CURRENT ISSUES IN WEED MANAGEMENT

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Introduction

Weed management is in a continual state of change, however there are several issues that will likely be major considerations for several years and reflect concerns for the environment and the economics of weed management. These issues include guaranteed performance agreements and the advisability of respray programs, herbicide resistance in weeds, herbicide resistant crops, the interaction of pesticides as it affects crop phytotoxicity and new herbicide products and associated environmental risks. This paper will briefly review these issues and provide the perspective of the authors about the impact of these issues on weed management.

Discussion

Guaranteed Herbicide Performance Agreements. Herbicides are used on more than 95% of the row crop acres in Iowa. Given that the herbicide market in Iowa represents an estimated $450,000,000 annual expenditure, competition among companies is intense.

Herbicide performance is affected by environmental conditions and management decisions and skills. Typically, herbicide performance is variable and growers have resisted utilizing remedial management techniques because of perceived expectations of product performance and product cost. These expectations about performance are the result of aggressive marketing campaigns and sales presentations by the industry. Unfortunately, these remedial techniques, if accomplished in a timely fashion with appropriate skill, are usually enough to resolve any economic concern about herbicide performance.

The industry generally recognizes that growers have an obligation to participate in the management of herbicide performance and frequently comment about concerns that growers are unwilling to take initiative to accomplish the required best management practices. However it is the industry who has moved the growers into this position. The industry has used product performance guarantees as a marketing tool and have aggressively positioned products by removing any obligation of the grower to accept risk of poor environmental conditions or to provide remedial procedures in a timely fashion.

Product performance guarantees have caused considerable, and inappropriate, expenditures of time and money by the industry, agchemical dealers, and growers. More importantly, it is

likely that the resprays that are part of the performance guarantees represent an inappropriate use of herbicides. This reflects agronomic and environmental perspectives.

Given the perception that the public has of the herbicide industry and the inadvisability of the performance guarantee programs, any attempt by the industry to position itself as environmental stewards will be met with considerable negative publicity. By positioning growers to resist using environmentally and economically appropriate weed management, the herbicide industry encourages resolution of this problem by increasingly restrictive laws that will be developed by people without an understanding of agriculture. Iowa State University strongly disagrees with any performance guarantee and recommends that the herbicide industry reflect on the potential outcome of this marketing ploy.

Herbicide Resistance in Weeds.

Weeds that are resistant to herbicides continue to develop at an increasing rate. The lack of alternative management strategies, reduced tillage regimes and herbicide use patterns are influencing the speed and frequency that these resistant weed populations develop. Currently, herbicide resistant weeds are not a major economic problem in Iowa. However, current weed management practices will likely result in significant problems in the future.

The repeated use of a herbicide creates a selection pressure that provides a biological advantage to weed biotypes that have the ability to withstand the herbicide activity. Typically, weed biotypes have this ability as a result of an alteration in the specific site of herbicide activity thus negating the phytotoxicity of the herbicide. This alteration generally occurs at a low frequency in the natural weed population and numerous generations of selection pressure (years of specific herbicide use) are required before a significant number of plants within a population have this trait. Growers will begin to notice that a problem with herbicide resistant weeds has developed when approximately 30% of a weed population has herbicide resistance.

Other factors that are involved with the speed at which weed resistance develops is the fitness of the resistant biotype relative to the fitness of the sensitive biotype. Triazine herbicide resistant weeds are not as fit as weeds that are sensitive to these herbicides. Thus, without triazine herbicide selection pressure, the resistant biotype population will not increase dramatically. Unfortunately, weeds that are resistant to specific ALS herbicides do not demonstrate a significant fitness penalty, compared to weeds that are sensitive to ALS herbicides. As a result, the initial frequency of ALS resistant biotypes is potentially high in a natural weed population.

The use of ALS inhibitor herbicides continues to increase in Iowa. These herbicides are used on corn and soybeans, can be applied in various application techniques, may demonstrate considerable residual activity and have activity on a broad range of species. Importantly, the specific site of herbicidal activity for the ALS inhibitor herbicides demonstrates considerable plasticity with regard to the number of naturally occurring alterations on this enzyme. This results in a very high frequency of ALS resistant weeds in a population. Consequently, economically important populations of ALS resistant weeds are very likely to develop rapidly.

Current marketing strategies will also increase the speed at which ALS resistance develops. Guarantees programs, which reduce the likelihood that alternative weed management strategies will be used, and the repeated use of specific ALS inhibitor herbicides are most

concerning with regard to the development of ALS resistant weed populations. Attempts by the industry to develop and promote management programs to minimize the development of ALS resistant are commendable but will not likely greatly deter this problem.

Herbicide Resistant Crops.
Numerous herbicide resistant crops are being developed and these will become important tools in Iowa agriculture. Currently, there are sulfonylurea herbicide resistant soybeans and imazethapyr resistant corn hybrids commercially available to Iowa growers. In the future, soybeans that are resistant to glyphosate and corn that is resistant to glyphosate, gluphosinate or sethoxydim will also be available. It is also possible that seed companies may provide varieties or hybrids that have resistance to several herbicides with different mechanisms of action.

These herbicide resistant crops may improve control options for specific weeds, allow the widespread adoption of conservation tillage practices and the use of specific herbicide resistant crops may eliminate concerns of herbicide carryover. For example, shattercane is a difficult weed to control in corn; the use of imazethapyr in resistant corn hybrids provides an excellent and consistent management tool for this weed. The most important impediment of the widespread adoption of narrow-row soybeans grown in no tillage culture is concern for consistent and economic weed control. When glyphosate-resistant soybeans become available, this fear will be alleviated and this soil conservation practice should rapidly spread through Iowa. A majority of soybean acres are treated with ALS inhibitor herbicides that have long residual characteristics; the use of resistant hybrids lessens the concern for carryover injury from these herbicides.

However, the adoption of herbicide resistant crops are not without potential problems. Notably, the use of these crops may result in the repeated use of specific herbicides and thus enhance the development of weed populations resistant to that herbicide. Another concern is that herbicide resistant crops may lessen the use of alternative weed management strategies; growers may be less likely to rotary hoe or cultivate if they know that the crop is resistant to a herbicide that can be applied postemergence even if mechanical control would be more economically and environmentally acceptable. Another concern is that resistant crops are being developed for herbicides that are very efficacious on nontarget plants and sensitive crop hybrids. Thus, herbicide drift becomes increasing problematic. Finally, it will be critically important to insure that the application of these herbicides is made in the fields planted with the resistant crops. Application mistakes due to poor communication between the grower and the ag chemical dealer will be extremely costly.

Generally, the benefits of herbicide resistant crops are greater than the risks. It is important that the long term implications of resistant crops be assessed. Herbicide resistant crops will require a high level of management skill and communication must be good to minimize problems.

The Interaction of Pesticides. Pesticide interaction has historically been a concern in Iowa. Atrazine carryover interacted with metribuzin application resulting in more soybean phytotoxicity than either of these herbicides alone. Another occasional problem was the interaction of organophosphate insecticides, used for soil insect management in corn, inadvertently applied to soybeans during planting and metribuzin used for weed management.

The resultant phytotoxicity from this interaction was usually serious. Current interactions of agronomic concern are those that result from the organophosphate insecticide terbufos and several ALS inhibitor herbicides used for weed management in corn and soybean ALS inhibitor herbicides interacting with ALS inhibitor herbicides used in corn.

The interaction of terbufos and ALS inhibitor herbicides is an occasional problem. The risk of this interaction can be lessened by using different formulations of terbufos and observing the most restrictive labels of the ALS inhibitor herbicides. Another consideration is the environmental conditions that precede the application of the herbicide. If rainfall occurs soon before the application of the herbicide, there may be a greater risk of the interaction because the insecticide is in the soil solution and available to the plant. The interaction can also be lessened by directing the herbicide application between the rows rather than a broadcast application that may place a relatively high rate of the herbicide in the whorl of the corn plant. The best resolution to this interaction is to follow the herbicide label and observe all restrictions.

The interaction of ALS inhibitors with ALS inhibitors is more problematic and difficult to assess. As a general statement, the new herbicides currently used in Iowa inherently demonstrate a closer margin between crop tolerance and crop injury than some of the older herbicides. Thus, other factors such as environmental stress, management decisions and application skills become more important. Crops that are under stress as a result of poor weather, shallow planting, poor soil-seed contact, early planting, improper calibration and other factors will not be in a position to tolerate marginal herbicide injury when compared to crops that are growing vigorously and under no ancillary stress.
The majority of soybean acres in Iowa are treated with ALS inhibitor herbicides. Slight amounts of herbicide carryover likely occur as an annual event, but is not noteworthy due to the environmental conditions favoring corn recovery. When environmental conditions are not favorable, this carryover can result in more serious injury; the relative response of the crop is dependent on the amount of herbicide carryover. Similarly, ALS inhibitor herbicides that are applied corn respond to the environment and may cause slight injury when the corn is under stress. When slight amounts of ALS inhibitor herbicides carryover and an ALS inhibitor herbicide is applied to corn, an interaction can occur, given the similar mechanisms of action and degradative pathways.

The level of this interaction reflects the rate of carryover and timing of herbicide application in the corn. Research conducted at Iowa State University has not demonstrated that this interaction is a major concern. However, when environmental conditions are not favorable and the corn is under stress, the interaction of ALS inhibitor herbicides can result in significant corn injury. This interaction was demonstrated in 1994 with several ALS inhibitor herbicides applied for soybean weed management in 1993 and flumetsulam applied for weed management in corn. Other ALS interactions observed were with soybean ALS inhibitor herbicides and ALS inhibitor herbicides applied postemergence to corn. Further, ALS inhibitor herbicides applied for corn weed management interacted resulting in significant corn injury.

The major factor influencing these interactions was the predisposition of the corn by unfavorable environmental conditions to herbicide injury. Other factors that enhanced the occurrence of the ALS interactions was early planting and shallow seeding depth, resulting in poor soil-seed contact. Unfortunately, these interactions are extremely difficult to diagnose due

to the lack of specific symptomology on the corn. Unless an appropriate comparison is available in the field, identification of these interactions is difficult.

New Herbicide Products.
There are a number of new herbicide products that are or may be available for weed management in 1995. These include, but are not limited to Broadstrike Plus Corn PRE/PPI, Contour, Harness Extra, Resolve CP, Resource, Rezult and Shotgun. These herbicides are briefly described in the following text. Refer to the herbicide label for specific application instructions and restrictions. INCLUSION OF A TRADE NAME DOES NOT IMPLY ENDORSEMENT OF THAT PARTICULAR BRAND OF HERBICIDE NOR DOES EXCLUSION IMPLY NONAPPROVAL.

Broadstrike Plus Corn PRE/PPI is a prepackage mixture of flumetsulam and clopyralid and can be applied preplant incorporated and preemergence to corn. This product is primarily effective on broadleaf weeds and a herbicide for grass control should be included if these weeds are a concern. Broadstrike Plus Corn PRE/PPI is registered for field corn only and should not be applied to sweet corn or popcorn.

Contour is a prepackage mixture of imazethapyr and atrazine registered for early preplant, preplant incorporated, preemergence an postemergence application on Pursuit resistant/tolerant field corn hybrids. Contour is labeled for many tank mixtures thus offering a broad spectrum of weed control. Iowa State University has concerns for the use of Contour following application of imazethapyr products in soybeans because of the potential for ALS inhibitor herbicide resistant weeds.

Harness Extra is a prepackage mixture of acetochlor and atrazine registered for application in field corn, production seed corn, silage corn and popcorn. Harness Extra can be applied early preplant, preplant incorporated and preemergence. Observe restrictions relating to ground and surface water contamination on the label.

Resolve CP is a co-pack product of imazethapyr and dicamba registered for Pursuit resistant/tolerant hybrids. Resolve CP should be applied postemergence when the corn and weeds are actively growing but before weeds exceed a height of 3 inches. Iowa State University has concerns for the use of Resolve CP following application of imazethapyr products in soybeans because of the potential for ALS inhibitor herbicide resistant weeds.

Resource is a new postemergence herbicide being developed by Valent for use in corn and soybeans. Resource has a unique mechanism of action and is fast acting when applied to the foliage of susceptible plants. Activity occurs quickly when conditions are sunny. Resource will be used in tank mix combinations and demonstrates consistent activity on velvetleaf. Registration is anticipated in 1995.

Rezult is a prepackage mixture of bentazon, sethoxydim and proprietary adjuvants that is marketed in a closed delivery system. This system reduces user exposure and herbicide container disposal. Rezult is labeled for application in combination with Blazer or Concert. UAN is currently the only recommended additive.

Shotgun is a prepackage mixture of 2,4-D and atrazine registered for postemergence application in corn. Shotgun can also be applied preplant to control existing broadleaf weeds and preemergence prior to corn emergence. Follow all restrictions for atrazine.

Conclusions

The issue of guaranteed herbicide performance has the potential to do considerable harm to agriculture. Unless this problem is resolved, it is likely that legislative changes will be implemented to further restrict herbicide applications. Herbicide resistant weeds will also increase, but can be managed effectively by growers. However, these management strategies must account for the longer term implications of weed management rather than yearly concerns. While the frequency of pesticide interactions will likely increase, particularly for ALS inhibitor herbicides, the demonstration of symptoms is largely dependent on the environmental conditions. Proper management can remove most of the risk for these interactions.