Deep Tillage (Acre) 324

DEFINITION

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

PURPOSES

- 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, over wash or deposits from wind and 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* sub soiling, ripping, or row-till, *Para-plowing*, performed *not as a part of the tillage operations or at an altered depth.*

CRITERIA

General Criteria Applicable to all Purposes

Perform deep tillage operations when soil moisture is less than 30 percent of field capacity, according to the "feel test" or other acceptable method, at the maximum tillage depth *to which the tillage will be done*. See NRCS Michigan Agronomy Conservation Sheet 324.1 – Soil Compaction Symptoms, Causes, Correction, and Prevention *and 324.2 -- Deep Tillage*.

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 bottom 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 [in the case of crops broadcast-planted or drilled in narrow rows (less than 15 inches), the fractured zone may be disrupted completely].

The following Michigan soil series have naturally occurring cemented horizons or layers below 16 inches:

Baraga	Gogebic	Saugatuck
Champion	Iron River	Skanee
Channing	McBride	Stueben
Elo	Munising	Wakefield
Finch	Ogemaw	Yalmer

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 over wash, 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 over wash, tillage equipment such as large chisel plows 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 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 Michigan State 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.*

Consider using narrow strip cropping or no till to control equipment traffic. See NRCS eFOTG MI Agronomy Tech Notes 40 & 41.

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.

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 compaction, it is desirable to conduct normal tillage operations when soil moisture is less than 30 percent of field capacity. When possible, harvest operations should be avoided when soil moisture is greater than **30** percent of field capacity. See NRCS eFOTG MI Job Sheet 324.2 DEEP TILLAGE for guidance on determining the per cent soil moisture using the feel method. Field harvest haul traffic should be limited to head lands 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. Substitute lighter equipment for heavier equipment for any operation whenever possible.*

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. 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 destructive impact.

Disruption of the soil surface is not desired and should be minimized where possible through the 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.

Improve drainage with surface and subsurface drainage to improve soil moisture content and increase the number of days for field operation with minimal compaction. See NRCS MI Standard Subsurface Drainage (606) and NRCS MI Standards Surface Drainage (607 & 608).

On fields with subsurface drainage, deep tillage can damage shallow tile lines. Try to maintain a minimum of 1 foot between the tip of the deep till equipment and the top of the tile lines to keep from fracturing or crushing tile.

Fall tillage after deep tillage is not recommended. Tilling after deep tillage will speed up sealing of the shattered area.

Moisture content has the greatest influence on the amount of soil compaction produced by a given axle load pressure.

Other methods that can be used to further spread the load and potentially reduce soil compaction include using dual tires or tracks beneath tractors, grain wagons, slurry tanks, etc.

Consider using **triple tires** when soil moisture content is between 26-30 percent moisture capacity on Michigan soil management groups 2.5, 1.5, 1, and 0 to minimize economic yield loss. Yield loss from soil compaction with **triple tires** starts showing up at 34 percent soil moisture capacity.

Consider using **dual tires** when soil moisture content is 19-25 percent moisture capacity on Michigan soil management groups 2.5, 1.5, 1, and 0 to minimize economic yield loss. Yield loss from soil compaction with **dual tires** starts showing up at 26 percent moisture capacity.
Consider using **single tires** when soil moisture content is 18 percent moisture capacity or less on Michigan soil management groups 2.5, 1.5, 1, and 0 to minimize economic yield loss. Yield loss from soil compaction with a **single tire** starts showing up at 18 percent moisture capacity.

Freezing and thawing do not correct deep compaction immediately. It may take as long as 3-5 years on some soils.

Add organic matter to improve soil structure by growing more small grains, green manure crops (red and sweet clover), deep-rooted crops, or applying animal manure.

If application of this practice will impact cultural resources (archaeological, historic, historic landscape, or traditional cultural properties), follow NRCS national policy and state operating procedures for considering cultural resources.

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 Operation and Maintenance (O&M) described in this practice.

The minimum documentation for this practice as applied is:

- *Cultural Resource Evaluation completed first.*
- Location map.
- Time of year for deep tillage.
- Type of investigation to determine the need.
- Depth of deep tillage.
- Soil moisture conditions.
- O&M plan to prevent future soil compaction.

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.

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