CULTIVATION:
An Effective Weed Management Tool

Although more than 95 percent of Iowa row crop acres are treated with herbicides, cultivation remains popular with Iowa growers. In 1994, more than 70 percent of corn acres and 50 percent of soybean acres were cultivated to control weeds. However, most acres also were broadcast with herbicides, and not many growers applied herbicides in a band, a method that uses fewer chemicals and reduces the farm operator's exposure to chemicals. In 1994, only 17 percent of the herbicides used on Iowa corn acres and 9 percent of the herbicides used on Iowa soybean acres were applied in a band.

This publication answers some of the most common questions about reliance on cultivation for interrow weed control. It also addresses other factors—such as time, weather conditions, erosion control, and cost—that enter into decisions about weed management.

Herbicides have replaced a lot of cultivation for controlling weeds in row crops. Why would a grower go back to cultivation?

The bottom line on any weed management decision is cost. For example, if you apply a band rather than a broadcast herbicide and cultivate once during the growing season for interrow weed control, your annual savings could be $2,500 to $6,000 for every 500 acres. You also handle less herbicide, and fewer chemicals reach surface water run-off, which is directly related to the amount of surface area treated.

Cultivation can be effective when used as part of other management plans that don't use banding. Cultivation helps avoid development of herbicide-resistant weeds, and it is an inexpensive way to control weeds that escape broadcast treatment.

How do band and broadcast application costs compare? And what about cultivation costs?

Band application is less expensive than broadcast application because only a portion of the field (the area over the row) is treated. For example, broadcast herbicide may cost $30 an acre, compared to $15 an acre for a 15-inch band application in 30-inch rows. Equipment costs for these two applications are about the same. Cultivation costs about $6 an acre for machinery, fuel, and labor.

If you use a band application for weed control within the row and cultivation for interrow weed control, you still can save $9 an acre compared to a single broadcast application. Actual savings vary depending on equipment, herbicide costs, and the size of the bandwidth; however, you still can figure a $5 to $12/acre savings with this alternative. For a narrower band width, crop input costs would be reduced even further (for example, a 10-inch herbicide band for one-third field coverage reduces the overall input by $14/acre).

What about the time it takes to cultivate fields?

It might not take as much time as you think to cultivate fields. Depending on size, many cultivators easily can cover 100 acres in only part of a workday, particularly at higher speeds of 6 to 7 mph. Table 1 below includes time for turning and taking short breaks.

I have a large operation and don't have enough time to cultivate everything. How can this approach help me?

If time is a factor, consider using cultivation and a band herbicide application on only a portion of your acreage. Experience may show you how to add more acres for greater savings. Remember that June days allow you 17 to 18 hours of available light for catching up after a rainy period; however, safety should always be a priority. Take 15-minute breaks to reduce fatigue, get

Table 1. Hours needed to cultivate 100 acres

Type of cultivator (No. of rows-row width)	Speed (mph) 4	5	6	7
6-30 in.	16.8	13.4	11.2	9.6
8-30 in.	12.9	10.3	8.6	7.4
12-30 in.	8.8	7.1	5.9	5.0
6-38 in.	13.2	10.6	8.8	7.6
8-38 in.	10.2	8.1	6.8	5.8
12-38 in.	7.0	5.6	4.6	4.0

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adequate rest, eat regular meals, and do not work long hours more than several days.

If I try to cultivate more acres at greater speeds, don't I risk plant damage from soil thrown into the row?

Soil movement into the row depends on cultivator design and shielding. ISU research that began in 1993 shows that a cultivator with open-top shields and low-profile single sweeps between rows threw an average of less than an inch of soil into the row, even at speeds of 7 miles an hour. When you use herbicide in the row for weed control, you can delay cultivation until the crop is taller and less susceptible to damage from thrown soil.

Can I rely on cultivation to control weeds? Can I afford the risk of reducing my herbicide application?

Crop input costs are affected by the extent that you can use cultivation to reduce herbicide applications on the area between rows. The 1993-95 ISU research shows that you can improve the effectiveness of cultivation for weed control. In a project funded by the Leopold Center for Sustainable Agriculture, agricultural engineers and weed scientists at ISU investigated the effects of different cultivator sweeps (including the smith fin and point-and-share sweeps, shown in Figures 1 and 2), cultivator speeds, and herbicide bandwidths on weed control and yield in a no-till system.

Only a single cultivation was used during the study. If you can control weeds effectively with a single cultivation, you may be able to cultivate more acres and also minimize costs.

What did the project show about weed control?

In most cases, weed control was just as effective with 15-inch band herbicide application and cultivation as it was with broadcast application and no cultivation (see Table 2). In 30-inch corn rows, weed populations were statistically the same for broadcast herbicide application (without cultivation) compared to a 15-inch band application with a single cultivation. Plots that were cultivated once statistically had more weeds in two of the three years when only a 7.5-inch band of herbicide was applied, compared to the wider 15-inch band.

How did various cultivation methods affect yields in the project?

In 1993, the first growing season in the project, yields were greater with cultivators that used disc-hillers compared to those that did not use them (see Table 3). Banded versus broadcast herbicide applications statistically did not affect yield when disc-hillers were used. In comparing two herbicide bandwidths (7.5 and 15 inches), weed populations differed but yields were not significantly different.

During the second and third growing seasons, disc-hillers were used on all cultivator styles in the experiment. Cultivated plots with a 15-inch herbicide band had higher yields than those with a 7.5-inch band. Yields were about the same for wider bandwidths as when only a broadcast application was used for weed management (no cultivation).

Fields cultivated with either a low crown sweep or the smith fin had higher yields than fields cultivated with a protruding subsoiler point and plow-like shares (point-and-share) following the second growing season.

Did the speed of the cultivator reduce weed control or yields in the ISU research?

No. In the second growing season of the experiment, yield was *higher* in plots cultivated at 7 than at 4 miles an hour (see Table 4). This study shows that high-speed cultivation may offer two benefits: growers can cover more acres in less time, and they may have slightly higher yields while improving weed control. For safety purposes, consider using a guidance system when cultivating larger acreages to avoid operator fatigue.

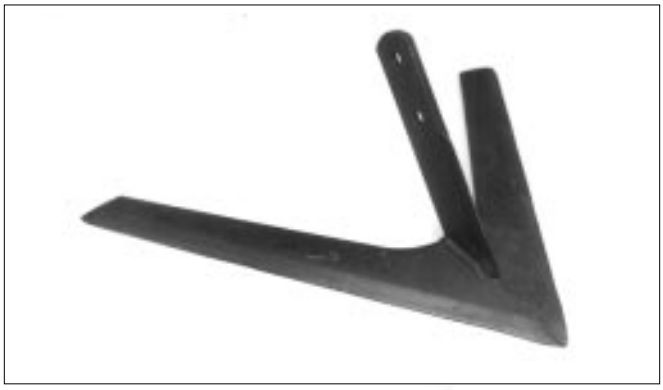

Figure 1. A smith fin is a flat sweep and is used for cultivation in southern agricultural regions.

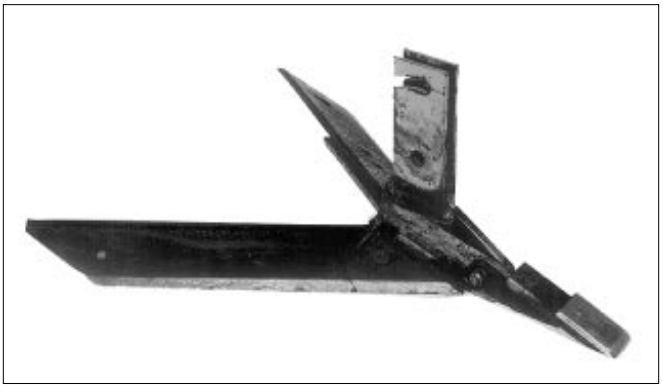

Figure 2. A point-and-share sweep has a protruding subsoiler point and uses plow-like shares.

Table 2. Weed density with three cultivation strategies

	Number of weeds per square yard after cultivation		
	Broadcast only	Wide-band	Narrow-band
Year	No cultivation	One cultivation	One cultivation
1993	1	4	8
1994	3	9	17
1995	12	19	90

NOTE: In all three years, there was no significant difference between broadcast and wideband herbicide application. This is based on research at fields west of Ames.

Table 3. 1993 corn yield in different weed management trials

Cultivator type	Speed (mph)	Bandwidth (inches)	Yield (percentage of broadcast-only application**)
Sweep	3.5	7.5	63
	3.5	15.0	81
	5.0	7.5	70
	5.0	15.0	78
Point-and-share	3.5	7.5	77
	3.5	15.0	78
	5.0	7.5	86 *
	5.0	15.0	73
Sweep w/disc-hillers	3.5	7.5	90 *
	3.5	15.0	90 *
	5.0	7.5	86 *
	5.0	15.0	86 *
None (Broadcast application only)			100 *
None (Weed check only)			49

NOTE: The * indicates there was no statistical difference in yields between this treatment and the broadcast herbicide.
** All yields are expressed as a percentage of the broadcast-only treatment.

Table 4. 1994 and 1995 corn yields in different weed management trials

Cultivator type	Speed (mph)	Bandwidth (inches)	1994 yield (percent**)	1995 yield (percent**)
Sweep	4	7.5	78	68
	4	15.0	95 *	93 *
	7	7.5	86	59
	7	15.0	99 *	95 *
Point-and-share	4	7.5	63	64
	4	15.0	80	74
	7	7.5	68	70
	7	15.0	98 *	88 *
Smith fin	4	7.5	85	53
	4	15.0	95 *	91 *
	7	7.5	83	67
	7	15.0	98 *	87 *
None (Broadcast application only)			100 *	100 *
None (Weed check only)			14	0

NOTE: The * indicates there was no statistical difference in yields between this treatment and the broadcast herbicide.
** All yields are expressed as a percentage of the broadcast-only treatment.

What combination of herbicide application and cultivation do you recommend for weed control?

Based on the 1993-95 research on single cultivation strategies, ISU Extension recommends a 15-inch-wide herbicide band application combined with a single cultivation using low-profile sweeps operated at speeds of 5 to 7 miles an hour. Growers may choose to cultivate fields more than once, which may allow less herbicide use.

These recommendations are consistent with other research, as well as with earlier on-farm trials that showed equivalent yields at 63 of 64 sites that compared banded herbicide application and cultivation with only broadcast application.[1]

Does cultivation eliminate erosion control benefits I get from residue cover? Won't cultivation increase erosion on sloping land?

Research shows that a wide-sweep, high-residue cultivator buries only about 5 to 15 percent of residue cover in a no-till system. At cultivation, the crop canopy is rapidly expanding to partially compensate for reduced cover. Iowa's current conservation compliance rules allow cultivation a few weeks after planting as necessary for weed management. Contouring can help to further minimize erosion potential.

In wet years, how can I rely on cultivation for weed control?

This is a major concern because when you use a band preemergence herbicide, you rely solely on cultivation for weed control between rows. Although the window of opportunity narrows during a long, rainy period, producers rarely are prohibited from making at least one planned cultivation. Even during the very difficult, wet growing season in 1993, Iowa ridge tillers were able to cultivate many of their acres once. Post-applied herbicides also are an option if soil is able to support wheel traffic but is not tillable. Although weed control and yield can be affected adversely by excess moisture, alternative systems also can have problems and may not fare better.

[1] Based on research conducted by R.G. Hartzler, B.D. Van Kooten, D.E. Stoltenberg, E.M. Hall, and R.S. Fawcett, and published as "On-farm evaluation of mechanical and chemical weed management practices in corn," in *Weed Technology* 7:1001-1004 (1993).

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