

MIKE MURPHY (D565-1)

## Keeping Weeds in Check With Less Herbicide

**H**ow do you kill weeds in a field?

That depends. Weed patches vary in size, shape, and composition and often require different treatments. And herbicide effectiveness varies with soil type.

Nevertheless, many farmers apply herbicide uniformly. This can lead to overapplication, causing leaching, carryover, and unnecessary expense. Fortunately, methods exist to control and reduce the application rate, say scientists in the ARS Water Management Research Unit at Fort Collins, Colorado.

### To Weed or Not To Weed?

Site-specific weed management (SSWM) encourages farmers to limit the amount of herbicide they apply to a field. SSWM identifies which portions of the field require herbicide treatment and targets those areas for application. It's sort of like dabbing calamine lotion on each individual mosquito bite instead of dipping your whole arm or leg in it. Selecting and then applying the best treatment for each area of the field is equally important.

With SSWM, farmers can manage weeds with incredible precision. So why aren't more farmers using it?

"There are two major obstacles," says plant physiologist Lori Wiles. "Lack of cost-effective methods to map weed distribution and lack of information about potential benefits."

Farmers who adopt SSWM can match treatments to the weed profiles of specific fields, resulting in more cost-effective control. But the advantages vary according to the characteristics of the weed patches and the fields, as well as the technology used by the farmer. So two adjacent fields might respond differently to SSWM.

Before investing in new technology, growers need assurance that the benefits will exceed the costs without compromising future weed control. So how do farmers decide whether SSWM is right for them?

WeedSite is a convenient software program that Wiles and her colleagues developed to evaluate the effects of SSWM for irrigated corn cropping systems. It and other ARS agricultural software programs can be downloaded for free at [arsagsoftware.ars.usda.gov](http://arsagsoftware.ars.usda.gov).

To make a weed map of a fallow field, plant physiologist Lori Wiles sets up a camera and a GPS unit to collect images and automatically record their locations.



Growers run WeedSite themselves, using the computer's mouse to draw weed maps of their fields on the computer screen. The program uses the maps to calculate the untreated area of the field, herbicide use and cost, yield loss from weed competition, and number of weeds left in the field. With this information, the program computes the net benefit to the grower from using SSWM instead of applying herbicide uniformly across the field.

### Getting It Just Right

Too much herbicide can harm the environment, but too little won't kill any weeds. New technology can help farmers easily select an amount of herbicide that is just right and apply it to the areas that need it most.

With the help of agricultural engineer Paul Irvin of the Fort Collins unit, Robert Waltermire of the U.S. Geological Survey, and several local farmers, Wiles developed and tested a simple, low-cost system to map weeds in fallow fields. By mounting a digital still camera and a GPS unit on a tractor, the grower can take photographs and match them with GPS coordinates.

"This software estimates weed cover from the images and then automatically constructs a weed map for the farmer," Wiles says. With this map and a sprayer, a farmer can easily locate and treat weed-covered sections, detect new invasions, and monitor

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**Plant physiologist Dale Shaner examines a patch of field bindweed in a cornfield. Mapping these weed patches and applying herbicides only to the patches will reduce herbicide use and cost.**

changes in existing patches. With a click of the mouse, the user can view the image taken in a specific area to find out which weed species are present.

### **Conduction Junction: What's Your Function?**

Another factor to consider in treating weed-infested fields is the soil itself.

“The amount of soil-applied herbicide needed to control weeds depends on the texture—determined by sand, silt, and clay—and organic matter in the soil,” says plant physiologist Dale Shaner. A field’s soil variability can be determined by measuring soil electrical conductivity (EC), a measure of how easily soil allows a current to pass through it. Heavy soils—those with more clay and organic matter—have a higher EC and require more herbicide.

Shaner, aided by ARS colleagues Brien Henry, of the Central Great Plains Research Station at Akron, Colorado, and Gerald Buchleiter, at Fort Collins, is researching how EC maps can be used to determine variable soil types. With this information, farmers can create herbicide application maps, allowing them to make better decisions.

By adjusting the application rate based on variations within the soil, farmers can reduce the risk of the herbicide leaching while maintaining its efficacy. In a field with equal parts heavy and light soils, a farmer could save about 25 percent on herbicide costs by applying less on the lighter soils, Shaner says.

### **They Kill Weeds, Don't They?**

Herbicide selection is an equally important aspect of weed control. Atrazine is one popular choice, but in the course of his research, Shaner discovered something about its degradation. Atrazine’s half-life—the length of time before half of it becomes ineffective—is typically 30 to 45 days. But Shaner found that period reduced to 4 to 6 days in fields where atrazine has been used for many years. This rapid breakdown could be the work of bacteria.

“Weeds resist control because of the rapid dissipation, and then the farmers have to spray another herbicide,” Shaner says.

An inexpensive field kit could help farmers and crop consultants identify whether fields are at risk before they apply atrazine. Shaner is investigating whether test strips used to analyze water for atrazine’s presence could be modified to test the soil. Though a field kit is still in early development, Shaner believes it could help reduce herbicide overdose.

“If the farmers knew in advance that their soil has the capacity for enhanced atrazine degradation, they could choose a different herbicide,” he says. “This would save them considerable time and money.”

In the future, Shaner and Wiles hope to work together to develop a system for applying herbicide at variable rates based on soil characteristics and weed distribution.—By **Laura McGinnis**, ARS.

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