Does Crop Health Management Improve Cereal Silage Production in Alberta?

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Take Home Message

- Integrated Crop Management (ICM) concepts focus on integrating all approaches to crop health, which are driven by the economic and ecological limits of the system
- Higher seeding rates result in plant populations that create competitive barley stands and higher silage yield
- Diversify crop rotations, either through barley variety or use of other crop types, to meet the production and management needs of the farmer
- Normal date of silage harvest with low rates of herbicide can enhance wild oat management, but early-harvested silage can be a very effective wild oat management tool without herbicides
- Scouting fields and understanding the complex relationship between crop and pest issues adds valuable experience and knowledge to the farmer

Introduction

The growth of the silage industry continues to expand as beef and dairy producers utilize more and more annual crops. Continuous silage limits crop rotation and consequently disease and weeds can limit yield and quality. Interest in integrated approaches to crop management in western Canada is being driven by declining crop prices coupled with increased input costs, consumer concerns about the environmental and health effects of pesticides, increasing incidences of weeds becoming resistant to herbicides, and loss of disease resistance. Diversity of practices should be a high priority to keep pests off-balance and unprepared. Also, there has been a re-examination of agronomic practices due to conservation farming.

Duane Beck (Dakota Lakes Farm, South Dakota) reminds us that “successful crop production, regardless of the methods used, is a careful piecing together of numerous components into a system. Simply replacing one component with another is seldom successful”. Focusing on crop competitiveness and health will lead producers to rely on packages of tools which include such things as healthy, vigourous seed, sanitation (prevention of weed seed and disease contamination), low disturbance seeding systems, higher seeding rates, optimum fertilizer placement and balance, and diverse crop rotations. A healthy, competitive crop is the key to integrated crop management (ICM) in any cropping system.

▪ Why is it Important to Optimize Crop Health?

It is important to optimize crop health so that healthy roots and shoots can compete against weeds, avoid or tolerate diseases and insects, utilize nutrient and water resources efficiently and capture the sun’s energy. Optimizing crop health unlocks the potential for harmonizing cropping systems with nature’s biological processes and man-made inputs that can reverse the depletion of natural resources. The ICM concept focuses on integrating all approaches to crop health, which are driven by the economic and ecological limits of the cropping system.

▪ What is the Ecological Starting Point for Crop Health?

The ecological starting point for crop health requires knowledge of the characteristics of the cropping system environment, what is in the soil (microbes, earthworms, pathogens, insects, weed seeds, etc.), an understanding of pest characteristics and methods to prevent pest buildup and infection of the crop, and knowledge of factors that maximize the plant’s ability to defend itself. The focus of most current crop production practices is pest control with little effort applied to why pest outbreaks occur. Cropping practices that degrade soil and limit genetic diversity contribute to increasing pest populations.

▪ Why Integrated Approaches?

Integrated research studies incorporate a number of factors into an experiment increasing the complexity and the difficulty of interpreting and understanding results. Experiments with one or two variables have been common and provide valuable information on technologies and inputs. However, these experiments are conducted in isolation of any interactive effects that may be occurring in the plot. Farmers are constantly dealing with many factors that occur simultaneously in their fields. Integrated research studies will help determine the impact of one technology on other technologies incorporated into the cropping system.

Variety and Other Options

Can some varieties compete with weeds better than other varieties? Can some varieties resist diseases better than other varieties? Can increasing the seeding rate make barley varieties more competitive with weeds and help plants defend themselves against disease simultaneously? How does variety interact with seeding rate and seeding depth to provide a vigorous start? What impact has your previous management had on weeds and disease and how does this affect your weed and disease control options? What impact does variety selection, previous management, and current management have on crop health? It is obvious from some of the questions that can be asked – variety selection is a more onerous task than it first appears.

Early crop emergence can be promoted by planting vigorous crop seed at relatively shallow depths when the seedbed is moist and firm (as is often the case in zero tillage systems). A study at Lacombe, Beaverlodge and Melfort showed that barley varieties obviously had higher emergence as the seeding rate increased from 100 to 400 seeds per m^2. However, hulled barley emergence was only 75% of what was expected to emerge, while hulless barley ranged from 50 – 65% of expected. The less than expected crop emergence in these trials is similar to what occurs in farm fields. These plant populations are well below the target farmers are expecting in their fields. Increasing seeding rates above what is normally seeded will not increase the percent emerged, however, increased seeding rate will result in plant populations that create competitive barley stands. There are some disadvantages inherent in higher seeding rates, particularly in drier regions. Farmer experimentation and experience will help to determine optimum seeding rates.

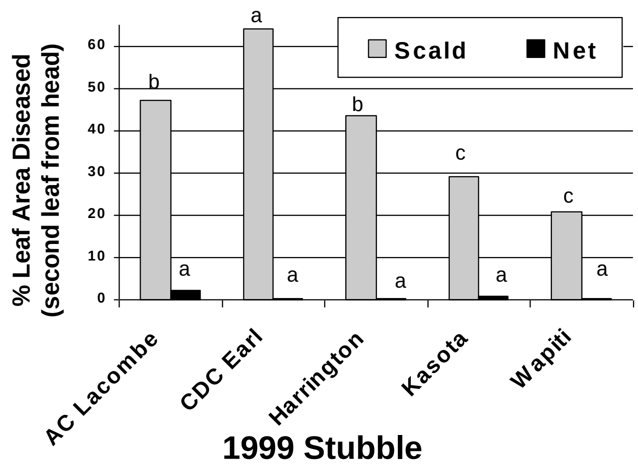
Crop Rotation

Crop rotation is another obvious discussion point in an ICM system. Farmers are well aware of the benefits of rotating crops in a cropping system. Most farmers have a favorite rotation and some may include continuous barley. Crop rotation with a diversity of crops, such as field pea, canola and spring and winter wheat, provide benefits in the ability to rotate herbicides (reduce weed resistance potential) and reduce the build-up of soil- and residue-borne disease organisms.

Farmers that produce continuous barley do so for feed grain and silage production for livestock. However, continuous barley production leads to a build-up of disease in these fields and a general reduction in yield potential over the long-term. Yield losses in silage barley can be 10 to 25% in silage yield on a dry weight basis as a result of the development of leaf diseases like scald and net blotch.

Although producers may not have the ability or desire to switch to a different crop type, recent research at the Lacombe Research Centre may provide a solution to mitigate disease problems in the short-term (Turkington et al. 2002). Producers switching to a different barley variety each year, especially if it is from a different breeding program, can reduce leaf diseases and increase yield. By changing varieties, the producer has the potential to change the disease resistance genes that they use each year, thereby reducing the impact of disease. This can also help to restrict the ability of the scald and net blotch pathogens to adapt to the same variety when grown year after year. Figures 1a and 1b illustrate differences in disease levels that can be obtained by rotating the variety that is grown. In 1999, disease levels could be reduced by 45 to 80% simply by growing the variety CDC Earl on residue of a different variety or on triticale residue compared with growing CDC Earl on its own residue. Growing CDC Earl on residue of a different barley variety or on triticale obtained similar results in 2000 where disease levels were reduced by 26 to 67%.

Barley variety rotations can help to reduce disease levels and maintain crop productivity, but it is not a magic bullet and will not completely eliminate the risk from leaf diseases. The main disease encountered at Lacombe is scald; however, net blotch and perhaps even spot blotch can also be diseases that cause problems in Alberta barley silage fields. The variety Seebe has one of the best levels of resistance to scald. Another variety, CDC Dolly has an intermediate level of scald resistance. Although rotating between these varieties may reduce your risk of scald, you will likely see a significant increase in the level of net blotch and/or spot blotch. The main reason for this is that both these varieties do not have good resistance packages in terms of net and spot blotch and these diseases would begin to build up resulting in yield losses. When making the decision of which variety to grow, producers should not only try to choose a variety with the best package of disease resistance available, but also one that meets their production requirements. Rotating varieties with different sources of resistance ensures that crop health is maintained, extends the life of the variety, and limits the build-up of disease organisms. However, rotating barley varieties is only a short-term solution, the ultimate goal should be the use of diverse crop rotations that meet the production and management needs of the farmer.



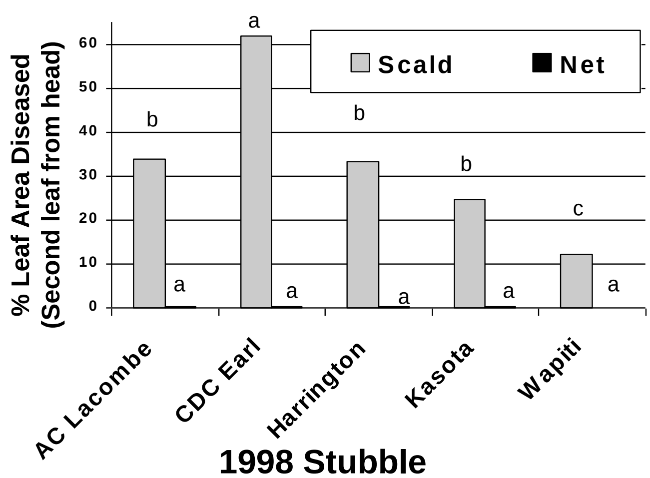


Figure 1. Percentage leaf area diseased with scald and net blotch on CDC Earl barley when grown in 2000 (top) or 1999 (bottom) on residue stubble of different barley varieties or triticale from 1999 (top) and 1998 (bottom) respectively.

Nutrient Management

Nutrients play a major role in determining crop health. It is obvious that nutrients contribute to healthy roots and shoots. However, environmental conditions can contribute to a decline in crop health once growth is successfully established. Nutrient and environmental conditions that promote crop health and weed competition can also create circumstances that may lead to the promotion of disease. Management of weeds and disease can be manipulated with thoughtful pyramiding of management decisions. Using a combination of strategies such as cultivar, plant architecture, balanced fertility and judicious fungicide applications can minimize the impact of disease when trying to maximize crop health and competitiveness. Proper placement of nutrients avoids deleterious effects on crop emergence and establishment, thus enhancing crop health, the ability to defend against pests and makes for efficient use of inputs. Fertilizing a crop without thinking of the consequences of all management decisions can lead to major disappointments when harvest arrives.

Integrated Weed Management with Harvest Management

Effective, long-term wild oat management requires an integrated approach that employs management techniques beyond simple herbicide application (Clayton et al. 2002; Clayton and Harker 2001; Harker et al. 2001; O'Donovan et al 2001a; O'Donovan 1996; O'Donovan et al 2001b). Before wild oat herbicides were widely available, farmers employed cultural measures to manage wild oat populations; one of these methods was harvesting crops early. There is considerable evidence that crops harvested earlier than normal for green forage or silage can reduce wild oat densities (Banting 1969; Dunn 1955; Gummesson 1972; Thurston 1959). The removal of immature wild oat seed from fields before most of the seed is shed helps explain the weed management benefits of earlier harvest dates. In addition, Blackshaw and Rode (1991) found that the ensiling process completely eliminated wild oat seed viability.

A five-year (1996 to 2000) zero tillage study was conducted to assess the influence of barley harvest timing on wild oat densities in subsequent years at Lacombe, Alberta, Canada and Melfort, Saskatchewan, Canada (Harker et al. 2003). Harvest timings included barley harvested 1 wk after heading (early), approximately 14 to 16 d later at the soft dough stage (normal), and at maturity (grain). In the absence of herbicides, wild oat densities decreased in silage plots harvested early and increased in grain plots. Reductions were more distinct at Lacombe where barley phenological differences and whole plant moisture contents between early and normal silage harvests were greater than at Melfort. Half rates of wild oat herbicides (Achieve and Assert) did not augment reductions in wild oat densities after early silage harvest, but did improve wild oat management after normal silage harvest and in grain production. At Lacombe, early silage harvest reduced wild oat densities more than herbicides in grain production. Similar trends were apparent at Melfort, but not statistically significant. Early barley silage harvests may be an effective integrated weed management tool for wild oat.

Recently, greater interest in health, environment, and integrated management strategies has reawakened interest in cultural methods of weed management (Thill et al. 1994). Shirtliffe et al. (2000) showed that early wheat harvest could be used as a weed management tool to maximize wild oat seed export from the field. Employing cultural weed management tools such as early-harvested silage encourages operational diversity and requires greater knowledge of crop/weed interactions than does the simple application of herbicides. Barley silage growers attempting to improve wild oat management by harvesting barley silage 14 to 16 d earlier than normal should expect slightly lower dry matter yields (Baron et al. 1992). However, lower dry matter yields may be offset by lower storage losses when silage is harvested at slightly higher moisture contents and by lower herbicide costs. There is a need for more detailed research on the timing of barley silage harvesting and its interaction with and influence on various aspects of crop production and wild oat population dynamics. Further early-harvested silage research in other crops with other weeds may also prove useful.

Scouting

Scouting fields and understanding the complex relationship between crop and pest issues adds valuable experience and knowledge to the farmer. Focusing on factors that enhance crop competitiveness and health will lead producers to rely on packages of tools, which include such things as healthy, vigourous seed, low disturbance seeding systems, proper seed placement, higher seeding rates, optimum fertilizer placement and balance, pesticides, and diverse crop rotations. Management strategies need to be considered holistically. For example, lack of balanced nutrition or poor fertilizer placement can reduce crop health to the degree that the benefits of all of the other tools employed for crop and pest management are negated.

Scouting and information gathering should not only take place on your own farm. There are numerous agriculture research and producer field days throughout the province of Alberta that focus on ICM and general production as well as crop walks sponsored by producer organizations. These field days can provide the producer, extension personnel, industry agronomists and researchers with the opportunity to learn from each other and generate new ideas.

In a strict sense, ICM is not extensively practiced. Pesticides dominate the tools used in crop management systems, partly because researchers and industry have studied pesticides most extensively, and partly because pesticides offer simple and cost-effective, albeit short-term, solutions to difficult problems. ICM research should focus on combining several crop/pest management and biological management tools into diverse cropping systems that focus on crop health as well as look at why pests are present and how to manage them. ICM requires less man-made inputs, more knowledge and the use of integrated pest management systems.

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