Nov 30th, 12:00 AM

Weed Management Update

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INTRODUCTION

A number of significant problems related to weed management developed during 1995. The most influential factor in many of these issues was the environment. However, with proper planning, adjustments could be implemented in the system to resolve many of these problems. Also, many of these problems have been building during previous years and conditions in 1995 emphasized their impact on crop production. Pigweed control was of concern during 1995. Herbicide injury from postemergence applications was widespread, particularly in soybeans. The potential for the interaction of herbicides resulting in adverse effects to crops continued to be an issue. Grower expectations for weed management and company programs also impacted overall weed control strategies. Finally, weed management in no tillage programs and CRP was a concern. This paper will briefly discuss factors that influenced the development of the problems.

PIGWEED PROBLEMS

Pigweed problems continued to increase in Iowa during 1995. Most of these problems are due to increasing infestations of common waterhemp (Amaranthus rudis) rather than tall waterhemp (Amaranthus tuberculatus). Iowa State University extension weed scientists first noted that pigweed problems were increasing several years ago. However, the problems are now recognized to be widespread and consistent throughout the state. A number of factors have influenced this change in weed populations.

Common waterhemp has likely been the predominant pigweed in Iowa for many years. However, while the species was not properly identified until recently, taxonomy was not the major factor that allowed the increase in population. Population estimates from ISU experiment fields indicates that common waterhemp represented approximately 90 to 95% of the pigweeds found in 1995. The pigweed species were mixed infestations of redroot pigweed (Amaranthus retroflexus) and smooth pigweed (Amaranthus hybridus); redroot pigweeds were more populous than smooth pigweed. Factors that have caused the current pigweed population to change include reduced tillage systems, differing herbicide strategies and changes in mechanical control practices.

High residue environments favor small-seeded annual weeds. They are able to germinate shallow and opportunistically when conditions are favorable. Changes in herbicide use practices have been also influenced the pigweed population. Lower rates and less market share of the dinitroaniline herbicides have resulted in poorer control of small-seeded annual broadleaf weeds including the pigweeds. Also, common waterhemp has demonstrated the ability to germinate.
later in the season, likely after the herbicides have degraded below the rate that will provide consistent control.

The use of ALS-inhibitor herbicides has increased dramatically in the last 4 to 5 years. These herbicides are used on most of the soybean acres and the number of acres in corn are increasing dramatically. ALS-inhibitor herbicides have a very specific mechanism of action and generally provide excellent control of sensitive weeds. Common waterhemp is a dioecious plant which provides a greater opportunity for genetic diversity. As a result of the biochemical characteristics of the ALS-inhibitor herbicides and the biological characteristics of common waterhemp, numerous locations have been identified that include an ALS-resistant common waterhemp population. This problem is relatively widespread across Iowa and appears to be increasing rapidly in frequency. Importantly, these populations tend to demonstrate a high level of cross resistance to other ALS inhibitor herbicides.

Strategies to resolve this problem include rotation of herbicides away from the ALS inhibitors. Tank mixtures with non-ALS inhibitor herbicides will help solve the problem also. Mechanical control strategies should be included in the overall weed management plan. Generally, it is important to reduce the selection pressure from the ALS-inhibitor herbicides; the more diverse the management strategy becomes, the less likely the development of an ALS-resistant common waterhemp population.

**Herbicide Injury**

Herbicide injury was very evident in 1995. Generally, crops were under stress, planted late, slow in developing and behind in growth relative to weeds. Tillage and soil-applied herbicides provided less than effective weed control and mechanical strategies were not timely, if growers were willing to use these traditionally successful techniques. Thus, postemergence herbicides were widely used, but typically applied to larger weeds and crops that were under stress. Further, weather conditions during much of the postemergence applications were extremely hot and humid further increasing the potential for crop phytotoxicity. Last, many of the ALS-inhibitor herbicides used have somewhat narrow margins of crop safety, particularly in corn. The dithiopylerherbicides also have a close tolerance for crop safety in soybeans. The results of unfavorable environmental conditions, crop stress and large weeds were foliar injury to the crops and relatively inconsistent weed control.

While much of this injury was short-lived, hot dry conditions later in July and August decreased the opportunities for crops to recover fully. Further, rescue herbicide treatments often added significantly to the problem. Typically these treatments were applied to larger crops further increasing the odds for injury. When corn is treated with an ALS-inhibitor herbicide after earshoot development has begun, or when soybeans have begun to flower, the potential for damage to crop yields increases. In these situations, the use of directed herbicide applications, or better yet, mechanical weed management will lessen the potential for herbicide injury to the crop.

There was widespread injury to soybeans in 1995. The symptoms of this injury were leaf puckering, leaf strapping, curled leaf margins and occasional leaf chlorosis. These symptoms
were attributed to growth regulator herbicides, particularly dicamba products. However, many of the injury situations were evenly spread across a field and a postemergence treatment to soybeans had recently been applied. This injury pattern can indicate sprayer contamination, however in most situations, there was little possibility of a contaminated sprayer. In a fewer number of situations, there was no postemergence application, yet the injury was still widespread in the field. Again, growth regulator herbicides were identified as the cause, although in these situations, drift was the suggested cause of the problem.

Observations at ISU indicated that while in specific situations there was injury to soybeans as the result of a growth regulator herbicide, most of the complaints were not attributable to herbicide drift or sprayer contamination. ISU experiments had similar symptoms on soybeans where only adjuvants or typical postemergence herbicide treatments were applied. There was no growth regulator herbicide involved, yet the symptomology was evident. It is suggested that the stress conditions brought forth by the environment and the postemergence applications slowed or stressed the meristematic areas within the leaf. This resulted in the symptoms that appeared similar to those resulting from a growth regulator herbicide. Typically, the next developing trifoliate did not demonstrate the injury further suggesting that there was no involvement from herbicide contamination or drift.

**Pesticide Interactions**

The issue of pesticide interactions continues to be a concern in Iowa agriculture. Unfortunately, the proposed interactions are difficult to demonstrate and quantify. Many factors are involved and affect the relative severity of the interaction, the frequency of the problem and the predictability of the outcome. The management factors that are most important include the choice of herbicide(s) and application timing. Other considerations are physiological condition of the crop, size of the crop, herbicide application technique, insecticide use and environmental conditions.

Pesticide interactions have been a factor in crop production and weed management for many years. Interactions resulting from the use of organophosphate insecticides and metribuzin on soybeans or the interaction of atrazine carryover and metribuzin use on soybeans resulting in significant crop injury are well-documented. However, the current concern for pesticide interactions reflects changes in herbicide chemistry and generally are demonstrated by ALS-inhibitor herbicides. Current herbicide use practices indicate that these herbicide classes are extremely effective for weed control and have been widely adopted for weed management in soybeans and corn. These herbicides have exceptional environmental characteristics, a wide range of application techniques available, control a broad range of weeds and specific ALS-inhibitor herbicides can be used in most Iowa weed management programs. Generally, the ALS-inhibitor herbicides provide benefits to Iowa growers that far out-weigh the risks of use. However, the relative crop tolerance for ALS-inhibitor herbicides, particularly under specific situations, is close. Thus, when other stresses or pesticides affect the crop, the potential for interaction and thus injury, increases.
The stresses include anything that results in poor crop growth such as soil temperature, soil moisture, planting depth, or fertility. Pesticides that can interact include growth regulator herbicides applied in combination with an ALS-inhibitor herbicide, other ALS-inhibitor herbicides (with residual activity) applied to the previous crop, ALS-inhibitor herbicides applied previously to the crop, or combinations of ALS-inhibitor herbicides applied to the crop. Further, organophosphate insecticides can occasionally interact with ALS-inhibitor herbicides resulting in crop damage.

If an ALS-inhibitor herbicide does not follow another application of an ALS-inhibitor herbicide, the risk of an interaction is eliminated. This management decision also is appropriate with herbicide-resistant weed management strategies. Often, an ALS-inhibitor herbicide is applied late as a rescue treatment. It is not advisable to apply an ALS-inhibitor herbicide after the corn has reached V6 to V8 developmental stage. This is when earshoot development begins and the potential for accumulation of the herbicide at this metabolic sink is high. Similarly, ALS-inhibitor herbicides should not be applied to soybeans that have entered the reproductive developmental stage.

Generally, the potential for pesticide interactions that result in significant crop injury and yield reduction is low. Given the importance of ALS-inhibitor herbicides in Iowa weed management, these risks can be considered acceptable. However, it must be recognized that ALS-inhibitor herbicide selectivity is based on the ability of the crop to quickly metabolize the herbicide to non-phytotoxic components. Environmental conditions that slow plant growth will slow herbicide metabolism and thus increase the risk of an interaction. As the amount of a herbicide increases, the lower the stress level that is needed to affect herbicide metabolism. Thus, if the crop is under slight growth stress and has been exposed to an ALS-inhibitor herbicide, whether from the year previous or an earlier application during the growing season, the risk of crop injury increases significantly when another ALS-inhibitor herbicide is applied.

Avoid the application of ALS-inhibitor herbicides to crops under growth stress, crops entering reproductive development or to crops that have been previously exposed to an ALS-inhibitor herbicide. Combination of ALS-inhibitor herbicides that are labeled for application may be at a higher risk with regard to crop injury, given the total amount herbicide used when compared to the single herbicide treatments. If the crop is not under stress, if there has not been a previous exposure (in season) to an ALS-inhibitor herbicide or if the application is timely, the risk of an interaction that results in significant crop is negligible.

**Weed Management and Company Programs**

Concerns about inappropriate herbicide applications as a result of guaranteed weed control promotions, grower perceptions of the necessary level of weed control and dealer programs continue in Iowa. While many companies have made concerted efforts to curtail the resprays and have not endorsed weed control guarantees, other factors have influenced this misuse of herbicides. The problem exists for a number of reasons; the herbicide market in Iowa is extremely competitive, dealers see company programs as a business opportunity and growers...
have a perception of weed control which does not reflect the level actually required to maintain economically optimum yields.

Growers have been effectively convinced that weed management programs must eliminate weeds for the entire season. This belief is reinforced by company advertising which depicts herbicides as the sole strategy for complete weed control. Further, economic concerns about the cost of late season herbicide applications are negated by fears of increasing weed populations, losing rental land, and peer pressure. Importantly, there is no objective, long-term research that demonstrates the implications of minimizing late-season applications. However, when the short-term effects of late-season, rescue herbicide applications are considered, a strong case can be made to make more objective judgements about their use.

Generally, the negative impacts of late-season herbicide applications outweigh any benefits. Late-season applications typically are timed when crops are more sensitive to herbicide injury and weeds are larger and thus less susceptible to treatment. The fact that the applications are paid for, either completely or in part, by companies does not lessen the potential for crop injury nor improve weed control.

In many cases, the lateness of the rescue application reflects faulty weed management decisions; mechanical control strategies can usually resolve these issues when the problem is identified early. Further, late applications are usually delayed until after any crop yield loss due to weed interference has occurred. Second and third herbicide applications also have negative implications on herbicide-resistant weed management. Finally, the amount of weed seed returned to the soil, while potentially significant with regard to future weed management practices, will not result in weed infestations that are unmanageable.

The one economically important reason to strive for total weed control reflects ownership of the land: land that is farmed under a rental agreement may need a higher level of weed control. Unfortunately, many land owners evaluate the management skills of the renter as their ability to control weeds. Weeds that are not controlled are assumed to mean that the agronomic and economic skills of the tenant are poor and the lease arrangement is thus at risk. Research at ISU demonstrates consistently that the level of weed control that is achieved from an appropriate herbicide program, supplemented with alternative weed management, will provide sufficient weed control to allow the maximum potential crop yield.

These strategies will consistently provide 90 to 95% control of weeds. Controlling the last 5 to 10% of the weeds is extremely expensive, relative to the agronomic return on the investment. However, later emerging weeds may develop, and escapes will replenish the soil seedbank. Fortunately, on most of these fields, the change in weed population is negligible and adjustments to management strategies can be made to resolve the problems.

Companies and agchemical dealers that promote or endorse guaranteed weed control are not effectively improving weed management and, in fact, may be causing agronomic and environmental damage. Growers who use these guarantees are making decisions based on information that herbicide marketing has given them. These guarantees are rationalized by
growers to represent an effective means of managing weed control risks. The solution to this problem includes more accurate marketing of the herbicides, company programs that do not include written or implied guaranteed performance, agchemical companies that recognize the potential problems that guarantees represent and actively work to eliminating them with their clientele and growers who will assume more management responsibility for weed control programs.

Weed Management in No Tillage Systems

No tillage crop production systems are more management intensive than where significant tillage is employed. Weed control is more difficult and herbicide performance more variable in no tillage compared to conventional tillage systems. Generally, a no tillage system favors weed development; typically there is a greater diversity of weed species in no tillage and weed germination events occur over a longer period of time. This results in difficult management decisions, particularly when postemergence herbicide treatments are used as weed size will be variable and it may be difficult to determine the optimum time for applications.

While no tillage weed management requires better and more timely decisions than conventional tillage, weed control can still be achieved. Growers must recognize the need for timely decisions. No tillage favors small-seeded annual weeds, early germinating species, biennials and perennials. Weed populations can change dramatically in no tillage systems compared to conventional tillage systems. This can be resolved when growers carefully observe weed development and make timely decisions when control options are available. Growers should also recognize the need for a diverse weed management strategy. Opportunities to utilize mechanical and cultural weed control should be identified and included in the weed control program.

Weed control in no tillage systems in 1995 was, in general, not good. Environmental conditions impacted the performance of soil-applied herbicides, late season weed emergence affected postemergence herbicides and alternative strategies were not used by growers to solve the problems. Most of these problems could be minimized with better management choices. Using single herbicide applications, as compared to combinations of soil-applied and postemergence treatments, will not provide consistent weed control. Supplementing herbicides with mechanical control techniques is an economically effective management strategy.

Fall applications of herbicides has been widely promoted as a strategy to improve weed management in no tillage systems. While ISU has demonstrated the success of this application strategy, the consistency of performance has been variable. It is likely that control will not be as good as a spring application that also receives alternative management treatments. Other issues such as the potential for environmental contamination have not been clearly identified and quantified.

CRP and Weed Management

Unless nonselective herbicide treatments were applied to CRP this fall, the best opportunity for consistent and economical weed control has been lost. Spring applications of nonselective
herbicides have not consistently controlled weeds in CRP. CRP cover, whether mixed stands of bromegrass, fescue and legumes or switchgrass, is best controlled during the fall. In most cases, it is best to mow the CRP first, remove the residue and allow regrowth to occur prior to herbicide application. This option does not fit in well for spring treatments. Thus, tillage may be used by growers to prepare CRP for crop production.

Tillage is not a desirable management strategy for CRP, given the potential for soil erosion. Further, tillage will not be effective at controlling the CRP species but will serve to delay the regrowth and minimize herbicide options. It may be advisable, if tillage is used in CRP, to delay planting until the CRP species have begun to re-establish and use a nonselective herbicide application. If legumes were not a major component of the CRP species, soybeans are the best crop to return CRP to crop production.

Glyphosate-resistant soybeans, if adapted varieties are available, represent an excellent opportunity for consistent weed control in CRP land returned to crop production. However, concerns for control of the CRP cover still exist; these species will require considerable attention for control. Residual weed control is still required in glyphosate-resistant soybeans, and while reapplication of glyphosate does provide a manner of residual control, these applications also increase the potential for drift to nontarget species.

Woolly Cupgrass Management

Woolly cupgrass continues to increase in economic importance in Iowa. Despite claims, no single herbicide or application strategy will provide consistent control of this highly competitive weed. Options for woolly cupgrass control in soybeans are excellent; there are soil-applied herbicides with good activity on this weed and numerous postemergence herbicide options are also available. The opportunity for delayed planting of a soybean crop also represents an excellent cultural strategy that will allow the nonselective control, either with herbicides or tillage, of one or more woolly cupgrass germination flushes. Mechanical control techniques are also effective for woolly cupgrass management in soybeans.

In corn, there are also good options for woolly cupgrass control, however the risks are somewhat greater and the cost of control somewhat higher than in soybeans. Generally, soil-applied herbicides provide inconsistent control of woolly cupgrass. However, due to multiple germination events, residual control for woolly cupgrass management is essential. Thus a combination soil-applied herbicide and other strategies is most effective. These strategies should include mechanical weed control practices although postemergence herbicides also represent an effective strategy.

Accent provides excellent woolly cupgrass control albeit without residual activity. Application timing is critical for maximum efficacy and minimum crop injury. Delayed application when the corn is V6 or larger, or when woolly cupgrass is larger than 4” tall increases the risk of crop injury and reduces potential control, respectively. Complete coverage of the weed is essential for best control; in low woolly cupgrass population densities, tillering may occur earlier and thus coverage of the daughter plants becomes difficult. When woolly cupgrass population densities
are high, competition occurs earlier and thus applications should be made earlier. Soil-applied herbicides may provide residual control to supplement an Accent treatment. However, timely cultivation should be included regardless of the herbicide treatments used.

Sethoxydim-resistant corn is also an excellent strategy to help control woolly cupgrass. However, Poast has limitations similar to Accent with regard to residual activity. Soil-applied herbicides, mechanical control or both should also be included in a woolly cupgrass management program using sethoxydim-resistant corn. This strategy introduces a non-ALS inhibitor herbicide into the system and thus has positive implications on the selection for ALS resistant weed population.

Summary

The greatest potential problems for 1996 are control of common waterhemp in soybeans, the interaction of ALS-inhibitor herbicides resulting in damage to crops, and management of woolly cupgrass. Of these, only the interaction of ALS-inhibitor herbicides can not predicted with any certainty. The problems with common waterhemp and woolly cupgrass existed in the target fields previously and the severity of the infestations has likely increased. The potential impact of these problems reflect management strategies; if management decisions are made in a timely fashion with due consideration to factors influencing the severity of the problem, the impact will be minimal.

For the weed problems, it is critical to include alternative strategies such as rotary hoeing and cultivation. The common waterhemp problems have developed, in part, due to increased use of ALS-inhibitor herbicides. Changing to herbicides with a different mechanism of action are a recommended strategy to deal with these resistant populations.

Crop injury from herbicide interactions can be eliminated with appropriate management decisions. However, this problem is closely related to grower perceptions of weed control and company guarantees. It is advisable not to follow an ALS-inhibitor herbicide with herbicides of the same mechanism of action. Making timely applications, avoiding applications to stressed crops and selecting tank mix herbicides carefully will further minimize the potential for crop injury.