NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

DEEP TILLAGE

(Ac.)

CODE 324

DEFINITION

Performing tillage operations below the normal tillage depth to modify adverse physical or chemical properties of a soil.

PURPOSE

This practice supports one or more of the following purposes:

- Bury or mix soil deposits from wind or water erosion or flood overwash – Resource concern (DEGRADED PLANT CONDITION – Undesirable plant productivity and health).
- Fracture restrictive soil layers – Resource concern (SOIL QUALITY DEGRADATION – Compaction).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land having adverse soil conditions which inhibit plant growth, such as compacted layers formed by field operations, restrictive layers such as cemented hardpans (duripan) in the root zone, overwash or deposits from wind and water erosion or flooding.

This practice does not apply to normal field operations and tillage methods for planned crop production.

CRITERIA

General Criteria Applicable to All Purposes

Deep tillage operations shall be performed when soil moisture is less than 30-50 percent of field capacity, according to the “feel test” or other acceptable method, at the maximum depth to which the tillage will be done.

If erosion is a potential problem as a result of this practice, other practices should be planned and used in conjunction with a complete conservation management system.

Deep tillage operations applied on terraced land will be conducted on the contour and in such a way that terraces are not damaged and remain fully functional for their intended purpose.

Underground utilities shall be checked for depth and location prior to deep tillage.

Additional Criteria to Fracture Restrictive Soil Layers

Deep tillage operation to fracture restrictive layers shall be operated, at a minimum, to a depth of 1" below the bottom of the restrictive layer. Tillage depth should be set carefully and periodically checked to maintain this working depth.

The horizontal extent of the fractured layer, at a minimum, shall be sufficient to permit root penetration below the restrictive soil layer. Complete fracturing of the restrictive layer is not required. The fractured zone does not need to extend to the row middles and should be limited to the area near the rows [in the case of crops broadcast-planted or drilled in narrow rows (less than 15 inches), the fractured zone may be disrupted

Average minimum bulk densities that restrict root penetration in soils of various textures

Texture	Bulk Density g/cc
Coarse, medium, and fine sand	1.80
Loamy sand and sandy loam	1.75
Loam and sandy clay loam	1.70

Clay loam	1.65
Sandy clay	1.60
Silt and silt loam	1.55
Silty clay loam	1.50
Clay	1.40

Additional Criteria to Bury or Mix Soil Deposits from Wind and Water Erosion or Flood Overwash

To bury soil deposits from wind and water erosion or flood overwash, tillage equipment such as large disk plows and, moldboard plows with the ability to reach the required depth shall be used.

To mix soil deposits from wind and water erosion or flood overwash, tillage equipment such as large chisels with twisted points, disc plows and moldboard plows shall be used. Soil deposits shall be mixed a minimum of two times (2X) the depth of the soil deposit to achieve a desired available water-holding capacity (AWC) and to break the hydraulic barrier caused by the soil deposit layer.

CONSIDERATIONS

Where restrictive layers are a concern, the effects of this practice can be enhanced by including deep rooted crops in the rotation that are able to extend to and penetrate the restrictive layer.

Avoid making tillage operations when the soil is wet. Water in the soil acts like a lubricant, so soil particles are easily rearranged and jammed together tightly decreasing pore space in the soil and increasing bulk density. A good rule of thumb is that soil squeezed in your hand then tossed about should fall apart. If not, it is too wet.

Reduce or control equipment traffic during periods when soils are prone to compaction and formation of tillage pans. Caution should also be exercised when excessively heavy equipment is used to ensure that soils are not prone to compaction. Loads greater than 6 tons/axle have been found to cause compaction to depths of approximately 16 inches which is below normal depths of tillage and may cause yield reductions for several years.

Reducing contact pressure between the load and the soil may also be helpful to reduce compaction. Typical bias-ply tires require excessive inflation pressures which can concentrate the loads on the soil surface and cause excessive soil compaction. Radial tires offer superior soil compaction and traction characteristics when properly inflated to the manufacturer’s specifications. Other methods that can be used to further spread the load and potentially reduce soil recompaction include using dual tires or tracks beneath tractors, grain wagons, slurry tanks, etc.

Research on numerous crops has shown that tillage conducted excessively deeper than the compacted layer does not promote increased yields, requires excessive amounts of tillage energy, and promotes future compaction from nearby vehicle traffic.

To help reduce development of compacted restrictive layers, conduct normal tillage operations when soil moisture is less than 50 percent of field capacity. When possible, harvest operations should be avoided when soil moisture is greater than 50 percent of field capacity. Field harvest haul traffic should be limited to end rows or haul roads. Compacted regions between crop rows that are not fractured can assist in supporting vehicle traffic, limiting rutting and soil compaction beneath the row.

When infertile flood overwash is mixed with the pre-flood soil profile, the soil rebuilding process can be enhanced by additions of organic matter, such as manure or cover crops utilized as green manure. Crop rotations, tillage and planting systems, which maintain high levels of crop residues, such as no-till, can also accelerate this process.

When the underlying soil and the deposited soil are sand or loamy sands, tillage may not improve the water holding capacity.

Where the flood overwash layer is too thick to effectively mix with the pre-flood soil profile, redistribution of the overwash layer by smoothing or removal may be necessary. Generally, no more than about 6 inches of overwash can be uniformly mixed into the soil profile using commonly available equipment. Specialized equipment may be necessary where greater depths of overwash are to be incorporated.

Where unfavorable soil materials such as high sodium, calcium, gypsum or other undesirable materials, are within anticipated deep tillage depth and would be brought to the surface by deep tillage operations, this practice should not be applied.

Transport of sediment-borne pollutant(s) offsite can be reduced when this practice is used in a conservation management system, by reducing the concentration of pollutants in the surface layer.

Moldboard plows and large tandem disks, when used to bury and mix soil deposits can have a destructive effect on soil physical characteristics. These implements create conditions ideal for soil compaction to occur. Chisels with twisted points have a slightly less destructive impact.

Disruption of the soil surface is not desired and should be minimized where possible through proper selection of shanks. Excessive disturbance of the soil surface can cover plant residues which should be maintained on the soil surface to intercept rainfall and impede surface runoff.

Reduce the number of tillage trips across the field. Try to combine as many tillage trips as possible or settle for a less perfect seedbed. Most of the new drills and planters operate well under minimum tillage conditions.

Vary the depth of tillage from year to year and restrict the use of disc plows. Use chisels more than plows to do primary tillage. Sometimes chisels may require more energy to pull but leave residues on the soil surface. They also shatter and loosen the soil better.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the Criteria, Considerations and Operations & Maintenance described in this standard. At a minimum, the following items shall be included in the conservation plan:

- Type of tillage equipment
- Depth of tillage
- Timing of tillage

Record practice design using approved Deep Tillage Worksheet.

OPERATION AND MAINTENANCE

Evaluate effectiveness of deep tillage field operations applied for fracturing restrictive layers or mixing soil deposits and adjust plan if needed and reapply deep tillage when these field conditions reoccur.

REFERENCES

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