4º PAINEL – MANEJO INTEGRADO DE PLANTAS DANINHAS

INTEGRATED WEED MANAGEMENT - MAKING AN OLD CONCEPT PRACTICAL IN TODAY'S WORLD

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Weed science pioneers understood and strongly recommended integrated weed management practices but did not call it by this term. The preventive, cultural and mechanical/physical weed management methods available before the advent of selective herbicides were simply part of a sound cropping systems program. A 1944 extension bulletin from the Univ. of Wisconsin gave these "Ten Commandments" for weed management:

1. Don't let weeds go to seed.
2. Buy only weed-free seeds and feeds.
3. Clean home-grown seeds carefully.
4. Grind or screen weedy feed grains.
5. Don't let machinery spread weeds.
6. Renovate run-down weedy pastures.
7. Use good rotations and cultural practices.
8. Cultivate intensively and use smother crops.
9. Eradicate perennials with sodium chlorate.
10. Eradicate mustard and other broadleaved annuals with Sinox (DNBP).

It is a nice mix of preventive, cultural, mechanical and chemical suggestions and certainly most of these were practiced more routinely then than today.

A return to emphasizing the use of all appropriate weed management practices has occurred but have producers responded? The status of integrated weed management adoption is difficult to determine but clearly we have much work to do in both research and outreach to achieve higher levels of integration. The continued appearance of herbicide resistant weeds is proof of this statement.

Perhaps a useful reference point in discussing integrated weed management is to review the practices used by organic producers. Because they cannot use herbicides, they must employ a diverse and integrated mix of practices to contain weeds. How many of these do we see on most non-organic farms today?

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- staggered planting dates
- diverse rotations, including forages and at times fallowed land
- row spacing that allows for multiple mechanical weeding operations
- cover crops, allelopathic crops
- hand weeding
- specialized row cultivation tools and attachments
- seed separators on harvest equipment
- innovativeness practices, such as using allelopathic crops
- flame weeding

Sustainable agriculture is a relatively new term. The goal of sustainable weed management is to integrate the appropriate mix of practices into effective, economical and environmentally friendly programs. Long before sustainable agriculture emerged, weed scientists and agricultural educators and consultants encouraged the implementation of cultural, chemical, mechanical and biological controls as components of integrated weed management systems. However, we often find that growers prefer simplicity to complexity. As a way to foster greater understanding and adoption of integrated practices, I propose that we change the name from "integrated" to "diversified" weed management. I believe this will be better understood and producers will, therefore, more seriously consider more holistic systems as they develop their weed management programs. Organic producers use "many little hammers" to keep weeds in check. The monetary and philosophical motivations in organic systems inspire producers to spend considerably more time per unit area to suppress weeds. Nevertheless, the concept of "many little hammers" is one that all producers should consider and implement as possible and practical.

Farm size continues to increase in many regions of the Americas. This disfavors the adoption of diversified weed management programs because producers often seek simplicity over complexity. Particularly in North America, farm survival has focused on efficiency and increasing gross income by farming more land because the profit per hectare has remained steady or declined in many cases. Often the increase in the land base occurs by renting additional fields, not by purchasing them. The increase in land area and the absentee landlord situation work against diversifying and fine-tuning the weed management within a field and in many cases producers with large areas want one basic system that fits many fields. In the process of expansion, employing measures to prevent weed introduction, careful field monitoring, localized weed management (spot treatments, hand roguing, field border mowing/spraying, etc.), detailed weed maps and records, implementing diverse rotations, fine-tuning herbicide rates and selection, and careful attention to resistance management are less likely to be practiced.

Another consequence of renting land is that the visual appearance of the crop during the growing season is perceived to be an important factor in maintaining the land rental agreement with the owner. Weedy fields would be perceived by the land owner to be the result of poor crop management when in reality the appearance of some weeds may be due to the implementation of weed thresholds that indicate the best economic decision is to not control escaping weeds. Such social dynamics that basically establish a weed threshold of zero are difficult to counteract by simply educating producers on the validity of integrating the threshold approach to weed management into their systems.

Integrated pest management emerged in the entomology discipline. The key components of IPM include careful crop/pest monitoring and making management decisions based on economic threshold criteria. For many reasons, few producers use such an approach in weed management. Many weed scientists are working to refine our understanding of the complex weed-crop interactions, particularly at the multispecies level. This will further enhance our ability to predict the impact of weed interference, including effects of this year's decisions on next year's weed and crop conditions.

Weed scientists have worked to adapt the IPM concepts into integrated weed management programs and various computer models have been developed. An example of such an effort is WeedSOFT, a comprehensive computer aided weed management decision support system. Conceived and born in North Carolina as HERB, raised in the state of Nebraska as NebraskaHERB, WeedSOFT has matured into a robust decision-aided program that has been adapted to and adopted in seven Midwestern states of the USA. This program considers soil physical and chemical characteristics, rotational crops, the relative density or number of individual weed species, crop row spacing, relative heights of crops and weeds, effectiveness and cost of available herbicides at conventional and reduced rates, the relative risk of developing herbicide resistance, the impact of selected treatments on the weed seed bank, and whether or not cultivation will be done to predict the impact of escaping or uncontrolled weeds on crop yield and economic returns.

To help growers assess their level of using integrated measures, we developed an IPM scorecard (Anon. 2001). This instrument asks producers to think of their weed management practices and consider ways they could modify their production practices to achieve more holistic and sustainable systems. Each question has several options to choose from and each option has a point value. The points increase as the practice is more integrated or sustainable. For example, producers consider this question:

You generally plant corn:

a. in the same field every year	- 3 points
b. on a two-year rotation with another crop	+ 2 points
c. on a three-year rotation with other crops	+ 6 points
d. on a four-year or more rotation	+ 8 points

As you can see, there is a significant value in the cultural practice of crop rotation as a component of integrated weed and pest management. Other questions are more directly related to weed management. For example:

Do you rotate herbicide modes of action to avoid resistance development?

a. no	0 points
b. yes	+ 6 points

Other questions ask about sprayer calibration, herbicide selection criteria, spray tank cleaning, mechanical weeding practices, preventing the spread of weeds, weed maps and weed monitoring practices. Growers total the points and are then told where they fall on a scale of low or high levels integration. This serves as a base line for similar assessments in future years.

Some changes in weed management bring with them a more integrated system. The labeled rates of herbicides are designed to control weeds in a wide and diverse set of environments. Once producers understand the principles of controlling weeds with lower rates, they can consistently achieve excellent control. The basic principles of using reduced rates differ between preemergence and postemergence herbicides. Applying reduced rates of preemergence products means that weed control will decline sooner than normal. The producer's response to this situation is to mechanically cultivate or use other means to compensate for the shorter duration of control.

For postemergence products, the key to successfully lowering the use rate is to treat weeds when they are relatively small and when the environmental conditions are favorable for rapid growth and development. Because postemergence herbicides in North America are relatively cheaper than soil applied products and because it isn't possible to treat large areas when weeds are relatively small, producers have shown less interest in using reduced rates of postemergence products. In soybean, we face the added fact that most this crop is usually planted in narrow rows which eliminates the possibility of row cultivation and producers fear that an earlier application than usual may require a second treatment. If true, then the total cost is considerably more than using the normal rate once.

In Wisconsin, we have worked extensively with maize producers and have consistently demonstrated the practicality and low risk nature of using

20 to 50% less preemergence herbicide and then cultivating once when maize is 30 to 40 cm tall. Beyond this point in time, the crop canopy will provide sufficient shade to minimize the appearance of new weeds. For producers who already use row cultivation after planting, this requires no changes in practices at all. For those with minimal weed seed bank populations, the risk of failure is low. By promoting reduced rates, we are also promoting integrated weed management because growers must use mechanical weeding to complement this practice, especially with soil-applied products. However, reduced rates will not perform well on perennial species nor on weeds that are hard to control with conventional rates.

We have also discovered that reduced rates of some postemergence products are highly effective on *Elytrigia repens* (quackgrass). The initial recommended rate of glyphosate to control this perennial grass was 1.7 kg ae/ha. The current recommended rate is 0.85 kg ae/ha **if** applied in reduced water volumes of 100 L/ha or less of water. We also found that nicosulfuron consistently controls quackgrass in maize at half the labeled rate, even without a subsequent cultivation. In contrast, primisulfuron did not give full season quackgrass control unless a cultivation followed the application of a half rate.

Cash grain producers should strive to have more weed suppressing potential and impact from their cropping system. Perhaps we should challenge them to reach the point often seen in well managed forage fields and pastures (Figure 1). Once established, we seldom need to use herbicides in forages and pastures because the work horse is the competitive stand of legumes and/or grasses that usually maintain the upper hand.

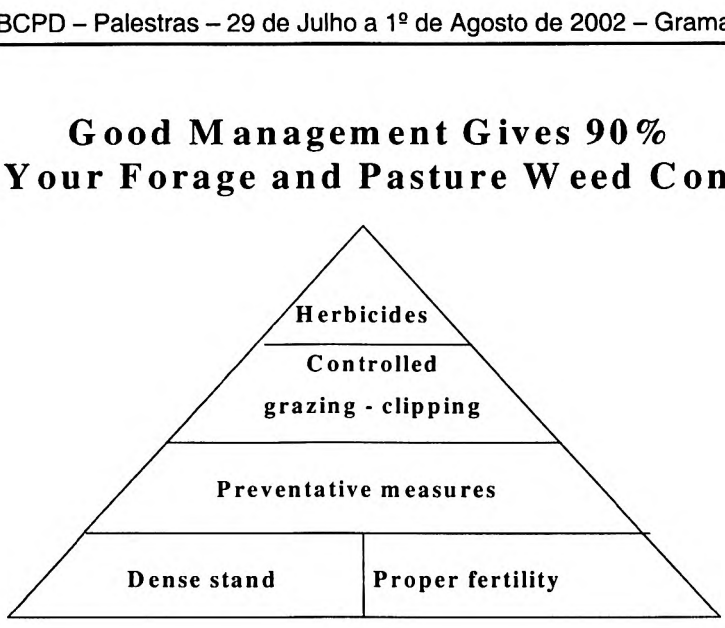

Figure 1. An illustration of how integrating cultural and mechanical practices into well-managed and established forages and pasture systems minimize the need for herbicides.

A recent book chapter, "Development of Weed IPM: Levels of Integration" (Cardina et al, 1999), describes the challenge of moving through five levels of integration:

1. The weed control level - what kills this weed?
2. The weed management level - can we coordinate the use of multiple tools to prevent economic losses due to weeds?
3. The cropping systems level: can seed banks be reduced? Can we limit the spread of weeds across the landscape? What is the best mix of crops to grow?
4. The landscape and regional level: what are the downstream effects of management practices? How are communities affected? Can we minimize new and herbicide resistant weeds at these levels?
5. The agro-eco region level: regional and global impacts on weeds such as climate changes, international trade, etc.

Some of these concepts and questions are similar to those posed by Radosevich et al. (1997) in the book, "Weed Ecology." The following table (adapted from Table 2.2, p. 49 of the book) gives the key concepts for the industrial, current IPM and agroecological approaches to pest management.

We can certainly consider them from a weed management perspective to assess where we are on the spectrum of integration.

Table 1. A comparison of three approaches to pest management.

	Industrial	IPM	Agroecology
Goal	Eliminate/ reduce pest	Maximum $	Several economic, social & ecological goals
Target	Single pest	Several pests	Fauna/flora of an area
Principle method	Pesticide	Prevention, scouting multiple strategies	System to minimize outbreaks; mixed strategies
Diversity	Low	Low to medium	High
Spacial scale	Field	Farm or region	Agrogeograhpic region
Time frame	Now	Season	Long-term
Research goal	Better pesticide	Better systems	Minimize need to intervene

How can we enhance the adoption of more diversified weeding systems? Will we be able to make the "carrot" look sufficiently attractive on the merits of primarily long-term benefits (more sustainable systems that are more environmentally friendly, keeping seed banks low, preventing weed shifts or resistance development, etc.)? Or should we look to government policies that penalize producers who do not rotate herbicide modes of action, do not have diversified rotations, do not make decisions based on timely and regular field monitoring? Or do only farmers who have and implement and integrated weed management program receive government support? Only time will tell.

References

Anonymous. 2001. Pest Management Assessment for Field Corn. Univ. Wisconsin. Integrated Pest Management Program. 12 pages.

Cardina, J., T.M. Webster, C.P. Herms and E.E. Regnier. 1999. Development of weed IPM: Levels of integrations for weed management. *In*: D.D. Buhler, ed. Expanding the Context of Weed Management. Binghamton, NY: Hawthorne Press. pp. 239-268.

Radosevich, S., J. Holt and C. Ghersa. 1997. Weed Ecology: Implications for Management. 2nd edition. John Wiley & Sons. New York. 589 pages.

Schwendimann, A. and G. Briggs. 1944. Fight weeds - it will pay. 1944. Univ. of Wis. Agricul. Exten. Ser. Bull. 345. 12 pages.

WeedSOFT. 2002. Software program available from http://weedsoft.unl.edu.