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## G92-1098 Cultivators for Conservation Tillage

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## Cultivators for Conservation Tillage

Cultivating residue-covered fields and ridge-till considerations are among the topics covered here.

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In any conventional, conservation or no-tillage planting system, crop cultivation can be an excellent method of weed control. Cultivators used in residue-covered fields must allow residue to flow through the implement without clogging.

Extra penetration force may be required to cultivate no-till fields as compared to tilled fields. While many high-clearance cultivators are designed to handle conservation tillage conditions, some older cultivators can be modified to work in residue-covered fields when residue flow and soil penetration are maintained.

Combining mechanical and chemical weed control is economical and effective because weed control does not totally rely on one method. For example, apply a band of herbicide, either pre- or postemergence, and rely on cultivation to control weeds in the row middles. Or, use a less-expensive, lower-performing herbicide, or use lower-than-label rates, then supplement the weed control with cultivation as needed.

Crop cultivation should be used primarily to control weeds, but can be used to rebuild ridges or aerate poorly drained or crusted soils. Cultivation for the sake of stirring the soil usually dries the soil and may result in lower yields during drier cropping conditions. Cultivating during warm and windy conditions can result in 1/4 to 3/4 inches of soil moisture loss.

Aeration of a wet, poorly drained bottom land soil with a cultivator sometimes improves yields. However, on typical sloping eastern Nebraska soils, aeration is not necessary and may not result in a

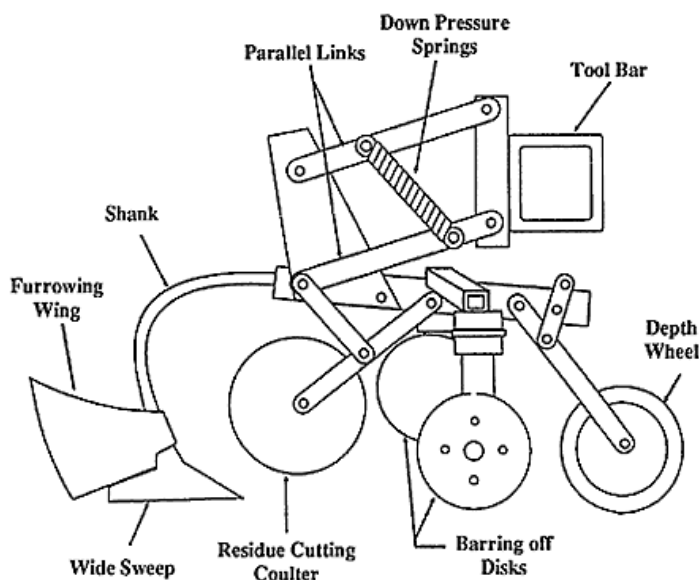
yield benefit.

In comparing no-till soybeans and grain sorghum with and without cultivation over a 10-year period on a silty clay loam soil in southeast Nebraska, no significant yield response to cultivation was found (weed control was not needed). Response to cultivation sometimes can be seen in wet, cooler soils in central corn-belt states where greater rainfall occurs.

The main difference between a conservation tillage cultivator and a conventional cultivator is the ability to handle residue and to penetrate the soil. By definition, conservation tillage should leave at least 30 percent of the soil surface covered with crop residue after planting. Conservation tillage includes several tillage systems that have pre-plant tillage operations to loosen the soil, as well as no-till and ridge-till plant systems.

## Cultivator Components

Conservation tillage cultivators differ greatly from conventional cultivators. The three to five shovels per row of a conventional cultivator generally have been reduced to a single shank having a wide sweep or horizontal disk. To allow residue to flow past the shank, usually a coulter is mounted in front to cut the residue.



**Figure 1. Components of a conservation tillage cultivator.**

Shovels located adjacent to the rows of a conventional cultivator have been replaced with barring-off disks. These disks cut residue and can be set to move soil either toward or away from the row, and control weeds in areas not undercut by the wide sweep. Some manufacturers use an extra-wide sweep to eliminate the need for barring-off disks. The coulter, barring-off disks and sweep (*Figure 1*) are positioned so residue can flow easily through a conservation tillage cultivator.

Soil penetration must be considered when selecting a cultivator for no-till and ridge-till systems. The cultivator must be heavy enough to penetrate untilled soil and to cut large amounts of residue. This extra weight often is inherent as the cultivator is constructed using heavier and stronger shanks, frame members and tool bars. Down pressure springs often are used to transfer weight from the tool bar to the individual row units.

Conservation tillage cultivators usually have flexible row units with independent depth control. As such, these cultivators have a depth gauge wheel or depth band adjacent to the coulter to control the operating depth of each row unit. To maintain the proper operating angle of the sweep and to allow operation through uneven surface conditions, individual row units often are attached to the tool bar by a wide, stable parallel linkage.

## Cultivating Residue-Covered Fields

Cultivation can begin when corn and grain sorghum is over 3 inches and soybeans are over 2 inches tall. Soil should be relatively dry to maximize soil mixing and clod shattering. The point of the sweep must be operated below the soil surface at a depth sufficient to keep soil moving over the sweep. This helps avoid plugging because the residue is carried by the soil through the cultivator. However, excessive depth can cause soil slabbing and poor weed control because weeds may be enrooted in chunks of soil.

Caution should be used when the crop becomes taller than 15 inches because sweeps can prune crop roots and low toolbars can break plants. Producers with a serious infestation of below-ground spreading weeds like quackgrass and nutsedge may need to combine cultivation and herbicide application.

Proper planning and timing are essential for mechanical weed control. Poor timing or rain delays can cause a flush of weeds that limit crop yields and may cause difficulties in cultivation. Coordinating cultivation with herbicide application is also critical for good weed control.

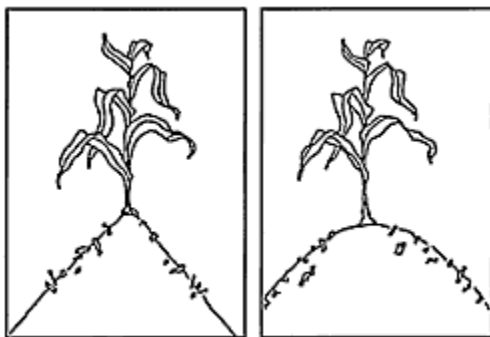
Most soil-applied herbicides remain active for 4 to 6 weeks. Timing the cultivation to the weed pressure and crop canopy closure may be the best way to use the conservation cultivator. This practice requires careful operation because of the potential for crop damage, but results in the most effective method for low-input weed control and improved erosion control.

## Ridge-Till Considerations

Cultivation is an integral part of ridge-plant or ridge-till systems, and is used for both weed control and rebuilding the ridge. Two cultivations, or a cultivation and a ditching operation in furrow-irrigation fields, usually are necessary to rebuild the ridges.

The ridge planter moves crop residue, weed seed and seedlings out of the row, and deposits them between the row where potential weeds can be controlled with cultivation. As much as 70 percent of the previous year's weed seed is moved out of the row. A herbicide band can be used at planting to control weeds that develop in the crop rows. During cultivation, ridges are rebuilt or reshaped for the next season. Ridge planting can result in effective and economical control of some difficult weeds, including shattercane and volunteer corn, with lessened reliance on herbicides.

The first cultivation should be early in the growing season and should be relatively deep, to kill weeds and loosen soil. The leading edge of the sweep or horizontal disk must be below the residue in the bottom of the furrows. A deep cultivation at early crop growth stages reduces the chance of pruning or damaging crop roots and keeps the cultivator operating below residue between the rows. This also provides plenty of soil to carry the residue over the sweeps.



**Figure 2. Desirable ridge shapes.**

The second cultivation or ditching operation is used for rebuilding the ridge with the previously loosened soil. In cases where most of the ridge remains after planting, a second cultivation may not be necessary since only a little soil needs to be moved. The first cultivation must be used to rebuild and reshape the ridge.

The shape of the ridge is critical. Ideally, the ridge should be rounded or flat-topped (*Figure 2*). A peak-shaped ridge is easier to make, but it is difficult to keep a planter centered on the ridges.

To form a rounded or flat-topped ridge, push soil to the row rather than throw it. The ridge should be 6 to 8 inches high after cultivation. With weathering and settling, ridges will be 4 to 6 inches tall the following spring.

Many ridge-plant cultivators are equipped with "barring-off" disks mounted adjacent to the row. During the first cultivation, disks remove soil and emerged weeds from each side of the ridge. During the second cultivation, disks are reversed and positioned to move soil toward the row and to cover small weeds.

Ridging or furrowing wings, attached behind the center sweep or horizontal disk, build rounded or flat-topped ridges. Most wings can be raised out of the way when not in use by repositioning a pin or bolt.

Wings push the soil from the sweep or disk to the row area. Ridging wings are credited with building flatter ridges than disk-hillers. For furrow irrigators, a shovel-type ditcher, rather than a disk-hiller, should be used to build the ridge. Care must be taken because disk-hillers tend to form peak-shaped ridges.

Traditionally, adjustment and use of crop shields have not been of much concern, especially during the second cultivation. However, with ridge-till, the crop shields can play an important role by helping control the ridge shape during the second cultivation.

Since the crop may be relatively tall at second cultivation, the use of open-top shields is necessary. Open-top shields are less limited to crop height and are fully adjustable both vertically and horizontally.

The first step of ridge-planting is to plant conventionally or no-till in the spring. Plant exactly where the rows need to be for the next 5 to 10 years. Provide the cultivator plenty of tilled soil to construct a ridge.

Because of harvest problems, avoid building ridges in a soybean crop. Corn can tolerate ridging, and the soil pushed up at the stalk will not reduce yields. Form ridges when the corn is 12 to 18 inches tall.

Remember that ridge building is a process. Do not expect to build a 6 or 8 inch ridge the first year. This would require moving a lot of soil. Start with a 4 to 6 inch ridge; if the ridges are not torn down or damaged from wheel traffic or livestock, each year more soil can be added to the ridge.

The goal of a 6 to 8 inch high ridge may be a two to three year process. Higher, more stable ridges are possible with 40" rows than with 30" rows.

The number of rows on the cultivator or ditching implement and the planter must be the same. This ensures that all ridges within a single pass of the planter are parallel and equally spaced. Otherwise, when a planter straddles a guess row from the previous season's ridging operation, it is difficult to keep all planter row units on top of the ridges.

## **Guidance Systems for Cultivators**

Staying "on-the-row" while cultivating sloping fields can be challenging. Stabilizer or guidance systems using a large coulter, angle tracking wheels or electronic trackers have proven helpful. Automatic guidance systems are available for keeping field equipment (cultivators, sprayers, planters) centered over the row. These units allow the cultivator to be adjusted closer to the crop without crop damage or root pruning.

When the cultivator works closer to the crop, a narrower herbicide band can be used. By following the old row or crop during planting, ridges can be maintained longer without ridge movement while working on the contour. With automated equipment, operator fatigue is reduced, less skilled operators can be used and operational speeds may be increased.

### **Other Uses of Conservation Cultivators**

Because most cultivators built for conservation tillage systems are more rugged and heavier than standard cultivators, they can be used as an anhydrous ammonia or liquid nitrogen applicator. This improves cost effectiveness and increases nitrogen efficiency because nitrogen can be applied as a side-dress at lay-by. Applying part of the crop's total nitrogen at this stage reduces nitrogen losses that may occur from fall or early spring applications.

### **Modification of Conventional Cultivators**

Some conventional cultivators can be modified to handle residue but may not have sufficient strength to carry the extra weight needed for penetration. However, some older cultivators easily can be modified to handle soybean residue or low amounts of corn and grain sorghum residue.

Cultivators with five shanks per row have difficulty maintaining residue flow through the row units. One solution is to remove some shanks and place wider sweeps on the remaining shanks, especially the one centered between rows. Some farmers also change shank arrangement.



**Figure 3. Conventional shank arrangement for a shovel-type cultivator.**



**Figure 4. Modified shank arrangement for a shovel-type cultivator to allow residue flow.**

On older cultivators, shanks often are arranged in a V-shape formation (*Figure 3*). This arrangement concentrates residue into the trailing center shank that can cause plugging. This plugging problem can be remedied by removing shanks, using wider sweeps, and changing the shank arrangement to an inverted V-shape (*Figure 4*). This allows the residue to flow past the first shovel and to be distributed evenly between the two shovels near the row.

Remember to run all sweeps

sufficiently deep so the soil will help move the residue over the sweep.

Several cultivators that use rolling spiders or disk gangs can be used successfully in residue-covered fields. The rolling spiders are designed so the gang angle can be changed with respect to both the vertical and horizontal planes for added penetration and residue clearing. Some rolling cultivators may not have sufficient strength to carry the extra weight needed for penetration.

Rotary hoes provide early weed control in some conservation tillage situations. Rotary hoe performance depends on the quantity of residue and the firmness of the soil surface. If a rotary hoe penetrates the soil, it may be useful when cultivating crops following soybeans and small grains, and has proven successful when corn residue has been chisel-plowed or disked. Forward speed of 8 mph may be required to ensure residue does not plug the hoes. One or two passes may supplement or eliminate the need for banded herbicides.

## Conclusions

A combination of mechanical and chemical weed control results in a cost-effective system that is not totally reliant on either method. One such approach is to apply a band of herbicide (either pre- or postemergence) over the row and rely on cultivation to control weeds between the rows. **Remember: fields planted using conservation tillage methods require cultivators that can handle residue and penetrate the soil.**

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