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

- Fracture restrictive soil layers.
- Bury or mix soil deposits from wind or water erosion or flood overwash.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land having adverse soil conditions which inhibit plant growth, such as:

- Compacted layers in the root zone formed by field operations.
- Naturally-occurring restrictive layers in the root zone such as cemented hardpans (duripan).
- Overwash or deposits from wind and water erosion or flooding.

This practice does not apply to normal tillage practices used to prepare a seedbed. It includes tillage operations commonly referred to as deep plowing, in-row subsoiling, strip-tillage, paratilling, subsoiling, ripping, or row-till, but only when these operations are performed at an altered depth or in a manner that otherwise differs from routine seedbed preparation.

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.

Additional Criteria to Fracture Restrictive Soil Layers

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, at a minimum, shall be sufficient to permit root penetration below the restrictive soil layer. For row crops in particular, the fractured zone does not need to extend to the row middles and may be limited to the area near the rows.

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

Deep tillage to invert and mix soil deposits shall be to the depth needed to meet planning objective.

In all cases, soil deposits shall be mixed at least two times (2X) the depth of the soil deposit.

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 or control equipment traffic and tillage during periods when soils are wet and prone to compaction and formation of tillage pans. To help reduce compaction, it is desirable to conduct normal tillage

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

and field operations when soil moisture is as dry as possible and never more than 50 percent of field capacity.

When heavy equipment is used ensure that soils are dry. Loads greater than 6 tons/axle on moist soils have been found to cause compaction 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 produce a smaller footprint, concentration of weight, and more 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.

Controlling traffic has great potential to limit compaction. Field harvest haul traffic should be limited to end rows or haul roads. Drive rows and compacted regions between crop rows that are not fractured can assist in supporting vehicle traffic, thereby limiting rutting and soil compaction beneath the row.

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.

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 materials such as high-clay, high-acidity, low-fertility subsoil are within anticipated deep tillage depth and would be brought to the surface by deep tillage operations, this practice should be modified as needed or not be applied.

Moldboard plows and large tandem disks, when used to bury and mix soil deposits and/or contaminants, 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 equipment selection. 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

Prepare specifications for implementation of this practice for each field or CMU (Conservation Management Unit).

Customize the language and level of detail in specifications as needed for each particular case. Focus on providing the client with the practical guidance needed to effectively put the practice on the ground.

Specifications shall at a minimum include all of the following elements:

1. A list of the field(s) and/or CMU(s) where this practice will be implemented.
2. A list of the purpose(s) for which the standard is being implemented.
3. A description of the planned crop rotation that indicates when and how often in the cropping sequence deep tillage will occur.
4. A statement of the general criteria that must be achieved in all cases where this practice is implemented.
5. A statement of any additional criteria that must be achieved based on the purpose(s)

for which the standard is being implemented (depth of fracturing, depth of mixing, etc.).

6. Site-specific recommendations, if any, for activities to be conducted prior to deep tillage. These include, but are not limited to, recommendations on diagnosing presence or depth of root-restricting layers to be fractured.
7. Site-specific recommendations for carrying out deep tillage operations. These include, but are not limited to, recommendations on timing, method, depth, frequency, etc.
8. Site-specific recommendations, if any, for activities to be conducted after deep tillage to evaluate the success of the practice and/or the need to repeat the practice.
9. Recommendations, if any, for implementation of complementary practices (controlled traffic, adding deep-rooted crops to the rotation, etc.).

Use the practice job sheet to plan and certify this practice.

OPERATION AND MAINTENANCE

Evaluate effectiveness of deep tillage with respect to relevant purpose (fracturing restrictive layers or mixing soil deposits). Adjust plan if needed and reapply deep tillage when necessary.

REFERENCES

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