - i. Dry product conversion factors:
      1. 1 pound = 16 ounces = 454 grams
      2. 1 ounce = 28.3 grams
    - ii. Liquid product conversion factors:
      1. 1 gallon = 4 quarts = 8 pints = 128 fluid ounces
      2. 1 pint = 2 cups = 16 fluid ounces = 473 milliliters
      3. 1 fluid ounce = 29.57 milliliters = 2 tablespoons = 6 teaspoons
      4. 1 teaspoon = 4.93 milliliters = 60 drops
- 6) If adjuvants are being tested for compatibility, these should be added last to one labeled jar. Use one of these formulas based on how the adjuvant rate is expressed: [adjuvant rate (pint/100 gal) x spray volume (gal/A) x 0.005 = adjuvant to add in teaspoons/jar], or [adjuvant rate (pint/A) x 0.48 = adjuvant to add in teaspoons/jar].
- 7) When all components have been added to the jar(s), invert each jar ten times to mix and let stand for 15 to 30 minutes. If the spray solution balls up or forms flakes, sludges, jels, oily films or layers, or other precipitates it is not compatible. If a compatibility agent has not already been tested, repeat the test with a suitable compatibility agent. The tank mixture should not be used if any signs of incompatibility are evident. If the mixture separates but can be remixed readily, the mixture can be sprayed as long as good agitation is used.
- 8) Compatibility may be improved by using the following methods when testing and mixing.
  - a. Slurry the dry pesticides in water before addition to the mixture.
  - b. Oily films are usually caused by incompatibility of emulsifiable concentrates (EC). Add  $\frac{1}{2}$  of the compatibility agent to the carrier and  $\frac{1}{2}$  to emulsifiable concentrates and/or flowable pesticides before adding them to the mixture.
- 9) When finished, properly dispose of any pesticide waste.

**Table 27: Accurate Herbicide Volume and Weight Measurements for Small Volume Applications**

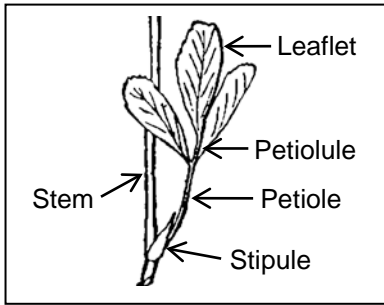
**Common Conversion Factors**

Liquid products	Quart (qt)	Pint (pt)	Cup	Fluid ounces (fl.oz.)	Tablespoon (Tblspn)	Teaspoon (tsp)	Milliliter (ml)
1 gallon	4	8	16	128	256	768	3785
1 quart	--	2	4	32	64	192	946
1 pint	--	--	2	16	32	96	473
1 cup	--	--	--	8	16	48	237
1 fl.oz.	--	--	--	--	2	6	29.57
1 Tblspn	--	--	--	--	--	3	14.8
1 tsp	--	--	--	--	--	--	4.9
<b>Dry products</b>	1 pound (lb) = 16 oz.wt = 453.6 grams (gr)				1 oz.wt. = 28.35 grams (gr)		

Spot-spray, wiper bar, or small area applications often require preparation of a small volume of spray solution. Backpack sprayers usually have a one to three gallon capacity. Spray concentrations for liquid herbicide formulations can be as low as 0.05 fl.oz. (1.5 ml) per gallon, and concentrations for dry herbicide formulations as low as 0.01 oz.wt. (0.28 gr) per gallon. Inaccurate measurement of these very small concentrations can cause large deviations above or below the intended application rate, resulting in possible crop damage, carryover, or poor weed control. For example, when measuring a pint of liquid herbicide, a deviation of 0.5 ml, which is equivalent to 6 drops from a dropper, would result in a negligible increase or decrease of 0.1% from the intended rate. However, the same 6 drop deviation when measuring 1.5 ml of a liquid herbicide would result in an unacceptable rate increase or decrease of 33%.

Most liquid measuring devices intended for use with agricultural products are good for measuring large volumes (pints, quarts, gallons), but are usually not accurate below a volume of 10 fl.oz. (296 ml). Two types of measuring devices are available for low volumes that are accurate and easy to use. Graduated cylinders are tall narrow cylinders with milliliter graduations along the outside of the tube. They are available in non-breakable polypropylene material that can be washed and reused. They are available in sizes ranging from 10ml (0.34 fl.oz.) with 0.2 ml increments to 4000 ml (1.06 gal) with 50 ml increments. Pouring liquid herbicides into small graduated cylinders from large containers can be difficult. Disposable syringes are probably the cleanest and most accurate way to measure small volumes of liquid herbicide. Although they are termed disposable, they can be easily dismantled, washed, and reused several times. Buy syringes without the needles if possible, or remove and dispose of needles before use to avoid possible injury or exposure to the herbicide through a skin puncture. A syringe is essential for measuring volumes of less than 0.17 fl.oz. (5 ml), and can be purchased in sizes ranging from 3 ml with 0.1 ml increments up to 60 ml with 1 ml increments. A good arrangement of measuring devices to have for medium to small volume measurements includes a 250 ml graduated cylinder with 2 ml graduations, and 3ml, 10 ml and 60ml syringes.

For dry products, Postal scales measuring to 0.1 oz.wt. are adequate for weights above 1 oz.wt. (28.4 gr). A gram scale accurate to 1/100<sup>th</sup> of a gram (0.01 gr) should be used for measuring weights of less than 1 oz.wt. Converting products measured by mass (oz.wt. or grams) into volume (teaspoons, tablespoons, or milliliters) is not practical because of the variability in the density (weight per given volume) of individual products. If sufficiently accurate weighing devices are not available, dry products requiring low concentrations should not be used for small volume applications.



### Cool Season Forage Legume Identification Key

page 1 of 2

First true leaf singular unifoliate;  
Subsequent leaves always trifoliate

First true leaf other than singular unifoliate

Leaflet branches of unequal length (pinnate leaf)

Leaflet branches of equal length (palmate leaf)

Leaflets elongate, oval, and widest near the center

Leaflets oval, widest near the tip

Vegetative parts densely hairy

Vegetative parts not hairy

Leaflet edge greater than 1/2 serrated

Leaflet edge less than 1/2 serrated

Leaflet edge near tip is serrated

Leaflet white watermark coloring usually present

Leaflet white watermark coloring usually present

Leaflet white watermark coloring never present



**Sweetclover**  
*Melilotus suaveolens*



**Alfalfa**  
*Medicago sativa*



**Black Medic**  
*Medicago lupulina*



**Red Clover**  
*Trifolium pratense*

Leaflet wider near tip, tip notched or blunt, and stems creeping

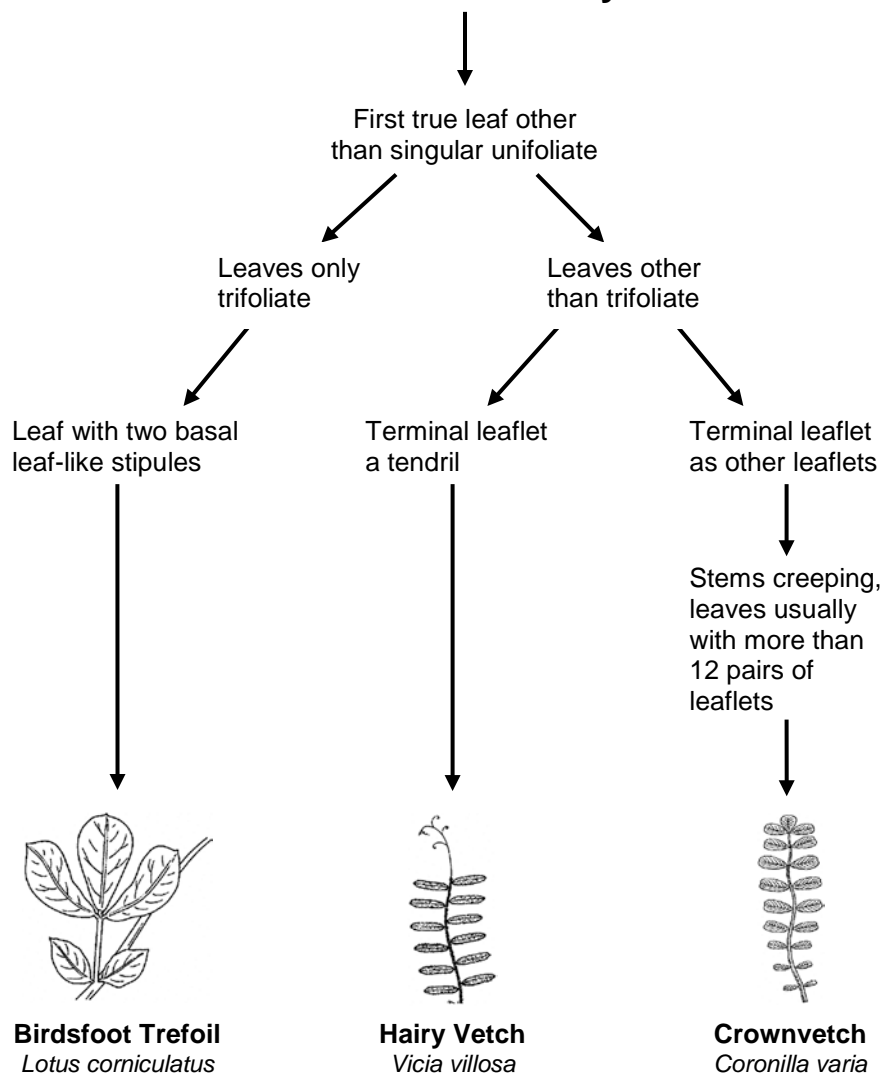


**White Clover**  
*Trifolium repens*



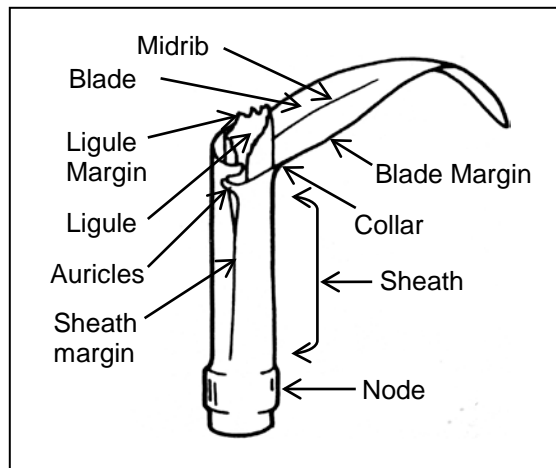
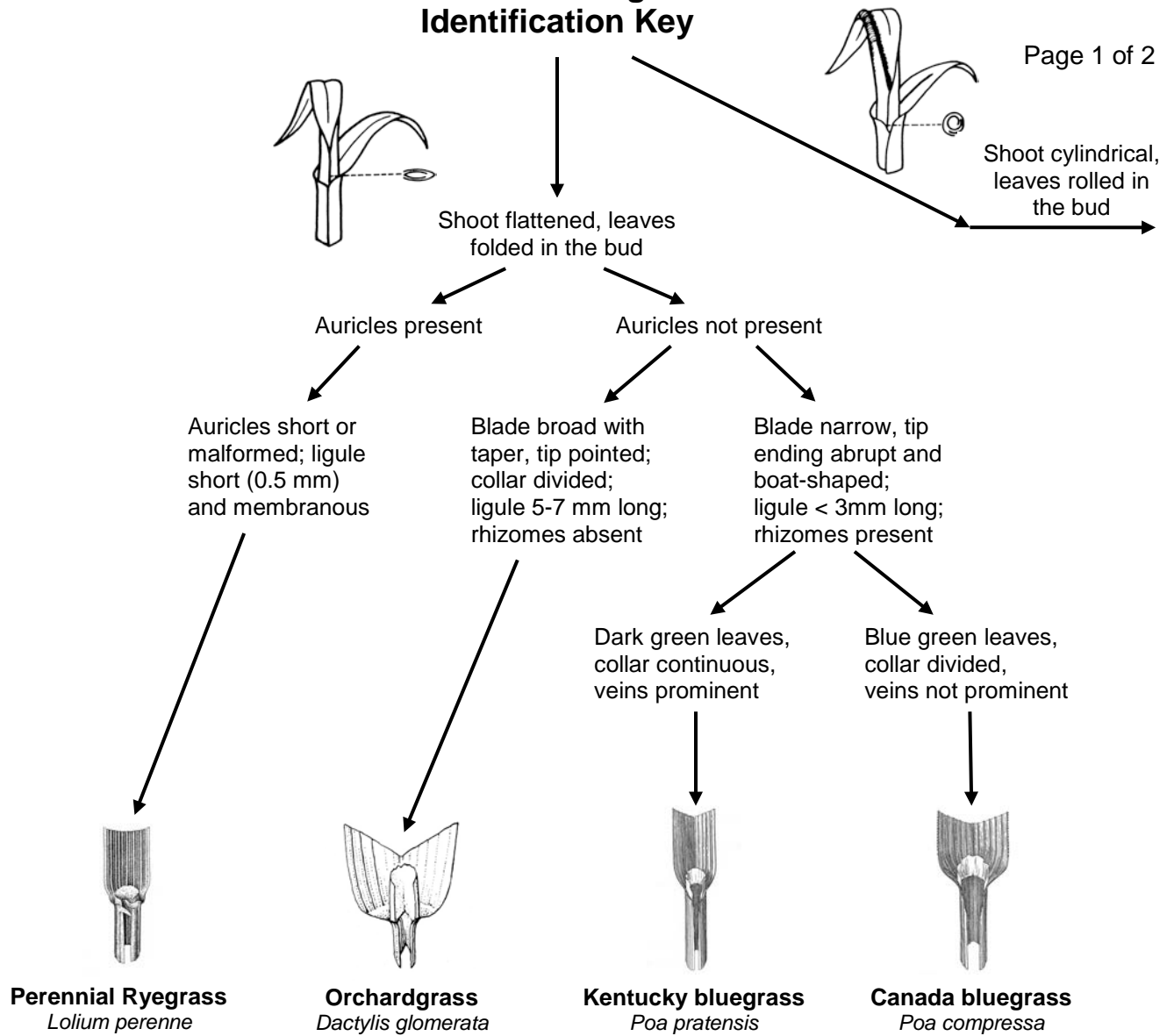
**Alsike Clover**  
*Trifolium hybridum*

### Cool Season Forage Legume Identification Key



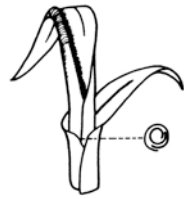


### Cool Season Forage Grass Identification Key



Adapted from "Grazing Systems Planning Guide", University of Minnesota Extension; Images provided by Ciba-Geigy Limited, Basel, Switzerland

### Cool Season Forage Grass Identification Key



Shoot cylindrical,  
leaves rolled in the bud

Auricles present

Auricles not present

Auricles short,  
blunt, and hairy;  
blade glossy and  
prominently  
veined on upper  
surface; rhizomes  
short

Auricles blunt to  
clasping, and not  
hairy; blade  
glossy below;  
rhizomes not  
present

Collar and sheath  
with fine hairs,  
sheath closed to  
near top

Collar and sheath  
not hairy, sheath  
split with  
overlapping  
edges

Ligule < 2 mm long,  
M constriction  
midway between  
collar and tip

Blade light green;  
ligule rounded,  
long (3-6 mm),  
and not notched;  
rhizomes present

Blade blue green;  
ligule rounded,  
short (2-3 mm),  
and notched near  
the front; rhizomes  
not present



**Tall Fescue**  
*Festuca arundinacea*



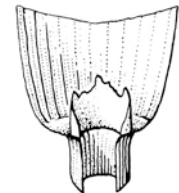
**Annual Ryegrass**  
*Lolium multiflorum*



**Smooth  
bromegrass**  
*Bromus inermis*



**Reed  
Canarygrass**  
*Phalaris arundinacea*



**Timothy**  
*Phleum pratense*

**--- Blank Page ---**

## Precautions for Pesticide Use

Use of restricted use pesticides requires certification

Use pesticides only when necessary

Use pesticides only at the recommended rates and timings to keep residues on crops within the limits set by law

Avoid spray or drift to other crops and sensitive areas

Read the pesticide label and follow all safety precautions listed

Wear protective clothing, eye protection and masks if specified on the label

Maintain pesticide use record and inventory

Avoid inhaling pesticides

Never eat or smoke while spraying, mixing or handling pesticides

Avoid spilling spray materials on skin and

clothing. If spilled, wash off immediately with soap and water

Store pesticides in original containers, out of reach of children, pets, and livestock, and away from food and feed; keep in a locked storeroom or cabinet marked "PESTICIDES – KEEP OUT"

Dispose of empty containers so that they are no longer a hazard to people, especially to children and animals

Do not contaminate streams, ponds, and water sources or endanger wildlife

If poisoning symptoms develop from pesticides, medicines, or other sources, show your physician a label of the material involved. Physicians can phone one of the Poison Control Centers for complete treatment information.

Clothing contaminated with pesticides should be washed separately

Before using any pesticide, read the directions on the label

National Poison Control Center; **800/222-1222**

## **DELAWARE**

Delaware Poison Information Center: **800/722-7112**

Wilmington Medical Center – Delaware Division

502 West 14 Street

Wilmington, DE 19899

### For Help with a Pesticide Spills or Emergency, Call

Environmental Emergency Hazardous Materials Release (DNREC): **800/662-8802** or **302/739-5072**

National Pesticide Telecommunications Network (NPTN): **800/858-7378**

Chemtrec: **800/424-9300**

Delaware Department of Agriculture: **800/282-8685**

### ***Delaware Cooperative Extension***

**College of Agriculture and Natural Resources**

**University of Delaware**

### ***Newark***

Cooperative Extension Education in Agriculture and Home Economics, University of Delaware, Delaware State University and the United States Department of Agriculture cooperating. Distributed in furtherance of Acts of Congress of May 8 and June 30, 1914. Delaware Cooperative Extension, University of Delaware. It is the policy of the Delaware Cooperative Extension System that no person shall be subjected to discrimination on the grounds of race, color, sex, disability, age or national origin.