Tillage Equipment

Pocket Identification Guide

Tillage Systems-

Primary Tillage-

Secondary Tillage-

Fertilizer/Manure-

Combination Tools-

Other-

NRCS

Natural Resources Conservation Service

September 2006

About this guide…

The purpose of the guide is to help you identify commonly used farm equipment. Its color photos and line drawings will facilitate communication between NRCS and our clients by providing common definitions and RUSLE2 terminology.

Revised Universal Soil Loss Equation, Version 2 (RUSLE2), was developed primarily to guide conservation planning, inventory erosion rates and estimate sediment delivery. Values computed by RUSLE2 are supported by accepted scientific knowledge and technical judgment, are consistent with sound principles of conservation planning, and result in good conservation plans.

The different systems reviewed in this guide are color coded. The page boarder colors will group the different systems together:

Tillage Systems-green	Fertilizer/Manure-brown
Primary Tillage-red	Combination Tools-blue
Secondary Tillage-yellow	Other-orange

Mulch-till planting will leave varying residue levels after planting depending upon the number of tillage passes and the level of soil disturbance.

Mulch-Till Planting System

Mulch-till - The soil is disturbed the full width prior to planting. Tillage tools such as chisels, field cultivators or disks are used full width. Weed control is accomplished with herbicides and/or cultivation.

Mulch-Till Planting System

No-till planting with residue. Long term, no-till is an effective erosion control and significantly reduces surface runoff. This reduces sediment and nutrient loading of lakes and streams, which improves water quality and reduces flooding.

No-Till Planting System

No-till - The soil is left undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners or disk openers. Weed control is accomplished primarily with herbicides. Cultivation may be used for emergency weed control.

No-Till Planting System

Ridge-till - The soil is left undisturbed from harvest to planting. Planting is completed in a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges. Weed control is accomplished with herbicides and/or cultivation. Ridges are rebuilt during cultivation.

Ridge-Till Planting System

Ridge-Till

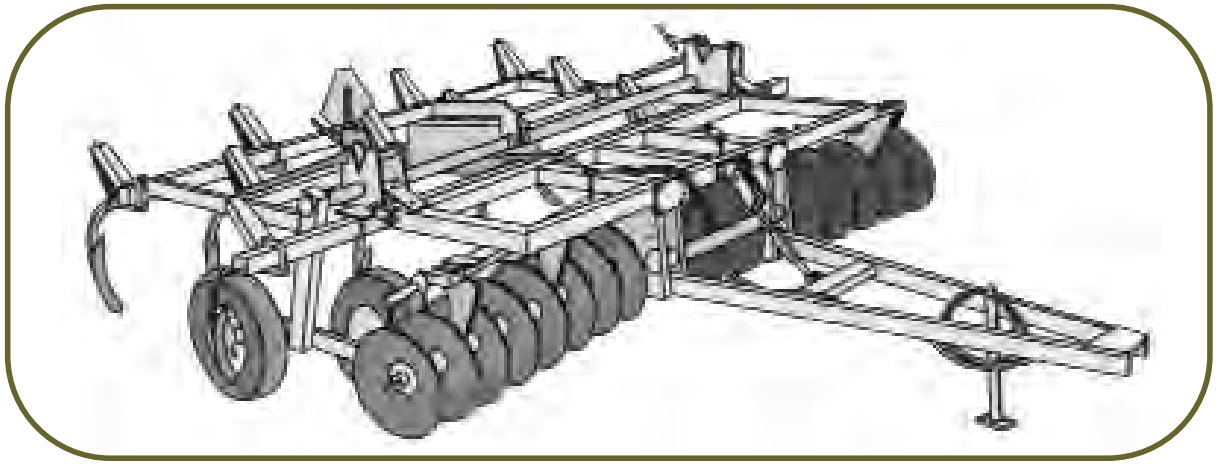
Seedbed preparation is completed in a narrow band no more than 1/3 of the row width. It may be completed in the fall with the application of nutrient or at planting time. Crop residue and soil consolidation is left undisturbed between the seedbed areas.

Strip-Till and Zone-Till Planting System

Strip-Till and Zone-Till Planting System

The Chisel Plow components may include various types of sweeps, spikes and shovels attached to the shanks. In the Midwest, many producers use 2-inch wide reversible-point spikes or 2.5-to 4-inch wide twisted shovels. Spikes and sweeps do less soil mixing and cover less residue than do twisted shovels.

Some chisel plows are equipped with a gang of coulters or disk blades mounted in front to cut residue.



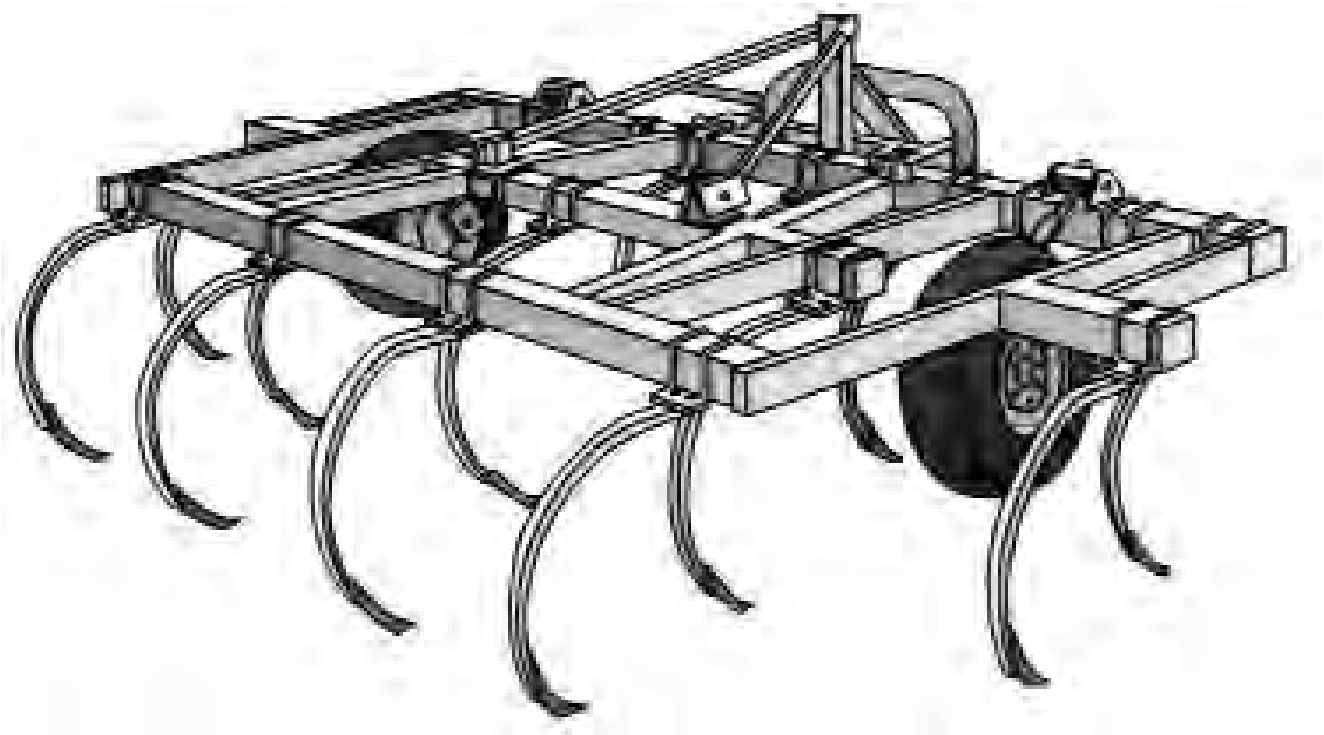
Reduced tillage is usually done with a chisel plow and leaves 15% to 30% residue coverage on the soil.

Chisel Plow

The selection of the specific primary tillage tool and type of points or blades is important to the success of mulch-till systems. Generally, the less inversion action the point or shovel creates, the less residue is buried.

Chisel Plow

RUSLE2 - Chisel, straight points

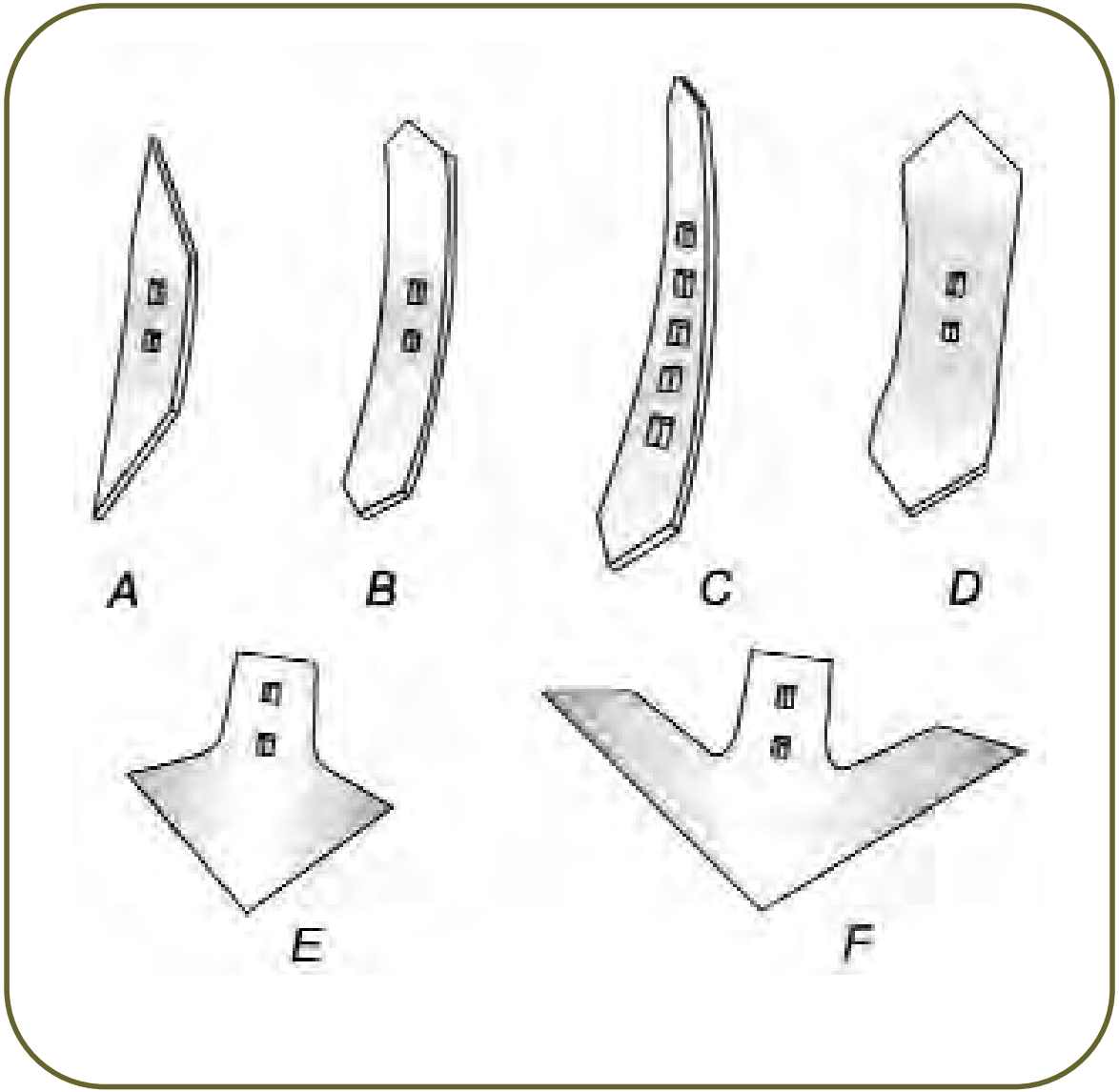


Primary tillage implement used in the fall that breaks and shatters the soil leaving it rough with residue on or near the surface. Operating depth ranges from 6 to 12 inches.

Chisel Plow

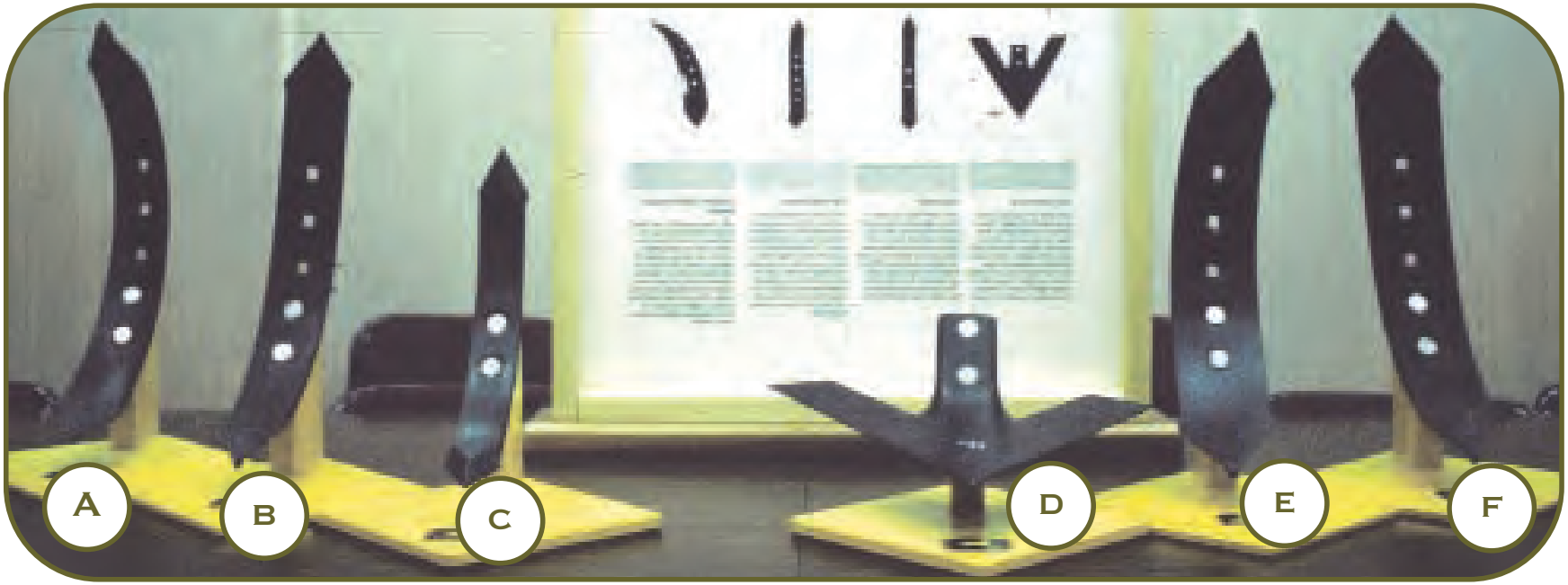
RUSLE2 - Chisel, Sweep Shovel

Chisel with Sweeps



A. 2” reversible pike point
B. 2” reversible Straight Chisel Point
C. 3” right and left twisted shovels Points
D. 4-1/2” reversible shovel
E. 8” or 10” shovels
F. 12”, 14”, 16”, or 18” sweeps

Chisel Points



Sweeps and spike points bury less residue than do straight points or twisted points. Slower speeds and shallower operating depths usually leave more residues.

(A) 3 inch twisted

(B) 3 inch straight

(C) 2 inch wide Straight

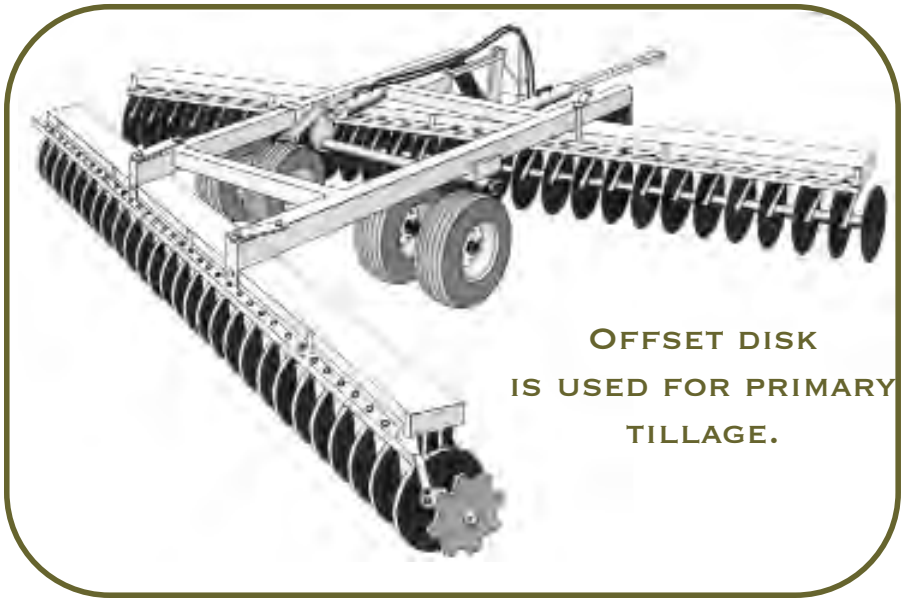
(D) Sweep

(E) 4 1/2 inch wide twisted

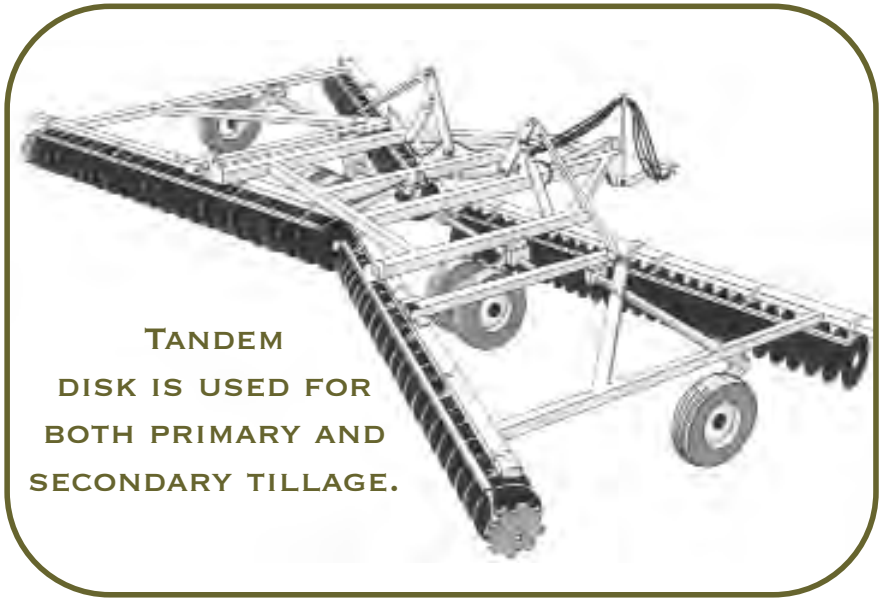
(F) 4 1/2 inch straight point

Chisel Points

RUSLE2 - disk, offset



RUSLE2 - disk tandem



A disk is a tillage implement that pulverizes or smooths the soil. Its concave cutting blades are mounted on a common shaft to form a gang. A disk consists of two or more gangs attached to a frame. The operating depth is usually one quarter of the disk diameter.

RUSLE2 - Disk, Tandem

Disk, tandem

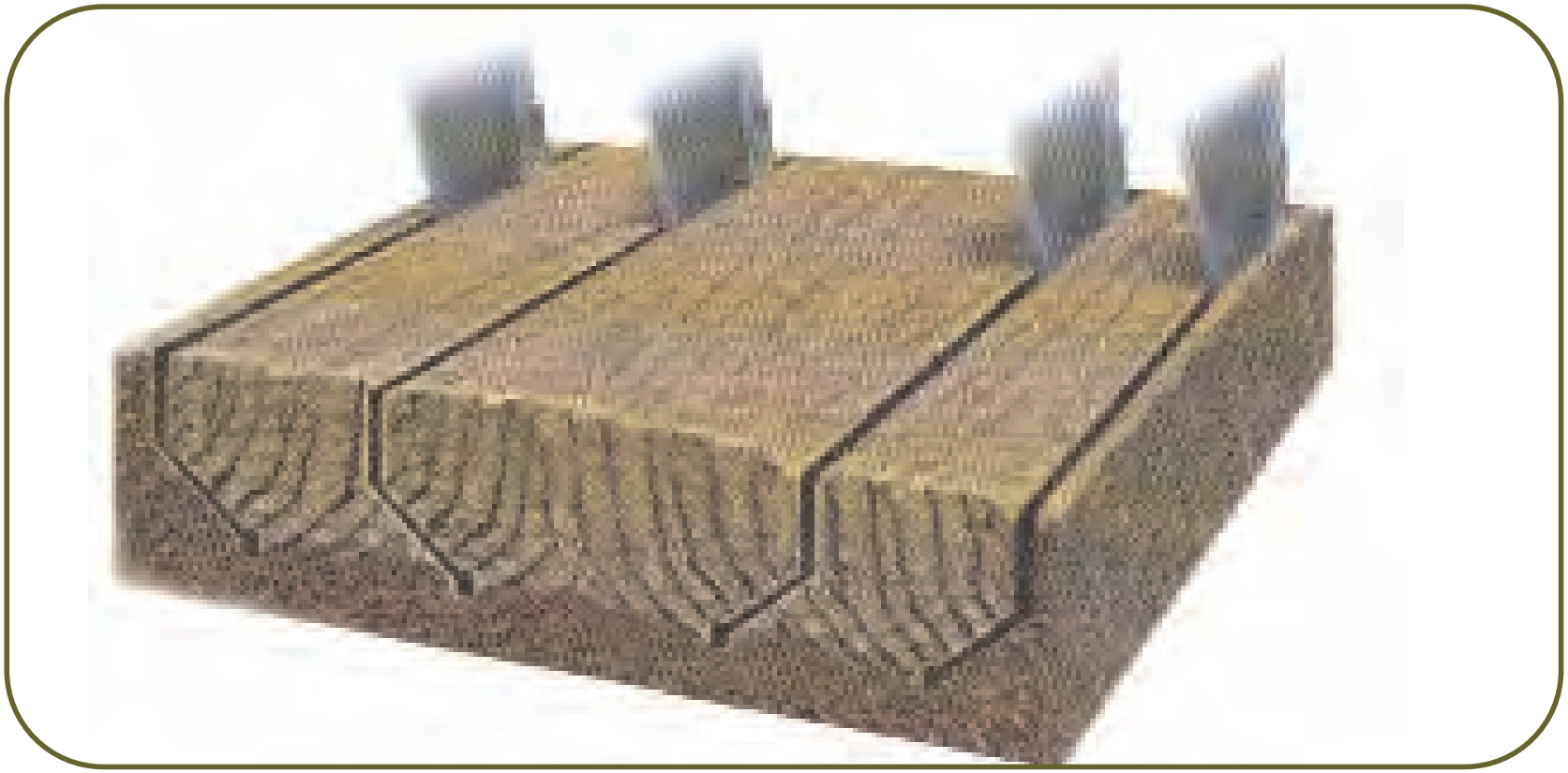
RUSLE2 - Disk, offset, heavy 15 inch depth

Sometimes called a plowing disk, this disk uses its weight and large diameter blades to slice and turn soil and residue. It does extensive soil disturbance and residue burial.

Heavy Offset Disk

The tandem light finish tool provides less soil disturbance than the offset disk, leaving more residue on the soil surface. The amount of residue left on the soil surface depends upon the depth of tillage, speed and moisture content of the soil at the time of tillage.

RUSLE2 - Para-plow or para-till



The purpose of the Para-plow is to loosen compacted soil layers 12 to 16 inches deep and still maintain high surface residue levels. The Para-plow lifts and fractures the soil.

Para-plow

Surface residue is left on the soil surface as the soil is lifted and fractured below.

Para-Plow

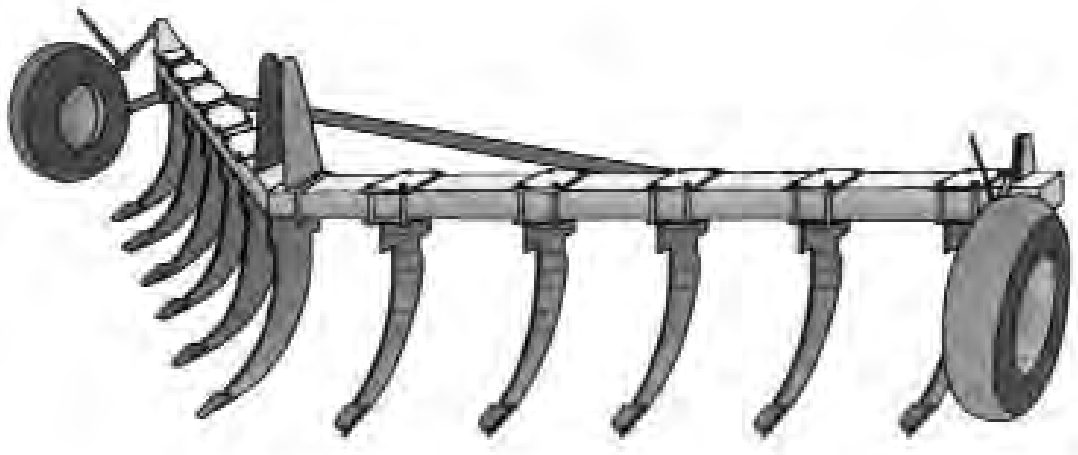
The moldboard plow thoroughly lifts and inverts the soil leaving very little residue on the soil surface.

Plow - Moldboard

RUSLE2 - Subsoiler

The subsoiler is a primary tillage tool, used in the fall, that is similar to a chisel plow. It is typically designed to penetrate 12 to 22 inches deep to alleviate soil compaction.

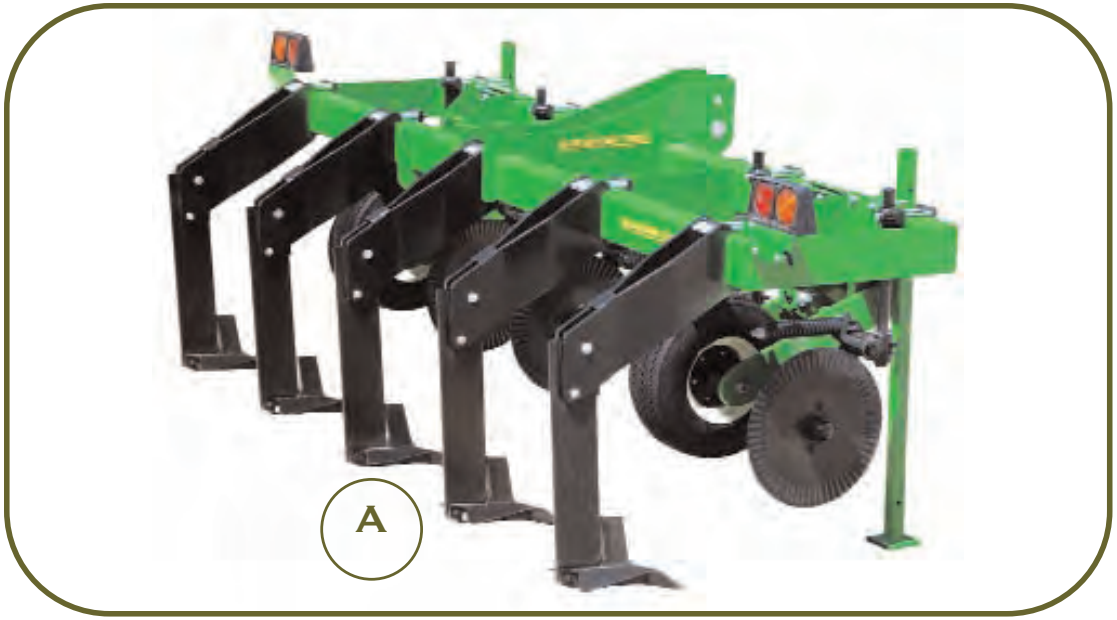
Subsoiling is often used to loosen compacted areas of fields where heavy loads have passed. The amount of disturbance will depend upon the shape of the shank and the working angle of the tool bar.

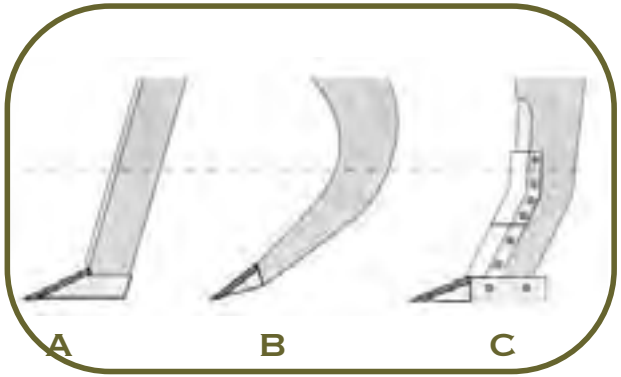


V-Ripper

In-Row Subsoilers do less soil disturbance than a conventional subsoiler or V-Ripper. Use "Subsoiler, in-row" for the RUSLE2 operation when using subsoilers that do little disturbance of surface residue.

Subsoiler/V-Ripper





Subsoiler shanks:

(A) straight

(B) parabolic

(C) bent leg

Subsoiler/Shanks

RUSLE2 - Aerator, field surface, ground driven

While maintaining surface residue, Shattertines crack and shatter compacted soil 8 inches to open new channels for air and water.

AerWay®

AerWay® shattertines lift and fracture the soil to increase air and water movement.

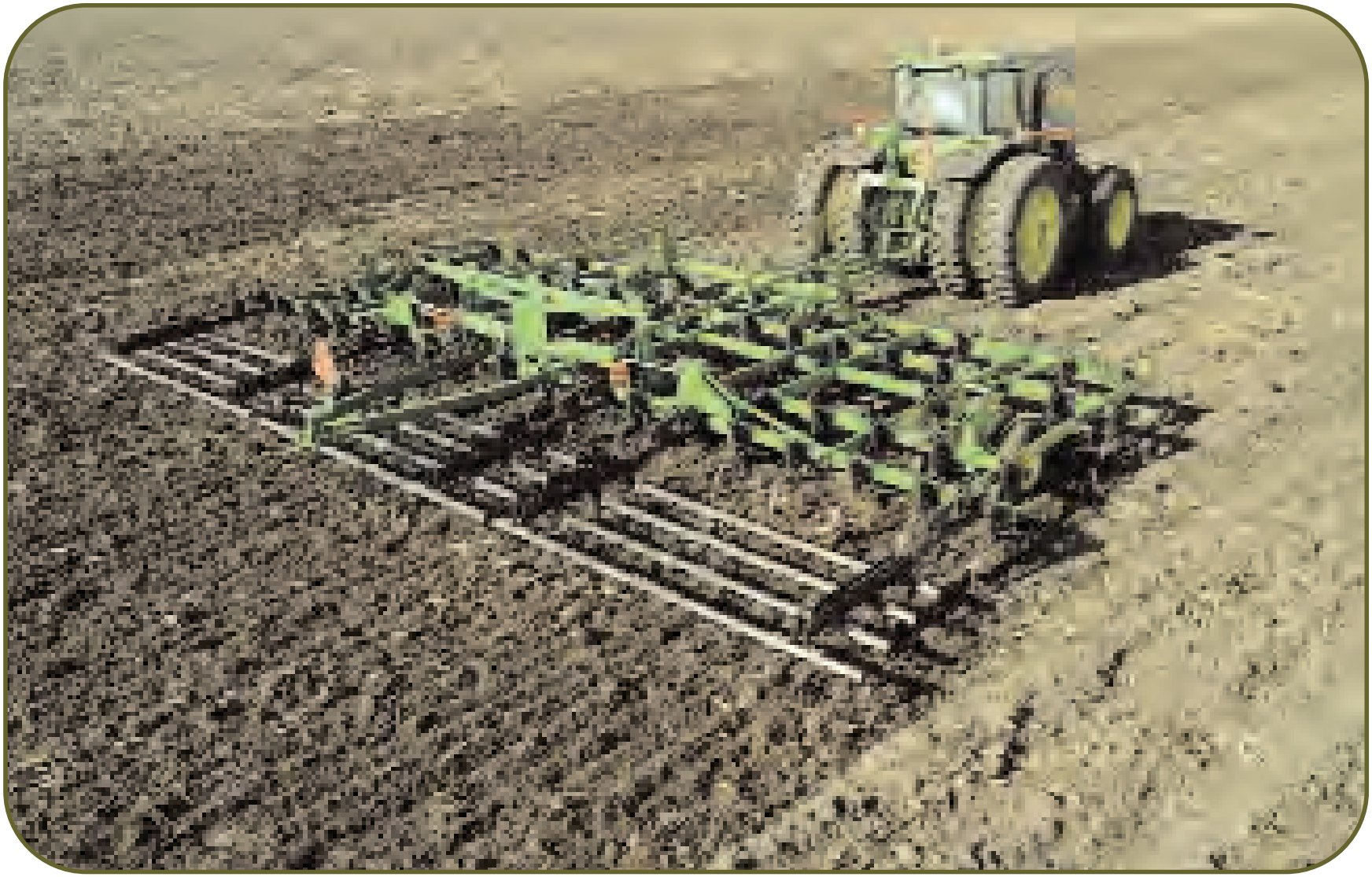
AerWay®

RUSLE2 - Cultivator, field with 6-12 inch Shovel C and Spiked Tooth Harrow Attachment

A field cultivator is designed for light tillage and field finishing. Usually they are used for secondary tillage and for incorporating herbicides. Spiked point field cultivators do little soil mixing and leave more residue on the surface.

For RUSLE 2 Calculations this is two operations–cultivator, field with 6-12 inch shovels and spiked tooth harrow.

Field Cultivator with Harrow Attachment



Field Cultivator–with Coiled Tine Harrow

RUSLE2 - Cultivator, field 6-12 inch sweeps

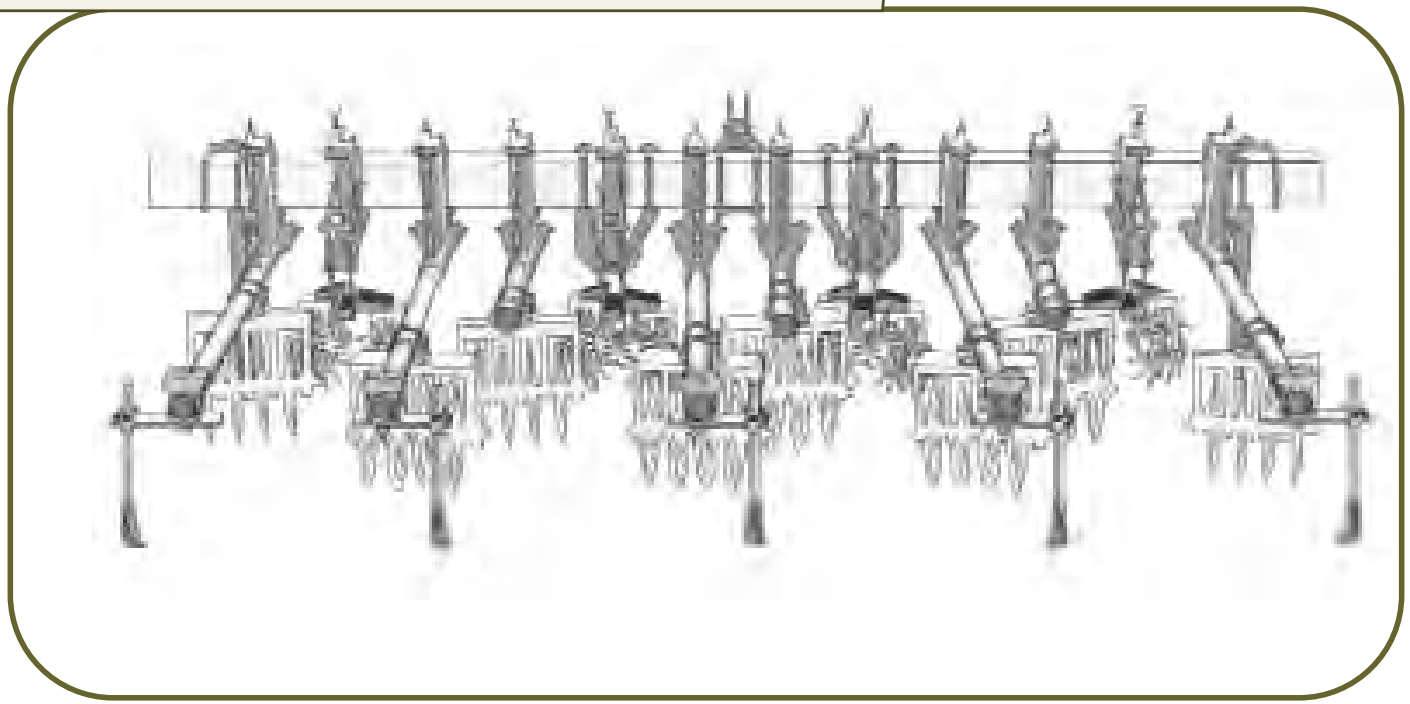
Field cultivators equipped with sweeps do extensive horizontal and vertical soil mixing. Sweeps are the choice for herbicide incorporation. Sweeps bury more residue than field cultivators equipped with spiked points.

Field Cultivator - Sweeps

RUSLE 2 - Cultivator, Field 6-12 inch sweeps with harrow coiled tine

For RUSLE 2 calculations, this is two operations– cultivator, field 6-12 inch sweeps with harrow coiled tines.

Field Cultivator - Sweeps



A Rolling cultivator uses two spider gangs on each row assembly. It operates in heavy residue without clogging.

Rolling Cultivator

RUSLE2 - Rolling Basket Incorporate

Rolling Cultivator

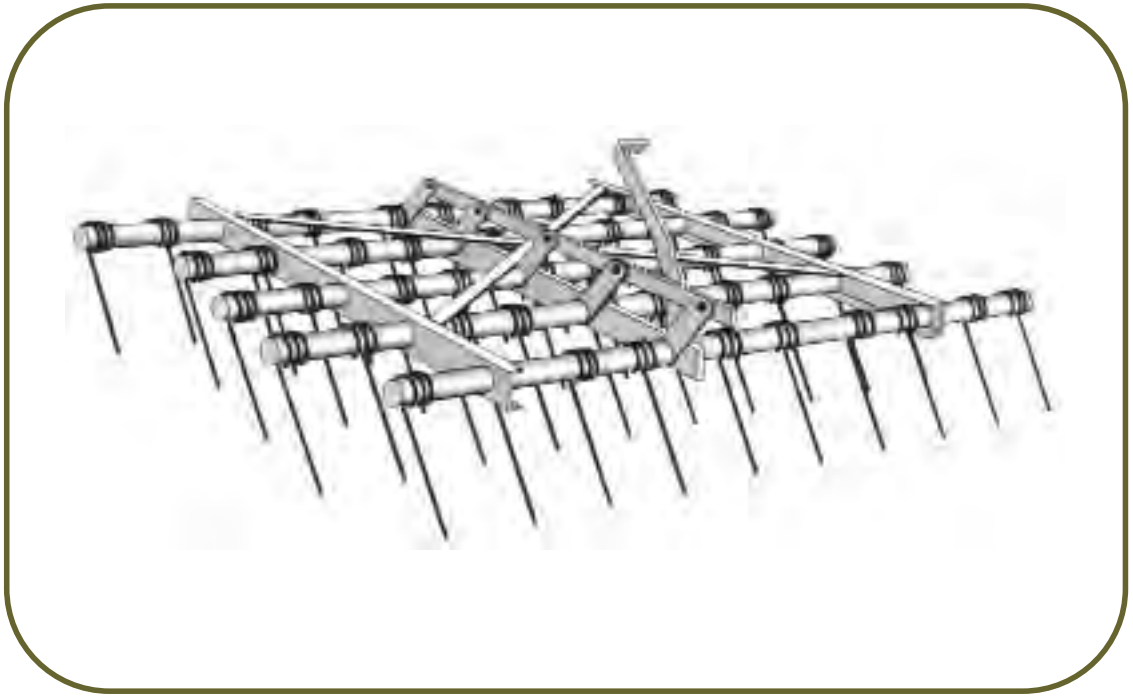
Row cultivators kill weeds while preserving the crop.

Row Cultivator

RUSLE2 - Cultivator, row, high residue

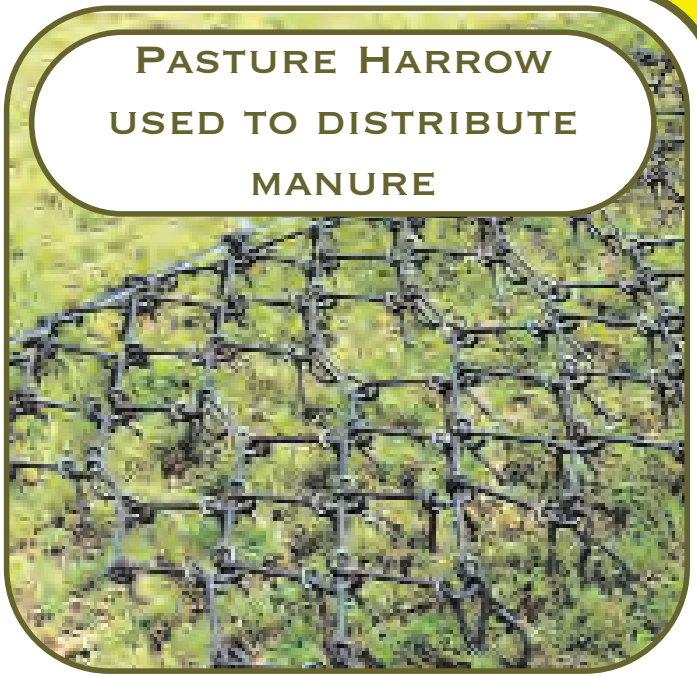
Row Cultivator

RUSLE2 - Harrow, Coiled Tine



Harrows are primarily used to level the soil surface, redistribute surface residue, pulverize clods and disturb germination of weeds. Harrows are often attached to the rear of disks, field cultivators, or drills to smooth and firm the soil surface and redistribute residue.

Coiled Tine Harrow



Pasture Harrow used to distribute manure

Spiked Tooth Harrow

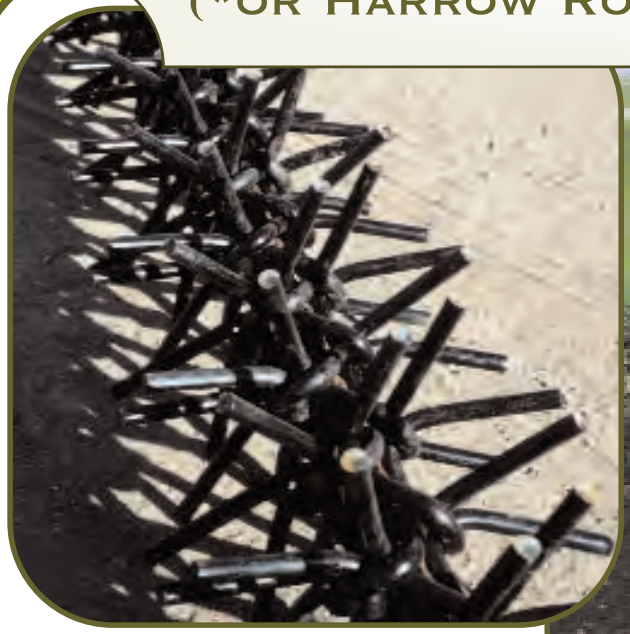
Harrows

RUSLE2 - Harrow, Rotary
(*or Harrow Rotary Light Fluff Fragile)

the Phillips™ Rotary Harrow works in the top inch or so to prepare seedbeds. It redistributes residue and levels the ground. (*Depending upon the type of residue present, use Harrow Rotary for heavy, nonfragile residue such as corn and Harrow Rotary Light Fluff Fragile for light residue such as soybeans.)

Harrow/Phillips™

RUSLE2 - Harrow, Rotary
(*or Harrow Rotary Light Fluff Fragile)



Tines disturb only the top inch or so of soil. In general, the greater a tool is angled off the tool bar, the more that operation will disturb the soil. The Phillips™ harrow is permanently set at a 45 degree angle. (Depending on the type of residue present, use Harrow Rotary for heavy, nonfragile residue such as corn, and harrow Rotary Light Fluff Fragile for light residue such as soybeans.)

Harrow/Phillips™

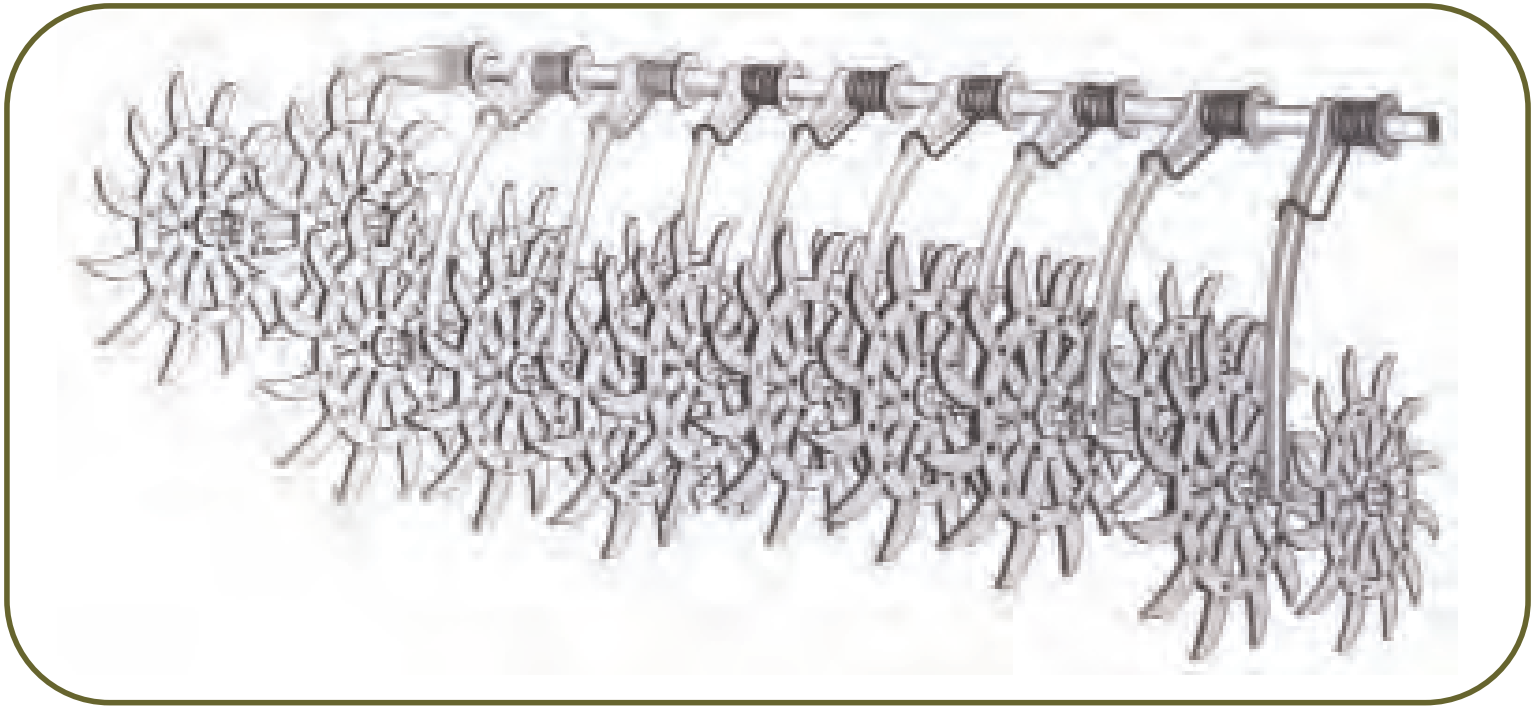
RUSLE2 - Harrow, Rotary
(*or Harrow Rotary Light Fluff Fragile)

The phoenix® harrow is a high residue tillage tool that disturbs the soil .5 to 2 inches deep, leaving most of the residue on the soil surface. The greater the harrow is angled off the tool bar, the more the operation will disturb the soil.

Harrow/Phoenix®

The phoenix® harrow is used to mix the top inch of soil surface to incorporate herbicides and level the ground. The angle may be adjusted from 20 to 45 degrees.

Harrow/Phoenix®



A rotary hoe consists of one or two staggered gangs of spider-like wheels about 3.5 to 4 inches apart. It is a fast, economical way to control small weeds and break surface crust to improve crop emergence.

Rotary Hoe

Fertilizer Application - Anhydrous Ammonia

RUSLE2 - Fertilizer application, anhydrous knife 30 inch

In the midwest anhydrous ammonia comprises the majority of commercial nitrogen application. Anhydrous ammonia must be injected into the soil. This is commonly done with narrow knives attached to a tool bar pulled by a tractor. Precise application is important from economic and environmental perspectives.

strip tillage combines the benefits of no-till and full-width tillage, but tillage is confined to 6- to 8-inch strips into which dry fertilizer and/or anhydrous ammonia can be placed. Loosened soil in the strips creates a ridge or berm 3 to 4 inches high, which settles down to 1 to 2 inches by spring planting. Crop residue in row middles is left undisturbed.

RUSLE2 - Fert. Applic., Strip-Till 30 inch

RUSLE2 - When strip-till operation is done at planting time with no previous tillage operation use "Planter, Strip-Till." When strip-till is created in the fall or spring prior to planting operation use "Fert. Applic., Strip-Till 30 in."

RUSLE2 - Manure injector, liquid high disturb 30 inch

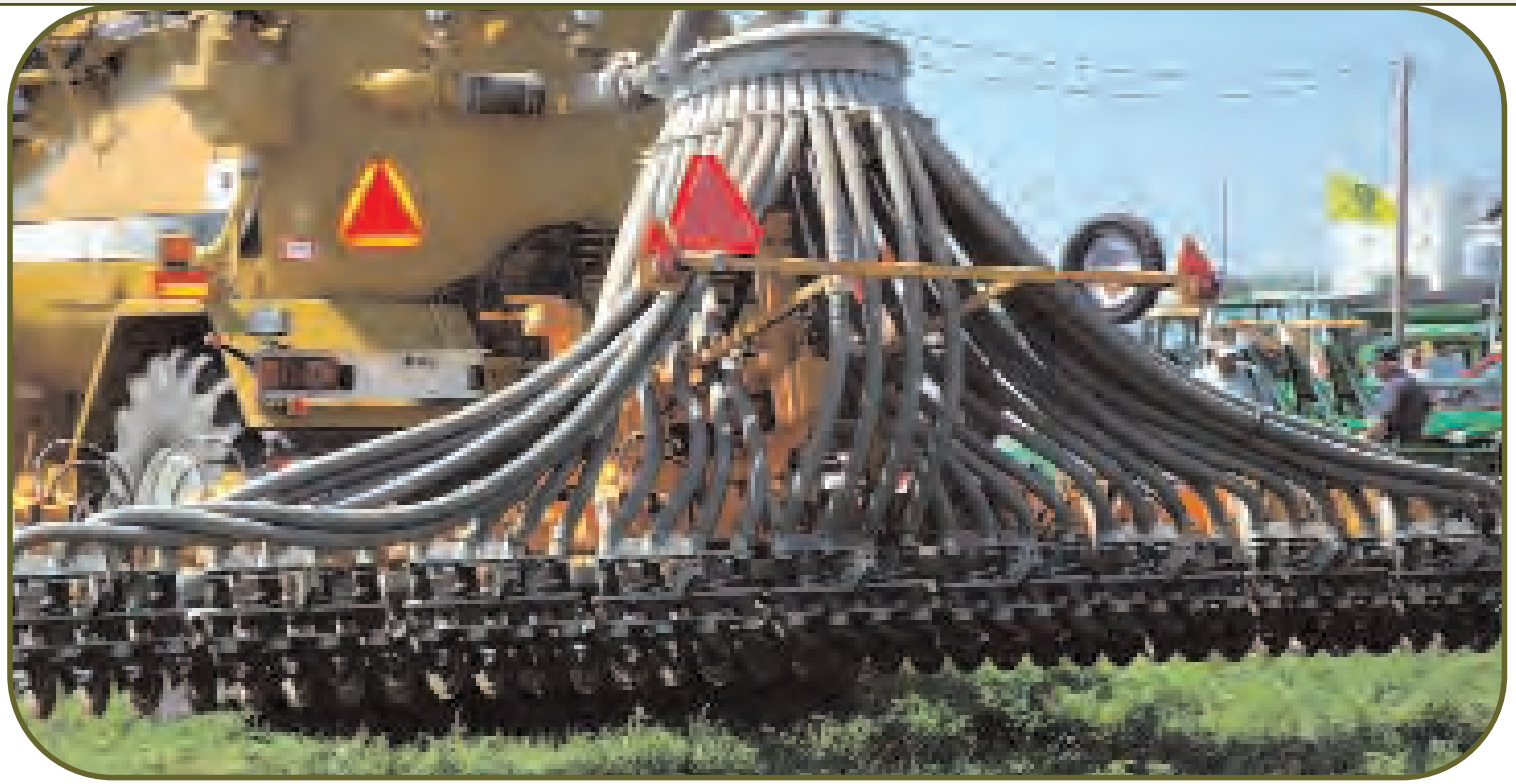
When using an Umbilical cord manure injection system on 30 inch spacing in bean stubble, the type of injector system will determine the amount of residue and soil disturbance.

Manure Injector - High Disturbance

Tank type liquid manure injector with high disturbance

Manure Injector - High Disturbance

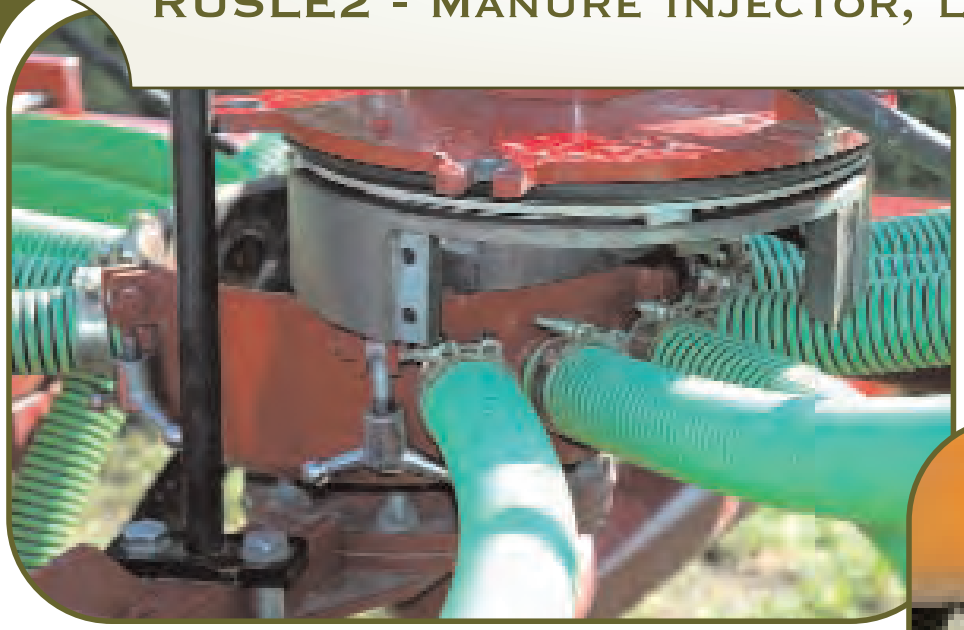
RUSLE2 - Manure injector, liquid low disturb 15 inch

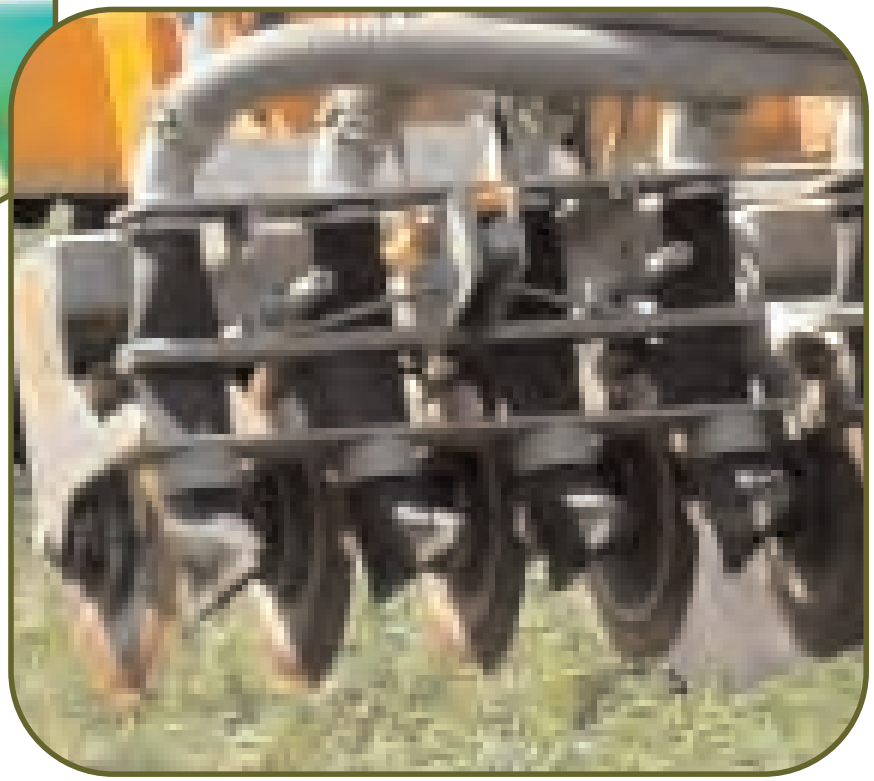


Tank type liquid manure injector with low disturbance coulters. However, because 15 inch rows are used here, this method disturbs twice as much soil surface as when 30 inch rows are used. As a result RUSLE2 soil loss calculations will be higher with 15 inch versus 30 inch units.

Manure Injector - Low Disturbance

RUSLE2 - Manure injector, liquid low disturb 15 inch





Pictured above is a disassembled manure distribution box which uses high speed rotating knives to cut manure chunks into a non-clogging size. To the right is a close up of the disks and injection blades.

Manure Injector - Low Disturbance

RUSLE2 - Aerator, Harrow, Rotary

For RUSLE2 calculations this is two operations–Aerator with Rotary harrow.

Combination Tool

Aerator

Combination Tool

Aerator with Rotary Harrow

RUSLE2 - Coulter Caddy, 2X with Coiled Tine Harrow

For RUSLE2 calculations this is three operations–two coulter caddies and one coiled tine harrow.

RUSLE2 - Coulter Caddy 2X with Rolling Basket Incorporate

For RUSLE2 calculations this is three operations–Coulter Caddy and a Rolling Cultivator. Note: This Turbo-till has a rolling basket instead of the coil tine harrow.

Combination Tool

Turbo - Till

RUSLE2 - coulter caddy with harrow, rotary 2X

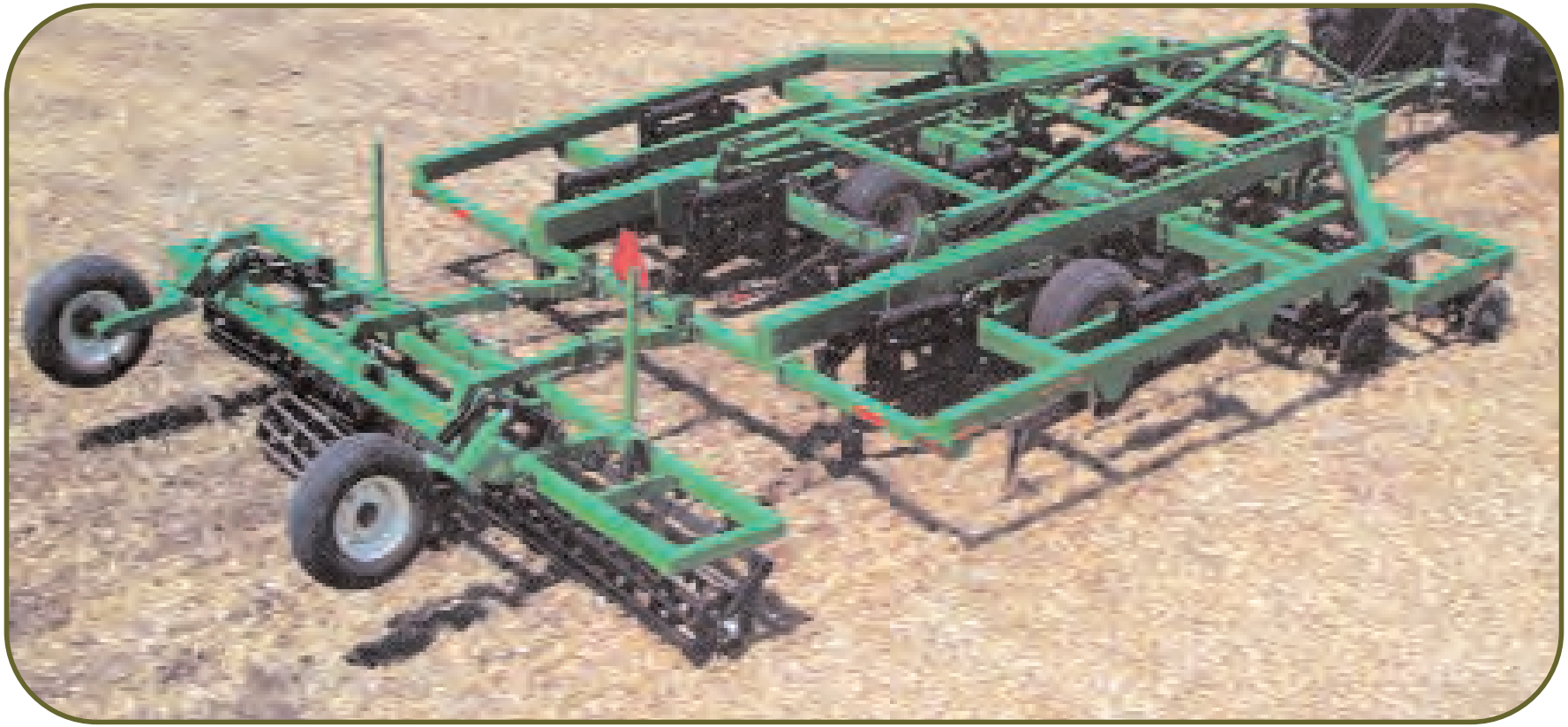
For RUSLE2 calculations this tillage tool is three operations–one coulter caddy and two phillips™ harrows.

RUSLE2 - Coulter Caddy with Harrow, Rotary 2X

Combination Tool

Ultra - Till

RUSLE2 - Coulter Caddy with Subsoiler and Rolling Basket Incorporate

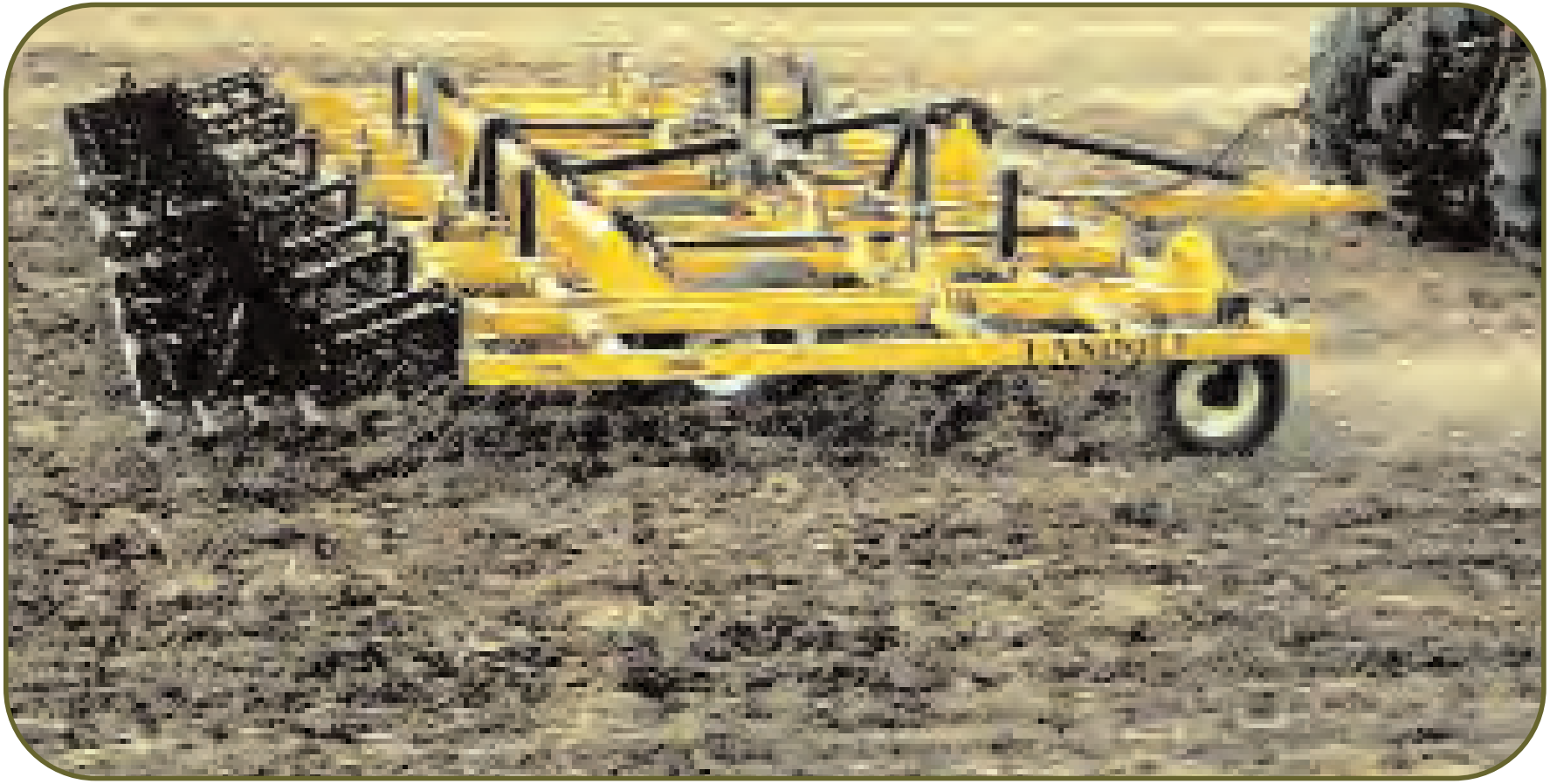


Verti-Till is a coulter/subsoiler designed to cut and size residue, as well as deep rip horizontal density layers in one pass. For RUSLE2 calculations this is three operations–coulter caddy with subsoiler and rolling cultivator.

Combination Tool

Verti-Till

RUSLE2 - Field Cultivator with Coiled Tine Harrow Attachment

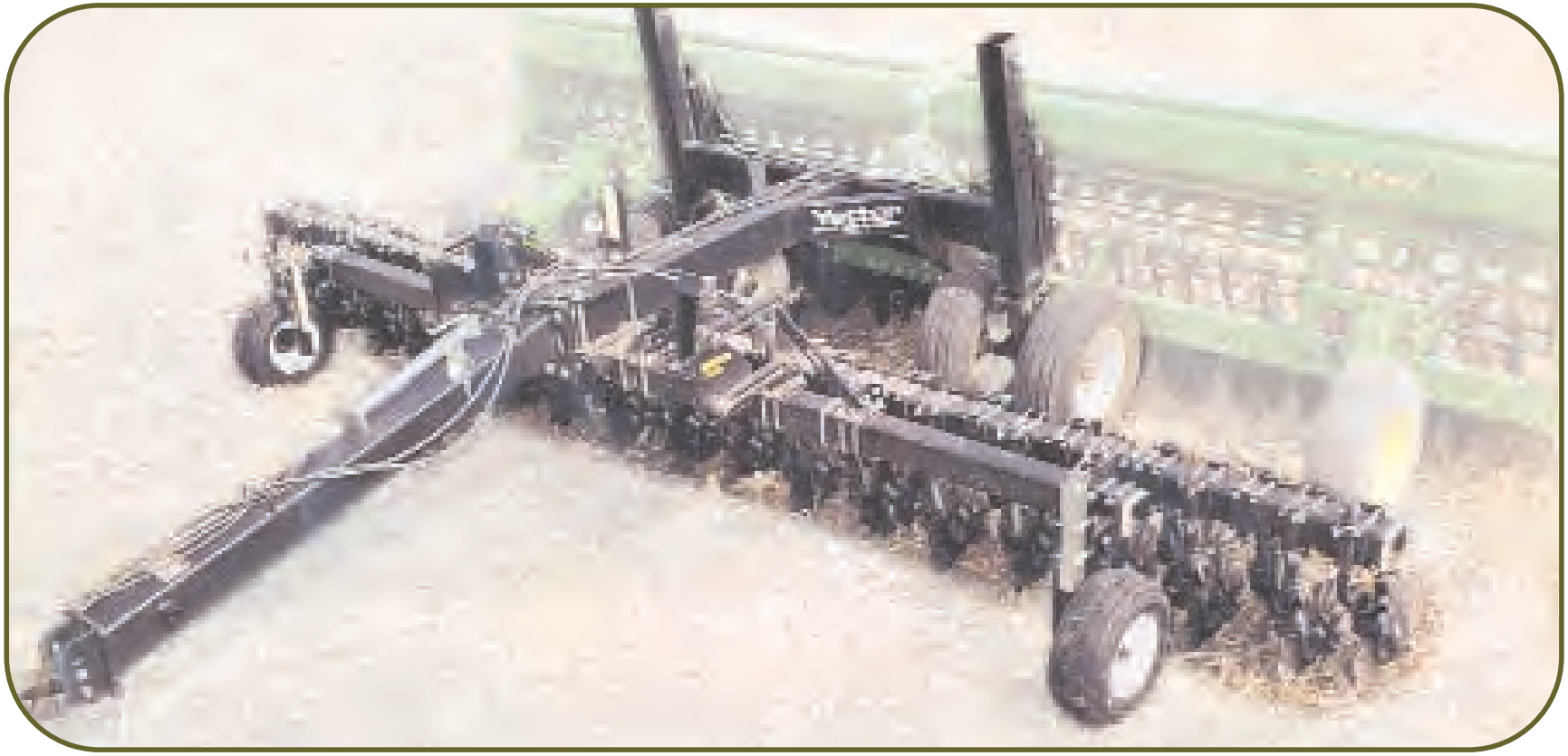


For RUSLE2 calculations this is two operations—field cultivator with coiled tine harrow.

Combination Tool

Landoll

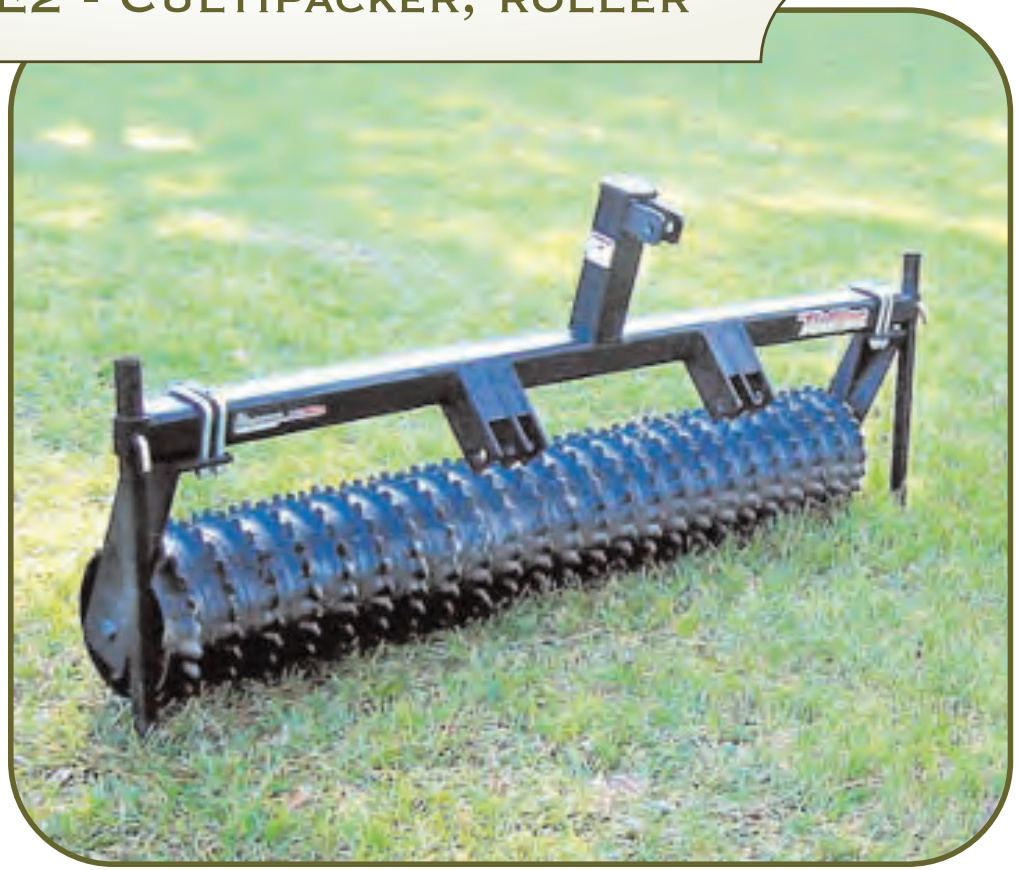
RUSLE 2 - Coulter Caddy with Fluted Coulters



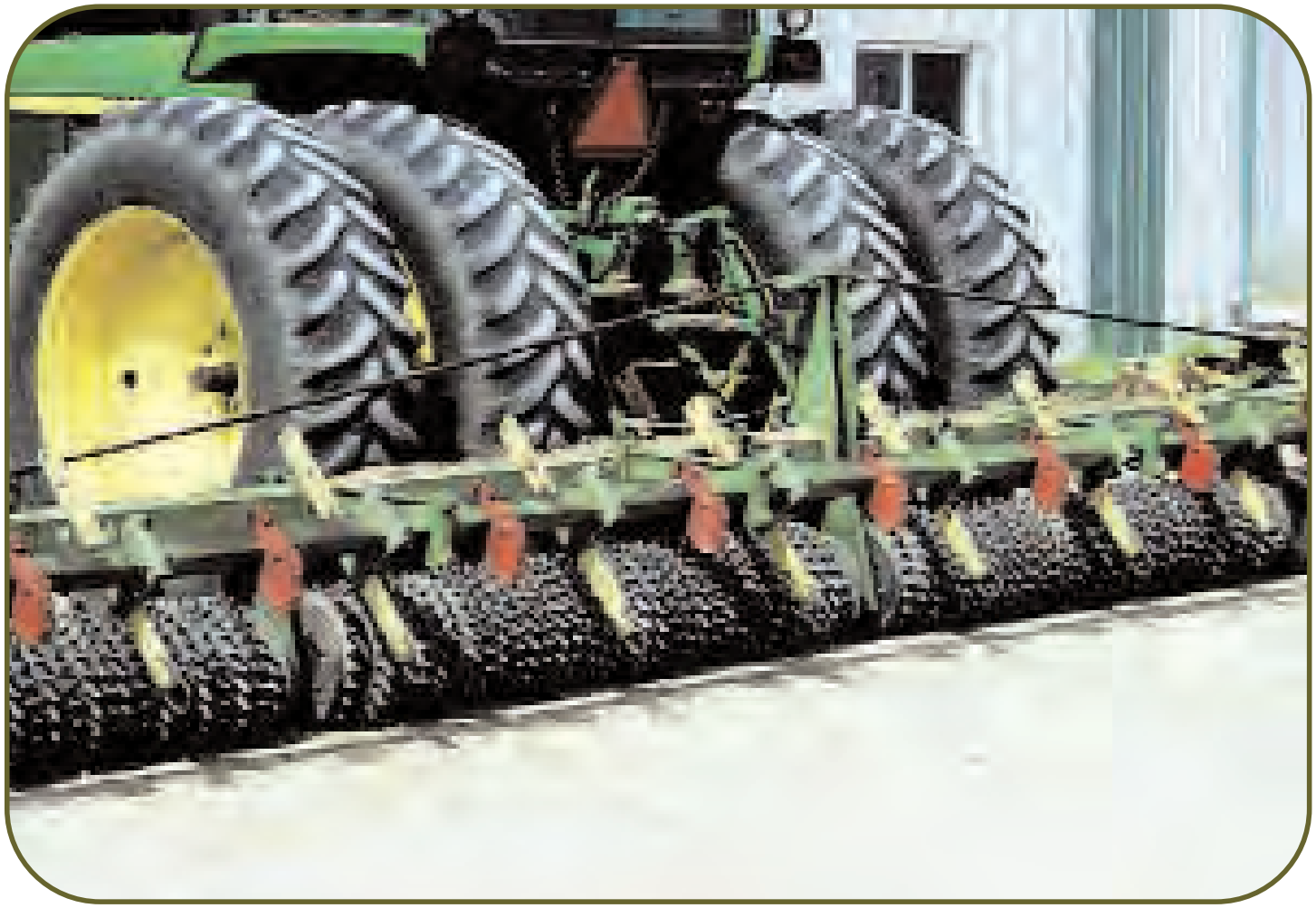
Coulter caddies are installed in front of grain drills and other planting equipment to facilitate planting under high residue conditions.

Coulter Caddy

RUSLE2 - Cultipacker, roller



The cultipacker firms the seed bed. This contributes to better seed soil contact and is important for establishment of small seeded crops like forages.



Cultipacker–Rolling

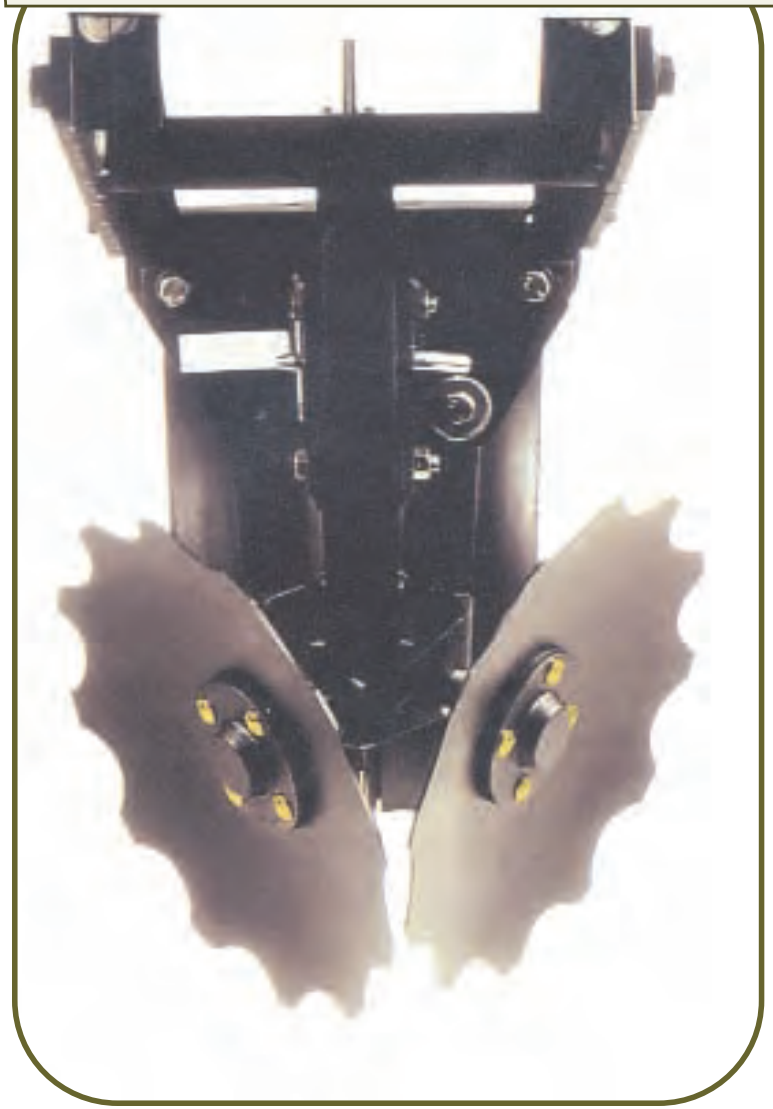
RUSLE2 - Drill, single disk openers, 7-10 inch spacing

Conventional grain drills deliver accurate seed metering and placement with optimum soil-to-seed contact.

Specialty drills provide exceptional seed placement and accurate seeding of everything from very small, light seeds to difficult to handle seed such as native grass seeds.

Grass Drills

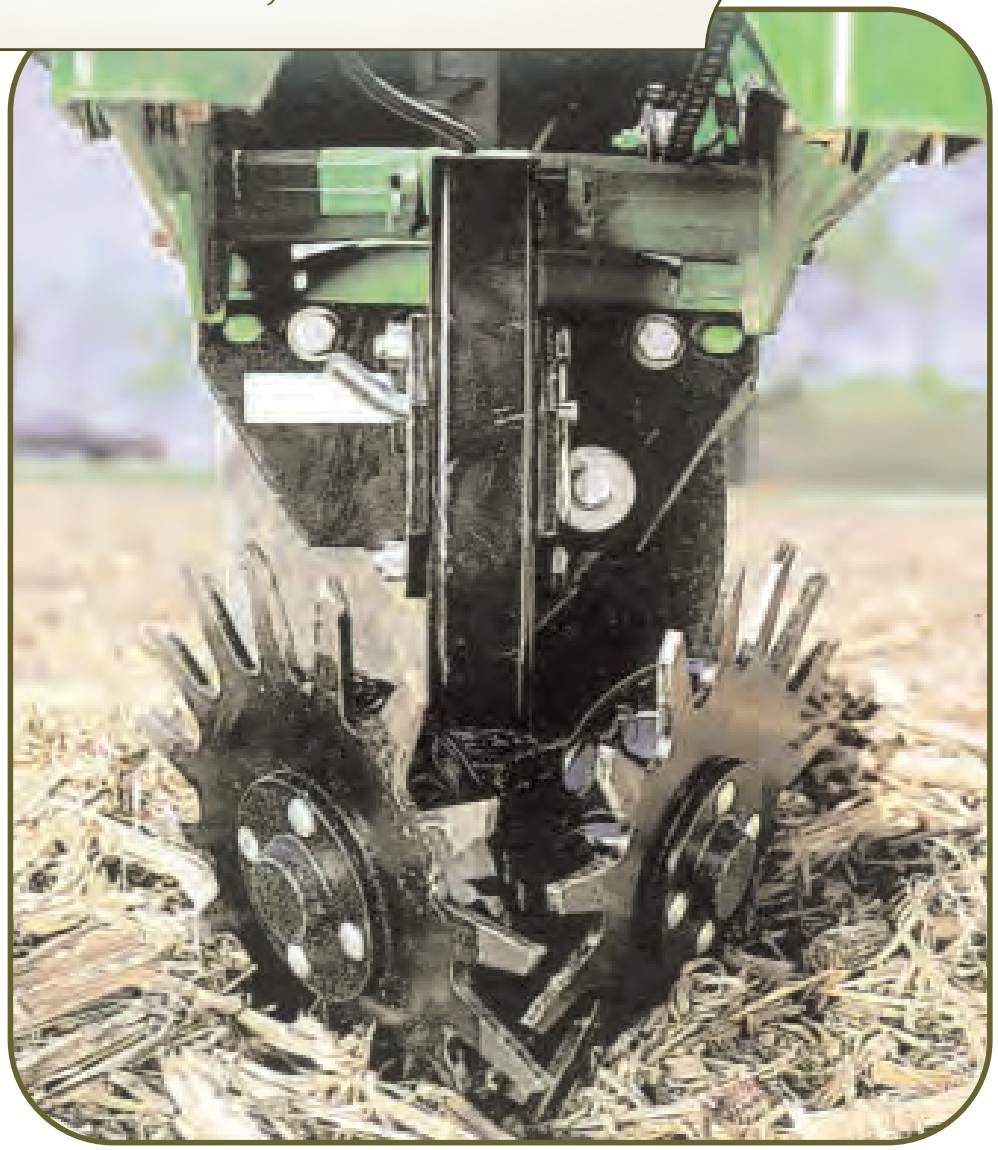
RUSLE2 - Residue, Row Cleaner



Residue row cleaners are used to move crop residue away from the seedbed to facilitate the planting process.

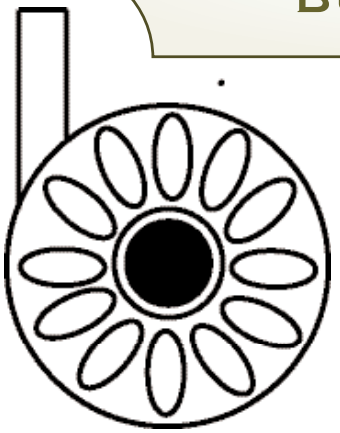
Residue Row Cleaner

RUSLE2 - Residue, Row Cleaner



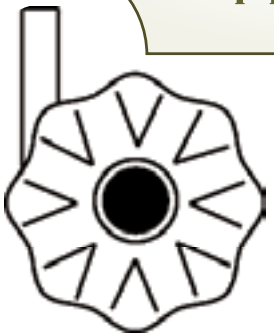
Residue Row Cleaner

Bubble Coulter



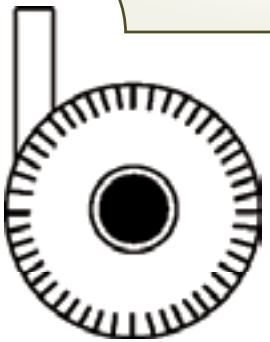
Bubble coulters till a narrow 0.5 to 0.75 inch slot and do not till as much of the seed slot. Planting depths are more restricted than with the fluted coulters.

Fluted Coulter

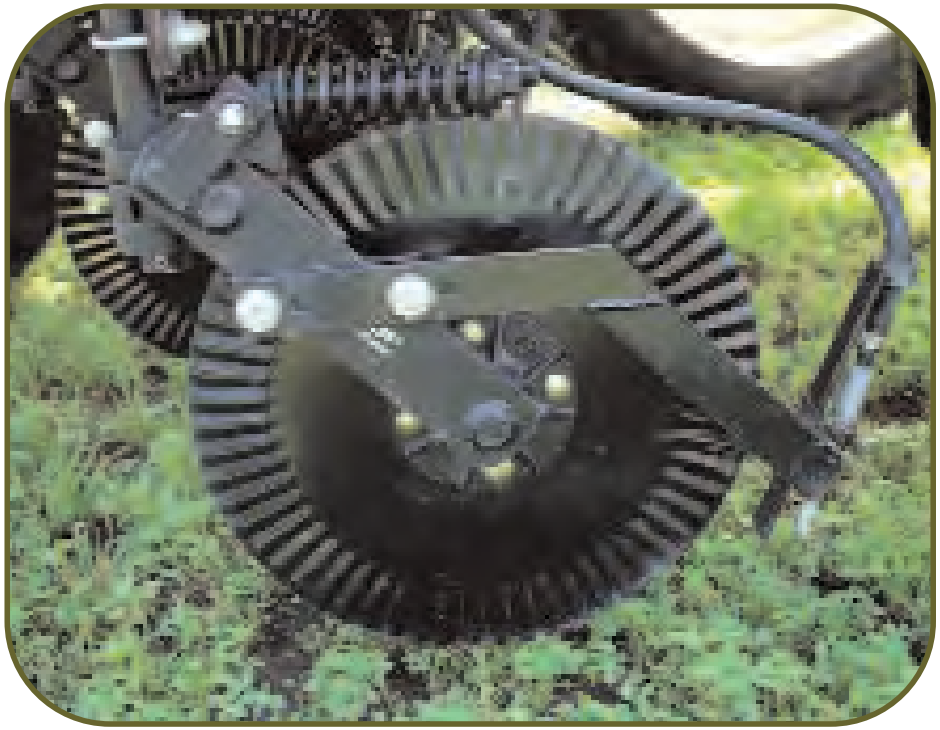


The 1 to 1.5 inch narrow fluted coulters till a slot wide enough to allow double disk openers to place the seed at optimum depths. This wider slot permits deeper placement of the seed.

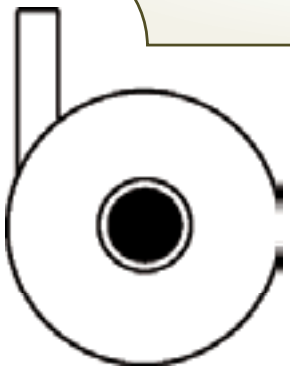
Ripple Coulter



rippled coulters till a narrow 0.5 to 0.75 inch slot and do not till as much of the seed slot. Planting depths are more restricted than with the fluted coulters.

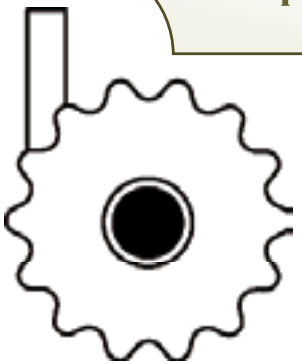


Concave Disk



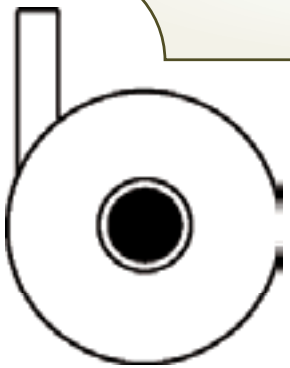
Depending upon the size and depth of tillage, the Concave disk does full width tillage and inversion of soil. It is used as a compaction tool.

Notched Disk

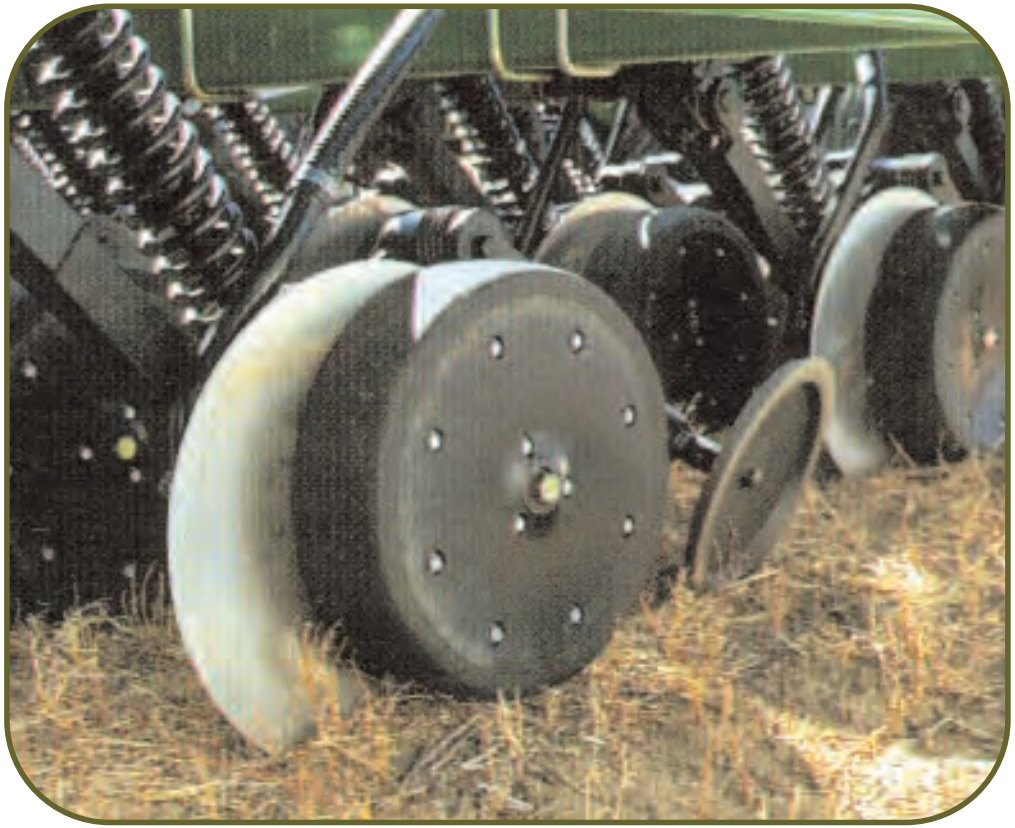


Notched Disks are very similar to the concave disk and depends upon the size and depth of tillage as to how much soil disturbance is done.

Straight Disk

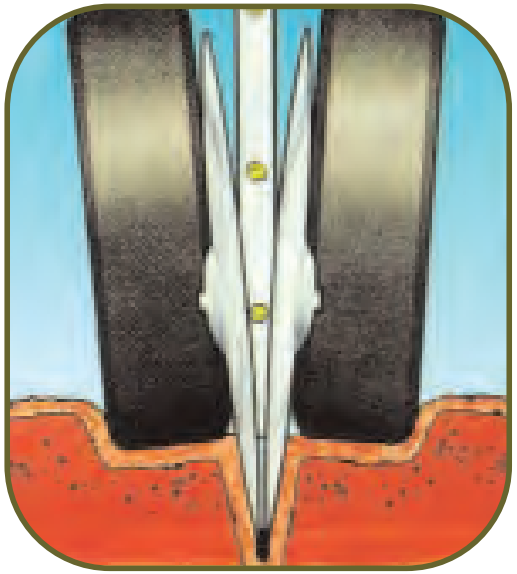


Straight disks are used to cut the surface residue and does little inversion of the soil.



Single disk openers are used to cut the surface residue.

Double Disk Openers



Double disk openers are typically used in no-till or high residue systems. They are mounted parallel and equidistant to each other and form a "V" shaped slot in to which the seed is dropped as the planter moves along.

RUSLE2 - Revised Universal Soil Loss Equation is an erosion predictor tool used to estimate average annual soil loss from sheet and rill erosion for a specific site.

The RUSLE2 crop year starts with the “harvest” of the previous crop and includes all of the operations that are completed to prepare the seedbed, plant, control weeds up to and including harvest. In the example below the first crop to be planted is corn followed by all of the operations. The second crop to be planted is soybeans and includes all of the tillage operations since harvest of the corn crop.

Example: corn grain; Sfcult, soybean; wr, FC st pt, disk, fcult

The above example is a Corn/Soybean rotation in which corn is planted into soybean stubble that has been spring field cultivated prior to planting; soybeans are planted wide row (30 inch rows) into corn stalks that have been fall chiseled with straight points, disked and field cultivated prior to planting.

RUSLE 2 Glossary of Abbreviations

Many tillage tools are combinations of operations described in RUSLE2. These tools can be accounted for in RUSLE2 calculations by combining two or more operations on the same day to fully describe the overall tool being used.

RUSLE2 Glossary of Abbreviations

3X	3 years of growth included
FC st pt	Fall chiseled with straight points
FC sweep	Fall Chiseled with sweeps
FC Twist	Fall Chiseled with twisted points
Fdisk	Fall disk
Ffcult	Fall field cultivate
FP	Fall Plow
NR or nr	narrow row
NT	No-till
NT anhyd	No-till with anhydrous application
RT	Ridge till
SC st pt	Spring Chiseled with straight points

RUSLE2 Glossary of Abbreviations Continued

SC sweep	Spring Chiseled with sweeps
SC Twist	Spring Chiseled with twisted points
Sdisk	Spring disk
Sfcult	Spring field cultivate
SP	Spring Plow
ST	Strip till
eh	early harvest
ep	early plant
lh	late harvest
lp	late planting date
mp	middle planting date
wr	wide row (> 30 inches)
z4	crop management zone 4
z16	crop management zone 16

NRCS

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