NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

DEEP TILLAGE

(Acre)

Code 324

DEFINITION

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

PURPOSES

This practice may be applied as part of a conservation management system to support one or more of the following:

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

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land having adverse soil conditions which inhibit plant growth. Adverse soil conditions include problems such as compacted layers formed by tillage and harvesting operations, restrictive layers caused by claypans, overwash or deposits from wind and water erosion or flooding, or contaminants in the root zone.

This standard includes tillage operations commonly referred to as deep plowing, subsoiling, ripping, or row-till, performed from time to time below the normal tillage 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 at the maximum depth of tillage, according to the “feel test” or other acceptable method.

NOTE: A higher compaction level than existed prior to the deep tillage operation may result if the practice is performed when soil moisture is higher than desirable.

On sloping sites, perform the operation as near to the contour as practical.

ADDITIONAL CRITERIA TO FRACTURE RESTRICTIVE SOIL LAYERS

Assess sites where soil compaction and/or root restrictive layers are suspected. Request assistance from a Soils Specialist, if necessary. An evaluation will be made prior to providing the landuser with a recommendation.

NOTE: Visual symptoms which may indicate problems are:

a) dark soil streaks
b) ponded water
c) accelerated runoff
d) delayed crop emergence
e) poor crop growth
f) abnormal crop color
g) abnormal root development
h) early plant water stress.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Tillage equipment such as chisels, subsoilers, bent-leg subsoilers, or rippers, with the ability to reach the required depth shall be used.

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.

NOTE: Soils with certain sandy characteristics tend to develop a dense, compacted layer beneath the surface. This layer, which generally begins at a depth of 6 to 8 inches from the surface, frequently restricts root development. The overall thickness of pan layers varies from about 2 to 12 inches. Thicker pan layers develop from increased heavy wheel traffic under wet conditions, and in soils with thick sandy surface horizons. As farm machinery/equipment has become larger and heavier, the potential of compacting the soil deeper into the profile has also increased. The majority of our soils with root-restricting pans are located in the Coastal Plain region.

On shallow sandy soils, where the clayey subsoil layer begins at a 10 to 15 inch depth, operate the subsoiler at about a 12-inch depth. In deeper sandy soils, where the clayey subsoil layer begins at a depth of 15 or more inches, operate the subsoiler at about a 16-inch depth. Spacing of subsoiler shanks will normally range from 2 to 5 feet. DO NOT OPERATE the subsoiler too far into the finer textured subsoil layer, as this will pull undesirable material up into the surface layer. *Keep in mind that maximum density of the restrictive layer is within its upper two inches, and gradually decreases with 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. Exception: (in the case of crops broadcast-planted or drilled in narrow rows (less than 15 inches), the restrictive layer may be disrupted completely).

Although certain forms of compaction problems may be present in Piedmont and Mountain soils, the root restricting pan layers normally do not exist. The potential value of loosening dense, silty, or clayey Piedmont or Mountain soils would be in the enhancement of rainfall infiltration, and reduction of runoff (which would also reduce erosion). *NOTE: If this practice is utilized, it shall be performed in the fall*. Sufficient vegetative cover will remain on the soil surface to maintain soil loss levels within plan requirements. Also, management of these soils to minimize compaction is more a matter of judgment in the timing and number of tillage trips than in any particular tillage practice.

Deep tillage will not be performed immediately prior to conventional cultural operations, as this procedure may result in a higher compaction level than previously existed.

If "deep tillage" is to be performed only once in a crop rotation cycle, it should be done just prior to or at time of seeding/planting the crop that has the greatest potential to offset the damage caused by compaction. The following crops (shown in descending order of their ability to offset or minimize soil compaction) can be used as a guide for timing the deep tillage operation within a rotational system:

a) hay or pasture

b) small grain

c) corn

d) soybeans, cotton or peanuts.

ADDITIONAL CRITERIA TO BURY OR MIX SOIL DEPOSITS FROM WIND AND WATER EROSION OR FLOOD OVERWASH

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

The tillage operation shall uniformly mix soil 6" or 2 times (2 X) the depth of overwash, whichever is deeper, to achieve a desired available water-holding capacity (AWC) and to break the hydrologic barrier caused by overwash layer.

CONSIDERATIONS

Generally, this practice alone will only provide temporary relief from problems associated with

compaction and/or naturally occurring restrictive soil layers.

Consider the following management options to minimize or possibly prevent the creation of compaction zones and/or to minimize any adverse effects related to naturally occurring restrictive soil layers:

a) crop rotations which include non-row crops

b) conservation tillage systems, particularly those that maintain high levels of surface residue

c) controlled machinery/equipment traffic

d) addition of organic matter through the use of cover and green manure crops

e) performing planting, tillage and harvesting operations only when soil moisture is at or below the optimum level.

Consider including perennial hay crops (which have extensive root systems) in long term rotations. These plants reduce the potential for soil compaction, and the deep roots improve soil structure by penetrating restrictive layers. Other deep-rooted crops may also have the same effect.

Consider the economics involved, and the landuser's available farm machinery. NOTE: Deep tillage of a severely compacted soil can require 40 to 60 PTO horsepower per shank.

To determine if soil compaction is really a problem, holes must be dug in the field to visually inspect the growth patterns of crop roots. NOTE: The crop is the ultimate indicator of the soil environment.

Refer to Soil Survey Data, if available, for a list of soils which may have a restrictive layer and/or be more susceptible to compaction. NOTE: Medium textured soils are more likely to compact than are soils that are almost all sand, silt, or clay. Also, soils that have a naturally high bulk density cannot be improved much by subsoiling.

Properly adjust packer wheels on planters and drills to minimize in-row compaction.

If possible, limit use of tillage implements such as disk harrows, which can cause soil compaction.

Research on numerous crops has shown that tillage conducted excessively deeper than the compacted layer does not significantly increase yields, requires excessive amounts of tillage energy, and may promote future compaction.

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

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, along with tillage and planting systems that 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 farm equipment. Specialized equipment may be necessary where greater depths of overwash are to be incorporated.

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

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.

To help reduce compaction, it is desirable to 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.

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 implementation and operation of the Virginia Conservation Practice Standard *Deep Tillage (Code 324)* shall be prepared according to the Criteria, Considerations, and Operation and Maintenance described in this standard and shall be recorded on approved specification sheets and as narrative statements in conservation plans.

As a minimum, record and maintain the following data:

- Tract number
- Field number
- Acres
- Soil type
- Type of problem (compaction, pan layer, etc.)
- Depth to and thickness of compaction or pan layer
- Implementation Plan to include as a minimum:
  - Cropping System, with timing of deep tillage indicated
  - Type of deep tillage proposed (chiseling, subsoiling, deep moldboard plowing, etc.); and tillage depth
- Follow-up records which could support further recommendations

OPERATION AND MAINTENANCE

Follow up with the landuser, and monitor the performance of this practice as necessary.

Evaluate the effectiveness of deep tillage on the soils in question, and as it relates to specific crops and management conditions.

Encourage the landuser to continue the application of this practice whenever compaction reoccurs and if it proves economically beneficial.

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.

REFERENCES

1. “Soil Compaction: Is the Cure Worth the Cost?” by Lyle E. Stephens, Paper No. 90-1075, An American Society of Agricultural Engineers meeting Presentation.

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Approved Practice Narrative

(Acre)

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324 D1 Deep Tillage: Deep tillage will be applied in this field as specified in plan provided by NRCS.