Clearfield® Wheat Production Systems in Oklahoma

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Clearfield® wheat production systems have the potential to drastically change weed management in wheat across Oklahoma. Since the late 1990s several grassy weeds including downy brome, jointed goatgrass, Italian ryegrass, rescuegrass, feral rye, and wild oat (Figure 1), have become widespread in continuous wheat production fields. Maverick herbicide, commonly used to control cheat, has little or no activity on these weed species and therefore leaves these weeds to mature and produce seed after its application. Mixed populations of these weeds and cheat in the same fields are quite common in western Oklahoma. Maverick herbicide adequately controls cheat; while Puma herbicide effectively controls wild oats; and Hoeplan herbicide controls Italian ryegrass and wild oats but has a full season grazing restriction. Until the availability of Clearfield® wheat systems, selective control of mixed populations of weeds, and/or monoculture populations of jointed goatgrass or feral rye in wheat was impossible. With the Clearfield® system and Beyond®, these weeds can be removed from the wheat crop and still allow grazing.

The purpose of this document is to introduce the reader to the Clearfield® technology, the current limitations of the Clearfield® system in Oklahoma, the weed control strengths of the Clearfield® system, and the considerations/precautions one should take when using the system.

Introduction to the Clearfield® Technology

The Clearfield® technology was first introduced into field corn varieties in the early 1990s with IR (imidazolinone resistant) and IT (imidazolinone tolerant) corn hybrids. In the late 1990s and early 2000s the technology was developed in canola, rice, sunflower, and finally wheat. The Clearfield® technology protects the crop from the effects of a family of herbicides that would otherwise kill the crop.

The herbicide resistant traits were developed from laboratory practices used to slightly modify the genetic code of an enzyme already found in the crop. The modification was refined using basic plant breeding techniques. This approach to developing the technology allows it to be classified as a herbicide resistant crop (HRC) but excludes it from being classified as a genetically modified organism (GMO). Therefore, the harvested seed does not need to be segregated and can be marketed/integrated with other wheat at the elevator.

Current Limitations of the Clearfield® Technology

Variety Selection/Availability

Clearfield® varieties that will be available for planting in 2003 and 2004 will include Above, a Colorado State University variety that will not be available in Oklahoma, and AgriPro AP 502 CL. Approximately 6,000 acres of AP 502 CL was grown in Oklahoma in 2002-2003 with the intent of certification and sale in the fall of 2003. Both of these Clearfield® wheat varieties have TAM 110 as their major parent and consequently suffer some of the same limitations as TAM 110. For example, both Clearfield® wheat varieties are very susceptible to low pH soils, leaf rust (Figure 2), and soil borne mosaic virus. Above and AP 502 CL should not be planted on soils with pH below 5.5. They should not be planted in central or eastern Oklahoma unless growers are willing to use foliar fungicide application(s) to control leaf rust. These varieties should not be planted in areas known to have severe problems with soilborne mosaic virus. Check the Oklahoma Agricultural Experiment Station wheat variety trial report to obtain grain yield data from at least 15 variety trials conducted at locations across the Oklahoma. Wheat breeders at OSU anticipate the release of Clearfield® wheat varieties more suited to Oklahoma growing conditions within a few years.

Potential for Developing Resistant Weeds

Beyond™ herbicide inhibits the growth of weeds similar to Amber, Finesse, Glean, and some other commonly used herbicides. Resistance to these herbicides is known to occur when these herbicides are continuously used year after year. Some areas of northern Texas already have populations of Italian ryegrass that are resistant to these herbicides, and will most likely be resistant to Beyond™ herbicide. Resistant populations of Italian ryegrass in southern Oklahoma are expected, but have not been confirmed.

Another weed with the potential for developing herbicide resistance is jointed goatgrass (Figure 3). Jointed goatgrass is a winter annual grass commonly found in many Oklahoma wheat fields. Jointed goatgrass is genetically similar to wheat.
Figure 1. Cheat (top left), jointed goatgrass (top right), feral rye (bottom left), rescuegrass (bottom right), and other common grass weed seeds infest grain harvested from wheat fields in Oklahoma. The Clearfield® technology can help to control most of these problem weeds.

Figure 2. Currently available Clearfield® wheat varieties (left) (i.e., Above and AP 502 CL) are very susceptible to leaf rusts (right). A foliar fungicide application may be needed if these varieties are grown in Oklahoma.
analyze his/her weed problem before applying the herbicide. This herbicidal quality also allows the grower to avoid the need for rainfall to activate the product as with preemergence herbicides. This herbicidal quality also allows the grower to apply the herbicide before the grassy weeds reach the two tiller stage, and/or when broadleaf weeds are three inches in diameter/height.

Figure 3. Jointed goatgrass (left) can cross-pollinate with wheat (right) to form a fertile seed (center). If this occurs with a Clearfield® wheat variety, the herbicide resistant trait can be transferred to the weed.

and can cross-pollinate with wheat to produce a fertile hybrid. If Clearfield® wheat crosses with jointed goatgrass, the herbicide resistant trait of the crop could be passed to the weed, forming a herbicide resistant weed. Since the Clearfield® production system is the only means of selectively controlling jointed goatgrass in wheat this should be prevented.

Saving Seed for Next Year’s Crop

Due to the potential resistant weed problems discussed above, new certified Clearfield® wheat seed will need to be purchased each year. In addition, the Clearfield® system can only be used in a field for two consecutive years. Following these recommendations will help to preserve the technology for future generations.

No Grazing Restriction

There is no grazing restriction following an application of Beyond™ herbicide. Since Beyond™ is most effective when applied in the fall to small, actively growing weeds, the most logical production system will consist of planting in the fall, allowing the weeds to emerge, applying the Beyond™ herbicide before the grassy weeds reach the two tiller stage, and while the crop and weeds have good soil moisture and warm temperature for growing.

Weed Control Strengths of the Clearfield® Technology

Planting a Clearfield® wheat variety is the first step in using the technology as Beyond™ herbicide will kill conventional wheat varieties most producers are currently growing. Always read and follow the pesticide label to insure safety to the handler, applicator, and the crop.

Postemergence Use

The postemergence activity of Beyond™ eliminates the need for rainfall to activate the product as with preemergence herbicides. This herbicidal quality also allows the grower to analyze his/her weed problem before applying the herbicide. However, the crop and weeds should be actively growing at the time of application, and not under drought or adverse weather conditions.

Beyond™ herbicide should be applied postemergence to the weeds and crop (i.e. after the weeds and crop have emerged from the soil and are actively growing). Apply the herbicide after the wheat crop has begun tillering, but before it begins jointing, and before grassy weeds are past the two tiller stage, and/or when broadleaf weeds are three inches in diameter/height.

Very Effective on Many Grass and Broadleaf Weeds

Beyond™ is very effective on monoculture or mixed populations of many grasses and broadleaf weeds commonly found in Oklahoma winter wheat fields. Beyond™ applied at 4 fl. oz/A with 0.25 percent v/v nonionic surfactant and 1.25 percent v/v liquid nitrogen fertilizer is excellent for controlling cheat, downy brome, jointed goatgrass, and wild oats. However, if feral rye, Italian ryegrass, or rescuegrass is the targeted weed, control is better when the herbicide is applied with 0.25 percent v/v nonionic surfactant and 25 percent to 50 percent liquid nitrogen as the carrier. Of the grassy weeds discussed, Beyond™ is perhaps weakest on feral rye, but with proper timing (i.e. fall applications when the feral rye is in the four to five-leaf stage) at least 90 percent control can be obtained (Figure 4). Likewise, Italian ryegrass should be targeted with fall applications of Beyond™ to avoid competition from the weed throughout the fall, winter and spring that can drastically reduce grain yields. Secondary flushes of Italian ryegrass can occur after treatment, but can be avoided by planting a minimum of 75 lb/A Clearfield® wheat seed, avoiding overgrazing (or eliminate grazing if possible), and properly fertilizing to ensure a competitive wheat canopy.

Beyond™ acts on emerged and actively growing broadleaf weeds at the time of application. The residual soil activity of Beyond™ is much shorter than other commonly used wheat herbicides, but should be sufficient to control many spring and early summer germinating weeds that can interfere with wheat harvest.

Considerations for an Effective Weed Management System

- Use a seeding rate high enough (at least 75 lb/acre) to obtain a wheat plant population that will be competitive against any weeds emerging after the Beyond™ application.
- Best control and highest wheat grain yields generally occur when Beyond™ is applied in the fall to small, actively growing weeds.
- Do not reduce the use rate of Beyond™ in an attempt to cut costs. First, this is against the Oklahoma Pesticide laws (http://www.oda.state.ok.us/main/srvs/agform/cpl.htm), and second, this may result in poor weed control and/or quicker development of weed resistance.

Precautions to Take When Using the Clearfield® Technology

- Avoid planting Clearfield® wheat varieties on low pH soils (i.e. lower than pH 5.5) or fields with known problems of soil borne mosaic virus.
• Be prepared to use a foliar fungicide application(s) on currently available Clearfield® varieties to control leaf rust.
• Apply Beyond™ herbicide only to Clearfield® wheat varieties.
• Avoid drift of Beyond™ herbicide onto conventional wheat varieties as death of the non-Clearfield® wheat will occur.

• Properly clean spray equipment following a Beyond™ herbicide application to avoid tank mix contamination prior to treating a conventional wheat field or other sensitive crop.
• Use the Clearfield® technology no more than two consecutive years in the same field.
• Do not apply Beyond™ to weeds or crops that are under stress from drought or severe cold conditions.

Figure 4. When used in a Clearfield® wheat system, Beyond™ herbicide can control feral rye at least 90 percent (left) compared to no control (right). Optimum feral rye control is achieved by applying Beyond™ with 0.25 percent v/v non-ionic surfactant and 25 to 50 percent liquid nitrogen as the carrier in the fall to small (4-5 leaf), actively growing feral