New England Guide to Weed Control in Field Corn

Bulletin #1124

Introduction

Weed management is a serious issue in forage crop production. Poor weed control can cause crop failures detrimental to New England dairy producers and create weed seed issues that will plague growers for years. Whether growers use herbicides or organic weed control methods, weed management represents a significant cost.

Growers need to consider several important factors in developing an effective weed management program for field corn. For instance, when dealing with specific weed infestations, it is important to scout and map weeds and gather as much information about the weed's life cycle as possible, then determine what alternative control options can be used. Factors such as proximity to water resources, soil type and depth to bedrock, and the chemical properties of herbicides inform weed control strategies and affect the environment.

We will discuss methods of field corn weed control, including commonly used herbicides, timing of applications, and alternative controls that reduce herbicide use and risks to the environment.

Lastly, field corn weed control programs need to rotate herbicide modes of action to avoid development of herbicide-resistant weed populations. Approaches may include variation in corn hybrids and herbicides, and the use of regular crop rotations.

A Comprehensive Approach to Weed Management

Weed management in field corn and other forages is not a simple matter. Crop losses from poor herbicide decision-making cost growers millions of dollars each year in the U.S. This publication briefly describes many different concepts, and we encourage readers to delve more deeply into specific issues as needed. We hope that this publication serves as a guide for making herbicide choices that provide effective weed management as well as environmental safety.

When choosing a weed control program, decisions should be based on actual and potential weed problems, crop and herbicide rotation, injury potential, tillage systems, soil properties such as texture and organic matter, potential environmental risks, and cost.

Legal Considerations

Herbicides are considered pesticides. All pesticides listed in this publication are registered and cleared for suggested uses according to federal registration and state laws and regulations in effect on January 1, 2006.

NOTICE: It is unlawful to use any pesticide for other than the registered use. READ AND FOLLOW ALL LABEL INSTRUCTIONS. The label is the law! Users assume all responsibilities for use inconsistent with the product label.

WARNING: Pesticides are poisonous. Read and follow the directions and safety precautions on the label. Handle carefully and store in the original containers out of the reach of children, pets, and livestock. Triple-rinse and dispose of empty pesticide containers according to state regulations. Do not contaminate soil, crops, or water resources.

Persons using a *restricted-use* pesticide must be certified in conformity with standards set forth by state and federal regulations. Lasso (alachlor), Dual (metolachlor), Princep (simizine), AAtrex (atrazine), and Gramoxone Extra (paraquat) are classified as restricted use herbicides in all states. Other herbicides may be restricted use in certain states.

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IPM and ICM Strategies to Reduce Weed Pressure

Integrated pest management (IPM) and integrated crop management (ICM) methods offer growers opportunities to reduce chemical inputs to their production systems through a variety of practices and tools. Specific IPM tactics include scouting and timing postemergence applications based on weed type and size, incorporating mechanical and chemical weed management measures to reduce costs, and carefully mapping weed species and densities in specific fields. ICM methods include crop rotations, changing harvest times (for short season corn), narrow row spacing and/or planting densities, and managing to minimize weed seed production. Many IPM/ICM techniques are discussed in this publication and are particularly important in preventing herbicide resistance and managing herbicide-resistant weeds.

Scouting

Scout fields regularly to identify and map problem weeds. If herbicide-resistant weeds become part of the feed in dairy and livestock operations, their seeds can spread quickly onto fields through manure applications. Seeds can also be spread by harvesting equipment. Be sure to thoroughly clean your equipment before moving to another field.

When corn is two to four inches tall, growers or consultants should scout crop fields to determine if there is a need for cultivation or postemergence herbicide application.

At the end of the season, growers can see which weeds have survived and determine possible causes. Late-season scouting can help you decide whether alternative approaches need to be tried the following year. Learn about the life cycles of any surviving weeds, including when they go to seed and how to prevent or reduce seed dispersal.

Nonchemical Weed Control Methods

Nonchemical weed control strategies are an integral element of a comprehensive weed management approach, as they can help you reduce chemical inputs and prevent the development of herbicide-resistant weeds.

Mechanical control is also an excellent way to avoid herbicide resistance, because weeds are physically disturbed but not exposed to the same mode of action. (See *Preventing the Development of Herbicide-Resistant Weeds* on page 5.)

Crop Rotation

A key nonchemical management strategy to control weeds is crop rotation. Specific weeds are commonly associated with certain crops. Annually tilled row crops, such as corn, require specific weed management strategies based on the length of time until the crop reaches canopy closure.

Rotating corn with a double crop forage (for example a double crop of winter triticale and brown midrib sorghum sudangrass, or BMRSS) can break weed cycles, and may allow the grower to avoid herbicides in that year, or at least suppress certain weeds that become problematic under a continuous corn cropping system. Crop rotations are highly recommended in cases where a particularly troublesome weed such as burcucumber becomes widespread and requires aggressive control.

Crop Selection and Row Spacing

Planting practices that reduce the length of time until canopy closure should improve weed control and may allow a grower to use less herbicide. Well-drained fields that may allow a grower to plant early may be better suited to a small grain crop (spring barley, oats, wheat, or spelt) than to corn. Because of the narrow row spacing and aggressive early-season growth, small grains can get established and reach canopy closure before summer annual weeds emerge. Taken for silage, the small grain crop can be followed with a warm season annual grass like BMRSS which is also planted in a narrow row. This warm season grass can also emerge quickly, often reaching canopy closure in a few weeks. In research conducted in Maine, we have found consistently lower weed pressure in these double crop systems compared to cultivated corn.

In conventional systems, decreasing row spacing by half (e.g. from 30 to 15 inches) has been shown to reduce the length of time to canopy closure. Research conducted in the northern corn-producing states has shown mixed results. Research results from the University of Maine

showed equivalent weed control with a 33 percent reduction in herbicide application rates when using narrow row spacing compared to a full rate application in wide rows. However, researchers in Massachusetts found increased grain and silage in 30-inch row spacings compared to narrow row corn. Others have found that even greater pesticide reductions were possible, but special harvest equipment such as a Kemper head is required to harvest narrow row corn. Since the Kemper heads are quite expensive, adoption of narrower row spacing has been slow.

Know Your Weeds

A good understanding of weed biology is essential to effective weed management. Knowing that a weed is an annual or a perennial will affect control strategies. Knowing when a weed emerges can affect timing and method of application. Developing an understanding of weed biology will improve the likelihood of good weed control with reduced chemical and energy inputs. Two examples of how understanding weed biology can improve effectiveness of control are presented below:

▶ Managing quackgrass

Let's consider quackgrass management. Once you understand the plant biology (perennial grass), know the strengths and weaknesses of all the possible control options and timings, and understand the impact those specific application timings may have on related operations such as corn planting dates, you can select the best program for the least cost.

Some growers may choose to control quackgrass in the fall because it requires less glyphosate than a spring application and doesn't delay planting. (After spring applications you must wait for the glyphosate to kill the quackgrass roots before planting corn.) However, a fall application involves an additional pass in the field, entailing increased time, labor, and fuel in exchange for reduced product cost and timely spring corn planting.

For a grower with delayed corn harvest, a fall application of glyphosate may not be effective. Once the quackgrass has been heavily frosted, it is best to wait until spring. In this case, the use of herbicide-resistant, genetically modified Roundup Ready or LibertyLink corn may be the most cost-effective option because you can effectively control all of the weeds, postemergence, in one pass across the field.

The key to IPM is simply to use all the tools that are available to you (weed mapping, alternative control measures, etc.) to reduce your inputs and costs.

▶ Managing burcucumber

Consider the following options in managing burcucumber. Aggressive control is needed to keep this weed from becoming widespread in a field.

One option is to plant a short-season, genetically modified corn such as Roundup Ready corn. This allows for postemergence control using glyphosate, a less environmentally risky method compared to a soil-applied treatment of atrazine. Depending on the severity of the problem, tank-mixing with another herbicide and/or split applications may be necessary.

Burcucumber will continue to emerge during the remainder of the growing season. Harvesting the corn in early September before the weed goes to seed will improve control.

Depending on the costs involved and the degree of success of these and other methods, crop rotations may be the most cost-effective and environmentally sound way to keep this weed from becoming widespread.

Organic Weed Control

Organic dairy production is one of the fastest growing segments of agriculture in the Northeast, and Maine leads the nation in the percentage of dairy farmers shipping to the organic market. Interest among farmers is strong, as organic prices for milk bring a premium that is currently more than double that of conventional milk prices.

Many organic growers rely completely on mechanical control. Mechanical control can be extremely effective if

- environmental conditions are favorable;
- the grower has the necessary cultivation equipment; and
- the grower carefully times the cultivations for maximum effectiveness.

Growers who are dependent solely on cultivation will need more than one type of cultivator to obtain adequate control. In-row and between-row weed infestations need to be considered. In-row weeds are the weeds growing between the individual corn plants in the row. These weeds are generally harder to control. Rotary hoes and tine cultivators, such as Lelys and Kovars, are designed to reduce the number of in-row weeds. Generally, these tools should be used preemergence, about five to seven days after planting. By traveling at 7 to 10 mph, one can quickly cover the field area and disrupt early-germinating weed seedlings without harming the crop. Once the corn has emerged, these tools can be used a second time because the growing point of the corn is still well below the soil surface. Weeds are best controlled with these cultivators when they are in the thread stage of development (see Photo 1).

Grasses can be difficult to control, particularly in heavier soils. Dry soils vastly improve cultivation effectiveness. The soil moisture conditions found in Photo #2 are ideal. After the corn is three to four inches tall, row cultivators and finger-weeder cultivating tools can be effective. When the corn is in the fifth to sixth leaf stage (10 to 12 inches tall), we recommend a final pass with a cultivator that has sweeps or shovels to push soil and bury weeds in the row. This will help control both in-row and between-row weeds.

Research from the University of Maine has shown that two tine cultivations and two between-row cultivations are necessary before canopy closure to obtain optimal weed control in field corn.

Many integrated crop management (ICM) methods, such as scouting, crop rotation, crop selection, and narrow row spacing, are also good strategies for organic growers. (See discussion on page 2.)

Photo #1. Thread stage weeds in preemergent corn (4 days after planting).

Photo #2. Ideal soil moisture conditions for tine cultivation.

Preventing the Development of Herbicide-Resistant Weeds

Many farmers who find a weed management program that is effective on their farms tend to use that program year after year. However, no herbicide is effective on all weeds, so weed populations will probably shift over time. Eventually, weed populations that are not controlled by the current herbicide program will develop and predominate. Eventually overuse of the same mode of action year after year will result in herbicide-resistant weeds.

Once herbicide resistance occurs in a population of weeds, it usually persists indefinitely. Prevention is the best approach.

The mode of action is the process by which an herbicide functions, such as stopping a specific plant process, altering an enzyme pathway, or altering overall plant growth. Often there is a specific site of activity within the plant for this process or a specific enzyme pathway. Resistance may occur when a given plant's biochemistry is slightly different from the weed population pool such that the herbicide will not function. That weed goes to seed, and its offspring will have the same resistance. If the same herbicides are used year after year and resistance builds within the weed population, crop failure is a possibility.

Presently over 65 species of weeds are resistant to the triazine family of herbicides (atrazine and simizine), and about 183 weed species have been found to be resistant to some herbicide.[1]

Once herbicide resistance occurs in a population of weeds, it usually persists indefinitely. Most herbicide alternatives for triazine-resistant weeds are costly, so prevention is the best approach.

In addition to nonchemical weed control methods, the following practices can help prevent the development of herbicide-resistant weeds.

[1] Heap, I. The International Survey of Herbicide Resistant Weeds. Retrieved January 08, 2007 from www.weedscience.com.

▶ Rotation and variation

- Avoid planting continuous corn and always practice crop rotation.
- Avoid using the same herbicide or herbicide combinations in the same field year after year.
- Avoid using herbicides with the same mode of action more than once a year in a given field.

▶ Herbicide rotation

A viable method to prevent weed resistance is to rotate herbicides from different families with different modes of action. Making two or more applications of herbicides with the same mode of action within a year will greatly increase the chance for herbicide resistance. Combinations of herbicides that blend different modes of action will reduce the likelihood of weeds developing resistance.

Please refer to Table 3 on page 12, which lists commonly used herbicides and their chemical modes of action.

Protecting Ground and Surface Water from Herbicide Contamination

It is useful to understand why some of the herbicides listed below have groundwater advisories. Herbicide properties, environmental conditions, and soil physical conditions interact to affect the likelihood that an herbicide will leach into groundwater.

The herbicides listed in this bulletin (see page 12) that have groundwater advisories generally have a high solubility (they dissolve easily in water), do not bind tightly to soil, and are persistent in the soil environment. Similar chemical properties affect the likelihood of loss to surface waters through storm water runoff. Herbicides that bind tightly to soil are less likely to leach into groundwater or be transported into surface waters except through soil erosion and sedimentation.

Soil physical factors also affect the likelihood of herbicide movement. Factors such as soil texture (percent sand, silt, and clay), soil permeability, infiltration rate, compacted soil layers, and the presence of cover or residues can greatly influence the herbicide fate. Dense, compacted soils are much more likely to slow infiltration and increase runoff potential. Sandy river-bottom soils or other coarse-textured glacial outwash soils allow water to infiltrate

and percolate through soil rapidly, increasing the risk of groundwater contamination. Soil chemical factors can also interact with soil physical factors to influence pesticide fate. Acidic soils with a low pH can limit soil bacterial growth and slow pesticide degradation—another important reason why growers should maintain proper soil pH levels.

Finally, environmental conditions have an extremely important effect on pesticide fate. If soils are moist when products are applied and conditions remain sunny and warm, pesticides will break down quickly. However, long spring rains can lead to pesticide loss from the site and potential contamination of water resources. Hot, windy weather can result in high losses due to volatility and reduced application accuracy. Generally, it is the interaction of all three factors (environmental conditions, soil physical and chemical factors, and pesticide chemistry) that ultimately affects whether an herbicide is likely to move off site and affect water resources.

Methods of Weed Control and Timing of Herbicide Applications

Below we present the various advantages and disadvantages associated with different timings of herbicide application. Many factors should be weighed when trying to determine the optimum timing on a specific farm, including

1) weed species of a field,
2) area of crops to spray,
3) soil types,
4) cost, and
5) whether it's a farmer or custom application.

▶ Preemergence weed control

Application of herbicides before the crop and weeds have emerged has long been the favorite weed management timing of corn growers in New England. Generally, preemergence products contain herbicide mixtures that control a wide spectrum of annual grass and broadleaf weeds. However, there are weeds that are not controlled well with most preemergence spray programs (see page 15). The effectiveness of most preemergence tank mixtures is dependent on the grower's knowledge of what weed species are likely to be present in the field, which allows selection of an herbicide with efficacy on those weeds, as well as sufficient rainfall to move the herbicide into the upper one-half to one inch of soil.

The advantage of this application method for dairy farmers is that the corn gets planted and sprayed before the first cutting of hay. However, one significant risk associated with this method of application is that early spring rains can cause herbicide runoff to surface water. Also, if conditions are excessively wet and growers are unable to apply the herbicides until the crop has emerged, effectiveness will likely be reduced. Before the advent of herbicide resistant (HR) corn, most growers preferred preemergence products. For those growers not adopting HR corn, new products like Lumax or Lexar—mixtures of atrazine, mesotrione, and metolachlor—provide growers with multiple modes of action and a broad spectrum of weed control activity.

Triazine Special Review

The triazine family of herbicides has been very popular for corn producers in the U.S. due to its low cost, wide spectrum of activity, and ease of use. Atrazine, first registered in the U.S. in 1959, is still widely used. These herbicides were initially used at very high application rates and tended to persist in soils. Over time, the triazine herbicides were detected in many surface and groundwater drinking water supplies. This prompted the Environmental Protection Agency (EPA) to conduct a review of these products and consider banning their use—something that many other countries have already done. One triazine product, Bladex (cyanazine), is no longer registered for use on corn. Atrazine use rates were lowered in the early 1990s. Some states, including Maine, have developed state management plans to reduce the potential for contamination of water supplies. Following the review, the EPA developed an agreement that would implement an early alert system to protect watersheds from atrazine runoff. The key components of the agreement are as follows:

- The EPA has implemented an early alert system to protect watersheds from atrazine runoff in areas of high atrazine use. The EPA is supporting site-specific monitoring and mitigation plans for any watersheds of concern.
- The EPA has confirmed that atrazine is not likely to be a human carcinogen and that humans are not at risk through dietary exposure.

Possible combinations: Atrazine pre-mix products such as Bicep II Magnum, Bicep Lite II Magnum, Cinch ATZ, or Harness Xtra are effective on many annual broadleaves and grasses. Three-way combination products like Lumax and Lexar are very effective on triazine-resistant (TR) weeds and some of the more difficult-to-control broadleaf weeds. The addition of some simizine in a mixture can also help improve annual grass control.

▶ Preemergence plus postemergence weed control

The combination of preemergence and postemergence weed management is generally the most expensive weed management program. There is added expense, such as your time, fuel, and wear and tear, involved with the two (pre- and post-) applications, and there may be added costs for HR varieties as well. Many seed companies producing HR corn varieties recommend both preemergence and postemergence applications for a weed management program. Many call this foundation weed control, as you provide the early-season weed control, and then decide later if a post material is necessary. However, the relatively short growing season in northern New England reduces the season-long weed problems found in many areas, and this standard recommendation is often not necessary in our region. Furthermore, recent research conducted across the Northeast shows that under most conditions, a single pre- or postemergence application program is sufficient.

Best results with preemergence and postemergence combination programs will be found in fields with

- quackgrass or burcucumber,
- heavy annual grass pressure,
- a developing resistance to a preemergence material, and/or
- inadequate rainfall to activate preemergence materials.

▶ Postemergence weed control

Postemergence weed management has traditionally been used as a rescue treatment for a failed or failing preemergence program in corn. It has also been used to correct a resistant weed population (e.g. triazine-resistant lambsquarter management).

During the 1990s, there was great interest by the EPA and among pesticide manufacturers to get growers to move to total postemergence weed management because of the environmental benefits to applying herbicides where crop cover was present, as well as reduced application rates and the capacity to target specific weeds. In some cases environmental conditions, such as timely rainfall, were less important to activate the products. These same benefits, however, also slowed rates of adoption. Many of these products have specific timing requirements. Some products work well on one- to three-inch-tall weeds, but don't perform well once the same weeds reach four to six inches. Targeting specific weeds requires producers to scout and map weeds with a short window of opportunity to control them once identified. Many dairy and livestock producers are also harvesting hay crops at this very demanding time and adequate control may not be achieved. In general, most postemergence product combinations have also tended to be somewhat more expensive than their preemergence alternatives.

Newer types of postemergence programs (particularly herbicide-tolerant and herbicide-resistant corn programs) have broadened the window of opportunity for control, improved control of annual grasses, and provided new methods of control for difficult-to-control weeds.

Please be sure to check the specific label for the appropriate recommended additive(s). These additives (nonionic surfactants, crop oils, etc.) will greatly enhance herbicide effectiveness. Failure to include them can lead to herbicide failure.

There are two primary types of herbicide-resistant corn available to growers in New England. There are lines of corn that have been developed from corn that has shown inherent resistance to the imidazolinone or sethoxydim herbicides (called IR or SR corn) that are providing some growers in New England with new herbicide options. There are also herbicide-resistant corn varieties now that have been genetically modified (GM) to resist herbicides.

IR and SR corn varieties are particularly effective where preemergence annual grass control has been weak, particularly with crabgrass, foxtails, and fall panicum. Most of the IR and SR corn varieties are longer-season varieties and have been primarily used in the mid-Atlantic as well as southern New England. Furthermore, with the advent of herbicide-resistant corn hybrids, use of IR and SR corn hybrids has dropped significantly. However, they could be useful tools for the prevention of herbicide resistance. Also, since the IR/SR hybrids are developed from lines naturally tolerant to these herbicides, organic producers have nothing to fear from cross-pollination, seed segregation, or similar issues.

Genetically Modified Corn

There are other herbicide-resistant corn varieties on the market today that have been genetically modified (GM) to resist herbicides. These GM corn hybrids offer growers another tool to control weeds postemergence. They include Roundup- or Touchdown-resistant (glyphosate-resistant) corn and LibertyLink-resistant (glufosinate-resistant) corn. Since Touchdown, Liberty, and Roundup are nonselective herbicides, they are simpler to use than many of the other postemergence herbicides, have a wider window of opportunity for application, and can help growers reduce their dependence on less environmentally friendly herbicides.

Timing is still important when growing GM corn because of the lack of residual herbicide activity. If applied too early, a second flush of weeds can compete with the corn before canopy closure. If application is delayed too long, weeds can cause too much early-season competition and reduce crop yields. In a regional study, applying glyphosate alone at the fourth leaf stage of corn development (approximately five- to seven-inch corn) provided growers with the best control without having to mix glyphosate with another tank mix partner.[2]

If you want to use GM corn and apply herbicide at an earlier growth stage, it is best to tank-mix another herbicide with residual activity to prevent a second flush of weeds. Current recommendations from Monsanto call for use of a half to full rate of a preemergence herbicide followed by glyphosate applied postemergence. This usage plan is being recommended in response to concerns about herbicide-resistant weeds, but the extra cost of this program does not seem viable. One way to use the technology and avoid weed resistance is to rotate modes of action; for example, use Roundup Ready technology as one method to solve specific problems (see the ICM quackgrass discussion on page 3). Use of the technology every year in a field significantly increases the risk of resistance.

Finally, due to concerns over pollen drift, growers should also determine whether there is an organic corn producer within close proximity to a production field. Rates of cross-pollination have been demonstrated at approximately 1 percent at 30 meters downwind from the production field, and dropped off exponentially from the field edge toward the middle (0.1 percent) and far edge (0.03 percent at 50 meters from the source) of the field.[3]

If organic producers have concerns over cross-pollination, leaving the outside four to six rows as a buffer may serve to prevent genetic contamination of their forage corn.

[2] Curran et al., 2002. *Northeast Weed Science Society Proceedings* vol. 56, p 6.

[3] Jemison and Vayda, 2001. "Cross Pollination From Genetically Engineered Corn: Wind Transport And Seed Source." *AgBioForum*, retrieved 12/19/06 from http://www.agbioforum.org/v4n2/v4n2a02-jemison.htm.

Triazine-Resistant (TR) Broadleaf Weeds

While TR broadleaf weeds were once a real issue for corn growers in New England, growers today have many options. Traditional options, such as Prowl at 1.5 qt/ac + Atrazine at 4 pt/ac, applied preemergence, will control most TR broadleaf weeds. However, this combination may not provide effective control of field bindweed, burcucumber, and ragweed. Also, one should include an herbicide that controls annual grasses. An older, but still effective, postemergence option for TR broadleaf weeds includes the use of Banvel or Clarity. Banvel is recommended at 0.5 pint/ac for corn over six inches tall. Weed control is most effective when weeds are less than three inches tall.

Newer options that are very effective on triazine-resistant pigweed and lambsquarters include Python (applied alone at 1 oz/ac) or Callisto (applied alone at 6–7.7 oz/ac) will provide excellent control. Impact, a new herbicide from AMVAC, has excellent activity on TR lambsquarters as well. Lumax or Lexar are formulations of preemergence materials containing Callisto, AAtrex, and Dual II magnum. A maximum of 3 qt/ac rate may be applied to corn.

Use of Roundup or Liberty with genetically engineered corn is another way to control TR lambsquarters or pigweed in corn. Applications of up to 2 pt/ac have provided good control postemergence. While control is effective up to the sixth leaf stage of corn development and taller, the early weed competition will probably limit yield. Applying herbicides when the corn is in the third to fourth leaf stage (approximately six inches tall) has been found to be most effective in New England. If this technology and weed control approach is used every year, weeds will develop glyphosate resistance. Use this approach only on an as-needed basis for specific fields with TR weeds and quackgrass problems (see below). Alternatively, apply a half to a full rate of a preemergence tank mix for annual grasses and broadleaf weeds, and use Roundup or Liberty as a follow-up control measure. However, the economics of the latter choice are not favorable compared to other options.

Quackgrass

Quackgrass is a perennial grass that is not well controlled by standard herbicide programs in New England. It tends to build up in corn fields over time. There are three possible times to control quackgrass: in the fall after harvest, in the spring before planting, or during the growing season with the use of herbicide-resistant, genetically modified corn hybrids.

Fall control requires an extra pass over the field, but control is quite effective as long as the plant is green and growing. An application of 1 qt/ac of a formulation of Roundup or Touchdown with appropriate adjuvants included in the mixture should provide adequate control.

You can use a lower rate in the spring, when the plant is sending nutrients down to the rhizomes. Control in the spring also requires the use of a nonselective herbicide like glyphosate (Roundup or Touchdown) or glufosinate (Liberty) after the quackgrass plant is about six to eight inches tall. Wait about four to five days (depending on the weather) before initiating field preparation. A rate of 2 quarts/ac is recommended for spring applications.

You can selectively control quackgrass and some additional weeds with the use of nicosulfuron (Accent) and primisulfuron-methyl (Beacon). These are low-rate products with good crop safety. Nicosulfuron provides better control of other escaped annual grasses, and both provide adequate control of TR pigweed and other broadleaf weeds if sprayed when these weeds are in an early stage of growth. Please refer to the label for heights where plants are well controlled.

Finally, if you use glyphosate- or glufosinate-resistant corn, you can control quackgrass postemergence. A rate of 2 pt/ac is generally sufficient to control quackgrass applied postemergence when corn is between the third and fourth leaf stages (around four to six inches tall). Check the formulation to see if stickers or adjuvants are required.

Nutsedge

This weed is a persistent problem in many New England corn fields, and particularly in wet, nutrient-rich fields. Nutsedge spreads by both rhizomes and tubers, and once a field becomes infested, chemical control is difficult and expensive. Thorough cleaning of field implements can help avoid introducing tubers into fields. There are three possible timings to control nutsedge: preplant incorporated, preemergence, and postemergence. All timings have strengths and weaknesses.

▶ Preplant incorporated

This approach involves spraying the soil, incorporating the material to a two- to three-inch depth, and then planting the field. This approach was used for a number of years with products like Sutan Plus or Eradicane. These products are no longer available. However, preplant incorporation of Dual II Magnum has provided excellent, consistent control of nutsedge. Generally with normal rainfall, Dual will not control the plants that germinate from lower levels; putting the herbicide where the tubers and rhizomes are producing new plants provides a very effective method. Herbicide application rates are based on soil type and organic matter, but use of the higher rates is recommended.

▶ Preemergence

Use of Dual II Magnum at the highest recommended rate for your soil type and organic matter content will probably provide adequate control of nutsedge. In research conducted in Maine, preemergence application provided good to excellent control in wet years, but was less favorable under dry conditions.

▶ Postemergence

Halosulfuron and halosulfuron-containing products have been a welcome development for corn growers in New England. Products like Permit (applied at 1 oz/ac) and Yukon (applied at 4–8 oz/ac) provide effective control of nutsedge. Be sure to follow label directions for tank mix combinations, needed surfactants or adjuvants, and possible antagonisms.

Velvetleaf

Velvetleaf is a large-seeded, broadleaf weed that is problematic for many New England corn growers. Due to the size and viability of the seed (because seeds buried in soil can germinate up to 50 years later), this weed remains a problem for many years. For effective preemergence control, choose a product that does not break down quickly in soils. Lumax, Lexar, and Hornet are all good preemergence materials. There are many postemergence options available to producers. Read the label carefully for velvetleaf size restrictions on herbicide effectiveness.

In Summary

Our goal was to present important factors that need to be considered for an effective field corn weed management program. We have discussed herbicides that are commonly used to control weeds in field corn, and methods of weed control, including timing of applications and alternative controls that reduce herbicide use and risks to the environment.

When dealing with specific weed infestations, knowledge is power. It is essential to scout and map weeds and gather as much information about the weed's life cycle as possible. Determine what alternative control options can be used. Consider surrounding environmental factors such as soil type and proximity to water resources, and consider the chemical properties of the herbicides available for control. For instance, does the herbicide bind to the soil or is it likely to leach or run off? Remember that practicing good herbicide rotation will help keep these products working effectively for New England field corn producers.

Tables

Table 1. Corn Herbicides Registered for Use in Maine/New England as of 2006

Table 1 presents the most commonly used corn herbicides in New England. This is not an exhaustive list for all states, but it does present a majority of the most commonly used herbicides, their common names and manufacturer, and some information on water quality and worker protection.

Trade Name	Common Name	Manufacturer	Restricted Use	Water Quality Advisory	Worker Re-Entry (hours)
2,4-D amine 4S	2,4-D amine	Several	No	No	48
2,4-D LVE 4E	2,4-D LVE	Several	No	No	12
AAtrex Atrazine 4L/90DF	atrazine	Syngenta, others	Yes	Yes	12
Accent 75DF/SP	nicosulfuron	DuPont	No	No	4
Aim 40DF/1.9EW	carfentrazone-ethyl	FMC	No	No	12
Banvel 4S	dicamba	Microflo	No	Yes	24
Basagran 4S	bentazon	BASF	No	Yes	12
Basis 75DF	rimsulfuron + thifensulfuron	DuPont	No	No	4
Basis Gold 89.5DF	rimsulfuron + thifensulfuron + atrazine	DuPont	Yes	Yes	12
Beacon 75 DF	primisulfuron	Syngenta	No	No	12
Bicep II Magnum 5.5L	s-metolachlor + atrazine	Syngenta	Yes	Yes	24
Bicep Lite II Magnum 6L	s-metolachlor + atrazine	Syngenta	Yes	Yes	24
Bronco 4E	glyphosate + atrazine	Monsanto	Yes	Yes	12
BUCTRIL 2E	bromoxynil	Bayer CropScience	No	No	12
BUCTRIL + atrazine 3L	bromoxynil + atrazine	Bayer CropScience	Yes	Yes	12
Bullet 4ME	alachlor + atrazine	Monsanto	Yes	Yes	12
Callisto	mesotrione	Syngenta	No	No	12
Celebrity Plus 70DF	nicosulfuron + dicamba + diflufenzopyr	BASF	No	Yes	12
Cinch 7.64E	s-metolachlor	DuPont	No	Yes	24
Cinch ATZ 5.5L	s-metolachlor + atrazine	DuPont	Yes	Yes	24
Cinch ATZ lite 6L	s-metolachlor + atrazine	DuPont	Yes	Yes	24
Clarity 4S	dicamba	BASF	No	Yes	12
Degree 3.8ME	acetochlor	Monsanto	Yes	Yes	12
Degree XTRA 4.0 ME	acetochlor + atrazine	Monsanto	Yes	Yes	12
Dual Magnum 7.62E	s-metolachlor	Syngenta	No	Yes	12
Dual Magnum 7.62E/Cinch	s-metolachlor	Syngenta/DuPont	No	Yes	12
Duramax	glyphosate	Dow AgroSciences	No	No	4
Durango DMA	glyphosate	Dow AgroSciences	No	No	4
Eradicane 6.7E	EPTC + safener	Cedar	No	No	12
Expert 4.88L	atrazine + s-metolachlor + glyphosate	Syngenta	Yes	Yes	12
Field Master 4.25SSE	glyphosate + atrazine + acetochlor	Monsanto	Yes	Yes	12
FRONTIER 6.0	acetochlor + safener	BASF	Yes	Yes	12
FulTime 4CS/EC	glyphosate + acetochlor + safener	Dow AgroSciences	Yes	Yes	12