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

- Bury or mix soil deposits from wind or water erosion or flood overwash.
- Reduce concentration of soil contaminants, which inhibit plant growth.
- Fracture restrictive soil layers.

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 water erosion or flooding, or contaminants in the root zone. This practice does not apply to normal tillage practices to prepare a seedbed.

This standard includes tillage operations commonly referred to as deep plowing, in-row subsoiling, strip-tillage, paratilling, subsoiling, ripping, or row-till, performed not as a part of the normal tillage operations or at an altered depth.

CRITERIA

General Criteria Applicable to All Purposes

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

Additional Criteria to Fracture Restrictive Soil Layers

Use tillage equipment such as chisels, subsoilers, bent-leg subsoilers, or rippers, with the ability to reach the required depth to fracture the restrictive layer.

The depth of tillage shall be a minimum of one inch deeper than the depth of the restrictive layer. Tillage depth should be set carefully and periodically checked to maintain this working depth.

Complete fracturing of the restrictive layer is not required. The fractured zone, as a minimum, shall be sufficient to permit root penetration below the restrictive soil layer. The fractured zone does not need to extend to the row middles and should be limited to the area near the rows.

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

To bury soil deposits from 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.

Additional Criteria to Reduce Concentration of Soil Contaminants Which Inhibit Plant Growth

The soil contaminant shall be uniformly distributed throughout the deep tilled layer.

Tillage equipment such as chisels with twisted points, disk plows, or moldboard plows with the ability to reach the required depth shall be used.

The tillage operation shall mix a sufficient amount of uncontaminated soil with the contaminated material so that the concentration of the contaminant is below the crop tolerance level. Crop tolerance levels shall be established in accordance with Land Grant University guidance and recommendations.

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.

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 recompaction. 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.

Reduce or control equipment traffic during periods when soils are prone to compaction and formation of tillage pans.

To help reduce compaction, it is desirable to conduct normal tillage operations when soil moisture is less than 50 percent of field capacity (see first page – only difference is depth, tillage is tillage. Cite the literature for using 50). 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.

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 and/or contaminants, have a severely 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.

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.

OPERATION AND MAINTENANCE

When deep tillage has been performed to reduce the concentration of soil contaminates, the contaminate levels in the root zone shall be monitored to assist with determining when or if treatment will be reapplied.

Deep tillage for reduction of soil compaction shall be performed whenever compaction reoccurs.

REFERENCES

Baumhardta, R.L., O.R. Jones, and R.C. Schwartz. 2008. Long-term effects of profile modifying deep plowing on soil properties and crop yield. Soil Sci. Soc. Am. J. 72:677-682.

Reeder, R. and D. Westermann. 2006. Soil management practices. p. 63. In M. Schnepf and C. Cox (ed.) Environmental benefits of conservation on cropland: The status of our knowledge. Soil and Water Conservation Society, Ankeny, IA.

USDA, NRCS. 1996. Soil Quality Information Sheet: Sediment deposition on cropland.