RUSLE2 Tillage and Crop Residue Management

Identifying and recording the tillage, planting, and harvest operations within a crop rotation is an important step in determining the soil loss that may occur on a cropland field. Tillage is a sequence of mechanical operations that lifts and pulverizes soil structure to kill weeds and incorporate surface residue, level the soil surface, incorporate pesticides and fertilizers, and make the soil surface firm but friable for the planting of the next crop. Tillage may be periodically repeated to fill and cover over rill and gully erosion while removing compaction and crusting from rain events and of course, terminating weed growth.

The Revised Universal Soil Loss Equation, Version 2 (RUSLE2) model is used to estimate the potential soil erosion by water based on the location, topography, soil type, farming operations and crop rotation, and structural practices installed to control runoff. The model also provides the planner with an assessment of the Soil Conditioning Index (SCI) and the Soil Tillage Intensity Rating (STIR). The SCI value is calculated based on field operations and the effect on soil erosion and soil organic matter; a positive value shows a possible increase in improving the soil resource. The STIR value is based on the annual soil disturbance (tillage, planting, and harvesting).

CONVENTIONAL TILLAGE
Tillage that occurs with the main focus of residue management, pest suppression, land forming or soil conditioning is an intense disruption in the surface layers of soil. Soil is displaced and thrown from tillage equipment in contact with the soil. Soil structure is destroyed, and soil particles are pulverized. This type of soil tillage makes the soil susceptible to soil erosion and sediment movement offsite by destroying the natural processes to consolidate soil particles. Tillage operations are generally full width implements; the entire field has the soil surface disturbed and displaced.

Tillage implements used as the primary conventional tillage operation are moldboard plows, chisel plows, chisels, sweeps, heavy disks, powered rototillers, and bedders. Secondary operations are smaller and lighter disks, harrows, packers, ground-driven rotary tillers, field cultivators, field conditioners, rollers, bed shapers, and rotary hoes. Light tillage may occur immediately prior to planting merely to kill weeds that have emerged. Tillage to cultivate the crop after planting to remove undesired vegetation may be row crop implements with ground-driven rotary tines, spring tooth tines, shank tine cultivators, rotary hoes, or power-driven rotary tillers. Using tillage for weed control after a crop has been planted is risky – the equipment operator must have the tillage tool set to remove weeds without damaging the planted crop.

Combination tools that perform primary and secondary tillage in one pass may be used. These combination tools may include coulter blades to cut and size surface residue, subsoiler shanks to lift and fracture the soil, or chisel plow shanks and disk blades to fluff and displace soil while covering residue. Secondary tillage tools may be incorporated in a combined tool to “dress up” the field by leveling ridges, filling furrows, packing the surface, or crumbling soil aggregates. RUSLE2 calculations must account for each of these separate operations that occur in a one-pass
tillage system. In some cases even the planting equipment is attached to the tillage tool to reduce time and fuel to get the crop planted.

Conventional tillage will generally have an SCI value that is negative (-) value showing that the farming system is not sustainable and a STIR that is higher than 60. Residue is usually less than 15 percent ground cover with conventional tillage. In most cases this amount of crop residue is not a significant factor in reducing soil erosion by wind or water.

CONSERVATION OR MINIMAL TILLAGE (includes Vertical Tillage)

Conservation tillage is used when there is a need to maintain surface residue from harvest to planting time for soil surface protection from wind or water erosion forces. The surface residue is maintained at 30 percent ground cover or higher to provide some mulching effect – allowing crop seedlings to germinate and emerge with some protection from the forces of nature.

The goal with conservation tillage is to leave residue on the surface equal to or in excess of 30 percent ground cover while controlling the weed population and preparing a firm seedbed for the planting of the next crop. Tillage operations are the full width of the implement and will disturb the entire soil surface for the field.

The RUSLE2 SCI with conservation tillage may be either a negative or positive value depending on the type of tillage used. The STIR value is generally between 20 and 70 showing significant soil disturbance.

Vertical Tillage

Vertical tillage is the new “buzz word” for tillage equipment and is an attempt to reduce the impact of conservation tillage on the soil surface by using implements that merely till narrow bands, zones, or strips of soil with shanks or smooth coulters entering and exiting the soil on a vertical plane. The primary reason to use vertical tillage is to size heavy residue for planting operations with minimal lateral displacement of soil. The secondary reason is to remove compaction with shanks or coulters pulled through compacted zones. These tillage operations occurring together in one implement are not part of a “no till” system – too much soil is moved and displaced to be considered no till. But the operation may be considered minimum tillage based on the amount of surface soil disturbance, horizontal soil displacement, and residue destruction. True vertical tillage implements size residue but are not residue management implements.

Very few of the implements sold as “vertical tillage” actually work as described above. The implements are generally set at a shallow draft and are pulled at speeds often as high as 8 to 10 miles per hour. A review of a sampling of these vertical tillage implements sold by common manufacturers have shown that the majority of the implements are merely another form of the basic disk harrow. Check equipment out either in the farmer’s equipment lot or on-line to determine the tillage accomplished. Since there are many different combinations of tillage tools that can be used on this equipment, a planner must be able to identify the RUSLE2 operations that are being performed.
Below is a summary of some of the tools sold as vertical tillage but is not intended to be a complete list of what will be found on the typical Midwest farm: All of these implements may be configured with different or additional attachments than described here.

- **Alamo Earthmaster Verti-Go MWT3400**: two gangs of 25-tooth concave disk blades on 7.5-inch spacing sold at a gang angle setting of 18 degrees designed to move soil horizontally. Implement also includes a seedbed finisher. This implement does **NOT** meet the definition of a vertical tillage tool; it is a tandem disk harrow with seedbed finisher.

  **Example RUSLE2 operation:**
  Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

- **Blu-Jet Coulterpro**: two rows of individually mounted coulters used to size residue prior to planting. This tool is a vertical tillage implement and a strip till operation only when the disturbed soil area is less than 30 percent of the narrowest row width in the crop rotation. With no till the crop must be planted in all the tilled strips.

  **Example RUSLE2 operations:**
  1) Coulter caddy, with fluted coulters or
  2) Coulter caddy, with smooth coulters

- **Case IH True-Tandem 330 Turbo**: two offset gangs of disk blades at 18 degree angle designed to move soil horizontally. This implement does **NOT** meet the definition of a vertical tillage tool; it is a tandem disk harrow. This is not a “no till” operation.

  **Example RUSLE2 operation:**
  Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

- **Case IH Ecolo-Til 2500**: individual coulter for each ripper shank. Minimal surface disturbance with sizing residue and lifting and fracturing soil. This implement is a vertical tillage tool by definition but does not qualify as a no till operation due to the amount of soil displaced.

  **Example RUSLE2 operation:**
  Subsoiler, inline with coulter caddy

- **Degelman Pro-Till**: A compact disk cultivator with independently mounted disks on 10-inch spacing set at 16 degrees. This implement does **NOT** meet the definition of a vertical tillage tool; it is a tandem disk harrow with a strip roller packer. This is not a “no till” operation.

  **Example RUSLE2 operation:**
  Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

- **Gates Magnum Coulter Disk**: implement is gangs of coulters mounted for on-the-go hydraulic adjustment from 0 to 15 degree angle. Gangs may have an optional manual adjustment at 0, 5, 10, or 15 degrees. This is a vertical tillage implement only when pulled through the field with gangs set at a 0 degree angle to the direction of travel. Any other setting that angles the coulters in relation to the direction of travel would make this tool a disk harrow and would **NOT** meet the definition of a vertical tillage implement. This is not a “no till” operation.
Example RUSLE2 operations:
- 0-degree angle – Seedbed conditioner, coulter caddy, coil tine harrow, rolling basket
- 5 to 15 degree angle – Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket (combination tool)

Great Plains Ag
- Turbo-Chopper: a combination tillage tool with 20-inch diameter turbo coulters spaced every 10 inches, 18-inch diameter chopper reels with 6 blades, a series of rolling spike harrows, and a rolling reel harrow. The turbo coulters, chopper reels, and rolling spike harrows effectively disturb and till the entire soil surface. This tool does NOT meet the definition of a vertical tillage implement. This is not a “no till” operation.

Example RUSLE2 operation:
- Seedbed finisher, single disk, field cultivator coil tine harrow, rolling basket

Turbo-Max: a combination tillage tool with 2 offset gangs of turbo coulters spaced at 7½ inches (effective tillage every 3½ inches). Angle on the gangs can be set from the tractor seat at 0° to 6° making this implement into a tandem disk. Common attachments are a rotary spike-toothed harrow and rolling basket. This tool does NOT meet the definition of a vertical tillage implement. This is not a “no till” operation.

Example RUSLE2 operation:
- Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

Turbo-Till: a combination tillage tool with 2 offset gangs of turbo coulters, angled rotary spike-toothed harrows, and a rolling reel. The entire soil surface is disturbed with this equipment with some lateral movement of soil. Implement is used to size residue and cover residue with soil to speed decomposition. This is not a “no till” operation.

Example RUSLE2 operation:
- Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

HCC Smart-Till: an aeration tillage tool with multi-tine disks mounted on angled gangs to be operated at shallow depths up to a maximum of 8 inches deep. This implement disturbs the entire soil surface and does NOT meet the definition of a vertical tillage tool. This is not a “no till” operation.

Example RUSLE2 operations:
- Harrow, rotary

Kongskilde Vertical Tillage 9100: coulters in gangs that can be angled to the direction of travel at 0, 4, 8, 12, or 16 degrees. Coulters are mounted at an 8-inch spacing. This implement is a vertical tillage tool only when set at an angle of 0 degrees; when set at the 4, 8, 12, or 16 degree settings, this tool does NOT meet the definition of a vertical tillage tool and tills the soil as a tandem disk. This is not a “no till” operation.

Example RUSLE2 operations:
- 0-degree angle – Coulter tiller and spike harrow
- 4-16 degree angle – Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket
- **Kuhn Krause Excelerator 8000**: fluted coulter blades with scalloped edges mounted on gangs adjustable from 1 to 5 degrees. There are gangs of “star wheels” following the coulter blades set at a 6 degree angle and designed to fluff the surface soil while killing small weeds. The implement is designed to throw soil somewhat like a disk and a rotary hoe combination. This tool does **NOT** meet the definition of a vertical tillage tool. This is not a “no till” operation.

  **Example RUSLE2 operation:**
  Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

- **Landoll Series 7400 VT Plus**: shallow concave disk blades mounted in gangs spaced every 7 inches set at a 10-degree angle. This implement is a tandem disk and does **NOT** meet the definition of a vertical tillage tool. This is not a “no till” operation.

  **Example RUSLE2 operation:**
  Disk, tandem secondary operation

- **Mandako Twister**: angled coulters up to 9 degrees with spring-tooth harrow or Phillips harrow attachment. Very aggressive tillage with significant horizontal soil movement – this implement does **NOT** meet the definition of a vertical tillage implement. This is not a “no till” operation.

  **Example RUSLE2 operation:**
  Coulter tiller and spike harrow

- **McFarlane Reel Disk**: an angled gang of disks followed by a chopper reel, a spiked tooth harrow, and a rolling reel basket. This implement does **NOT** meet the definition of a vertical tillage tool. This is not a “no till” operation.

  **Example RUSLE2 operation:**
  Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket

- **Salford Residue Tillage Specialist Extreme (RTS XT)**: two rows of individually mounted coil spring coulters. This is a vertical tillage implement and can be a strip till operation if the crop is planted in the tilled strips.

  **Example RUSLE2 operation:**
  Coulter caddy, double gang with fluted coulters

- **Salford Independent 4100 (HD Extreme)**: two gangs of concave disk blades followed by two rows of coulters. This is **NOT** a vertical tillage implement. This is a disk and coulter system of tillage.

  **Example RUSLE2 operation:**
  Disk, tandem heavy primary op., roller, smooth

- **Summers Supercoultor Plus**: two gangs of coulters mounted at a 0-degree angle. This is a vertical tillage implement and can be a strip till operation if the crop is planted in the tilled strips

  **Example RUSLE2 operation:**
  Coulter caddy, double gang with fluted coulters
**Sunflower 6630 Series:** two offset gangs of scalloped disk blades at an 18-degree angle to the frame. This implement does **NOT** meet the definition of a vertical tillage tool. This is a tandem disk with gangs set at the standard 18 degree angle. This is not a “no till” operation.

**Example RUSLE2 operation:**
- Disk, tandem secondary operation

**NO TILL**
No full width tillage operation in contact with the soil is allowed under this tillage classification. From harvest of the previous crop to harvest of the current crop, the soil is kept covered in crop residue and the soil has very minimal disturbance from mechanical operations. The planter or drill may be equipped with a coulter to cut residue, residue fingers or wheels to move residue, stronger springs to increase down pressure, extra weight on the planting unit for better penetration, and disk seed-furrow or hoe openers. The area between rows may have as much as 30 percent of the surface soil disturbed (strip till) during or just prior to the planting operation and still qualify as a no till operation. Global positioning technology may allow two operations (sizing residue and planting) to occur at separate times but within the same zone not significantly disturbing the soil area between rows.

The RUSLE2 SCI for no till will usually be a positive value as soil erosion should not be a major concern and there are no field operations that are destroying soil organic matter. The STIR value will be less than 20 with the most desired farming systems having a STIR value less than 10.

**SUMMARY**
The following table lists all RUSLE2 operations as of May 2016 that may be selected when modeling the farming system. The wording used here is a little different from how it is displayed in the RUSLE2 model as the majority of the abbreviated words have been fully written out to assist the RUSLE2 user with understanding the operation.

**Complete RUSLE2 Operations Database**

- **Add PAM** (polyacrylamide)
- **Add mulch**
- **Aerator**, field surface, ground driven 0 degree offset
- **Aerator**, field surface, ground driven 10 degree offset
- **Aerator**, field surface, ground driven 5 degree offset
- **Aerator**, single drum, lugs, angle 0
- **Aerator**, tandem drum, lugs, angle 10
- **Aerator**, tandem drum, lugs, angle 5
- **Aerial interseeding**
- **Aerial overseeding**
- **BFM** (bonded fiber matrix) application
- **Bale Corn** husk, cob and chaff windrows
- **Bale Corn stalk strips**
- **Bale combine windrows**
- **Bale corn stover**
- **Bale straw** or residue
- **Bed shaper**
- **Bed shaper** high disturbance
- **Bed shaper**, 12 inch
- **Bed shaper**, 12 inch, low flattening
- **Bed shaper**, low flattening, high disturbance
- **Bedder**, hipper, disk hiller
- **Bedder**, hipper, hiller 12 inch high
- **Bedder**, hipper, hiller 15 inch high
- **Bedder**, hipper, hiller 18 inch high
- **Begin growth**
- **Begin new growth**
Begin weed growth
Bulldozer, clearing/cutting
Bulldozer, clearing/cutting light
Bulldozer, filling/leveling
Burn residue
Burn residue, high intensity
Burn residue, low intensity
Burn residue, moderate high intensity
Burn residue, moderate intensity
Chisel plow, coulter, straight points
Chisel plow, coulter, straight points, cover disks
Chisel plow, coulter, straight points, cover disks, rolling basket
Chisel plow, coulter, sweeps
Chisel plow, coulter, twisted points
Chisel plow, coulter, twisted points, cover disks
Chisel plow, disk, straight points
Chisel plow, disk, straight points, cover disks
Chisel plow, disk, twisted points
Chisel plow, disk, twisted points, cover disks
Chisel, 12-16 inch low crown sweep 3 to 4 inch depth
Chisel, straight point
Chisel, straight point 12 inch deep
Chisel, straight point 15 inch deep
Chisel, straight point 5 inch deep
Chisel, straight point 5 inch deep, coil tine harrow
Chisel, straight point, coil tine harrow
Chisel, sweep shovel
Chisel, sweep shovel 5 inch depth
Chisel, sweep shovel 5 inch depth, coil tine harrow
Chisel, sweep shovel, coil tine harrow
Chisel, twisted shovel
Chisel, twisted shovel (do not use – remove)
Chisel, twisted shovel, coil tine harrow
Chisel, winged with furrow diker
Continuous disturbance and smoothing
Coulter caddy, double gang with fluted coulters
Coulter caddy, with fluted coulters
Coulter caddy, with smooth coulters
Coulter tiller and spike harrow
Coulter tiller, 10 degree angle, coiled tine harrow, rolling basket
Cover crop underseeder
Cultipacker, roller
Cultivate, manually
Cultivate, manually, low intensity
Cultivate, manually, moderate intensity
Cultivate, rows manually
Cultivator, between beds, add residue
Cultivator, field 6-12 inch shovels Central
Cultivator, field 6-12 inch sweeps
Cultivator, field 6-12 inch sweeps, coil tine harrow
Cultivator, field w/ spike points
Cultivator, field w/ spike points, coil tine harrow
Cultivator, flame
Cultivator, hipper, disk hillers on beds
Cultivator, off bar w/disk hillers on beds
Cultivator, rotary
Cultivator, rotary on beds
Cultivator, rotary on beds; Bedder, hipper, disk hiller
Cultivator, row - 1st pass ridge till
Cultivator, row - 2nd pass ridge till
Cultivator, row 1 inch ridge
Cultivator, row 3 inch ridge
Cultivator, row between beds
Cultivator, row, high residue
Detasseler, seed corn
Disk, inter row strips
Disk, offset, heavy
Disk, offset, heavy 12 inch depth
Disk, offset, heavy 15 inch depth
Disk, offset, heavy, roller, corrugated packer
Disk, offset, heavy, roller, smooth
Disk, oxen, strip 30 percent disturb
Disk, oxen, strip 60 percent disturb
Disk, single gang
Disk, tandem heavy primary operation
Disk, tandem heavy primary operation, roller, smooth
Disk, tandem light finishing
Disk, tandem secondary operation
Do all (Duall)
Do all, on beds
Dozer track walking
Drill or air seeder  single disk openers 7-10 inch spacing
Drill or air seeder  single disk openers, fertilizer openers 7-10 inch spacing
Drill or air seeder  tee slot openers 7-10 inch spacing
Drill or air seeder,  combo field cult, double disk openers
Drill or air seeder,  combo single disk-hoe openers, 10 inch spacing
Drill or air seeder,  hoe opener inch heavy residue
Drill or air seeder,  hoe opener inch heavy residue w/ fertilizer openers
Drill or air seeder,  hoe/chisel openers 12-15 inch spacing
Drill or air seeder,  hoe/chisel openers 6-12 inch spacing
Drill or air seeder,  hoe/chisel openers 6-12 inch spacing w/ fertilizer openers
Drill or air seeder,  double disk opener w/ fluted coulter 5x10 paired row
Drill or air seeder,  double disk opener, w/ fertilizer openers
Drill or air seeder,  double disk, w/ fluted coulters
Drill or air seeder,  offset double disk openers
Drill or air seeder,  4 inch stealth openers on 12 inch spacing
Drill or air seeder,  6 inch stealth openers on 12 inch spacing
Drill or air seeder,  sweep or band opener
Drill, deep furrow  12 to 18 inch spacing
Drill, deep furrow  7 to 10 inch spacing
Drill,  double disk,  7-8 inch packer Central
Drill,  double disk,  orchard vineyard cover
Drill, heavy,  direct seed,  double disk opener
Drill, heavy,  direct seed,  double disk opener w/row cleaners
Drill,  semi-deep furrow 12 to 18 inch spacing
Drip tape extractor
Drip tape injection shank
Drip tape injection shank on beds
Drip tape injector bed shaper
Erosion blanket application
Fertilizer applicator  anhydrous knife 12 inches, coil tine harrow
Fertilizer applicator broadcast by hand
Fertilizer applicator coulter, high pressure inject 12 inches
Fertilizer applicator deep placement heavy shank
Fertilizer applicator shank low disturbance, 12 inches
Fertilizer applicator shank low disturbance, 12 inches, coil tine harrow
Fertilizer applicator shank low disturbance, 15 inch spacing
Fertilizer applicator  side-dress, liquid
Fertilizer applicator surface broadcast
Fertilizer applicator, aerial
Fertilizer applicator anhydrous knife 15 inch spacing
Fertilizer applicator anhydrous knife 15 inch spacing high disturbance
Fertilizer applicator anhydrous knife 15 inch spacing high disturbance, coil tine harrow
Fertilizer applicator anhydrous knife 15 inch spacing, coil tine harrow
Fertilizer applicator anhydrous knife 30 inch spacing
Fertilizer applicator anhydrous knife 30 inch spacing, bedded
Fertilizer applicator anhydrous, minimal disturbance precision placement, 30 inch spacing
Fertilizer applicator anhydrous, low disturbance single disk opener, 30 inch spacing
Fertilizer applicator double shot knife 15 inch spacing high disturbance
Fertilizer applicator shallow anhydrous knife 38 inch spacing
Fertilizer applicator single disk opener, low disturbance, 30 inch spacing
Fertilizer applicator, strip-till 30 inch spacing
Furrow diker
Furrow shaper, torpedo
Germination of dormant seeding
Graze, continuous
Graze, continuous overgrazing
Graze, continuous, heavy hoof traffic
Graze, continuous, light hoof traffic
Graze, continuous, moderate hoof traffic
Graze, intensive rotational
Graze, rotational
Graze, stubble or residue
Missouri RUSLE2 Instructions

Graze, stubble or residue 25 percent
Graze, stubble or residue 50 percent
Graze, stubble or residue 75 percent
Grazing set season, time on, time off, rate
Grazing, continuous, high traffic, set season, rate
Grazing, continuous, set season, rate
Grazing, continuous, severe hoof traffic, set season, rate
Grazing, continuous, time on, time off, rate
Grazing, frost kill
Grazing, set end height, and rate
Grazing, set end height, and time on
Grazing, set Harvest portion and time on
Grazing, set Harvest portion, and removal rate
Grazing, set season, Harvest portion, removal rate and start mass
Grazing, set season, start height, end height, rate
Grazing, set season, start height, end height, rate, then mowed
Grazing, set season, start height, end height, time on
Grazing, set season, start height, end height, time on, then mowed
Grazing, set season, Harvest portion, start mass, and time on
Harrow, coiled tine
Harrow, coiled tine weeder
Harrow, disk chain
Harrow, heavy
Harrow, heavy on heavy residue
Harrow, rolling
Harrow, rotary
Harrow, rotary paddle wheel and spike gangs
Harrow, rotary, light, fluff fragile residue
Harrow, rotary, light, fluff residue
Harrow, spike tooth
Harrow, spike tooth, cover seed
Harrow, tine, on beds
Harvest, broccoli and cauliflower
Harvest, cabbage and head lettuce
Harvest, cabbage and head lettuce, hand
Harvest, combine windrows
Harvest, corn cobbage or earlage
Harvest, corn grain and 60 percent of residue mass
Harvest, corn grain and cobs
Harvest, corn grain and part of stover, 14 inch stubble
Harvest, corn silage with cover crop
Harvest, cotton
Harvest, cotton and shred
Harvest, cut flowers
Harvest, dig root crops 12 inch depth residue buried
Harvest, dig root crops 12 inch depth residue on surface
Harvest, dig root crops residue buried
Harvest, dig root crops residue buried 10 inch ridge
Harvest, dig root crops residue on surface
Harvest, forage sorghum
Harvest, fruit crops
Harvest, grain, grow cover
Harvest, grass or legume seed, burn forage
Harvest, grass or legume seed, leave forage
Harvest, grass or legume seed, remove forage
Harvest, grass seed, remove forage
Harvest, hand pick
Harvest, hand pick multiple times
Harvest, hand pick vegetables
Harvest, hand pull
Harvest, hay set date
Harvest, hay set season, start and end height
Harvest, hay, grass
Harvest, hay, legume
Harvest, hay, no regrowth
Harvest, kenaf
Harvest, killing crop 10 percent standing stubble
Harvest, killing crop 20 percent standing stubble
Harvest, killing crop 20 percent standing stubble, release cover crop
Harvest, killing crop 30 percent standing stubble
Harvest, killing crop 50 percent standing stubble
Harvest, killing crop 50 percent standing stubble, release cover crop
Harvest, killing crop 60 percent standing stubble
Harvest, killing crop 70 percent standing stubble
Harvest, knife, windrow, combine
Harvest, leafy vegetables
Harvest, leafy vegetables mechanical
Harvest, legume seed, remove forage
Harvest, onions
<table>
<thead>
<tr>
<th>Operation Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Harvest, orchard and nut crops</td>
<td></td>
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<tr>
<td>Harvest, residue, forage chopper, complete</td>
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<tr>
<td>Harvest, residue, forage chopper, incomplete</td>
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<tr>
<td>Harvest, residue, forage chopper, intermediate</td>
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<tr>
<td>Harvest, rootcrops, manually</td>
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<tr>
<td>Harvest, rootcrops, manually, 25 percent of field disturbed</td>
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<tr>
<td>Harvest, rootcrops, manually, 33 percent of field disturbed</td>
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<tr>
<td>Harvest, rootcrops, manually, 50 percent of field disturbed</td>
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<tr>
<td>Harvest, seed heads by hand</td>
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<tr>
<td>Harvest, silage</td>
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<tr>
<td>Harvest, silage 3-foot stubble</td>
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<tr>
<td>Harvest, small grain haylage 5 inch height</td>
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<tr>
<td>Harvest, small grain silage with cover crop</td>
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<tr>
<td>Harvest, small grain, release understory</td>
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<td>Harvest, snapper header</td>
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<td>Harvest, sprig rototiller digger</td>
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<td>Harvest, stalk chopping corn header</td>
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<td>Harvest, stripper header</td>
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<tr>
<td>Harvest, timber remove tops</td>
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<tr>
<td>Harvest, tobacco, burley</td>
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<tr>
<td>Harvest, tobacco, burley, mechanical harvester</td>
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<td>Harvest, tobacco, flue cured</td>
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<tr>
<td>Harvest, tobacco, flue cured, 1 pass mechanical</td>
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<tr>
<td>Harvest, tobacco, flue cured, selective mechanical harvest</td>
<td></td>
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<tr>
<td>Harvest, tree buck</td>
<td></td>
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<td>Harvest, tree length logs</td>
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<td>Harvest, tree pulpwod cut</td>
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<td>Harvest, tree, Christmas grow cover</td>
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<tr>
<td>Harvest, trees, chipper</td>
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<tr>
<td>Harvest, vine crops</td>
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<tr>
<td>Harvest, vine crops, mechanical</td>
<td></td>
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<tr>
<td>Harvest, windrows</td>
<td></td>
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<tr>
<td>Harvest, woody biomass</td>
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<tr>
<td>Hilling, manual hoe</td>
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<tr>
<td>Hydro-seeder</td>
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<tr>
<td>Install Compost Sock</td>
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<tr>
<td>Install Silt Fence</td>
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<tr>
<td>Install Straw Bale</td>
<td></td>
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<tr>
<td>Kill crop</td>
<td></td>
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<tr>
<td>Knife, windrow dry beans</td>
<td></td>
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<tr>
<td>Land plane</td>
<td></td>
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<tr>
<td>Land plane; orchard and vine crops</td>
<td></td>
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<tr>
<td>Laser Land leveler</td>
<td></td>
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<tr>
<td>Lister, 30 inch</td>
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<tr>
<td>Lister, 30 inch with fertilizer applicator</td>
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<tr>
<td>Lister, 40 inch</td>
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<tr>
<td>Lister, 40 inch with fertilizer applicator</td>
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<tr>
<td>Log skidder</td>
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<tr>
<td>Manure injector, liquid high disturbance 30 inch</td>
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<tr>
<td>Manure injector, liquid low disturbance 15 inch</td>
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<tr>
<td>Manure injector, liquid low disturbance 30 inch</td>
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<tr>
<td>Manure injector, low disturbance 15 inch</td>
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<tr>
<td>Manure injector, low disturbance 30 inch</td>
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<tr>
<td>Manure spreader, liquid</td>
<td></td>
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<tr>
<td>Manure spreader, slurry</td>
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<tr>
<td>Manure spreader, solid and semi-solid</td>
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<tr>
<td>Manure, liquid irrigation</td>
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<tr>
<td>Middle buster, digger</td>
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<tr>
<td>Mow pasture</td>
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<tr>
<td>Mower, swather, on stubble</td>
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<tr>
<td>Mower, swather, on stubble 4 inch</td>
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<tr>
<td>Mower, swather, windrower</td>
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<tr>
<td>Mulch crimper</td>
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<tr>
<td>Mulch treader</td>
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<tr>
<td>No operation</td>
<td></td>
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<tr>
<td>Para-plow or para-till</td>
<td></td>
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<tr>
<td>Pasture renovator</td>
<td></td>
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<tr>
<td>Paving</td>
<td></td>
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<tr>
<td>Permeable weed barrier applicator</td>
<td></td>
</tr>
<tr>
<td>Planter, RELAY INTERCROP, double disk opener w/fluted coulter</td>
<td></td>
</tr>
<tr>
<td>Planter, double disk opener on 12 inch high beds</td>
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<tr>
<td>Planter, double disk opener on 15 inch high beds</td>
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<tr>
<td>Planter, double disk opener on 18 inch high beds</td>
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<tr>
<td>Planter, double disk opener on 8 inch high beds</td>
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<tr>
<td>Planter, double disk opener</td>
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<tr>
<td>Planter, double disk opener w/fluted coulter</td>
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<tr>
<td>Planter, double disk opener w/fluted coulter with starter fertilizer</td>
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<tr>
<td>Planter, double disk opener w/fluted coulter, 15 inch row spacing</td>
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<tr>
<td>Planter, double disk opener with starter fertilizer</td>
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</table>
Planter, double disk opener, 15 inch row spacing
Planter, double disk opener, 18 inch rows
Planter, double disk opener, 40 inch rows
Planter, furrow opener 4 inch deep furrows
Planter, furrow opener 6 inch deep furrows
Planter, furrow opener 8 inch deep furrows
Planter, in-row subsoiler
Planter, in-row subsoiler low disturbance
Planter, in-row subsoiler w/residue managers
Planter, narrow slot w/smooth or rippled coulter
Planter, potato, 6 inch beds
Planter, ridge till
Planter, runner opener
Planter, small vegetable seed
Planter, small vegetable seed on 8 inch high beds
Planter, sprig conventional
Planter, sprig, no-till
Planter, sprigs on beds
Planter, strip till
Planter, strip till, 22 inch
Planter, strip till, shallow subsoiler
Planter, strip till, subsoiler
Planter, transplanter, vegetable
Planter, transplanter, vegetable on 8 inch high beds
Planter, transplanter, vegetable, no-till
Planter, tree, mechanical transplanter
Planting, broadcast interseeder
Planting, broadcast seeder
Planting, hand 10 percent disturbed
Planting, hand 5 percent disturbed
Planting, manual
Planting, manual on 8 inch high beds
Planting, no-till manually
Plastic hoop tunnel installation 100 percent cover
Plastic hoop tunnel installation 50 percent cover
Plastic hoop tunnel installation 75 percent cover
Plastic hoop tunnel installation on beds 50 percent cover
Plastic hoop tunnel installation on beds 75 percent cover
Plastic hoop tunnel removal on beds
Plastic hoop tunnel removal
Plastic mulch applicator 40 inch beds 100 percent cover
Plastic mulch applicator 40 inch beds 75 percent cover
Plastic mulch applicator 48 inch beds 100 percent cover
Plastic mulch applicator 48 inch beds 80 percent cover
Plastic mulch applicator 54 inch beds 100 percent cover
Plastic mulch applicator 54 inch beds 80 percent cover
Plastic mulch applicator 64 inch beds 100 percent cover
Plastic mulch applicator 64 inch beds 85 percent cover
Plastic mulch applicator 100 percent cover
Plastic mulch applicator 40 percent cover
Plastic mulch applicator 50 percent cover
Plastic mulch applicator 75 percent cover
Plastic mulch, 5 percent removal
Plastic mulch, 10 percent removal
Plastic mulch, 25 percent removal
Plastic mulch, 50 percent removal
Plastic mulch, remove all
Plastic weed barrier 40 inch beds 100 percent cover
Plastic weed barrier 40 inch beds 50 percent cover
Plastic weed barrier 40 inch beds 75 percent cover
Plastic weed barrier applicator 100 percent cover
Plastic weed barrier applicator 50 percent cover
Plastic weed barrier applicator 75 percent cover
Plastic weed barrier applicator 75 percent cover
Plow, deep, large, moldboard
Plow, disk
Plow, moldboard
Plow, moldboard 10 inch depth
Plow, moldboard 6-7 inch depth
Plow, moldboard, conservation
Plow, moldboard, up hill
Plow, oxen 12 inch ridge
Plow, oxen 18 inch ridge
Plow, oxen on 6 inch ridge
Plow, oxen, strip 30 percent disturbance
Plow, oxen, strip 60 percent disturbance
Plow, reversible
Power mulcher bed conditioner
Pruning
Rake or windrower
Reel disk vertical tiller
Regrow
Remove Compost Sock
Remove Silt Fence
Remove Straw Bale
Residue conditioner, coil tine harrow, rolling basket
Residue removal by wind
Residue, row cleaner
Rice residue stomper
Ripper, intra row
Ripper, intra row and furrow diker
Road grader
Rodweeder
Rodweeder, harrow, spike tooth
Roller harrow
Roller, corrugated packer
Roller, corrugated packer 6 by 16
Roller, crimp, cover crop
Roller, on beds
Roller, residue
Roller, residue incorporator
Roller, row shaper
Roller, smooth
Rolling basket incorporator
Root rake
Rotary hoe
Rotary hoe, on heavy soil
Rotary hoe, residue
Rototiller, field
Rototiller, field, add residue
Rototiller, on beds
Rototiller, row cultivation add residue
Rototiller, row cultivator
Scalper, tree
Scarifier
Scraper/pan/gradar, clearing/cutting
Seedbed conditioner, coil tine harrow, rolling basket
Seedbed conditioner, coulter caddy, coil tine harrow
Seedbed conditioner, coulter caddy, field cult, spike harrow
Seedbed conditioner, coulter caddy, field cult, spike harrow, rolling basket
Seedbed conditioner, coulter caddy, spike harrow
Seedbed conditioner, coulter caddy, spike harrow, rolling basket
Seedbed finisher
Seedbed finisher, field cult, chop, spike harrow, rolling basket
Seedbed finisher, field cult, coil tine harrow, rolling basket
Seedbed finisher, field cultivator, mulch treader
Seedbed finisher, field cultivator, rotary harrow
Seedbed finisher, single disk, field cultivator, coil tine harrow, rolling basket
Seedbed finisher, single disk, rotary harrow
Seedbed finisher, single disk, field cultivator, coil tine harrow
Seeder, corrugated packer
Seeder, dormant, corrugated packer
Seeder, high density vegetable
Shred residue, 6 inch stubble
Shred standing residue in live cover crop
Shredder, flail or rotary
Shredder, flail or rotary, add other cover
Shredder, flail or rotary, filberts and pecans
Shredder, rotary mower
Shredder, rotary, regrow vegetation
Shredder, rotary, remove residue
Slip plow 48 to 60 inches deep
Sod cutter
Sod installation
Spader
Spader, shallow depth
Spray, glyphosate on resistant growing crop
Sprayer, backpack, kill vegetation
Sprayer, backpack, post emergence
Sprayer, defoliant
Sprayer, fungicide
Sprayer, fungicide and insecticide tank mix
Sprayer, growth regulator
Sprayer, insecticide post emergence
Sprayer, kill cover in growing crop
Sprayer, kill cover in growing vegetables
Missouri RUSLE2 Instructions

Sprayer, kill crop
Sprayer, kill strips
Sprayer, post emergence
Sprayer, post emergence and fertilizer tank mix
Sprayer, pre-emergence
Stalk chopper, rolling
Stalk chopper, rolling, light disturbance
Stalk chopper, rolling, on ridgetill ridges
Stalk chopper, rolling, strip
Stalk chopper, rotary
Stalk chopper, strip rotary
Stalk puller
Stalk puller high disturbance
Stalk slicer

Stop Grazing
Strip till bed conditioner
Strip tiller w/ middlebuster on beds
Subsoil disk ripper
Subsoil disk ripper, coulter smooth, rolling basket
Subsoil disk ripper, roller smooth
Subsoiler
Subsoiler bedder (ripper/hipper)
Subsoiler leveler
Subsoiler ripper, 24 to 40 inches deep
Subsoiler, 12 foot spacing
Subsoiler, in row
Subsoiler, in row strip conditioner
Subsoiler, in row strip conditioner, 40 inch row
Subsoiler, inline heavy shanks with coulter caddy
Subsoiler, inline with coulter caddy
Subsoiler, rolling stalk chopper, roller, mulch treader
Subsoiler, wide spacing
Subsoiler; stalk chopper, rolling
Sweep plow 20-40 inch wide
Sweep plow wider than 40 inch w/ mulch treader
Sweep plow, under bed
Sweep plow, wider than 40 inches
Sweep, single under row
Sweep, single under row, regrow perennial
Tree spade, holes left
Tree spade, holes plugged
Water mulch; on
Water mulch; off
Weed control, hoeing in row
Weed control, manual hoe
Weed control, string trimmer
Weeder, finger weeder
Winter kill annual crop