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WEED CONTROL OPTIONS FOR ORGANIC AND SUSTAINABLE PRODUCTION SYSTEMS

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Many producers have become interested in growing crops using sustainable and/or organic systems. Interest has grown because many of these producers want to reduce or eliminate pesticide use while taking advantage of premiums paid for pesticide-free or organic crops. Although there are many obstacles to overcome when shifting to these types of production systems, one of the biggest hurdles to overcome is achieving good weed control without synthetic chemicals.

At Iowa State University’s Southeast Research and Demonstration Farm near Crawfordsville, Iowa, we have begun studying an organic production system to better understand the requirements for such a system. This system was begun in a field that had been in a corn/soybean rotation through 1997 where herbicide use was the primary method for controlling weeds. In 1998, we entered our three-year transition period to an organic production system. Our system involves many strategies for controlling weeds that will be discussed below. These strategies include using crop rotations, cover crops, delayed planting methods, and cultivation both before and after planting.

Rotations

Our organic cropping system is comprised of a corn/soybean/spring barley and red clover rotation. We planted a spring barley and red clover mixture in one third of the field, corn in another third of the field, and soybeans in the other third. The barley is generally harvested during the first week of July, and the red clover crop is allowed to grow the rest of the season. The subsequent year, manure is applied on top of the clover crop to supply any additional nutrients needed, and the clover is plowed under. A corn crop is planted into the plowed ground and harvested that autumn. A winter rye crop is planted no-till into the standing corn stalks in the autumn and is allowed to over-winter and grow through early spring. This rye crop is then disked down in the spring and soybeans are planted into the residue.

Cover Crops

As mentioned above, both red clover and winter rye are used as cover crops. Red clover acts to both add nitrogen to the soil and to suppress weeds during the fallow period after the barley is harvested. Weed suppression is achieved because red clover has an allelopathic affect on weeds. This allelopathic affect is defined as a release of a chemical by a plant (in this case the red clover) that inhibits the growth of nearby plants (weeds) and thus reduces competition. Red clover is also very good at freeing up P and K in the soil, its deep taproot acts as a subsoiler by breaking up hardpans, and it attracts many beneficial insects ( Bowman et al., 1998). Additionally, the red clover crop can be used as a livestock feed if so desired.
The winter rye crop is planted in autumn after the corn crop is harvested. The following spring the rye is disked down when the rye is approximately one foot tall. The rye residue also has an allelopathic effect on weeds, reducing weed pressure in the subsequent soybean crop. In addition, the rye crop is an excellent choice for preventing soil erosion during the winter and early spring periods (Bowman et al., 1998). Finally, winter rye can provide good grazing for livestock early in the season if so desired because rye has high forage value and is one of the first crops to green up in the spring.

**Delayed Planting Methods**

Planting time is important when herbicides are not an option. Traditionally, producers try to plant as soon as conditions are right (i.e., when soils are dry and warm enough). However, if you do not wish to use herbicides, then the best management practice may be to delay planting. The reason for not planting early is that many more weed species will germinate when crops are planted early. This early planting creates a competitive environment that favors the weeds. However, by planting later in the season, producers can cultivate out early flushes of weeds that normally interfere with the crop. On the other hand, producers should not wait too long to plant their crops because there is a yield penalty associated with delayed plantings. In addition, certain pests such as European corn borer may be attracted to late-planted fields.

**Cultivation Both Before and After Planting**

As mentioned above, cultivation can reduce the weed pressure early in the season by killing early flushes of weeds. We also incorporate a moldboard plowing operation to bury the red clover and thus kill it out. This tillage operation also helps break up the lifecycle of perennial weeds and can help control annual weeds by burying them deep in the soil. But weeds will undoubtedly present themselves after the crop is planted if nothing is done to control them. Thus, two main methods for controlling weeds after the crop is planted are implemented. These methods include rotary hoeing and row-crop cultivation.

Rotary hoeing should begin at 3 to 5 days after planting. This timing of cultivation catches young weed seedlings in the “white hair” stage or when the roots are just forming but before they have anchored the weed seedling firmly in the ground. Hoeing at this time allows the implement to fling the weed seedling out of the ground more easily. Subsequent hoeing operations should be done every 5 to 7 days until the crop is too large to get through without causing serious damage.

Row-crop cultivation should begin approximately 5 to 7 days after the last rotary hoeing is done. Subsequent cultivation passes should be made every 5 to 7 days until the crop forms a canopy. These cultivation passes will usually control weeds well between the rows but may leave some weeds untouched within the row. One method for controlling these weeds within the row is to use a row-crop flamer. A flamer is basically an LP burner that kills the weeds using heat. However, care must be taken not to injure the crop. Another option is hand weeding the field. However, this task can be very labor intensive and may not fit well with most operations.
Discussion and Conclusions

There are many tasks involved when trying to control weeds without chemicals. Any one task alone will not prevent weeds from becoming a problem. However, when combined together, good weed control may be achieved.

One of the problems we encountered when we began our organic system was not getting our rotation in place the first year. Rather, we grew corn in the entire field the first year. This prevented us from taking advantage of all our options such as cover crops and certain tillage operations. We also had problems with our experimental design. We planted our plots without taking into account an easy row-crop cultivation strategy. Thus, we ended up turning on our rows a great deal in the field. These cultivation operations, especially the later ones when the crops where tall, caused us to break over the crop plants. This created open areas in the canopy where weeds grew. In subsequent years, the weed pressure increased, and it took implementing all the weed control strategies available to us and a new plot design to begin cleaning up our weed problem. The four weed control strategies that were most helpful in cleaning up our weed problem were moldboard plowing to bury weed seed, establishing our crop rotation to break up weed cycles, using cover crops to suppress weed seedlings, and developing an experimental design that favored a good row-crop cultivation practice. This new design meant that we cultivated straight through the field without turning on rows in the middle of the field.

We are still working to get good weed control, but I think that this situation will greatly improve next year. Nevertheless, having developed a weed problem and then finding out how to get it under control has taught us more than if we had never developed a problem in the first place. Yet, through our mistakes, others may learn how to avoid weed problems in their own operation.

Literature Cited