

Weed Management

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Weed management and IPM

Cultural management

Effective weed management involves the use of sound agronomic practices and the use of herbicides when necessary. Maintaining a dense, healthy stand of turfgrass is the best way to suppress annual grass weeds and broadleaf weeds. Vigorous turf deters the invasion and establishment of new weeds while helping to crowd out existing weeds. To this end, proper mowing height and frequency, fertilization, and irrigation are part of a sound integrated weed control program and should be practiced throughout the growing season. Correct selection of turfgrass species and accurate application timing for proper amounts of balanced fertilizer will improve the chances of establishing strong, healthy turf.

When weeds are present, it is critical that the turf manager accurately identifies the weed species and understands the life cycle prior to selecting a control method. Knowledge of which weeds are present may provide information on poor site conditions such as low fertility, compaction, pH imbalance, or excessive moisture. Correcting these poor growing conditions is necessary to deterring future weed encroachment.

Other cultural methods of weed control include removing clippings when seed heads of grassy weeds are

present, and hand pulling weeds when it is practical to do so. Accurate scouting of weeds during periods of peak germination is also important, allowing control efforts to be aimed at weeds when they are youngest and most vulnerable.

Chemical management

Preemergence: Preemergence herbicides provide effective control of crabgrass and other annual grass weeds for several weeks or months, depending upon the application rate and the product. The effectiveness of preemergence materials is based upon their ability to provide excellent weed control with minimum injury to desirable turf species. The best approach is to apply a preemergence or annual grass control herbicide before annual weed seeds germinate. If a preemergence product is applied after annual grasses appear above ground, the application will be ineffective. Preemergence herbicides should be watered in so that the chemical can form a barrier in the soil prior to seed germination. It is important not to disturb the soil during the key weed germination period as this barrier may be disrupted.

Timing is important for any herbicide application. Preemergence herbicides should be applied one to four weeks prior to the expected weed seed germination period. Generally, the best time for annual grass weed control is late April or early May in Massachusetts. Note that crabgrass germination occurs

when the soil temperature reaches 55 degrees and the temperature remains at 55 degrees for one week.

Monitoring soil temperatures closely will provide the turf manager with an accurate means of timing preemergence applications for crabgrass. If application timing does not coincide with the natural germination period of annual grassy weeds, weed control results may be erratic or poor.

Postemergence: Control of emerged grass seedlings with postemergence herbicides can complement a sound weed management program. The primary postemergence materials for grass weed control in turfgrass are the arsenates: MSMA, DSMA, and AMA. It should be noted that these compounds can injure desirable turfgrasses, especially when applied during hot weather. Fenoxaprop (Acclaim) is also available for annual grass weed control. This herbicide offers a wider window of postemergence control than the arsenates with less potential for turfgrass injury.

Records

Keeping accurate records on weather conditions (temperature, rainfall, etc.), scouting results, cultural practices used, herbicides applied, application dates and rates, and observations of control response will assist in selecting and timing weed management strategies for the next season and beyond.



Environmental considerations

The application of herbicides is often necessary as a component of a complete IPM system to maintain turf at an acceptable level. Some pesticides have the potential to leach through the soil to groundwater, and excessive movement of pesticides into groundwater can make the water unfit for use. However, pesticides applied to

the soil are subject to physical, chemical, and biological processes that affect their movement through the soil and their potential for groundwater contamination.

Pesticides applied to turf are further subject to interception by the turfgrass plants themselves, as well as by thatch.

Herbicide applications should be justified based on monitoring and threshold levels. Careful adherence to label directions, application rates, and pertinent laws and regulations can minimize the threat of groundwater contamination.

Soil characteristics

Soil texture plays a major role in herbicide performance and persistence. Furthermore, the presence of soil organic matter can make a difference in herbicidal activity. It is important to consider soil type and organic matter content when selecting an herbicide for a particular application. Pesticides tend to move more readily through coarse textured soils with low organic matter content. In contrast, fine textured soils with high organic matter are highly adsorptive, and therefore provide an environment less conducive to leaching.

Herbicide characteristics

ADSORPTION

Some herbicides bind strongly (adsorb) to soil particles and therefore may persist longer in a soil. Clay minerals and organic matter favor strong adsorption. Use soil analysis information on soil texture and organic matter content when selecting preemergence herbicides and application rates.

SOLUBILITY

Some herbicides are highly soluble in water, which can increase their leaching potential. However, leaching of an herbicide can be minimized by herbicide application rate and by the timing and method of application. Choose the right herbicide and rate for the situation.

PERSISTENCE

The rate of herbicide degradation by natural processes is highly dependent on both the herbicide class (chemistry) and environmental factors. Sunlight, temperature, microbial activity, soil pH, and other soil characteristics affect the persistence of herbicides.

Some herbicides break down slowly, and therefore have a greater potential for leaching. On the other hand, short-lived herbicides may be degraded before any movement occurs. Choosing a short-lived herbicide when practical can minimize leaching potential.

Microbial degradation occurs when fungi, bacteria, and other soil microorganisms use an herbicide as a food (energy) source. Organic matter content, along with other factors such as moisture, aeration, temperature, and soil pH can influence microbial degradation. In addition, chemical degradation of herbicides can occur by reaction with water, oxygen, and other chemicals.

In general, herbicides that are highly water-soluble, relatively persistent, and not readily adsorbed by soil have the greatest potential for leaching.

Thatch layer

In a good growing environment, the rate of plant tissue accumulation often exceeds the rate of decay, resulting in the development of a moderate thatch layer. Thatch is composed of both living and partially decayed leaves, roots, rhizomes, and stolons. This layer of living and non-living material accumulates between the layer of green vegetation and the soil. The thickness of the thatch layer is dependent upon the turfgrass species, environmental conditions, and the management practices imposed. In general, a moderate thatch layer is beneficial in holding pesticides and nutrients, thus minimizing excess leaching. In addition, the organic matter in this

layer increases as leaves, stems, roots, and rhizomes decompose with time. This increase in organic content also helps in binding of pesticides and thereby reduces potential leaching.

Field studies conducted in the Northeast have revealed that pesticides applied to turfgrass do not move significantly further than the thatch layer.

Water table

Sites with high water tables may be vulnerable to contamination by pesticides due to the relatively short distance between the soil surface and the groundwater. The presence of coarse textured soils on sites with high water tables further increases the potential for contamination.

Specific application information for each herbicide is detailed on the herbicide label. Careful adherence to pesticide application directions, combined with proper equipment calibration, are the best methods of preventing groundwater contamination.

Herbicide resistance

Some species of weeds which were previously susceptible to herbicides are developing resistance to certain compounds. The problem of herbicide resistant weeds was first reported in the mid-1960s at a nursery in Washington. Since the discovery of the triazine-resistant weeds, the number of resistant weed species and their distribution has increased. Triazine-resistant weeds include common lambsquarters, redroot pigweed, smooth pigweed, common ragweed, kochia, and others. In Massachusetts, triazine-resistant pigweeds and common lambsquarters, both of which are primarily found in cornfields, have been identified. In turf, only one or two lawn weed species have been reported to be resistant, to the dinitroaniline class of herbicides.

Examples of this class are benefin (Balan), pendimethalin (Pre-M), and benefin + trifluralin (Team).

Alternating with herbicides from different herbicide classes, which act differently to control weeds, every two to three years will help to prevent the development of herbicide resistant weeds.

Characteristics of herbicides

2,4-D Type Herbicides

Examples of this herbicide class are 2,4-D, 2,4-DB, MCPA, and MCPP. Herbicides in this class are generally applied as foliar sprays. They are readily absorbed by the foliage and usually distribute relatively well throughout the plant. They are selective herbicides. Selectivity is physiological in nature and 2,4-D type herbicides control only broadleaf plants and not grasses. General symptoms on susceptible weeds include growth regulator effects. The most obvious effects are twisting and downward curvature (epinasty) of the stems and leaves. Broadleaf herbicide combination products that contain 2,4-D-type herbicides are listed in Table 15.

Bentazon (Basagran T+O)*

Bentazon is a selective, postemergence contact herbicide used for control of many broadleaf weeds and sedges (yellow nutsedge) in turfgrass. Bentazon inhibits photosynthesis in susceptible plants, resulting in yellowing and eventual death. Symptoms occur within two to seven days after application. Bentazon is readily metabolized in tolerant plants, and has no activity in soil at postemergence rates.

Carfentrazone (Quicksilver and formulated in combination with other herbicides)

Speed Zone and Power Zone* are new commercial combination products that contain carfentrazone

(Tables 15 and 16). Carfentrazone is the newest herbicide active ingredient for the turfgrass market. It inhibits a key enzyme in chlorophyll production, and this causes cell membranes to rupture and rapidly disintegrate within hours. Treated weeds die within 7 to 14 days. Carfentrazone is a non-persistent compound in the soil and has no leaching potential.

Clopyralid (Lontrel and in several broadleaf herbicide combinations)

Clopyralid, a pyridine, is a post-emergent broad spectrum broadleaf herbicide. Clopyralid is a translocated herbicide and injury symptoms are typical of other auxin-type herbicides including the epinastic bending and twisting of leaves, stems and petioles. Clopyralid is weakly adsorbed to soil and has a moderate leaching potential. Herbicide products that contain clopyralid are restricted on residential turf. Turf clippings from treated areas should not be collected for mulching and composting or sent to a recycling facility. Clopyralid is very effective on members of the aster family (dandelion and hawkweed) and bean family (clover and birdsfoot trefoil). Use caution near ornamentals from these two families, including aster, coneflowers, liatris, redbud and honey locust.

Corn gluten (Concern Weed Preventer)

Corn gluten is an organic product, recommended for preemergence use twice a year for weed control in turfgrass. It controls several weed species, including crabgrass and several broadleaf weeds. It is a byproduct of the wet-milling process and is sold as a feed material for livestock. Corn gluten meal is produced as a fine, yellow powder or in pellet form. The product is a 60 percent protein material that is approximately 10 percent nitrogen by weight. Due to the nitrogen content, fertility programs must be adjusted accordingly. Corn gluten contains

* Regulated under the Massachusetts Public Drinking Water Supply Regulations. See page 49 for additional information.

several individual dipeptides (combinations of two amino acids). These dipeptides appear to suppress the growth of susceptible weed species.

Dicamba (Banvel, Vanquish)

Dicamba is very similar to the 2,4-D type herbicides. It is foliar applied and systemic in nature. Selectivity is physiological in nature and therefore dicamba controls only broadleaf plants and not grasses. Symptoms are very similar to phenoxy-induced effects. Dicamba is recommended for use in established turf. Drift to desirable plants, particularly flowers, ornamentals, and other broadleaf plants should be prevented. Take necessary precautions and avoid drift during spraying. Dicamba leaches readily in soil.

Dithiopyr (Dimension, Dimension Ultra, Lifeguard)

Dithiopyr is a selective herbicide primarily used as a preemergence treatment for annual grass weed control in established turf. Dithiopyr also provides selective postemergence control of crabgrass and other grass weeds. This compound enters plants through the roots and shoots, and the major site of physiological activity is within developing plant tissues found in the roots and shoots of susceptible species. The inhibition of cell division is thought to be the mode of action. Dithiopyr is broken down in the soil by both chemical and microbial degradation. Very little vertical or lateral movement of dithiopyr occurs. As a result, there is little chance of groundwater contamination when dithiopyr is used according to label directions.

Ethofumesate (Prograss)

Ethofumesate is a selective herbicide for use on established perennial ryegrass, Kentucky bluegrass, creeping bentgrass and turf-type tall fescue for the control of annual bluegrass and several broadleaf weeds. Ethofumesate has both preemergence and early (two-

leaf stage) postemergence activity. It is readily absorbed by emerging shoots and roots. Soil persistence is between two to five weeks. Leaching potential is low. Ethofumesate is recommended for professional use only on golf courses, sod farms, parks, cemeteries, and lawns of commercial establishments.

Fenoxaprop (Acclaim)

Fenoxaprop is recommended for postemergence control of annual grass weeds in turfgrass. It is absorbed through the foliage and acts physiologically to selectively control annual grass weeds. Fenoxaprop does not control broadleaf weeds, and it has no preemergence activity. Drought stress may significantly reduce the efficacy of this compound. The application rate of fenoxaprop depends on the stage of growth of annual grass weeds.

Fluroxypyr (Spotlight and in several broadleaf herbicide combinations)

Fluroxypyr, a pyridine, is a postemergent broad spectrum broadleaf herbicide and has no effect on grasses. It is primarily foliar absorbed and translocated throughout the plant. In susceptible weeds, fluroxypyr induces an epinastic (leaf curling) response and death occurs in days or weeks. Fluroxypyr displays little soil activity. A non-volatile ester formulation, fluroxypyr provides effective control of ground ivy, common woodsorrel, chickweed, clover, plantain and dandelion.

Glufosinate (Finale)

Glufosinate-ammonium is an herbicide primarily used to non-selectively control most weeds and grasses. This foliar applied herbicide inhibits photosynthesis and kills plants within three to four days after application. It has limited systemic activity, and is most effective as a contact herbicide. It has no residual

soil activity. Glufosinate-ammonium degrades into natural compounds such as carbon dioxide, nitrogen, and water. Turfgrass seeding can be done one day after application of glufosinate.

Glyphosate (Roundup or Touchdown)

Glyphosate is formulated as Roundup (isopropylamine salt) and Touchdown (trimethylsulfonium salt). Glyphosate is a non-selective herbicide. It is strictly used as a foliar spray. It is systemic in nature and distributes well throughout healthy plants. Glyphosate is very effective for control of perennial weeds because of its translocation characteristics. It inhibits plant growth by inhibiting the biosynthesis of three amino acids. Glyphosate binds strongly to soil particles and is inactivated by most soils. Visible symptoms generally occur on annual plants in two to four days and on perennial plants in seven to ten days. Symptoms on shoots include yellowing and wilting, which progress from the new to the older tissues. Glyphosate is commonly used for turf renovation.

Halosulfuron (Manage, Sedgehammer)

Halosulfuron is a selective, foliar applied herbicide that affects meristematic (areas of new growth) regions of plants. Halosulfuron inhibits the production of three essential amino acids used in protein synthesis. The lack of protein production results in death of the plant. Halosulfuron is degraded by microbial activity in the soil and has a low potential for leaching.

Isoxaben (Gallery)

Isoxaben is the only compound available exclusively for preemergence control of broadleaf weeds in turf. An application made after the target species have started to germinate will not be effective. Use a postemergence material after broadleaf weeds have emerged. Isoxaben is not effective for control of annual grasses.

**MSMA, DSMA
(Weed-Hoe, Weed-E-Rad)**

These herbicides are arsenicals. They are primarily contact herbicides, and are strictly foliar applied with a surfactant. Symptoms include yellowing of foliage within seven days of treatment. These compounds bind strongly to soils. They are recommended for crabgrass control in established turfgrass.

Oxadiazon (Ronstar)

Oxadiazon is a selective herbicide, primarily soil applied. It controls

many annual grass weeds and some broadleaf weeds by killing them as they germinate. Oxadiazon is strongly adsorbed by soil colloids and therefore very little leaching occurs. This compound is recommended for preemergence use in established turf.

**Pendimethalin (Weedgrass),
Trifluralin (Treflan),
Prodiamine (Barricade),
Benfen (Balan)**

These herbicides are typically soil applied. They are mitotic (cell division) inhibitors, primarily effective in

inhibiting root growth of germinating seedlings. They are selective in controlling annual grass weeds in established turfgrass. These herbicides may break down in the soil by ultraviolet light and some are lost by volatilization (vapor loss), therefore these herbicides must be watered in. In general, herbicides in this class may persist for a relatively long period of time, resulting in season-long weed control. These herbicides are recommended for preemergence use in established turf.

Table 14. Commercially available herbicides for the management of weeds in turf

Problem/Herbicide	Product per acre	Comments
I. CRABGRASSES AND OTHER ANNUAL GRASSES		
A. Preemergence*		
<i>Benfen</i> (Balan 2.5)	Varies, see label.	May cause injury to bentgrass. Fair to good crabgrass control.
<i>Benfen + trifluralin</i> (Team Pro, Team 2G)	Varies, see label.	Good seasonal control. Team should not be applied in the spring to turfgrass planted in the previous fall.
<i>Bensulide</i> (Betasan 4E) (Pre-San Granular 7G + 12.5G) (Bensumec)	Varies, see label.	Relatively safe on all turf species. May restrict rooting of transplanted sod.
<i>Corn gluten</i> (Concern Weed Preventer Plus)	Varies, see label.	Recommended for use twice a year. Apply once in the spring three to five weeks prior to weed germination, and another application in the fall. This product is recommended for use on a three-year program cycle. Weed control effectiveness increases from the first year (50%) to the third year (90%). Adjust fertility program to account for N content.
<i>Dithiopyr</i> (Dimension 1EC) (Dimension Ultra 2SC) (Dimension Ultra 40WP) (Lifeguard)	Varies, see label.	Use only on established turfgrass. Excellent seasonal control at use rate. It can be applied as early as April because of its wider window of application. Some of the broadleaf weeds controlled include: common chickweed, common purslane, speedwell, henbit, prostrate spurge, and yellow woodsorrel. It also suppresses <i>Poa annua</i> . Do not overseed or reseed within 3 to 4 months after application.
<i>Oxadiazon</i> (Ronstar 2G)	Varies, see label.	For use in Kentucky bluegrass turf. Effective for goosegrass control.
<i>Prodiamine</i> (Barricade 65 WG) (Cavalcade 65 WG) (Proclipse)	Varies, see label.	Tall fescue, Kentucky bluegrass and perennial ryegrass are most tolerant, followed by creeping red fescue and bentgrass (minimum 1/2" height).
<i>Siduron</i> (Tupersan 50W)	Varies, see label.	Safe for use at time of seeding of turfgrasses, on seedling turf, and on sod to be harvested and transplanted.
<i>Pendimethalin</i> (Pre-M 60 DG) (Pendulum 60 WG) (Pendulum Aquacap) (Pre-M)	Varies, see label.	Good seasonal control. Controls spurge, chickweed, oxalis, and other broadleaf weeds.
B. Postemergence		
<i>Fenoxaprop</i> (Acclaim 0.57EC)	3.5 – 28 fl. oz.	Excellent crabgrass control with one application, especially at earlier stages of crabgrass growth.
<i>MSMA</i> (Daconate 6)	2.0 – 2.67 pts.	Apply as soon as crabgrass is noticed. Two or three applications at seven- to 14-day intervals are necessary. Some turf discoloration is likely.
<i>Quinclorac</i> (Drive)	1 lb.	Excellent control of crabgrass and various broadleaf weeds such as white clover, black medic, dandelion and others. Postemergence treatments require addition of crop oil concentrate.

(Continued on next page)

* All available in fertilizer combination products — rates will change.

(Table 14, continued from previous page)

Problem/Herbicide	Product per acre	Comments
II. BROADLEAF WEEDS		
A. Postemergence		
2, 4-D combined with one or more of the following: 2, 4-DP, MCP, MCPA-triclopyr, clopyralid, fluroxypyr, or carfentrazone (See Tables 15, 16, and 17)	Varies, see label.	Gives broad-spectrum broadleaf weed control. Best time to treat is in early fall or mid spring. Avoid using during hot weather. Do not apply on sod or within four weeks of transplanting. Products containing 20% or more 2, 4-D are RESTRICTED USE in Massachusetts.
B. Preemergence		
Isoxaben (Gallery 75 DF)	0.5–1.0 lbs	Gives preemergence control of many broadleaf weeds and partial control of some annual grasses. Apply in late summer–early fall or early spring prior to germination of target species. Gives season-long control. Safe on most turfgrasses.
III. ANNUAL BLUEGRASS (<i>Poa annua</i>)		
Bensulide (Pre-San Granular 7G) (Pre-San Granular 12.5G) (Bensumec) (Several fertilizer combinations)	107 – 143 lbs.	Apply in late March and again in early August to prevent infestation of <i>Poa annua</i> from seed. Use only where eradication of <i>Poa annua</i> will not create bare areas. Several annual applications may be necessary before control is satisfactory.
Ethofumesate (Prograss 1.5 E)	0.66 – 1.33 gal.	Preemergence and early postemergence annual bluegrass control. Repeat applications at 30- to 60-day intervals are needed to maintain control.
IV. YELLOW NUTSEDGE		
Bentazon* (Basagran T+O) (Lescogran)	0.5 – 2.0 qts.	Very good turf tolerance. Some injury to perennial ryegrass seedlings is likely. Summer treatments are most effective. Two applications may be necessary.
Halosulfuron (Manage 75 WG) (Sedgehammer)	0.66 – 1.3 oz.	Excellent control of yellow nutsedge. It is translocated to all attached parts of the nutsedge plant. Best to apply when nutsedge in the three- to eight-leaf stage. Requires the use of non-ionic surfactant. Most cool-season grasses show excellent tolerance.
MSMA (Daconate 6E)	2.67 pts.	Two or three applications spaced about 10 days apart are necessary. Turf discoloration is likely.
V. MOSS		
Copper sulfate	3 – 5 oz. in 5 gal. water/1,000 sq. ft.	Control is temporary. The only way to permanently control moss is to correct the conditions unfavorable for grass growth.
Iron sulfate	2 – 3 oz. in 5 gal. water/1,000 sq. ft.	Treatment of dormant moss will not be effective. Do not water in.
VI. COMPLETE PLANT KILL		
A. With No Residual Control		
Glufosinate (Finale 1 SC)	3 – 6 qts.	For non-selective weed control of emerged weeds in noncrop areas. Limited translocation and rapid control are advantages. Reseeding or sodding can be done soon after application.
Glyphosate (Roundup Pro) (Prosecutor) (Razor Pro)	1 – 2 qts.	Useful for turf renovations. Seedlings can be safely made within several days after treatment. A second application may be required. Effects not visible for seven to 10 days. Best results are obtained on unmown, mature plants. Sodding or reseeded can be done within days after application.
Paraquat (Gramoxone Extra 2.5 L)	2 – 3 qts.	Apply in 5 to 100 gallons of water per acre. Use 1 pint of X-77 or CHARGER per 100 gallons of water to improve wetting of foliage. Will not provide complete kill of perennial weeds, such as dandelion, clover, or quackgrass. Paraquat is a highly poisonous chemical. It is a RESTRICTED USE herbicide in Massachusetts. Application can be made only by certified private or commercial applicators. Reseeding or sodding can be done soon after application.
Pelargonic acid (Scythe 4.2 E)	5 – 10 gals.	Apply in a minimum of 100 gallons of water per acre. Active ingredient is a naturally occurring fatty acid which acts very rapidly by rupturing plant cell membranes. Works best on annual weeds less than 6" tall. It has no systemic activity. Regrowth is visible within two weeks after application. Will not control perennial weeds and therefore is not appropriate for renovation.
B. With Long-term Residual Control		
Prometon (Pramitol 25 E)	5.0 – 7.5 gals.	Complete plant kill, lasting six to 12 months, for driveways, parking areas, patios, Beware of treating areas where irrigation or heavy rains will wash the herbicide onto lawn or garden areas. It is best to water in gently. Several formulations or mixtures are available. It is RESTRICTED USE in Massachusetts.

* Regulated under the Public Drinking Water Supply Protection Regulations (333CMR 12.00) in Massachusetts. See page 49 for additional information

Quinclorac (Drive)

Quinclorac is used for postemergence control of annual grass weeds and several broadleaf weeds. It provides excellent control of clovers, black medic, common dandelion and speedwells. Quinclorac is absorbed by foliage and roots, and translocated throughout the plant. The control symptoms exhibited by broadleaf weeds include leaf and stem curl or twisting, and chlorosis. Susceptible grasses demonstrate stunting and chlorosis, and gradual reddening followed by necrosis and death.

Siduron (Tupersan)

Siduron is a selective herbicide. It is soil applied and is absorbed through roots. Siduron is a root growth inhibitor, and control

symptoms include slow death of young seedling weeds. It is used for selective control of crabgrass and other annual grass weeds. Siduron is the only herbicide that can be used safely in newly seeded turfgrass.

Triclopyr (several broadleaf herbicide combinations)

Triclopyr, a pyridine, is a postemergence broad spectrum broadleaf herbicide. Triclopyr is readily translocated throughout the plant after being taken up by either roots or the foliage. In susceptible weeds, triclopyr induces an epinastic (leaf curling) response and death occurs in days or weeks. The potential for leaching increases as soil organic matter decreases and when conditions reduce soil microbial activity. Triclopyr provides effective control of

ground ivy, wild violets and other tough perennial weeds.

Control of crabgrass and other annual grasses

Apply preemergence herbicides in late April or early May prior to the time that crabgrass seed starts to germinate. Water in the material if no rain occurs within a week of application. Except for siduron (Tupersan), do not use the materials in this section on seedling grass or in soil when seed or sod will be planted within three to four months depending on the product and its rates. Please refer to product labels for specific timing and use on different grass species.

Fall application of several preemergence herbicides can be made for weed control in the following year. Proflam and dithiopyr applied in the fall at higher rates provide excellent weed control. Weather conditions in the fall will determine the timing of

Table 15. Herbicide combinations containing 2,4-D for broadleaf weed control in turf

Trade Name	Active Ingredients
Chaser, Chaser 2 Amine	2,4-D + triclopyr
Chaser Ultra*	2,4-DP + MCPA + clopyralid
Chaser Ultra 2*	2,4-DP + MCPA + fluroxypyr
Coolpower, Horsepower*	MCPA + triclopyr + dicamba
Escalade 2	2,4-D + fluroxypyr + dicamba
Eliminate D	2,4-D + MCPP + dicamba
Millennium Ultra 2	2,4-D + clopyralid + dicamba
Momentum FX ²	2,4-D + triclopyr + clopyralid
Momentum	2,4-D + triclopyr + clopyralid
Momentum FX	2,4-D + triclopyr + fluroxypyr
Speed Zone	2,4-D + carfentrazone + MCPP + dicamba
Strike Three	2,4-D + 2,4-DP + fluroxypyr
Three-way Selective	2,4-D + MCPP + dicamba
Trimec (Classic)	2,4-D + MCPP + dicamba
Turflon D	2,4-D + triclopyr
Triplet	2,4-D + MCPP + dicamba
Weedestroy triamine	2,4-D + MCPP + dicamba
Weedone DPC	2,4-D + 2,4-DP

* MCPA is an active ingredient regulated under the Public Drinking Water Supply Regulations (333CMR 12.00) in Massachusetts. See page 49 for additional information.

Table 16. Herbicide combinations without 2,4-D for broadleaf weed control in turf

Trade Name	Active Ingredients
Battleship*	MCPA + triclopyr + clopyralid
Coolpower, Horsepower*	MCPA + triclopyr + dicamba
Confront	triclopyr + clopyralid
Gallery	isoxaben
MCPP-p 4 Amine	MCPP
Power Zone*	carfentrazone + MCPA + MCPP + dicamba
Three-way Ester*	MCPA + triclopyr + dicamba
Trimec Encore*	MCPA + MCPP + dicamba
Tri-power*	MCPA + MCPP + dicamba
Trupower 2*	MCPA + fluroxypyr + dicamba
Trupower Selective*	MCPA + clopyralid + dicamba

* MCPA is an active ingredient regulated under the Public Drinking Water Supply Regulations (333CMR 12.00) in Massachusetts. See page 49 for additional information.

applications. Do not make applications after the ground is frozen.

Control of broadleaf weeds

Postemergence: Two-way or three-way mixtures of herbicides containing 2,4-D are effective in controlling many established broadleaf weeds (see

Table 15). Also, there are several useful combinations that do not contain 2,4-D (Table 16). These mixtures give broad-spectrum broadleaf weed control. The best time to treat is early fall or mid-spring. The time of application of these treatments may vary depending on the weed species and their life cycles

(Table 17). Avoid using during hot weather, and do not apply on sod within four weeks of transplanting.

Preemergence: Isoxaben (Gallery) is a preemergence material for broadleaf weed control (Table 16). Application of this product must be made prior to germination of broadleaf weeds.

Table 17. Common turf weeds, life cycles, suggested control materials, and timing

Weed	Life Cycle ¹	Recommended Herbicide	Time of Application
Black medic	A,B,P	dicamba, MCP, TD ² , CF ³ , MU ⁴ , or TM ⁵	Early spring
Carrot, wild	B	2,4-D, TD, or TM	Spring
Chickweed, common	WA	dicamba, MCP, TD, MU, CF, or TM	Spring or fall
Chickweed, mouse-ear	P	dicamba, MCP, TD, MU, CF, or TM	Fall or Spring
Chicory	P	2,4-D, TD, or TM	Spring
Cinquefoil	P	2,4-D, dicamba, or TD	Spring or fall
Clover, hop	P	dicamba, MCP, TD, MU, or CF	Spring or fall
Clover, white	P	dicamba, MCP, TD, MU, CF, or TM	Spring or fall
Dandelion, common	P	2,4-D, TD, MU, CF, or TM	Fall or spring
Dock, curly	P	2,4-D, dicamba, CF, or TM	Fall or spring
Garlic, wild	P	2,4-D, dicamba, or TM	Late fall or early spring
Hawkweed(s)	P	2,4-D, dicamba, CF, or TM	Fall or early spring
Heal all	P	2,4-D, MU, or TM	Spring
Henbit	A	TD, CF, MU, or TM	Spring
Ivy, ground	P	MCP, 2,4-D, or TD	Fall*
Knotweed	A	dicamba, MU, or TM	Spring to early summer
Oxalis	P	TD, CF, MU, or TM	Spring or fall
Pearlwort	P	dicamba or MCP	Spring or fall
Plantain, buckhorn	P	2,4-D, CF, MU, or TM	Fall or spring
Plantain, broadleaf	P	2,4-D, TD, CF, MU, TM	Fall or spring
Purslane, common	A	2,4-D or TM	Summer
Red sorrel	P	dicamba, CF, or TM	Spring, summer, or fall
Sow thistle	A	2,4-D, dicamba, or TD	Fall
Speedwell, corn	A	TD	Spring
Speedwell, purslane	A	TD	Spring
Spurge, prostrate	A	TD or TM	Spring or summer
Spurry, corn	A	dicamba	Fall
Strawberry, wild	P	TD or TM	Fall
Thistle, Canada	P	2,4-D, dicamba, TD, CF, or MU	Spring
Violet	P	dicamba, TD, or CF	Spring*

1 A = Annual B = Biennial P = Perennial WA = Winter Annual

2 TD = Turflon D (a commercial mixture of 2,4-D and triclopyr).

3 CF = Confront (a commercial mixture of triclopyr and clopyralid)

4 MU = Millennium Ultra (a commercial mixture of 2,4-D, clopyralid and dicamba)

5 TM = Trimec (a commercial mixture of 2,4-D, MCP and dicamba)

*Repeat applications may be required for effective control