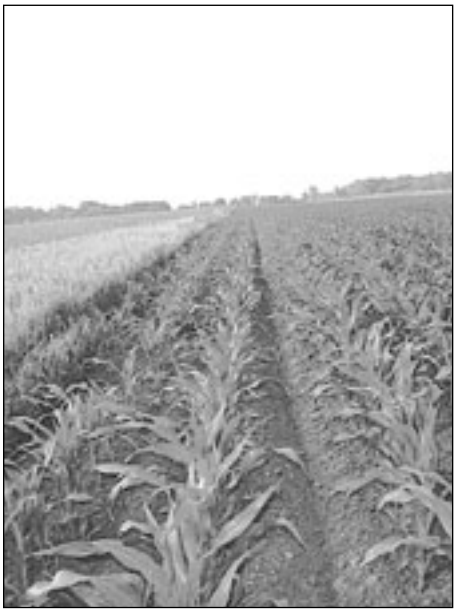
Organic Weed Control

Cultural & Mechanical Methods



Corn (next to a field of oats/peas/barley) that has recently been cultivated for the second and last time with a high-clearance cultivator.

Peter Martens, cultivating soybeans on a John Deere 3020 with JD725 front-mount cultivator and a IH133 rear-mount cultivator, both with C-shank teeth. The front has half sweeps, the back has sweeps. The front cultivator is modified to have two gangs per row instead of the standard single gang in the middle of the row. The rear cultivator is modified with a side shifter to keep it aligned with the front cultivator on side hills.

by Mary-Howell & Klaas Martens

Weeds happen. That is a fact of life for organic farmers, and therefore many of our field operations are designed to make sure that the health and quality of our crops are not jeopardized by the inevitable weed pressure. Planning an effective weed-control program involves many different aspects of organic crop production. As farmers begin to explore organic possibilities, the first two questions invariably seem to be: "What materials do I buy for soil fertility?" and "What machinery do I buy to control weeds?" We asked these questions when we started organic farming, but we rapidly realized that this is not the best way to understand successful organic farm management.

Reprinted from
ACRES USA
A Voice for Eco-Agriculture
August 2002 • Vol. 32, No. 8

To plan an effective weed-control program, you must integrate a broad spectrum of important factors, including your soil conditions, weather, crop rotations and field histories, machinery, markets and specific market quality demands, and available time and labor. You must have the ability to adjust your weed-control strategies to the unique and ever-changing challenges of each year. Above all, you must be observant, and, in the words of William Albrecht, you must learn "to see what you are looking at."

CULTURAL WEED CONTROL

Do you think that weeds just happen, that there is little you can do to limit your weed population other than cultivate? Then think again! Before you even think about cultivating, there are many things that you can actively do to change field conditions so that they favor crop growth and discourage weed pressure. Cultural weed control is a multi-year, whole-farm, multi-faceted approach — and you are probably doing much of it already without realizing the effect your actions have on weed pressure.

Writing in 1939, German agricultural researcher Bernard Rademacher stated, "Cultural weed control should form the basis for all weed control," and that "the other various means should be regarded as auxiliary only. The necessary condition for any successful weed control is the promotion of growth of the crop species. Vigorous plant stands are the best means for eradicating weeds." The same wisdom must be applied to organic agriculture today, actively incorporating the philosophy that good agronomic practices that result in vigorous, competitive crop plants are the real key to successful weed control.

Many agronomic procedures that encourage healthy soil conditions with a

diverse microbial population can also reduce weed pressure. Optimizing the biological terrain of the soil for the crop will create an unfavorable environment for many weeds, effectively reducing weed numbers and vigor. This concept forms the core of effective weed control in an organic production system.

Contrast this to the weed-control strategies of conventional farming, with heavy use of salt fertilizers, herbicides, monoculture and imbalanced cation saturations. Indeed, that environment could accurately be described as one of cultural weed *enhancement.* The conventional field environment presents heavy pressure to select for herbicide-resistant weeds that thrive under these conditions. Each year, these highly adapted weeds find the same favorable conditions and reproduce abundantly. It is really no wonder that most herbicides are only effective for a few years before a newer, stronger (and more expensive) chemical is needed to control weeds sufficiently.

It is important to know your enemy. All weed species have their weaknesses and their strengths, usually occurring at distinct stages of their life cycles or resulting from specific growth patterns. Different weeds present problems at different times of year, or with different crops. Some weed-control strategies, such as disking a field infested with quackgrass, may even increase the prevalence of certain species of weeds under specific conditions. Grassy weeds often require different control measures than do broad-leafed weeds. Correctly identifying the species of weeds that are causing major problems in your fields is critical to choosing and timing effective control measures. It is valuable to have a good weed-identification book and use it regularly during the season until you are confident recognizing your most common and troublesome weeds.

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ACRES USA
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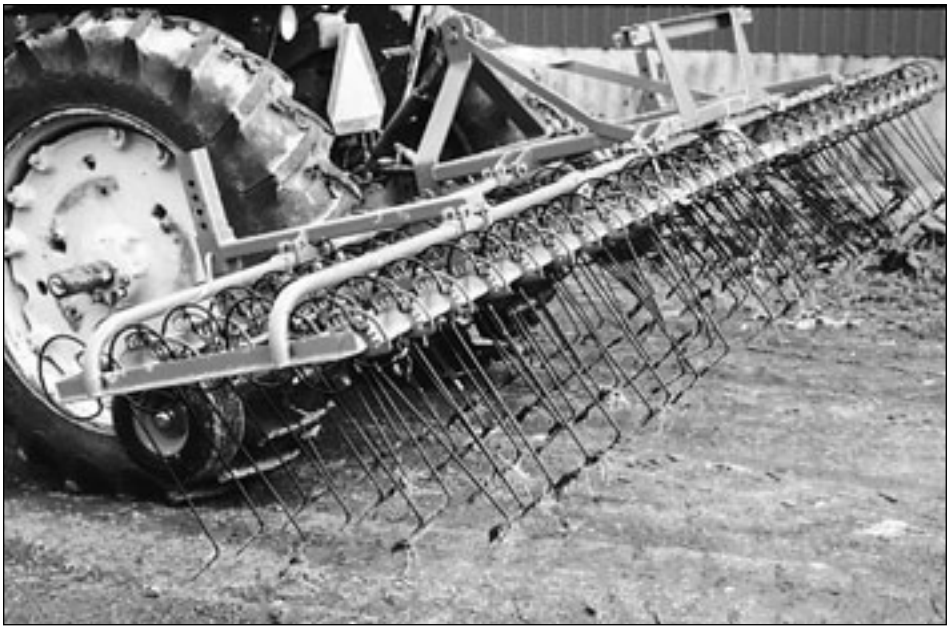
While no factor can truly be viewed as separate, it is important to examine some of the primary management concepts that contribute to effective cultural weed control.

1. Crop Competition. The most effective way to control weed growth is to have highly competitive crops. A vigorously growing crop is less likely to be adversely affected by weed pressure. It is imperative to create conditions where the intended crop can establish dominance quickly. Using high-quality, vigorous seed, well-adjusted planting equipment, adapted varieties, optimal soil fertility, good soil drainage and tilth, and proper soil preparation will usually result in rapid, vigorous crop growth.



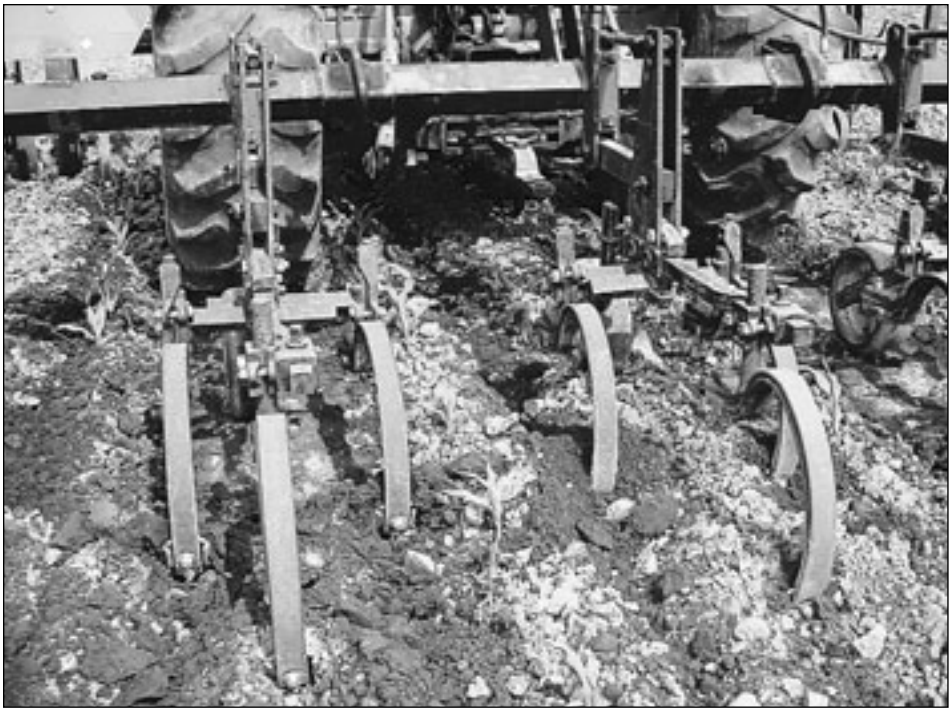
Lely weeder.

2. Soil Fertility & Condition. In an organic system, it is important to rely on the biological activity of the soil as the main source of fertility and favorable soil physical structure. An active and diverse soil microbial population is the key to growing healthy, high-yielding organic crops. Successful organic fertility management should primarily feed the soil microbial life in a long-term manner, rather than simply feeding the plants. Soil organic matter is a tremendous source of plant nutrients and water-holding capacity. Soil tests can be useful, but only if the results are interpreted appropriately for an organic system. Careful attention to the balance of key nutrients can often reduce weed problems and enhance crop plant growth. One common mistake made by many organic farmers is the improper application of manure or improperly finished compost. This can throw off the balance of certain soil nutrients and microbial life and can often increase weed growth. Some soil fertility amendments, such as gypsum, can increase the looseness and tilth of the soil. This improves success for mechanical-cultivation operations, but it also seems to reduce the pressure from certain weed species that are favored by hard, tight soils.

3. Crop Rotation. Diverse crop rotations are essential to build a healthy, sustainable organic system and break pest and weed cycles. In general, it is best to alternate legumes with grasses, spring-planted crops with fall-planted crops, row crops with close-planted crops, heavy feeders with light feeders. Careful use of cover crops during times when the ground would be bare adds valuable nutrients (especially nitrogen), adds organic matter, improves soil microbial diversity, and prevents erosion. Maintain a long-term balance of diverse crops on a farm, taking into account any necessary soil conservation practices, livestock requirements, time constraints and market profitability.

4. Allelopathy. Some plant species compete with each other by releasing chemical substances from their roots that inhibit the growth of other plants. This "allelopathy" is one of nature's most effective techniques of establishing plant dominance. Allelopathic crops include barley, rye, annual ryegrass, buckwheat, oats, sorghum, sudan-sorghum hybrids, alfalfa, wheat, red clover and sunflower. Selecting allelopathic crops can be useful in particularly weedy fields with reducing overall weed pressure.

5. Variety Selection. Careful selection of crop varieties is essential to limit weeds and pathogen problems and satisfy market



Cultivating corn, with view of IH133 rear-mount cultivator with C-shank teeth.

needs. It is important to consider planting disease-resistant varieties if certain pathogens are prevalent in the area. Any crop variety that is able to quickly shade the soil between the rows and is able to grow more rapidly than the weeds will have an advantage. Deep shading crops, which intercept most of the sunlight that strikes the field and keeps the ground dark, will prevent the growth of many weed species. Alfalfa, clover and grasses are particularly good shading crops because any weeds that grow in them will usually be cut when hay is harvested, thereby preventing weed seed production.

6. Sanitation. Using clean seed will prevent the introduction of new weed problems and will avoid planting a generous crop of weeds with your desired crop. Mowing weeds around the edges of fields or after harvest prevents weeds from going to seed. Hand-roguing weeds in problem areas, and thoroughly composting manure can reduce the spread of weed seeds and difficult weed species. Thorough cleaning of any machinery that has been used in weedy fields is a good idea, as is establishing hedgerows to limit wind-blown seeds. Common sense, yes — and it works!

Cultural practices won't prevent all weed growth, and some mechanical follow-up will usually be necessary, but cultural practices can improve soil conditions, permitting more effective mechanical control, they can adjust weed species to ones that are easier to control, and, most importantly, cultural weed-control practices can produce high-quality, vigorous, high-yielding organic crops.

MECHANICAL WEED CONTROL

We like to consider mechanical weed control as consisting of four distinct phases, each one very important to the overall success of your weed control program. The *point* in early mechanical weed control is to create as large a crop-to-weed size differential as possible, as early as possible, so that row cultivation is most successful. When crop plants are bigger and more vigorous than the weeds, the weed pressure will usually not jeopardize the crop. Therefore, effective early weed control, before weeds present a visible threat to the crop, is absolutely essential.

Tillage

Appropriate tillage of fields is critical:

1. To create a good seed bed for uniform, vigorous crop emergence.

2. To prepare the ground adequately for successful subsequent mechanical weed control operations.

3. To eliminate much of the weed potential.

When it is possible, initial tillage a week or 10 days before planting will allow the resulting flush of germinating weeds to be killed during final field preparation. Organic gardeners call this technique "stale seed bed." Weed seeds are stimulated to germinate by the first tillage, then they are killed by the second, final field preparation. Many organic farmers find that in heavily infested fields, late spring plowing will reduce weed pressure by killing weeds that have started to grow and burying many germinating weed seeds.

Plowing can have a different positive effect by inverting weed seeds that have started to germinate down deeply where they won't grow, and bringing other weed seeds that have not yet been stimulated to germinate to the surface. By the time these new weed seeds "get the message" to germinate, you can already have your crop growing.

It is important to note that weather conditions dictate how effective tillage is in controlling weeds. Naturally, the best weed control will be achieved with tillage on a hot, sunny day. Tilling soil that is too wet will result in compaction and loss of soil structure, which will then favor certain types of weeds that prefer hard ground and will also make later cultivation less effective. Wet weather following tillage may result in weeds re-rooting. Cold, wet conditions following initial tillage may also slow weed seed germination, reducing the effect of stale seed bed.

If the soil breaks up into large clods when plowing, weed seedlings may be protected within the clods and not killed by the tillage. If the ground is worked wet, and clods are formed during tillage, this will make subsequent mechanical weed control much more difficult.

When tillage is done on a sunny, warm day, troublesome weeds with long underground rhizomes, such as quackgrass, can be dragged to the surface and will dry out. Dragging a field with a spring tooth harrow can pull many of these rhizomes to the surface. This old technique can effectively rid an infested field of quackgrass if done several times.

To Till or Not to Till — that seems to be the burning question in American agriculture these days. Excessive tillage can result in soil erosion, breakdown of soil structure, a shift in microbial activity and loss of organic matter, and it uses consid-

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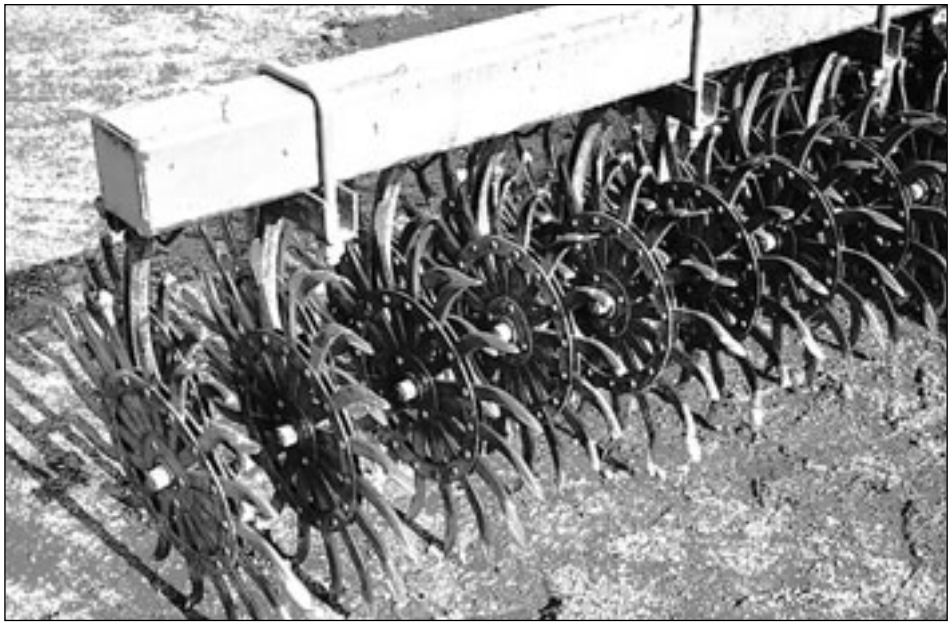
ACRES USA
A VOICE FOR ECO-AGRICULTURE
August 2002 • Vol. 32, No. 8

erable amounts of fuel and tractor time — this does not mean you should go out and invest in massive quantities of Roundup, however. Sometimes it seems that the current popular infatuation with no-till often amounts to little more than institutionalized support of Monsanto's profits. Not all soils, not all crops, and not all farms are well suited to no-till. After all, there is a well-known saying here in New York: "No till, no corn!"

Organic farmers *can* and *should* incorporate reduced tillage practices into their techniques. You do *not* have to plow every year, nor do you have to use herbicides to get the benefits of reduced tillage. Many crops — such as small grains, clover and grass hay — can be successfully planted in untilled or lightly tilled soil. Anne and Eric Nordell in Pennsylvania are no-till planting garlic into growing oats in the fall. The oats winterkill, forming a thick mulch that prevents weed problems in the garlic in the spring. Planting into a living crop, like the oats, provides continuous physical cover to the soil, and there is less soil damage by winter rains and snow than if the ground were bare. This helps maintain good soil pore space and healthy microbes during a vulnerable period for the soil.

There are many creative ways that organic farmers can incorporate reduced tillage into their operations, but we should not feel guilty about occasional plowing. Mixing the soil will redistribute nutrients and make them available to crop plants. The introduction of air into the soil is also important, especially in an organic system that relies on microbial activity to provide soil fertility. With the introduction of new oxygen, the soil microbes are able to digest soil organic matter, to convert it into stable humus, and to reproduce, releasing readily available nutrients into the soil solution which our crops will use. While some soil organisms may be harmed by the physical action of plowing, for many species and for plant roots this breath of fresh air is just what they've been waiting for. To organic farmers, the most important value of soil organic matter is its use as a source of fertility — and our friends the microbes need oxygen to do that.

The most successful no-till systems that we know of are actually being "bio-tilled," using plant roots and animals like earthworms to actively till the soil instead of machinery. We have fairly good success with no-till broadcasting small grains, like spelt and wheat, into fields of living soybeans in early fall. The grains are well started by the time the soybeans are harvested. This success is consistent with other successful organic no-till systems we've seen, where a new crop is planted into a still-living old crop, and where there are living roots and active soil microbial conditions. This is a much different biological environment than when a broad-spectrum herbicide is used to kill all living plant material in the field, and the ground is left bare over winter.



Rotary hoe.

"Carbon sequestration" is a real buzzword in conventional ag circles, the justification for promoting no-till/Roundup technology. If all you want to do is sequester the maximum amount of carbon in your soil and raise your soil organic matter, then burying fence posts would probably be your best bet. However, if you want the soil organic matter to be an active source of fertility and to support an active, diverse microbial population, then these tiny aerobic (oxygen-needing) organisms need air. Both Sir Albert Howard and Neal Kinsey have observed that there is a rapid loss of soil organic matter after soil becomes anaerobic due to excessive water or compaction. Plowing adds new air to the soil, releases the buildup of waste gases, mixes nutrients and organic material around in the soil, and when the plowing is not so excessive as to cause compaction, it helps to loosen soil and produce good soil-pore space for air and water holding capacity.

Remember that where no-till techniques are used, subsequent mechanical weed control options are more limited because of trash and because the soil may not be loose enough. Therefore, it is really critical to have your cultural weed control strategies in good shape before trying any no-till options.

PLANTING THE CROP

Few farmers realize that a well adjusted planter is one of their most valuable weed control tools. Uniform, proper placement of the crop seed will result in even vigorous growth. Don't assume that just because a planter has shiny paint, it is doing a good job! And remember to use cleaned, high-vigor seeds for rapid, strong emergence.

You should regularly get off the tractor and dig up the seed to check the accuracy of the planting and make adjustments if necessary. This should be done not only in the good locations in the field but also in lumpy, uneven or unusual areas too. Planting into wet or particularly lumpy soil should be avoided. Older corn planters with worn seed discs, gauge wheels, closing wheels or other parts can result in uneven planting. Worn parts should be replaced or repaired.

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Kovar coil-tine harrow.

The planter frame and units should also be regularly inspected to insure they are not bent or warped. Retrofitting with shoes, firming points, specially designed seed tubes or "eccentrically" (on an angle) bored gauge wheel bushings will often result in more uniform seed placement than what the planter had when it was new. Trash wheels in front of the gauge wheels will sweep away clods and stones, making for a level surface and therefore uniform planting.

BLIND CULTIVATION

"Blind cultivation" is the easiest and best opportunity to destroy the weeds that would be growing within the rows and presenting direct competition to the crop. In blind cultivation, the entire field is tilled shallowly with the implement, paying little attention to where the rows are.

The point of blind cultivation is to stir the top 1 to 2 inches of soil, adding air and causing the millions of tiny germinating weed seeds to dry out and die. The larger crop seeds germinate below the level of the cultivation and are not usually damaged by this operation. Weed seedlings are very vulnerable to drying out and to burying at this stage, and by doing an effective job of blind cultivation, you can achieve the biggest possible crop/weed size differential from the start. Blind cultivation also can break a soil crust, allowing crop seedlings to emerge.

Usually, the first blind cultivation pass is done right before crop emergence, with a second pass done about a week later, depending on conditions. The most effective blind cultivation is done when the soil is fairly dry and the sun is shining, a wind also improves the effect.

There are a number of implements that can be used for blind cultivation. Coil-tine harrows, rotary hoes, Lely weeders and Einböck tine harrows are some examples of useful tools that organic crop farmers use.

The Kovar coil-tine harrow has either regular straight tines, or new tines that are bent on the ends and the angle to the soil can be adjusted changing the aggressiveness. A 45-foot Kovar coil-tine harrow can actually cover the fields faster than a sprayer would and is very economical to operate.

Some organic farmers prefer to use the rotary hoe, going over the field the first time about three to four days after planting, and again five days later. Speed is a key factor in successful rotary hoe operation. A rotary hoe needs a high-horsepower tractor capable of moving at least 8-12 mph to be effective. Surprisingly, this does little damage to the young crop seedlings but destroys germinating weeds fairly effectively.

The Lely weeder works similarly by shaking the soil loose — killing small weeds but not harming the larger, deeper-rooted soybeans. The Lely weeder is very effective in breaking a surface soil crust. Do note, however, that the Lely can be rough on corn seedlings if it hooks the corn's branching root system.

There are other implements that do the same job of blind cultivation, such as the Einböck tine weeder. It pays to have several different tools on hand, so you can match the best tool to changing soil and crop conditions.

It is not uncommon to find inexpensive old, worn rotary hoes at auctions. Are they a good deal? Long before you think a rotary hoe is worn out, the teeth may be shorted, rounded and much less aggressive than new teeth. Such a rotary hoe will barely penetrate the ground properly, resulting in less dirt moved and few weeds killed. A good rotary hoe can be an expensive machine to maintain, but it is not essential to replace all the worn rotary hoe teeth. Since weeds growing between the rows will be controlled by later cultivation, you can economize by installing new rotary hoe wheels only directly over each row and leaving older wheels between the rows. Hoe bits can be welded to worn rotary hoe teeth to extend the life of the machine.

Weed species vary in their vulnerability to blind cultivation. Broad-leafed weed seedlings with their growing point above ground are easily killed when their tops are broken, while grasses with growing points below the soil surface need to be uprooted and desiccated. Most weeds are most sensitive to desiccation when they are in the "white hair" stage, early in germination. Established perennial weeds with deep roots and large reserves are not well controlled by blind cultivation and must be controlled by other methods.

Pounding rains can seal the surface of the ground, causing a crust to form. This problem can be especially troublesome on high magnesium or clay soils. Germinating crop seeds, especially legumes, can be trapped under the crust, unable to emerge or "breaking their necks" while trying to get through. A soil crust can also stimulate the germination of certain types of weeds. Ellen Chirco, seed technologist at the New York Seed Testing Laboratory, says that seeds of some plant species are stimulated to germinate by a buildup of carbon dioxide and ethylene in the soil, which results from improper air exchange and anaerobic conditions. Running a blind cultivation tool, like the coil-tine harrow or rotary hoe, through the field as a crust starts to form will often stop the hardening and thickening of the crust, allow crop seedlings to emerge, release some of the carbon dioxide and ethylene, let oxygen into the ground, and thereby slow the germination of some types of weeds.

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BETWEEN-ROW CULTIVATION

Effective early weed control, before weeds present a visible threat to the crop, is absolutely essential. The late-season weed control operations should be viewed as a follow-up, not as your primarily weed control. However, there are usually some escapes, and sometimes, unfortunately, there are lots of escapes. That's when it's time to set your cultivator correctly, drive straight and slow, and really pay attention to the details.

Front and rear view (before and after) of an older-style John Deere trip-shank cultivator. It is equipped with small shovels that allow the operator to cultivate very small crops at higher speed. This runs relatively shallow. This configuration is suitable for small weeds but not aggressive enough for large weeds or high weed populations.

When the crop rows are clearly visible and the corn plants are 8 to 10 inches tall — or soybeans are in the third trifoliate stage — it is time for between-row cultivation. Earlier cultivation may be necessary if a good crop/weed size differential has not been achieved, especially if weather has prevented your early season weed-control operations to be done optimally, but cultivation will go much slower and less aggressively when the plants are small because it is important to prevent the crop plants from being buried. In New York, two cultivation passes are usually required. The first pass is the most critical to determine the season's weed control, but the second is often necessary to eliminate the weeds that were stimulated to grow by the first cultivation, and to further aerate the soil.

There are rear-mounted and front- or belly-mounted models, and there are numerous types of cultivator teeth, shanks and points. Some farmers have tractors equipped with only a rear-mounted cultivator, while others get good control with a tractor equipped with both a front- and rear-mounted cultivator.

There are three main types of cultivator shanks:

Danish- or S-tine teeth will allow the greatest operating speed, they are not easily damaged by rocks, they will handle the most crop residue without plugging, and theyare relatively inexpensive. They do not penetrate as well in hard soil, however, and large rooted weeds may slip around the flexible teeth, thereby avoiding damage. Of different types of cultivator teeth, the operator has the least control over the action of the flexible Danish-tine teeth.

C-shank cultivator teeth are more rigid and give the operator more control. These may be the best for hard or rocky soil and for heavy infestations of quackgrass and other weeds with underground rhizomes. C-shank teeth are slightly more adjustable than the Danish-tine teeth.

Trip-shank teeth are the most rigid and require the slowest progress, but they give the operator superior weed control and adjustment ability. These are also the most expensive, large rocks can break the trip-shanks, and it takes a more experienced operator to make the necessary adjustments to get the full benefit of trip-shank teeth.

There are many different types and widths of points that can be put on different cultivator teeth. Danish-tine teeth offer the least opportunities to vary point type, while trip-shank teeth offer the greatest choice. The most versatile type of points are probably half sweeps next to the row and full sweeps between rows. Each type of point works best under specific conditions and on certain weed species. For example, a type of point called a "beet knife" is particularly effective on nutsedge. Narrow spikes may sometimes be used to advantage to aerate waterlogged soil.

We use a double-cultivator arrangement, with trip-shanks on the front cultivator and half sweeps next to the row. The rear-mounted cultivator, which has C-shank teeth with full sweeps, covers the between-row area. While this combination is slower than a single Danish-tine cultivator, it gives excellent control of most types of weeds, even under an unfavorable crop/weed size differential. John Myer, in Romulus, New York, has had

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ACRES USA
A Voice for Eco-Agriculture
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success with a rear-mounted Danish-tine cultivator with five shanks and 2.5-inch duck-feet points between each row. If the ground is hard, or if he has a quackgrass problem, he will instead use 1-inch spikes that are angled back to dig deeper. If he must cultivate when the soybeans are shorter than 7 inches, he will use half-worn teeth immediately next to the row.

Adjusting the cultivator to best fit the conditions is a fine art.

Relatively little adjustment is possible with Danish tines other than varying speed and depth and by changing the type of the points. With C-shanks, it is possible to change the angle to the soil and to the row slightly, but because they are springs, this adjustment changes in the soil as the cultivator moves. This is not a major problem when the cultivator is set deep and working between the rows, but it limits the success of controlling weeds within the rows. Trip-shanks allow wide adjustment of the angle of the points both to the row and to the soil.

Depth of the point is also easily adjusted. Because trip-shanks are rigid, the adjustments remain constant while cultivating. For example, by twisting the shank toward the row, a much greater amount of soil will be pushed into the row. Conversely, by twisting the shank away from the row, the soil thrown into the row is reduced. Changing the angle of the point to the soil can adjust for hard or soft soil. Under the right soil conditions, setting the points at an extreme angle to the soil can create a bulldozer effect, squeezing the crop row tightly with soil and thereby killing many weeds growing between the soybean plants and burying the rest.

Another logical but often overlooked point in successful cultivation is suggested by Cliff Peterson, a retired Yates County farmer, who remembers cultivating with horses when he was a boy. For the second cultivation in a field, Cliff suggests reversing the pattern/direction of the first cultivation. This alternating method can get weeds that were not fully removed in the first cultivation, and can compensate for gaps in cultivator coverage.

Plan on spending a lot of time when you first get out in the field adjusting the cultivator to get it to work right for the specific field conditions. As Cliff Peterson says, *"Almost* isn't good enough! Don't be satisfied with *almost!"* The first time through cultivating makes or breaks it — this pass will usually determine whether you are going to have a clean field or not. If you miss the weeds in the row the first time, cultivating more often later in the season will probably not make up for it. It's easy to get the weeds between the rows, but it takes real skill to get the weeds within the row. Cultivating works best when the ground is dry enough and in good physical condition. If you have to cultivate too wet, you can twist a piece of wire around the shovel and that will help break up the slabs of dirt as they flow over the shovel.

Critical Cultivator Adjustments:

1. Tractor speed — adjust constantly as you go across field.
2. Angle of the shovels, both laterally and horizontally to the row.
3. Depth of the shovels.
4. Down pressure on the gangs, if you have springs — this may need con stant adjustment, depending on changing field conditions.
5. Distance of the shovels from the row.

Adjustments will need to be done continuously through the day, as soil moisture and field conditions change, and as shovels wear or go out of adjustment. All rows need to be watched for adjustment needs. As you move along, watch *all* the rows, don't lock in on only one. If you don't watch all the rows, you can go along quite a distance before you realize something is wrong, by which time you've done lots of crop damage and missed lots of weeds. Carry a box of good tools on the tractor to make the adjustments easily and quickly, and carry common repair parts that may be needed.

It is essential to really focus on the rows and the job while cultivating, because even a slight drifting in the row can rapidly result in large sections of the corn or bean row being very effectively hoed out. Cultivating can be a very hot, boring job, especially when the crop plants are small. For the sake of the operator's health and attention span — and the health of the crop! — it makes a lot of sense to install a canopy on the tractor, bring a water bottle, and stop if you get sleepy.

It really helps to work with a farmer who is experienced with cultivating to learn and actually see how the dirt should flow, how much side pressure on the row is best, how much dirt should be pushed into the row to bury the weeds, how to make the proper adjustments, and to learn how hard you can treat the crop without hurting it.

One last word about cultivation and organic weed control: Trying too hard to get every last weed in a field can waste time, labor, and may actually do damage to the crop. Tractor operations after canopy closing will usually crush and tear crop plants excessively — and will probably be unnecessary, as shade from crop leaves will kill weeds trapped under the canopy. It is important to keep the whole crop in perspective, and not spend too much time making the first few fields immaculate.

Mary-Howell & Klaas Martens raise mixed grains on more than 900 acres in the Finger Lakes region of western New York, with every acre certified organic. Mary-Howell is a former genetics researcher and a frequent writer for Acres U.S.A. *They can be contacted by email at <kandmhfarm@sprintmail .com>.*