Weed Science Update 1990

Micheal D. K. Owen

Iowa State University
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Associate Professor, Extension Agronomist,
Iowa State University

Introduction

There are a number of major considerations with regards to weed management in 1990. Several weed species have been identified as potentially serious statewide problems. Herbicide carryover has the potential to be an issue in 1990 and should be considered seriously as decisions are made for crop rotation, tillage, and herbicide selection. Finally, there are several herbicide candidates that demonstrate significant weed control and may impact overall weed management choices in 1990.

Discussion

Weed problems

New weed problems have become more prevalent in the last few years. While little research has been conducted to define the agronomic or physiological implications of these weeds, observations suggest that they share several traits that make them potentially important in the future. These weeds include: shattercane (Sorghum bicolor [L.] Moench.), toothed spurge (Euphorbia serrata L.), and woolly cupgrass (Eriochloa villosa [Thunb.] Kunth.)

The common traits that these weeds demonstrate include a general lack of consistent management strategies, an ability to germinate and emerge later during the growing season, and a high level of reproduction. Observations and cursory data would indicate that shattercane and woolly cupgrass exhibit a high level of interspecific competition. These grass weeds are extremely competitive with corn and soybeans. Toothed spurge does not appear to be exceptionally competitive, however the ability to develop populations on stressed areas of the field, the lack of consistent herbicidal control, and the ability to germinate and emerge later in growing season insures that this weed will be successful and thus a problem in the future.

Shattercane

Shattercane has historically been a major concern in southwest Iowa and along the Missouri River Valley. Growers have developed and utilized innovative techniques to provide some modicum of control. These techniques include the use of dinitroaniline herbicides applied postemergence to corn and incorporated with the row cultivator. Directed applications of paraquat or sethoxydim have also been investigated and may, in the future, be important parts of a shattercane management system. Recently, government programs have resulted in the rapid spread of shattercane infestations. Many of these programs have required a cover crop; given the herbicide used the previous year, some form of sorghum was often the only cover crop option. Forage sorghums or sorghum-sudan grass was planted and not effectively managed. Fertile seeds were produced, and given the ability of
sorghums to hybridize between species and the complex taxonomy, many new infestations have been established.

While crop rotation with soybeans and the use of dinitroaniline herbicides, postemergence herbicides, and mechanical control will reduce shattercane infestations, there are no consistent management systems in corn. Shattercane demonstrates prolific seed production capabilities, thus infestations increase.

Further, recent studies have demonstrated variability, presumably genetic, within Iowa shattercane populations. This variability could be the result of "biotype" adaptation to local environment and/or agricultural management system. However, initial data do not support adaptation to environmental conditions. Rather, the variability in shattercane populations could be the adaptation of "biotypes" to specific management systems or a normal variability within a species.

While some of the variability was morphological adaptation such as seed color, plant size, ruptured pedicel, or seed shape, the most important variability was found for seed dormancy. Initial dormancy evaluated the fall of seed production varied from approximately 10% to 90%. Viability for these dormancy classes was similar. When dormancy was evaluated approximately 8 months after seed production, little difference in either dormancy or viability was found.

The differences in dormancy demonstrated by shattercane populations ("biotypes") is significant. However, current research has not determined if these differences are the result of the "biotypes" adapting to specific management systems. If shattercane does adapt to the specific management systems, whether tillage, rotation, or herbicide treatments, shattercane management will become increasingly more difficult. Further research is needed to fully understand the implications of variability of shattercane dormancy.

Toothed Spurge

Toothed spurge infestations apparently are increasing, both in frequency and population within a specific location. No biological nor physiological research has been conducted on toothed spurge. Observations do not suggest that this weed is particularly competitive, yet as the spurge family characteristically has a sticky, milky plant sap, and given that toothed spurge apparently has the ability to germinate and emerge late in the growing season, toothed spurge does represent a harvesting problem for soybean.

Iowa State University first became aware of toothed spurge infestations in the western and northwestern areas of Iowa. Serious infestations have also been located in Webster County. However, recent communications with growers suggest that toothed spurge infestations are more widely distributed than previously thought. Survey information about the distribution and severity of toothed spurge infestations are not available.

Observations suggest that toothed spurge control in corn is not a problem. Triazine herbicides demonstrate excellent activity on this weed, although there appears to be a significant rate response. This rate response may be the result of inherent tolerance or the ability of toothed spurge to germinate later in the growing season, at a time when most of the triazine herbicide has degraded. Several
postemergence herbicides such as dicamba or prepackage mixtures including atrazine, demonstrate good potential control of toothed spurge.

Herbicidal control of toothed spurge is difficult in soybeans. Observations suggest that toothed spurge and soybean have similar tolerance to metribuzin. Further, most soil-applied herbicides containing either imidazolinone or sulfonyl urea herbicides may not have sufficient activity to provide acceptable control. Again, these herbicides may degrade below the effective rate thus allowing later germinating toothed spurge to grow unimpeded.

Several postemergence herbicides demonstrate activity on toothed spurge. These herbicides include acifluorfen, chlorimuron ethyl, fomesafen, imazethapyr, and lactofen. The diphenyl ether herbicides have provided better control than the imidazolinone or sulfonyl urea herbicides in initial experiments. No research has been conducted on herbicide additives, application rates, or application timing. Another concern is the required timing of application, relative to soybean development. As residual control does not represent a major consideration for these herbicides, late germinating toothed spurge could still be a significant problem. Thus toothed spurge will likely require appropriate herbicide treatments and timely mechanical control.

Woolly cupgrass

Woolly cupgrass was first identified in Iowa during 1957 in Ringgold County. Since then, infestations have been discovered throughout Iowa. The most severe cupgrass problems are located in west central, northwest, north central and southeast Iowa. Severe woolly cupgrass infestations are also found in Benton, Iowa, and Linn Counties. Woolly cupgrass is also a problem in parts of Illinois, Minnesota, and Wisconsin. The phenomenal spread of this weed illustrates why woolly cupgrass represents such a major threat to row crop production in Iowa.

The limited knowledge about cupgrass, plus the inability of growers and agribusiness to properly identify woolly cupgrass further enhanced the proliferation of this weed. Until recently, no research other than limited herbicide screening had been conducted on woolly cupgrass. Iowa State University has conducted a number of studies on the biology and morphology of woolly cupgrass. Further, extensive research on candidate herbicides, herbicide application rates, and application techniques has improved this knowledge base.

Woolly cupgrass is extremely competitive; full season competition with natural infestations of woolly cupgrass has resulted in an 80% reduction in corn yield. Woolly cupgrass demonstrates prolific seed production. A single cupgrass plant grown full season in a non-competitive environment can produce 168,000 seeds. These seeds are 98% viable and generally dormant. An afterripening period is required before dormancy is broken.

Woolly cupgrass has been observed to demonstrate up to 5 germination flushes. Cupgrass can germinate early in the growing season and continue to successfully germinate and produce viable seed as late as July 15. In the field, woolly cupgrass has germinated and emerged at the soil surface and as deep as 3.5 inches. Laboratories studies have demonstrated cupgrass emergence at a depth of
Woolly cupgrass can germinate at soil temperatures between 50 and 113°F.

Given the biological parameters for woolly cupgrass, management of this weed is difficult. Woolly cupgrass presumably demonstrates tolerance to most commonly used herbicides. Dinitroaniline and thiocarbamate herbicides have, to date, the best and most consistent efficacy on woolly cupgrass. However, given the depth at which seeds can successfully emerge and the period over which cupgrass can germinate and produce viable seeds, herbicidal control has not been consistently effective.

Woolly cupgrass control strategies are similar to treatments used for shattercane. Preplant incorporated thiocarbamate products used at the highest rate allowable for the soil type must usually be followed with an early postemergence application of cyanazine, pendimethalin, or a combination of both. Mechanical control is mandatory; rotary hoeing with several cultivations will usually keep woolly cupgrass from significantly reducing corn yield potential. However, escapes will likely occur and thus, the soil seed bank will be replenished.

Innovative techniques for cupgrass control have been developed and are effective in small plot research. Directed postemergence applications following a thiocarbamate herbicide have consistently provided excellent woolly cupgrass control. The directed herbicide treatments include ametryne and linuron. These herbicides potentially can severely injure corn; the directed application must be precise and a height differential between the top of the woolly cupgrass canopy and the corn leaves must exist. These treatments should be considered a rescue application. Recently, research has been conducted with paraquat and sethoxydim as directed treatments in corn. Again, the success is dependent on the ability to direct the herbicide onto the cupgrass and away from the corn. Special equipment is required for directed herbicide applications to be effective without injuring the corn.

Soybean herbicide programs are usually more effective and consistent than corn programs. Several soil-applied herbicides including clomazone, ethalfluralin, pendimethalin, trifluralin demonstrate activity on woolly cupgrass. Generally, 2 incorporation passes are necessary for best results. Postemergence herbicides such as fenoxaprop, fluazifop P-butyl, quizalofop, and sethoxydim are exceptionally effective for woolly cupgrass control. However, soybean herbicide programs must also be accompanied with appropriate mechanical control.

**Herbicide Carryover**

Herbicide carryover has been a major issue in Iowa for the past 3 years. This was, in part, due to the environmental conditions but also reflected new herbicides that were widely used during 1987 and 1988. While the lack of rain reduced herbicide degradation and inhibited the ability of the crop to tolerate herbicide residues, thus increasing the economic impact of herbicide carryover, it is likely that herbicide carryover would have been a problem regardless of the environment.
Given the residual characteristics of the commonly used herbicides and the crop rotationi1 trends in Iowa, herbicide carryover is likely every year. However, it is important to make a distinction between the appearance of herbicide injury symptoms and actual yield response. Generally, most of the herbicides that cause early season carryover injury do not result in economically reduced yields unless a misapplication, misuse, or environmental stress was also experienced. A possible exception to this was imazaquin (Scepter, Squadron, and Tri-Scept). Currently labels do not allow the use of these herbicides as a soil application in Iowa and have corn as a rotational option within 18 months of application.

Herbicide carryover is likely in 1990. Rainfall patterns during 1989, particularly during the first 6 to 8 weeks after herbicide application indicate a strong likelihood for herbicide carryover in 1990. Whether or not these herbicide residues will cause significant economic reductions of crop yields will be somewhat dependent on the growing conditions during the early spring, 1990. However, if poor application techniques were used, label restrictions ignored, calibration skills lacking, or rate selection uninformed, serious carryover injury will be experienced regardless of the growing conditions.

Herbicides that have potential to cause carryover problems include atrazine (AAtrex, atrazine, various prepackage mixtures, and generics), chlorimuron ethyl (Canopy, Classic, Lorox Plus, and Preview), clomazone (Command and Commence), imazaquin (Scepter, Squadron, and Tri-Scept), imazethapyr (Pursuit and Pursuit Plus), pendimethalin (Prowl, Pursuit Plus, and Squadron, and trifluralin (Commence, Salute, Treflan, Tri-Scept, and generics). Application timing, incorporation, rate, and spring weather will influence the potential carryover of these herbicides.

Atrazine carryover is common and occurs every year. However, with dry conditions, carryover potential is greater. Atrazine persistence is affected by soil characteristics including soil texture, soil organic matter, and soil pH. Generally, preplant and preemergence applications of prepackage mixtures should not be a major concern except where application was made later in the growing season or the soil pH is above 7.0 to 7.4. Soybeans have reasonably good tolerance to atrazine, however applications of products containing metribuzin, or some postemergence herbicides may increase the severity of the triazine injury. Small grains and forages should not be planted the year following atrazine application, regardless of the application rate. Atrazine, as applied in postemergence prepackage mixtures (Buctril/Atrazine, Laddok, and Marksman), has not generally been a carryover concern to soybeans, given the rate of application. Atrazine and Princep are the only commonly used triazine herbicides that can carryover.

Chlorimuron ethyl carryover has not been a major problem unless the soil pH was greater than 6.8. Further, Classic has not been a carryover concern, given the rate of chlorimuron ethyl applied. Chlorimuron ethyl in Canopy, Lorox Plus, and Preview have the potential to be carryover problems when the soil pH is above 6.8. In 1989, some instances of chlorimuron ethyl carryover did occur on soils below 6.8, but this was not a major component of the carryover incidents. Given the results of the DuPont research and the field performance in 1989, chlorimuron ethyl carryover is not a major concern if the label restrictions are followed.
Clomazone carryover was not generally a major problem in Iowa during 1989. Clomazone carryover, however, was common. Symptoms were easily identified throughout Iowa early during the growing season. Corn generally outgrew these symptoms and no loss of yield occurred. There were isolated instances where the injury was more severe and chlorosis, stand reduction, and yield responses were measured. Application problems, extreme drought, and other herbicides were usually part of the problem in these instances. Clomazone carryover, given the type of injury usually observed, is not considered a major carryover problem in 1990.

Imazaquin injury to corn in 1989 was the major herbicide carryover problem encountered. However, the imazaquin label was changed in September, 1988 thus precluding soil applications with corn as a rotational crop the following year. If label restrictions are observed, imazaquin carryover should not be a problem in Iowa in 1990. Postemergence applications of Scepter do allow corn to be planted within 11 months of application. Iowa State University research and similar research at other universities suggests that Scepter applied postemergence should not be a carryover problem.

Imazethapyr should not be a major carryover problem. However, carryover can occur and, given the mechanism of action, corn yield may be reduced in some situations. The amount and severity of Pursuit/Pursuit Plus carryover will be dependent on the 1990 growing season.

Pendimethalin and trifluralin respond in a similar manner to soil moisture, temperature, and texture. Thus specific herbicides will not be mentioned, rather a general discussion about dinitroaniline (DNA) herbicides will be developed. Carryover of DNA herbicides is very common, given the widespread use on soybeans. In Iowa, approximately 65 to 75% of the soybeans are treated with a DNA herbicide. However, DNA injury in 1989 was not a major problem. Dry soil conditions reduced the availability of these herbicides to the root systems of rotational crops and thus, the overall severity of DNA injury was not great. However, with the dry conditions of 1989, the DNA situation for 1990 may be potentially worse than in 1989. If soil moisture conditions improve and corn seedlings are under temperature or compaction stress, more DNA injury symptoms may be observed. Recognize that research strongly supports the fact that early season injury does not usually result in significant yield reductions. When plant roots grow beyond the DNA zone, the injury symptoms decline and the plant recovers. While early season stunting may be observed, plants are able to recover. If significant yield reductions are measured, other factors are usually important components of the yield reduction.

Generally, herbicide carryover has the potential to be serious in 1990. If environmental conditions stress the rotational crop, carryover may be severe. If conditions favor crop growth, given the products now registered and used in Iowa, carryover will not be a major consideration.

New Herbicides

There are several new candidate herbicides that demonstrate excellent weed control and may significantly impact weed management in the future. Historically, consistent postemergence grass control in corn has not been available. As foxtails...
(ISetariai spp.) are the major weed problem in Iowa, and shattercane and woolly cupgrass are increasing problems, herbicides that consistently control annual grasses while providing corn selectivity could potentially change corn weed management. Many companies are currently developing herbicides that provide this type of activity. However, two companies have products that are close to registration. Ciba-Geigy and DuPont have candidate herbicides that will likely be available to the growers in the near future. These and other candidate herbicides will be described in the following discussion.

Primingulfuron is the proposed common name of CGA-136872 (Beacon) from Ciba-Geigy and will control weeds postemergence in corn. This herbicide is in the sulfonylurea family and is translocated in plants. Activity on weeds is observed several days after application and actual plant death may take 1 week or more. Primisulfuron demonstrates excellent shattercane activity and is efficacious on a number of broadleaf weeds including cocklebur (Xanthium strumarium L.), velvetleaf (Abutilon theophrasti Medic.), and pigweed species (Amaranthus spp.). Primisulfuron has not demonstrated consistent activity on other annual grass weeds. Corn demonstrates good tolerance to this herbicide, although certain hybrids may be sensitive. Primisulfuron has been shown to interact with certain organophosphate insecticides such as terbufos (Counter) with increased corn phytotoxicity resulting. Insecticide application technique and soil characteristics may influence the occurrence and severity of this interaction. Registration is anticipated in 1990.

DPX-V9360 (Accent) is a sulfonylurea herbicide from DuPont that will provide postemergence weed control in corn. The mechanism of action and symptoms for DPX-V9360 are similar to primisulfuron. However, DPX-V9360 will control most annual grass weeds including foxtail species, shattercane, and woolly cupgrass. Broadleaf weeds are also controlled; cocklebur and pigweed demonstrate excellent sensitivity to DPX-V9360 while velvetleaf control may be somewhat variable. DPX-V9360 also demonstrates an interaction with organophosphate insecticides although the likelihood of phytotoxicity is not well established. Registration is likely after the 1990 growing season.

DPX-V79406 is a candidate prepackage mixture of DPX-V9360 and DPX-E9636 and is formulated as a 1:1 ratio of the component herbicides. Similar to DPX-V9360, DPX-V79406 is used postemergence for weed control in corn. This package mixture demonstrates more consistent broadleaf weed control but may be potentially more injurious to corn. A registration package may be developed in the future.

Acetochlor is an acetamide herbicide with characteristics similar to alachlor (Lasso) and metolachlor (Dual). However, acetochlor may have longer residual characteristics and slightly higher injury potential than the other acetamide herbicides currently available. Acetochlor may be available from Monsanto or ICI Americas (ICI-5676). It is anticipated that acetochlor will be formulated with a safener to reduce the potential for corn injury. Acetochlor has demonstrated better activity on woolly cupgrass and shattercane than either alachlor or metolachlor. Registration date is unknown.
F-80 (Advantage) is naphthalic anhydride and will be marketed as a seed protectant, reducing corn injury from herbicides that carryover from applications the previous year in soybeans. Naphthalic anhydride was actually discovered and the safening activity documented many years ago by Gulf Chemical Company. However, FMC has recently initiated development of the material. Currently, FMC has an agreement with Cargill who will have exclusive rights to the seed safener. Cargill has developed a naphthalic formulation and seed coating procedure that will allow commercial seed treatment with few negative handling properties. Naphthalic anhydride has demonstrated some safening of corn to residues of clomazone (Command), chlorimuron ethyl (Preview and Classic), imazaquin (Scepter, Squadron, and Tri-Scept), and imazethapyr (Pursuit and Pursuit Plus). Thus, naphthalic anhydride may have utility in minimizing the negative aspects of herbicide carryover.

**Conclusion**

Several new weeds represent likely economic problems for Iowa growers in the future. The greatest threats are from shattercane and woolly cupgrass. While shattercane has been an isolated problem in Iowa, government programs and poor management strategies have dramatically increased the distribution of this weed. Woolly cupgrass is the major weed problem in the next decade. Inability of growers to identify cupgrass, lack of timely mechanical control, and poor herbicide selection have worsened the problem. Woolly cupgrass is now distributed to most Iowa counties and is a significant economic problem for many growers.

Herbicide carryover will again be a problem in 1990. If poor growing conditions result in crop stress, carryover symptoms may be severe and widespread. While rainfall patterns were better in 1989 than in 1988, a significant dry period early in the spring, 1989 likely reduced the timely degradation of many herbicides. Thus, carryover potential does exist for many herbicides and the severity of symptoms is dependent on the environmental conditions in 1990.

Finally, a significant breakthrough of herbicide technology may occur for 1990. Sulfonyl urea herbicides that will control annual grass and broadleaf weeds in corn selectively may be registered. Importantly, these herbicides do not demonstrate residual characteristics nor respond to soil pH like other sulfonyl urea herbicides. Thus, the use of these products will not be limited by soil pH or crop rotation intervals.