

## IPM Strategies to Optimize Herbicide Use

K. Neil Harker  
AAFC, Lacombe, AB

Widespread annual crop monocultures dominate the Western Canadian prairies and favour all three habitat characteristics that encourage plant invasions: 1) disturbances (tillage or herbicides), 2) low species richness, and 3) high resource availability (Booth et al. 2003). In other words, a lot of what we are doing in our cropping systems favours weed communities. Usually, the first and only thoughts evoked when crop weeds are discussed is “what herbicide can be applied for their control”? Herbicides rank second only to fertilizers as the most-costly inputs for crop producers. But, we “seldom examine the causes of the perpetual presence of weeds” (Buhler 1999).

Herbicide advertisements imply that, given the right herbicide, the task of weed control is “dead simple”; this is not the case. Despite the fact that approximately \$500 million dollars are targeted for wild oat control on the Canadian Prairies each year, the relative abundance of wild oat in post-management weed surveys has not changed since the 1970s. However, weeds have vulnerabilities that are exploitable. A key vulnerability is the fact that weeds are relatively susceptible to the negative effects of shade (Fenner 1978, Mohler 2001). Astute managers are aware of this vulnerability and strive to promote rapid, uniform crop emergence and ground cover to preempt light resources potentially available to weeds. One of the major keys for herbicide performance and for lower herbicide requirements in general is crop health. Crop health implies that crop roots and shoots are robust and will compete with weed species to the full extent of their genetic potential. In general, those agronomic practices that favour rapid canopy closure, also favour lower herbicide requirements and better performance when herbicides are used.

Hybrid cultivars, or simply more competitive cultivars, can be effective management tools to ensure that crop canopies develop quickly. Canola hybrids constitute 70% of the cultivars planted in Western Canada. Although their popularity is related to their resistance to broad spectrum herbicides, hybrids also compete more strongly with weeds than open pollinated cultivars (Harker et al. 2003, Zand & Beckie 2002), and may allow herbicide inputs to be reduced. The germination of many weed species is actually inhibited when light filtered through crop leaves becomes red-light depleted (Górski 1975; King 1975; Silvertown 1980).

Combining optimal agronomic practices can dramatically reduce weed infestations. In ongoing studies at Lacombe we are investigating cultivar, seeding rate, herbicide rate and crop rotation effects on barley health, productivity and weed management. Individually, these factors had considerable effects on wild oat (*Avena fatua* L.), but when combined, the effects are dramatic. For example, after five years of herbicides at ¼ of the recommended rate, the higher seeding rate decreased wild oat biomass and seed numbers approximately 3-fold, while the tall barley cultivar decreased wild oat biomass and seed numbers approximately 2-fold compared to the short cultivar. Combining higher seeding rates with the taller barley cultivar decreased wild oat biomass and seed numbers approximately 8-fold. Growing barley in rotation with canola and

pea rather than continuously, and combining the rotation effect with higher seeding rates and the taller barley cultivar decreased wild oat biomass and seed numbers approximately 70-fold. In another silage study at Lacombe, we are attempting to combine species and barley variety rotation with high crop densities and early silage cutting to successfully reduce wild oat populations without herbicides.

The complications of integrated crop management versus simple herbicide application can be intellectually intimidating. A higher degree of knowledge is required for the successful integration of biological inputs, since they are ‘living’, more diverse, or less specific, than single compounds and formulations of compounds. But the most economic and environmentally sustainable systems are likely to include a combination of biological and technological inputs, pieced together appropriately to solve crop management problems.

In the future, near weed-free fields may not be considered acceptable. The impact of weed management systems on the innumerable agroecosystem organisms contiguous with crops and weeds is largely unstudied. If we desire more agricultural support from urban constituencies that dominant political power and influence (votes), we might do well to alter our view of what is desirable: from an “ultra-clean” crop with no weeds visible to a more species-rich field with sub-threshold weed communities (Harker 2004).

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