About this guide....

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

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. Primary Tillage-red. Secondary Tillage-yellow. Fertilizer/Manure-brown. Combination Tools-blue. Other-orange.
Mulch-till planting will have various residue levels after planting depending upon the number and severity of tillage passes prior to planting.
Mulch-till - The soil is disturbed the full width prior to planting. Tillage tools such as chisels, field cultivators or disks full width are used. Weed control is accomplished with herbicides and/or cultivation.
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 - 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.
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
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
While maintaining surface residue, Shatertines crack and shatter compacted soil 8 inches to open new channels for air and water.
Aerway shattertines lift and fracture the soil to increase air and water movement.
The Chisel Plow components may include various types of sweeps, spikes and shovels attached to the shanks. In the Midwest, 2-inch wide reversible-point spikes or 2.5 to 4-inch wide twisted shovels are widely used. 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.
The selection of the specific primary tillage tool and type of points or blades are important to the success of mulch-till systems. Generally the less inversion action the point or shovel creates, the less residue is buried.
Primary tillage implement done 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.
A. 2" REVERSIBLE SPIKE 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
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.
A disk is a tillage implement that pulverizes or smoothes 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 the disk diameter.
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.
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.
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.
Surface residue is left on the soil surface as the soil is lifted and fractured below.
Moldboard plow does extreme lifting and inverting the soil leaving very little residue on the soil surface.
The subsoiler is a primary tillage tool, done in the fall, that is similar to a chisel plow. It is typically designed to operate 12 to 22 inches deep to alleviate soil compaction. Subsoiling is often used to try 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.

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 shanks: (a) straight, (b) parabolic, and (c) bent leg.
A field cultivator is designed for light tillage and field finishing. Usually they are used for secondary tillage and for incorporating herbicides. Spiked points 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--w/ COILED TINE HARRROW ATTACHMENT
Field cultivators, equipped with sweeps, do extensive horizontal and vertical soil mixing. Sweeps are the choice for herbicide incorporation. Sweeps bury more residue than spiked point equipped field cultivators.
For RUSLE 2 calculations, this is two operations—cultivator, field 6-12 inch sweeps with harrow coiled tines.
Rolling cultivator uses two spider gangs on each row assembly. It operates in heavy residue without clogging.
Row cultivators kill the weeds while preserving the crop.
RUSLE2 - Cultivator, row, high residue

Row Cultivator
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.
Pasture Harrow
Used to distribute manure

Coiled Tine Harrow

Spiked Tooth Harrow

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

The Phillips Rotary Harrow works in the top inch or so to work up 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 Light Fluff Fragile for light residue such as soybeans.)
Tines disturb only the top inch or so of soil. In general, the greater a tool is angled off of 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 light fluff fragile for light residue such as soybeans.)
The phoenix harrow is a high residue tillage tool that disturbs the soil one-half to two inches deep leaving most of the residue on the soil surface. The greater the harrow is angled off of the tool bar the more the operation will disturb the soil.
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.
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.
In the midwest anhydrous ammonia supplies 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-in. 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 in. high, which settles down to 1 to 2 in. by spring planting. Crop residue in row middles is left undisturbed.
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.”
Using an Umbilical cord manure injection system on 30 inch spacing in bean stubble leaves little residue left on soil surface.
Tank type liquid manure injector with high disturbance

Manure Injector - High Disturbance
Tank type liquid manure injector, low disturbance, but because of the 15 inch rows, will disturb twice as much soil surface as 30 inch rows.
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.
For RUSLE2 calculations this is three operations - two coulter caddies and one coiled tine harrow.
For RUSLE2 calculations this is two operations - Disk Light Finish and a Rolling Cultivator
For RUSLE2 calculations this tillage tool is three operations--one coulter caddy and two Phillips harrows.
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.
For RUSLE2 calculations this is two operations - field cultivator with coiled tine harrow.
Coulter caddies are installed in front of grain drills and other planting equipment to facilitate planting under high residue conditions.

RUSLE 2 - Coulter Caddy with Fluted Coulters
CultiPacker firms the seed bed. This contributes to better seed soil contact and is important for establishment of small seeded crops like forages.
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.
Residue row cleaners are used to move crop residue away from seedbed to facilitate the planting process.
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.
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.
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.
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 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 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 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 into 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 seedbed, plant, weed control 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.
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
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
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