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 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 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

Do not perform deep tillage operations when soil moisture is greater than 30 percent of field capacity. Use the "feel test" or other acceptable method, at the maximum tillage depth to determine moisture content.

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.

Till at least one inch deeper than the depth of the restrictive layer. Tillage depth should be set carefully and checked periodically.

Complete fracturing of the restrictive layer is not required. Fracture an area 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].

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, use large disk plows, moldboard plows, or similar equipment with the ability to reach the required depth.

To *mix* soil deposits from wind and water erosion or flood overwash, use large chisels with twisted points, disc plows, moldboard plows, or similar equipment with the ability to reach the required depth.

Mix areas of soil deposition to a depth of at least two times (2X) the depth of the soil deposit.

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

Use chisels with twisted points, disk plows, moldboard plows, or similar equipment with the ability to reach the required depth.

Mix the contaminant uniformly throughout the deep tilled layer.

Mix a sufficient amount of uncontaminated soil with the contaminated material so that the concentration of the contaminant is below the crop tolerance level. For crop salt-tolerance levels, use *Agricultural Salinity and Drainage*, UC publication 3375 or equivalent. Use University of California or other Land Grant University recommendations for other contaminants.

Whenever possible, manage saline or sodic soils using conservation practice standard, *Salinity and Sodic Soil Management* (610).

CONSIDERATIONS

This practice is not typically recommended as part of routine management of restrictive layers, but only as frequently as necessary to improve water infiltration and rooting depth. If done regularly, tillage practices and other management activities should be evaluated.

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. When possible, field 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.

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.

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.

Do not use this practice when undesirable chemical constituents are within anticipated deep tillage depth.

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.

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.

Water Quantity

Deep tillage increases infiltration and decreases surface runoff by mechanically shattering restrictive layers in the soil. Consider the following:

- Water storage may increase by 3 1/2 times after deep tillage.
- There is more rooting area, potentially increasing evapotranspiration.
- If water infiltrations below the root zone, ground water recharge may occur.
- Effects on water budget components, especially on volumes and rates of runoff and infiltration.

Water Quality

Small storm runoff and erosion may be eliminated. The practice improves soil drainage and aeration, decreasing the potential for denitrification. This may result in nitrates being leached deeper into the soil. The plant roots are able to go deeper so the nitrates may still be taken up by the plants. The time of year and extent of plant growth will need to be considered.

In rainfall deficient areas, deep tillage may bring salts and toxic materials to the surface or into the root zone, thus making these materials available to plants or subject to being relocated by erosion forces.

Poor physical conditions of a sodic soil may be ameliorated by deep tillage, which may bring calcium salts up into the surface horizons.

To protect water quality, consider the following:

- Effect of slope and direction of tillage
- Effects of erosion and the movement of sediment and sediment-attached substances
- Potential for development of saline seeps or other salinity problems resulting from increased infiltration to lower restrictive layers.

This practice occurs in areas that are likely to contain cultural resources, especially if the land has not been deep tilled in the past. Follow NRCS State policy and procedures for investigation of 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 Operations & Maintenance described in this standard.

OPERATION AND MAINTENANCE

When deep tillage has been performed to reduce the concentration of soil contaminates, monitor contaminate levels in the root zone to determine when or if treatment will be reapplied.

Repeat deep tillage only as necessary to reduce soil compaction.

REFERENCES

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